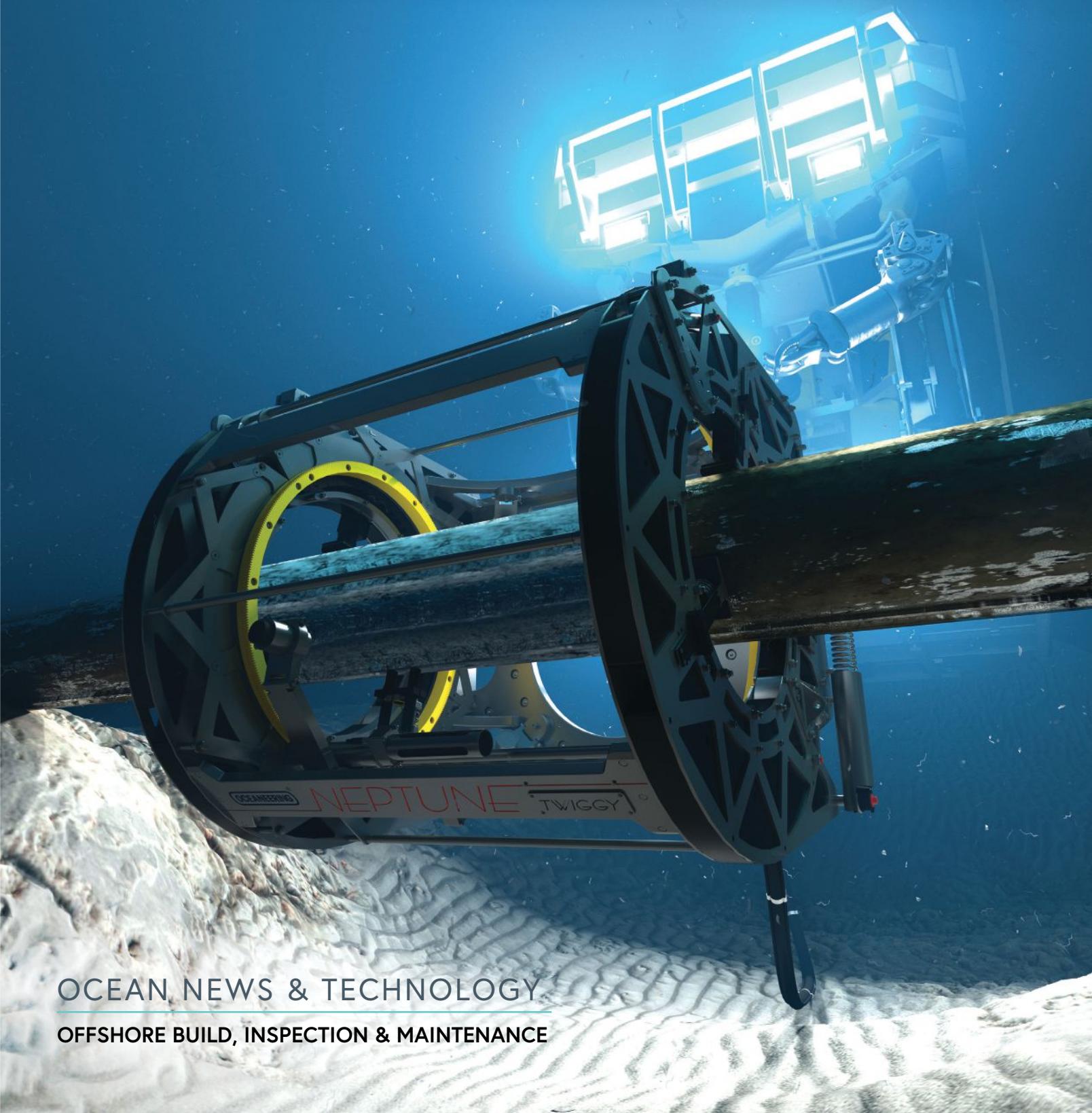


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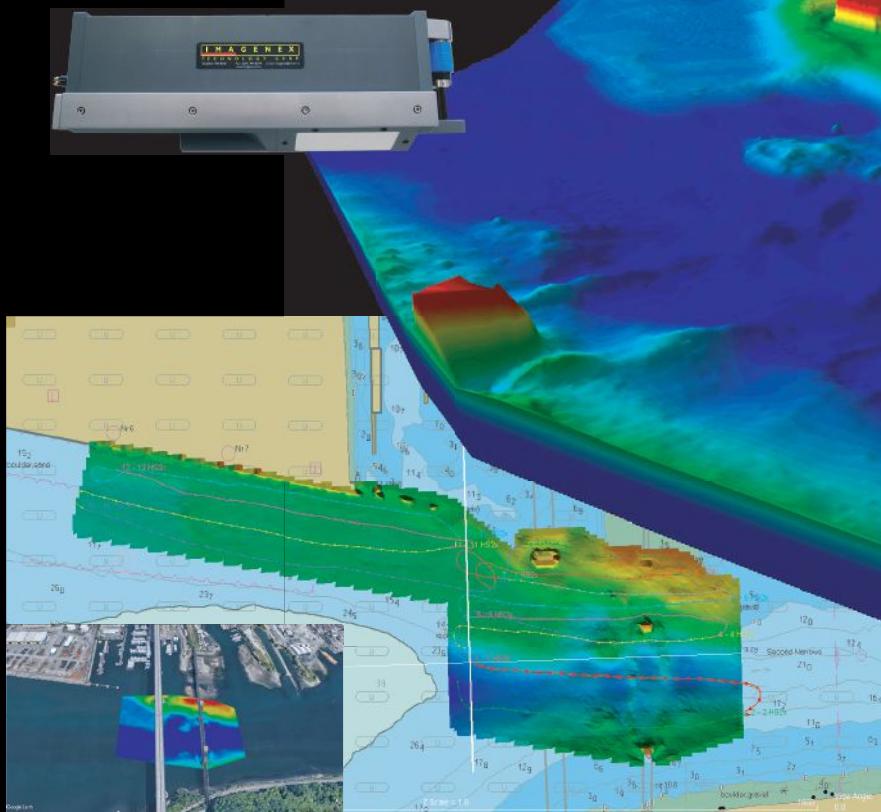


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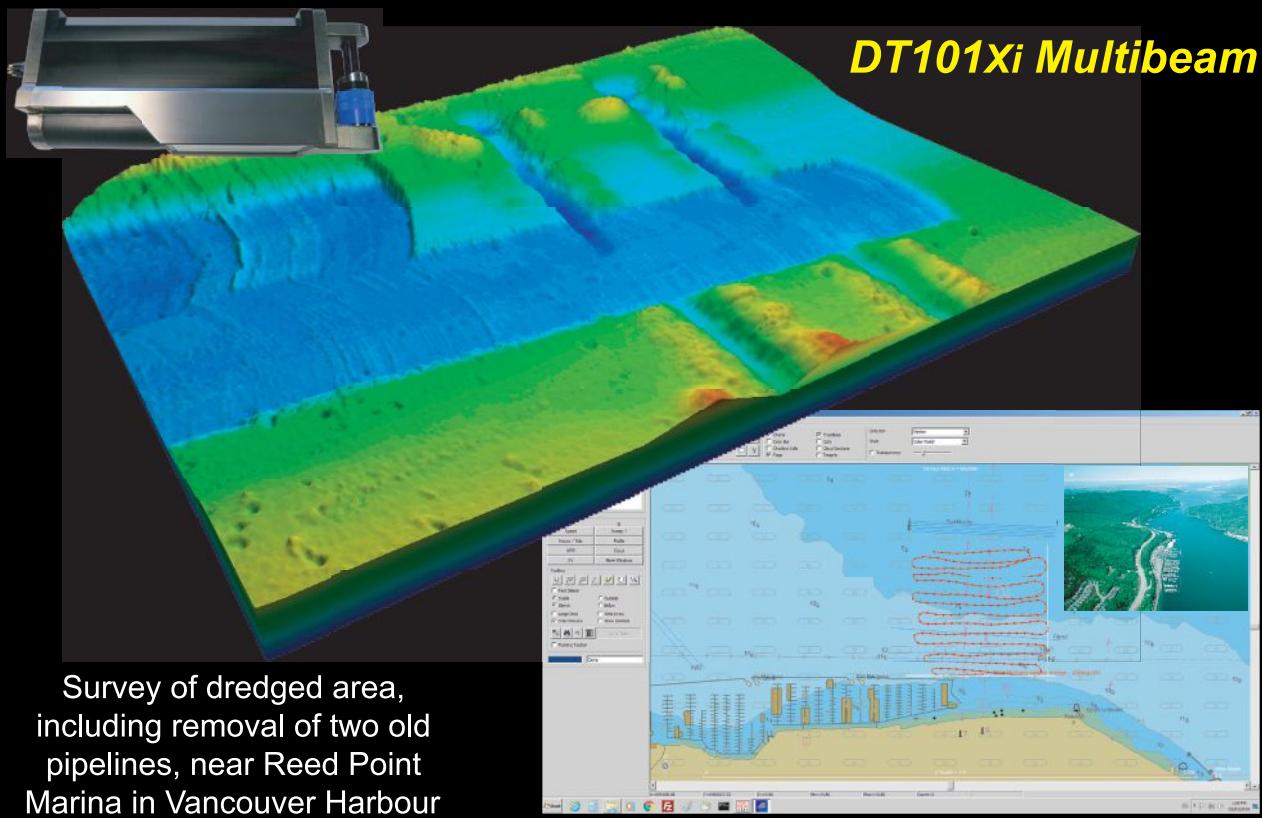


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Second Narrows in
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including bridge
footings and rock
covered cables

DT101Xi Multibeam



Survey of dredged area,
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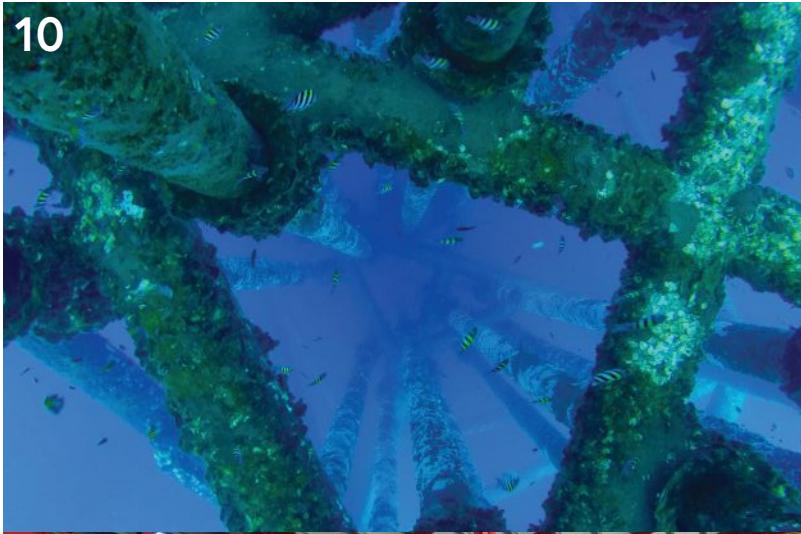
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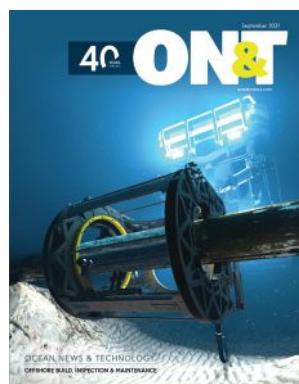


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ON THE COVER:
Neptune, a high-resolution ultrasonic testing tool designed and developed to examine welds, subsea pipelines, risers, and tubular structures.
(Image credit: Oceaneering)

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[WITH THANKS - Ed.]

Special thanks to Oceaneering, EC-OG, and Aquaterra Energy for their expert insights into the challenges and opportunities associated with the build, inspection, and maintenance of the critical infrastructure needed to support the offshore energy sector of tomorrow.

Speaking of future horizons, ON&T is pleased to announce that we will be publishing our second Special Edition, *The Future of Ocean Technology 2021*, in December. This feature-only (no news) lobby copy is designed to convene thought leaders to discuss the fresh thinking, applied science, and pioneering technology likely to reshape the ocean and offshore industries in years to come. Editorial opportunities are limited, so get in touch ASAP.
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OFFSHORE AUTOMATION CALLS FOR A NEW CLASS OF CREW

BY ED FREEMAN*Managing Editor, ON&T*

The first edition of Ocean News & Technology was published in 1981. As our reporting over the years amply attests, the last forty years of industry and ingenuity have resulted in the succession of ever more sophisticated marine technology. From smart sensors and hydrographic instrumentation to robust deck handling equipment and advanced communications systems, these technological breakthroughs have redefined the boundaries for safe and efficient operations in the field.

Of late, a growing ecosystem of AI-governed marine robotics speaks to the brimming ambition and emergent capacity for increasingly unmanned, and even autonomous, deployment. Not so long ago—certainly back in 1981—this paradigm shift would have likely seemed, while plausible, optimistic given the well-documented rigors of subsea exploration and the associated challenges of offshore planning, construction, and maintenance.

Today, however, we see swarms of ASVs, AUVs, and even UAVs, operating in unison for a host of applications, from mine countermeasures to multidisciplinary survey. We see the development of autonomous ships and the advent of subsea resident vehicles, primed for IMR duty. And it's not just the machines pushing the envelope. We see manned submersibles capable of taking oceanographers to the deepest, darkest chasms of the planet in the name of charting new frontiers. We see state-of-the art research vessels—essentially floating laboratories—equipped with the apparatus needed to advance ocean science, at any depth.

SCALABLE COLLABORATION

This rate of progress is only set to accelerate, as commercial, scientific and defense interests coalesce around a more concerted approach to the sustainable use of ocean resources for economic growth, improved livelihood, and jobs—the so-called Blue Economy.

The future is now, almost one year into the UN's Decade of Ocean Science for Sustainable De-

velopment. Access to the tools, expertise, and momentum for a meaningful sea change is no better exemplified than the coordinated efforts of the Seabed 2030 Project, an unprecedented initiative to unify all available bathymetric data to produce the definitive map of the world's ocean floor by 2030. And, further, make this invaluable data universally accessible to any interested party, for free. Given that data is often touted as the currency of the 21st century, this sector-wide commitment to the democratization of validated scientific information is an enduring sign of a progressively collaborative ocean community.

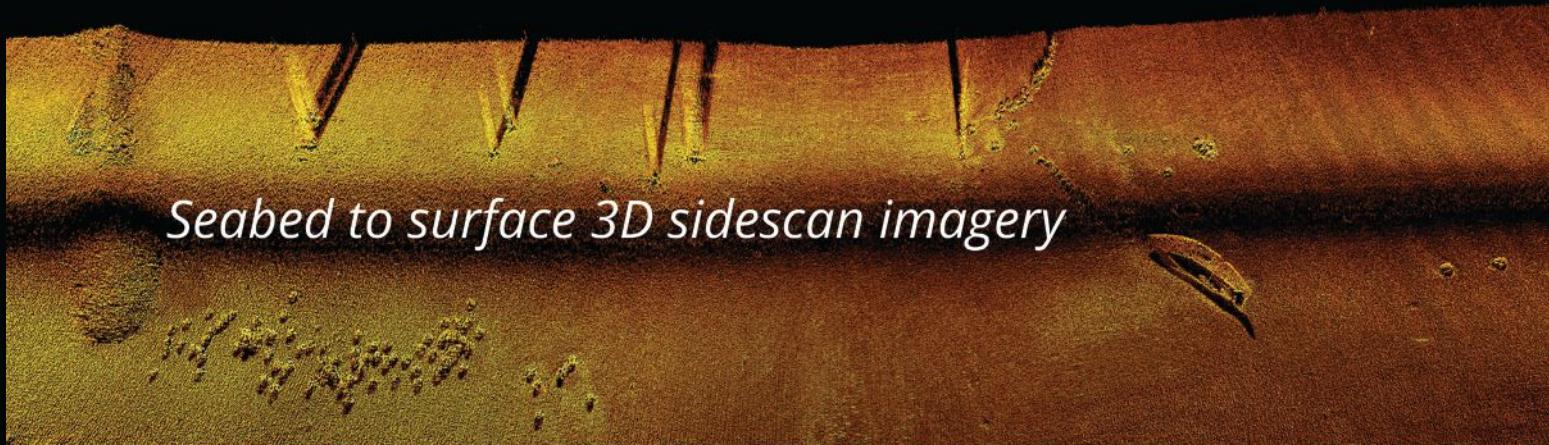
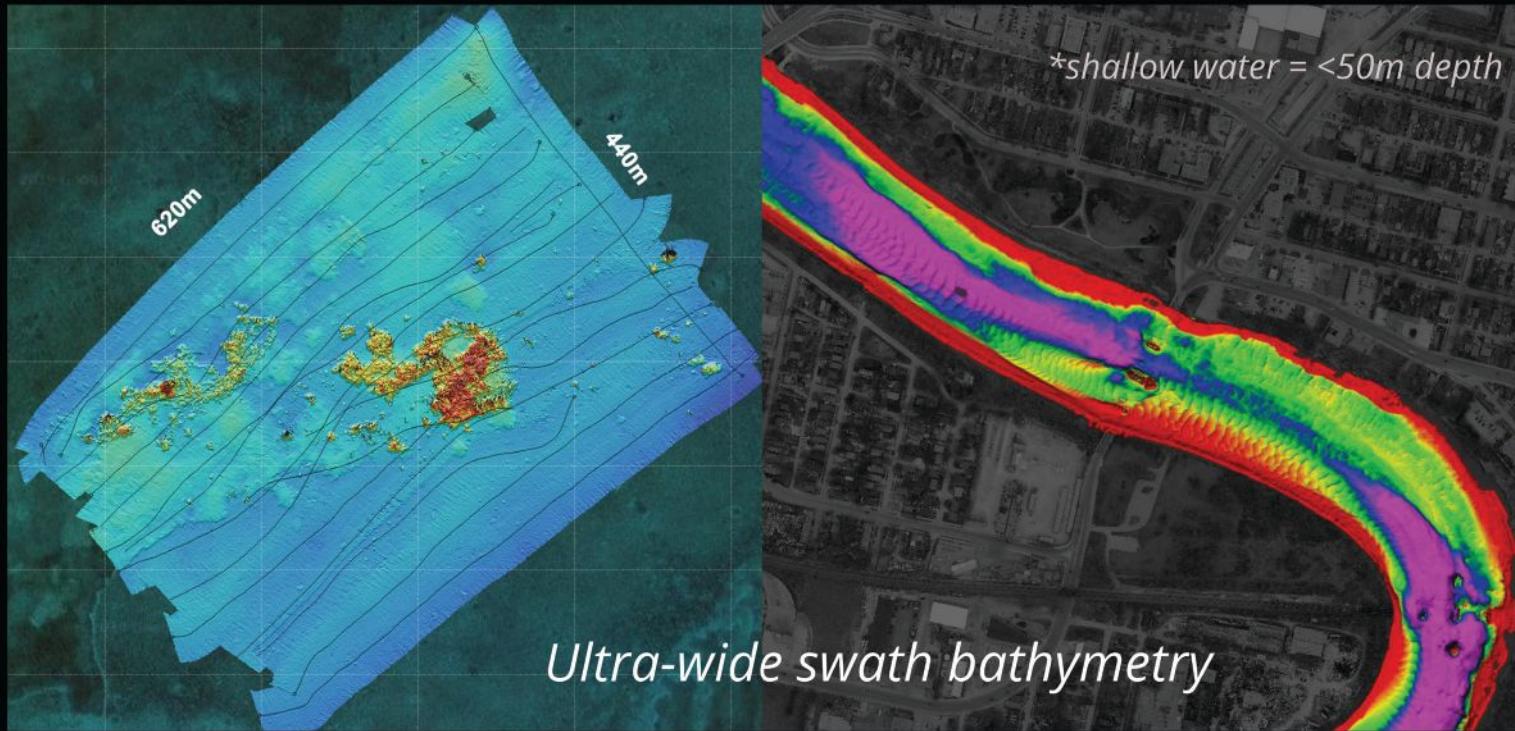
TALENT

But technology and public-private partnership will only get us so far. We need human capital; we need a funnel of upcoming talent. We need fresh vision and aptitude, like that of Matt Biddle, this year's recipient of Ocean News & Technology's Young Professional Award, in partnership with MTS.

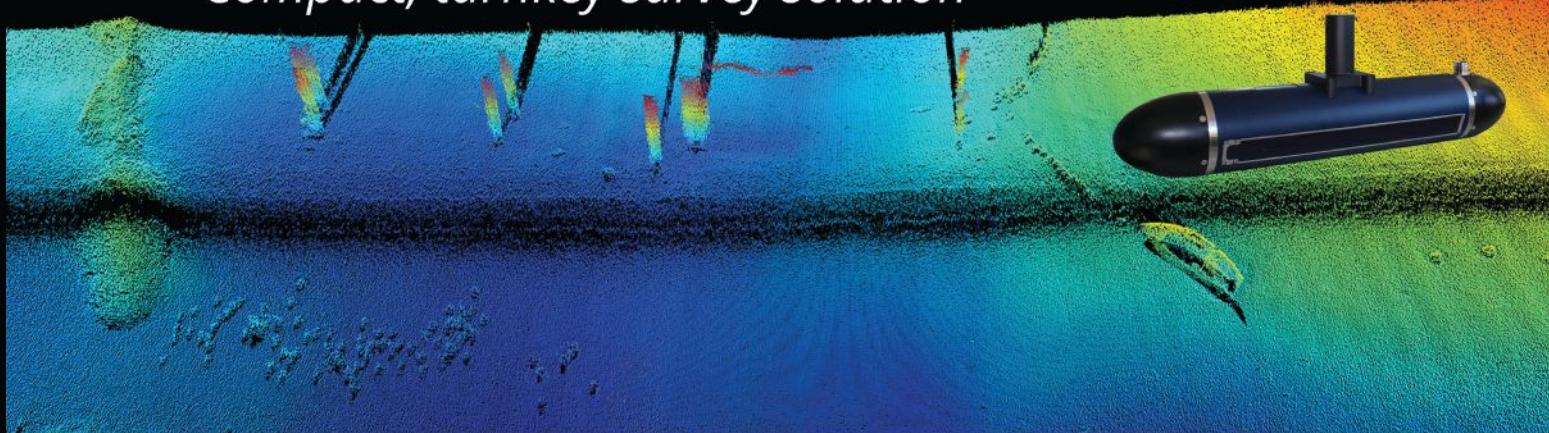
To date, Mr. Biddle's outstanding contribution centers around the integration and management of marine life data for the US Integrated Ocean Observing System (IOOS), a multi-stakeholder endeavor which requires Matt to work directly with NOAA's National Centers for Environmental Information to establish and harmonize interoperable biological data exchange standards and archival practices. In short, he facilitates actionable data.

In an effective digital world, one that promotes a legacy of data democratization and industry cooperation, the complex information systems and expert personnel capable of organizing and translating data into intuitive and centralized repositories of usable oceanographic knowledge will be as essential as the extraordinary technologies engineered to harvest it.

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USING HIGH ENERGY X-RAYS AND DIGITAL RADIOGRAPHY DETECTOR TO LOCATE LOST INSPECTION PIG



By Jim McNab,
Principal Engineer, Oceaneering

Maintaining flow assurance is a critical part of operations planning for oil and gas pipelines. The daily cost of unplanned maintenance and shutdowns can quickly accumulate.

Any number of things can set back successful operations, including damage to the pipeline from corrosion, pitting, and cracking, as well as buildup from hydrates and heavy wax.

There are a variety of measures operators can take to ensure flow and integrity of operations. Often cleaning pigs, which travel through the pipeline interior to clear blockages such as wax and other debris, can be used. And, while cleaning pigs are a reliable method, failures can happen, setting back operations until the pig can be successfully retrieved.

An oil and gas pipeline operator contacted Oceaneering because a cleaning pig was stuck in one of its pipelines in the North Sea. The pig had broken, and while one portion was recovered at the onshore reception facility, the rest remained stuck at an unknown position within the pipeline and was preventing oil production to the onshore terminal. The pipeline was suspected to be full of crude oil and wax deposits.

The pipeline blockage was discovered in 2018; initial recovery operations using pressurization regimes and cleaning pigs were attempted during 2019. An unfortunate outcome of these intervention operations was that part of the cleaning pig broke off; it was recovered at the terminal pig trap. However, the pipeline operator was concerned that other loose parts from the cleaning pig may have remained in the pipeline along with the rest of the pig.

A remediation plan for this situation not only required an expedited solution, but one that had the best probability of positively identifying the missing cleaning pig's location.

DEVELOPING A SOLUTION

There were no obvious known Non-Destructive Testing (NDT) solutions available for obtaining non-intrusive inspection (NII) data or visual images of the cleaning pig with any confidence. However, radiography had potential as a viable option for targeted inspections, including a subsea option if it had been required.

Subsea digital radiography can be used for shallow and deepwater asset integrity needs and can be provided by computed radiography (CR) or digital detector array (DDA) systems.

DDA produces a radiographic image that is instantly relayed to a topside monitoring and data collection system via a fiber-optic link. CR produces a radiographic image following exposure to a rigid or flexible phosphor imaging plate. The plates are placed in special vacuum-packed, static-free cassettes, scanned on the vessel, and interpreted using high resolution monitors.

Conventional radiography using high-energy gamma radiation was considered and rejected based on the method's insufficient penetrating power. The target areas of the pipeline included thick tee sections and complex non-return valves (NRVs). An additional consideration was the likelihood of the larger diameter pipe potentially being full of heavy crude wax.

Oceaneering was able to recommend its Betatron high-energy X-ray system as a solution. The Betatron system, also known as a cyclotron, is normally used in a purpose-built exposure compound onshore to X-ray components with thicknesses up to 250mm. It is, however, seldom used for open site-based locations; one of the main challenges is assuring personnel safety during the operations and setting up a 'Controlled Area.'

Oceaneering developed a timeline that included a data verification review using a similar data set from previous work involving a stuck pig and Betatron; pipeline exposures in our specialized facility at the Rosyth, U.K., dockyard; a presentation of the intended solution to the client; a detailed risk assessment of the site; and mobilization of equipment and specially trained personnel for the work from our head office in Aberdeen.

CHALLENGES

Several challenges presented themselves as the team prepared to execute the project plan, including radiation dose levels, stable power supply for Betatron, moist/salty air environment, scaffolding management, Nucleonics, and site personnel training.

To resolve the challenges, the Oceaneering team put controls in place, lead sheeting, and collimation to attenuate the beam and test exposure to ensure radiation dose levels were properly managed. Special job-specific and site-specific local rules were adhered to, and a high-energy monitor adequacy trial was completed.

The team also ensured that adequate and stable power supply to the Betatron unit could be supplied by working closely with the site's electrical supervisor to ensure that there would be no power output spikes.

To account for the moist and salty air environment, the team ensured that equipment was supplied with adequate covers and control habitat.

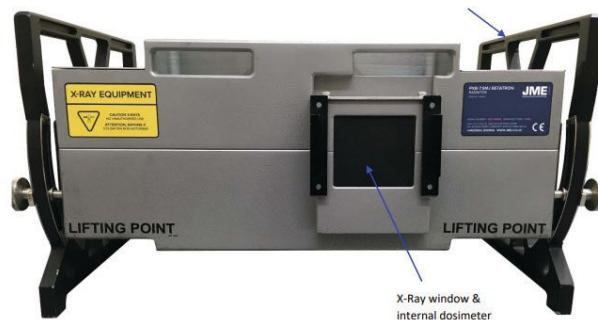
A scaffolding management protocol was implemented. This consisted of a lift plan and local manual handling and storage on the scaffold itself. The accelerator was stored in the transport case overnight. The team also installed a load-bearing overhead beam with shackle to support lifting. In addition, the group enlisted a specialized engineering design team for scaffold construction.

To ensure the beam did not affect nucleonic instrumentation, the team established precise beam control and collimation directed away from the pressure plant and equipment likely to be affected. For safety and site personnel radiation awareness, the team conducted on-site training and toolbox talks. The team provided daily scheduled calls to the site for project management fitness for service (FFS) input and image assessments from Subject Matter Experts (SME).

To identify and inspect additional risks, the team conducted a daily risk assessment and perimetry regime. By using high energy X-rays coupled with a digital radiography detector, the customer was able to resume pipeline production operations after only three months.

RESULTS

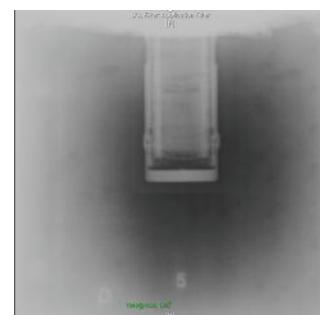
Oceaneering positively confirmed the position of the cleaning pig and the absence of pig debris in the tee prevention bars and inside the NRV. The pig's location would have prevented valve closure or even caused damage to the valve internals during the closure, which would have required a major pipeline intervention and workover to replace the valve. Around 20 m of pipeline was radiographed before the cleaning pig was eventually found. One of the main X-ray set-ups and actual X-ray digital image through the process thick wax product is shown.



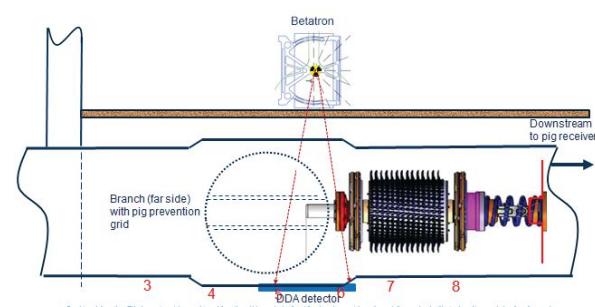
» The Betatron high-energy X-ray system was selected to help locate a missing cleaning pig. (Photo credit: Oceaneering)



» The Digital Detector Array is used with the Betaron to confirm the location of the missing cleaning pig and enable the pipeline to resume production. (Photo credit: Oceaneering)



» An actual X-ray digital image through the process thick wax product is shown. (Image credit: Oceaneering)



» An illustration of the main X-ray set up depicting the Betaron, Digital Detector Array and the pipeline with the missing cleaning pig. (Image credit: Oceaneering).



» An Oceaneering technician uses wearable, hands-free technology to relay real-time findings. (Photo credit: Oceaneering)

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» An Oceaneering technician examining piece of pipe in Houston, Texas, while receiving direction from SMEs in the UK. (Photo credit: Oceaneering)



DIGITIZING THE FUTURE OF ASSET MANAGEMENT

By Peter Flockhart and Lisa McCrory,
Integrity Management and Digital Solutions, Oceaneering

Leveraging technology to access real-time data enables companies to streamline activities, gain operational efficiencies, and improve worker safety by reducing the number of personnel required offshore. This is an evolution of operations that allows workers located around the world to unite as one interconnected team.

Pre-COVID, Oceaneering and its Integrity Management and Digital Solutions implemented an initiative to develop our roadmap of digital developments to support the "Route to Remote" for integrity management services.

Advances in the quality of data and communications available offshore have allowed SMEs matter experts and critical personnel to run operations from remote command centers onshore. Oceaneering's first Onshore Remote Operations Center opened in Stavanger, Norway, in 2015. The benefits are immediate: reduced personnel on board (POB), a measurable reduction in CO₂ emissions, reduced HSE (Health, Safety, and Environmental) risks for workers, and optimized efficiency.

Oceaneering remains focused on creating innovative technologies and practices to support remote inspection and monitoring of topside assets. The pandemic-induced remote work culture has demonstrated the potential of what can be achieved remotely, including some work scopes that have conventionally identified on-site personnel as essential components.

One of the main objectives of remote work is to maintain high-quality services with SMEs located across the globe and across various disciplines, a challenge further complicated by COVID-19 and the subsequent reduction in travel, available personnel, and associated

health and safety restrictions. However, this roadmap—and the technologies and services enabling remote work strategies for offshore assets—has benefits that extend beyond the pandemic.

CLOUD-BASED SOFTWARE & STORAGE

Platform as a service (PaaS) software coupled with cloud storage safely and securely transmits and stores data for easy accessibility for real-time decision-making. The Oceaneering Media Vault (OMV) software suite, leveraging Microsoft Azure, makes collaboration easier. OMV offers multiple live video streams in one convenient display with the ability to annotate video feeds, voice overs, and snapshots while a Voice Over IP (VOIP) system is used for audio communication with the offshore asset. OMV offers a secure and cost-effective media-management solution for customers to store and reliably search and access inspection data.

WEARABLES FOR INSPECTION

As members of HOIS Joint Industry Project, which seeks continuous improvement of NDT and inspection technology, Oceaneering has championed the use of wearable ATEX Tablet devices that enable real time video communication and information sharing with field personnel in hazardous environments.

Oceaneering has also developed a piping vibration measurement system that allows field personnel to make measurements on critical piping systems with full remote support from our vibration experts who have instant access to the data via cloud-based storage. When this system is combined with the wearable tablet device, it gives customers instant access to world class expertise in a faster timescale.

These solutions overcome the challenges of managing the risks of fatigue with the right balance of field personnel engagement and remote expert support. The goal is to minimize the risk of vibration induced fatigue failures that would result in hydrocarbon releases.

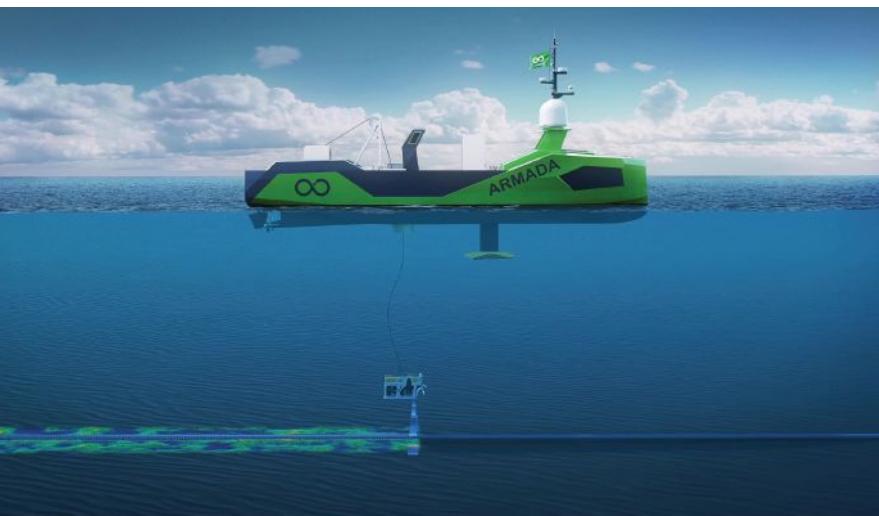
ADDRESSING CHALLENGES

Adoption by accreditation bodies and confidence of operators paves the way for a wider range of competent offshore crew members to do the on-site work, with a real-time link to onshore technicians who can offer supervisory and mentoring support, as well as to clients for instant discussion and feedback.

As with any new technology, there are challenges that must be addressed when considering remote inspection operations. Connectivity at plant sites and complex inspection methodologies must address the manual collection and transmission of data onshore.

For equipment that requires monitoring over time, permanent installation of sensors, or the introduction of remotely triggered robotic technology, must be considered. The latter could be a "garaged" solution that is prompted from onshore to perform a set inspection routine and upload the data for evaluation.

Asset integrity management is about ensuring a plant is fit-for-purpose, by delivering robust and real-time data to help operators make better and faster maintenance regime decisions in line with their efficiency goals, safety performance and environmental mitigation.



» Valeport sensor technology has been integrated into a selection of Ocean Infinity's fleet of uncrewed vessels.
(Image credit: Valeport / Ocean Infinity)

VALEPORT SENSOR TECHNOLOGY SELECTED BY OCEAN INFINITY

Valeport sensor technology has been selected by Ocean Infinity to provide sound velocity and bathymetric data for their pioneering Armada Fleet, the world's most environmentally sustainable fleet of ocean-going, robotic vessels.

The Armada Fleet, capable of remotely operated uncrewed operations, is widely recognised as breaking new ground in the remote and autonomous seabed data industry. Integrating a suite of Valeport's highly accurate sensors and profilers to a selection of the fleet's uncrewed vessels, will provide important data to support operations for Ocean Infinity.

Valeport's miniSVS will be mounted on the vessels beside the multi-beam echosounder in the sensor gondola, to provide surface Sound Velocity correction. Through the water column, the Midas SVX2, powered by the vessel, will deliver the Sound Velocity data of an SVP with the Salinity and Density data from a CTD. The Midas SVX2 has also been combined with the VA500 altimeter to provide range data for the vessels. Selected to interface with the Edge Tech side scan sonar and Saab Seaeye Leopard ROVs, the Valeport uvSVX will be integrated onto the vessels to deliver Sound Velocity, Temperature and Salinity combined with range data from the VA500 altimeter and precision depth from the minilPS2.

The compact and robust instruments will be fitted across a selection of six vessels in the fleet including the 21 m and 36 m vessels, to assist their offshore data acquisition and ROV work in both shallow and deepwater operations.

Ocean Infinity selected Valeport for the Armada Fleet on the back of their previous experience using the leading hydrographic and oceanographic instrument manufacturer's sensors and profilers. Valeport has already delivered the first instalment of instruments to Ocean Infinity's facility in Southampton UK and further deliveries will be made throughout 2021 and 2022.

The robotic vessels in Ocean Infinity's Armada Fleet use low emission technology, with an Armada robotic vessel emitting 90% less CO₂ than a conventional survey vessel.

"The Armada Fleet is an exciting demonstration of uncrewed, and sustainable, seafaring technology and we are very proud that Valeport technology is involved in this innovative project.

"These exceptionally efficient vessels undoubtedly will play an important role in the future of data acquisition and maritime activity, and the stable, high accuracy data performance from our instruments can play its part in helping to underpin this," commented Kevin Edwards, Head of Sales at Valeport.

"Working with Ocean Infinity engineers is an interesting project and we are pleased to offer them the solution required," concluded Mr. Edwards.

The Armada Fleet will serve a wide range of industries by being fully equipped to perform a multiplicity of offshore data acquisition and intervention operations down to a depth of 6,000 meters. Expected to be deployable from 2022, Ocean Infinity will control and operate the Armada Fleet from its onshore facilities in Southampton, UK and Austin, Texas.

Valeport has supplied the subsea sector for more than 50 years and continues to innovate in the design and manufacture of precision instrumentation for the hydrographic and oceanographic communities.

UNIQUE GROUP AND AMCS SIGN AGREEMENT TO DEVELOP USV COXSWAIN COURSE

Leading integrated subsea and offshore solutions provider, Unique Group, has signed a Memorandum of Understanding with AMC Search (AMCS), the training and consultancy division of the Australian Maritime College to jointly develop a maritime industry accredited Unmanned Surface Vessel (USV) Coxswain's course.

For over 30 years, AMCS, has offered bespoke courses and consultancy services for the civilian and defense maritime sector. This industry-academia collaboration will see Unique Group provide the latest autonomous survey technology from its pool of autonomous equipment, with AMCS developing a comprehensive training course incorporating collision regulations and navigation considerations for unmanned systems in commercial operations.

As well as being delivered globally by AMCS using Unique Group's fleet of USVs as training platforms and base stations as training simulators, the course will also be offered to Unique Group's clients, as a part of the USV product package.

Commenting on the partnership, Sahil Gandhi, Unique Group COO said: "We are excited to collaborate on building educational and training programs for the emerging autonomous offshore industry. We believe that this emerging technology will become a significant segment within the offshore value chain in the future and as technical experts, providing asset management and knowledge-sharing solutions for our customers globally is the next step for us. We look forward to this successful partnership with AMCS."

Dean Cook, AMCS CEO, added: "We have witnessed Unique Group's USV capabilities first-hand during our Winterfest '21 event, and we are delighted to partner with them to develop this course. Our mariner's course, encompassing all the latest technology upgrades available in the USV industry will equip future USV Coxswains with the best knowledge and skills."



» Unique Group's USV Uni-Pact in action. (Photo credit: Unique Group)



» Researchers have developed sphere-based triboelectric nanogenerators that can be incorporated directly into navigational buoys to provide electricity from ocean waves. (Image credit: Cátia Rodrigues)

POWERING NAVIGATIONAL BUOYS WITH HELP OF OCEAN WAVES

During the AIP Publishing Horizons — Energy Storage and Conversion virtual conference, which was held on August 4–6, Cátia Rodrigues, from the University of Porto, discussed the prospects of using power generators in the ocean to address the energy concerns of marine exploration. The presentation, *Performance of triboelectric nanogenerators based on rolling spheres motion under realistic water waves conditions*, was available during the three-day conference.

Traditionally used energy harvesting technologies, like photovoltaic panels or wind turbines, suffer from several limitations—critically, their intermittency and inability to maintain continuous operation. In the absence of daylight and wind, neither of the two can supply any power.

In the case of ocean buoys, a potential solution is omnipresent: wave energy. Abundant, predictable, and consistent, the ocean's own waves can be used to power navigation buoys.

"Even so, the development of wave energy converters has not yet reached its full potential due to the lack of technological consensus, uncompetitive energy generation costs, and the irregular and low-frequency nature of waves at sea," said Rodrigues.

The team developed sphere-based triboelectric nanogenerators (TENGs)—devices that convert mechanical motion into electrical power—that can be incorporated directly into navigational buoys to provide electricity from ocean waves.

When testing the TENGs on a 1:8 scale in real conditions, they determined maximum voltages can be generated when waves occur at heights of 0.1 meters approximately every 2.6 seconds—close to the natural period of the buoy. Even when waves are inconsistent and slow, the energy conversion efficiency of the TENGs is much larger than standard generators.

"Concerning wave energy, some relevant challenges still exist to the viable deployment of conversion technologies, mostly linked to the irregular nature of waves and the distribution of energy in both direction and frequency," Rodrigues said.

The group plans to deploy a prototype in Figueira da Foz, a seaport in Portugal.

NAVAL DOME CONCLUDES CYBER SECURITY PROJECT ABOARD DEEPWATER DRILLING RIGS

Cyber defence expert Naval Dome and the offshore division of a supermajor have completed a joint project to identify and mitigate cyber risks common to offshore deepwater drilling rigs.

Findings from the two-year project, culminating in the installation and pilot testing of Naval Dome's Endpoint cyber defence system aboard drilling rigs in the Gulf of Mexico, indicate that the minimum industry guidelines, regulations and security techniques are out of step with current platform technology, connectivity requirements and cyber-attack methodology.

In a joint research paper presented at an Offshore Technology conference in Houston last week, the authors state: "Activities over two years have demonstrated shortfalls and real challenges that need to be addressed if we are to create a more cyber-secure deepwater drilling rig environment."

In presenting the *Cyberdefence of Offshore Deepwater Drilling Rigs* paper to conference delegates, Adam Rizika, Head of Strategy, Naval Dome, said: "Where systems installed on offshore platforms had traditionally been isolated and unconnected, limiting cyber hack success, the increase in remote monitoring and autonomous control, IOT and digitalisation has made rigs much more susceptible to attack."

Going on to reveal how the test rigs' OT (operation technology) networks were penetrated using a software installation file for dynamic positioning (DP) and workstation charts, Rizika, explained that Naval Dome simulated an OEM service technician unwittingly using a USB stick with malicious software containing three zero-day exploits.

"The modified file was packaged in a way that looked and acted like the original one and passed anti-virus scanning without being identified as a cyberattack or picked up by the installed cyber network traffic monitoring system," he said.

Although the attack was carried out internally, Rizika noted remote execution was feasible using the rig's externally facing network connections.

"Penetration testing confirmed how a targeted cyber-attack on a deepwater drilling rig could result in a serious process safety incident, with associated financial and reputational impact," he said.

In the paper, the authors state that pilot tests confirm traditional, "perimeter type" IT transplanted OT cyber security solutions, such as anti-virus, network monitoring and firewalls, are not enough to protect critical safety and processing equipment from attack, leaving rigs vulnerable.

"It is abundantly clear that more advanced purpose-built solutions are needed to better protect an offshore platform from exposure to external and internal cyber attacks, whether targeted or otherwise," reported Rizika.

The paper goes on to highlight a shortage of OT cyber domain skilled staff, regulation and controls that are slow to evolve and be implemented, an IT-centric approached being applied to an OT environment, and a mismatch between drilling rig systems and equipment and their supporting software.

Rizika said: "Although industry guidelines and regulations offer minimum standard

requirements, we found the advancement in rig technology, connectivity and cyber-attack methodology has outpaced the regulations, driving the need for a more comprehensive approach."

Commenting on the project's findings, Naval Dome Chief Executive Officer Itai Sela, said: "The project and successful pilot testing of a multi-layer cyber defence solution aboard these rigs has demonstrated that both new and legacy OEM systems can be better protected from internal and external cyberattack vectors, without the need for expensive equipment upgrades, or higher overheads that lead to an increase in total cost of ownership."

"Results to date demonstrate that the endpoint system is robust and can operate without interfering with ongoing rig operations. The cost of upgrading the obsolete systems is high, and even if upgrades are undertaken vulnerabilities can still remain."

By approaching the problem differently, Naval Dome and the oil major believe that the attainment of a cyber resilient environment can be accelerated onboard offshore installations at a critical time for the industry. www.navaldome.com



GREENSEA ENTERS INTO CONTRACT WITH OCEAN POWER TECHNOLOGIES

Greensea Systems, creator of OPENSEA®, the universal open architecture software platform for the marine industry, recently contracted with Ocean Power Technologies (OPT) to provide development and engineering services. During the three-year contract, Greensea will support OPT to develop and launch the next generation of their PowerBuoy®-based Maritime Domain Awareness Solution (MDAS) on the OPENSEA platform and will work closely with OPT's other software partner, Fathom5.

"This is an exciting project to be involved in and it speaks to the versatility of open architecture and OPENSEA," said Ben Kinnaman, Greensea CEO. "It also takes into consideration what working with Greensea is all about, an open business relationship where we work collaboratively with all partners to develop their differentiating technologies based on the proven and stable technologies of OPENSEA. This is the

only way to eliminate the barriers that often prevent rapid technology advancement."

James Truman, VP of Engineering for Greensea, said: "We'll be standing up an engineering payload unit at our Plymouth, Massachusetts facility which will provide a continuous 'live' test and eval system for us and Fathom5. Greensea's over-the-horizon command and control suite, SafeC2™, will be playing an important role in the OPT project."

"There is growing international focus on Maritime Domain Awareness to prevent and prosecute activities from some of the most remote areas of the seas," commented Philipp Stratmann, OPT President and CEO. "Greensea brings decades of experience in developing agile and adaptable software solutions that can help our products withstand the harshest ocean environments. Along with Fathom5, Greensea will allow



us to seamlessly integrate video and radar from a PowerBuoy®-based Maritime Domain Awareness Solution with available satellite, weather, bathymetric, and other data feeds to form a customizable and detailed surface and subsea picture of a monitored area as we develop a best-in-class autonomous threat detection solution."

Fathom5 CEO Zac Staples added: "We are excited to be a part of the team put together by OPT and we are looking forward to working with Greensea to deliver this important advance in maritime domain awareness."



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INTELLIGENT BATTERY STORAGE: ENABLING SUSTAINABLE AND RELIABLE POWER FOR OPERATIONS IN THE BLUE ECONOMY



By Paul Slorach,
*Business Development Director,
EC-OG*

There is a growing market demand for an enabling technology which is the nerve center of a reliable and resilient electrical grid: intelligent battery storage. Responsible for augmenting output from resources such as wind and solar, helping to reduce the environmental impact of

power generation and improving grid efficiency, battery storage is experiencing rapid growth on a worldwide scale.

Taking my native UK as an example, there is now over 20 gigawatt-hours (GWh) of onshore battery storage across more than 800 projects, with a record-breaking number of

applications being submitted in Q2 of 2021. In early August, the UK became home to Europe's largest storage battery with two 50 megawatt-hour (MWh) systems being connected to the grid in Wiltshire.

The US has also made significant progress to meet demand, with figures from the national Energy

Information Administration showing a net increase in large-scale battery storage of 972MWh between 2010 and 2019. The costs associated with battery storage have also fallen by a substantial 72% between 2015 and 2019.



INTELLIGENT BATTERY STORAGE FOR THE BLUE ECONOMY

In the so-called Blue Economy, a term which describes the sustainable utilization of the marine environment, there is an increasing focus on decarbonization as well as the automation of dangerous underwater tasks and operations.

Battery storage in this underwater environment provides a local power enabler for remote and autonomous operations, reducing the need for people to be offshore therefore increasing safety, as well as improving the environmental impact associated with the transportation of personnel and equipment.

However, due to the remote nature of the offshore environment, it is simply not viable to connect offshore equipment directly to the onshore grid for smaller underwater operations such as environmental monitoring. Instead, through a combination of ocean energy and intelligent battery storage and management, an underwater micro-grid can be developed to power these remote assets in a sustainable and reliable way.

AN INTELLIGENT ENERGY MANAGEMENT SYSTEM

EC-OG, a leader in intelligent energy management and storage technologies for the energy industry, has developed a modular, scalable battery storage platform and gateway for renewable energy to high value underwater assets. The Halo system has been specifically designed for the harsh underwater environment, to provide a reliable, uninterrupted power supply for use primarily on the seabed.

A fundamental basis of the Halo system is its Intelligent Energy Management System (IEMS). The IEMS, a completely unique offering in the marketplace, is a fully integrated battery management system which autonomously maximizes available capacity of the battery system in real time. This allows the IEMS to monitor, control and protect the generation and storage system, alongside providing safety functionality.

Halo can enable longer duration operations through its high energy density and efficiency of the battery platform. This is particularly important for cost reduction of environmental monitoring and leak detection for pipelines and other underwater structures.



» Integrating the IEMS into the battery system. (Photo credit: EC-OG)

A WORLD FIRST DEMONSTRATION

The Halo system is part of a world first demonstration project where C-Power, a wave energy developer, will demonstrate its SeaRAY autonomous offshore power system (AOPS) in partnership with the US Department of Energy and US Navy.

The AOPS provides in-situ power, energy storage, and real-time data and communications to enable autonomous, connected, and resident offshore technologies. The configurations of an AOPS are flexible, allowing them to meet the needs of a wide array of customer applications. Examples include unmanned offshore activities such as subsea resident vehicle recharging and environmental monitoring, where it can provide in-situ power, energy storage, and real-time data and communications to autonomous underwater vehicles, sensor packages and operating equipment.

With sea trials set to begin in Q4 this year at the US Navy Wave Energy test site off the coast of Oahu, Hawaii, this will be the first time that an integrated battery storage and wave energy system such as this will deliver energy to a subsea payload.

EC-OG will supply its Halo lithium-ion battery system which will be fully integrated with the AOPS, providing the seafloor base unit and the payload interfaces for power, data, and communications. Other project partners include Saab, BioSonics and Franatech.

THE FUTURE OF UNDERWATER POWER

A further project where Halo is being used as part of an underwater demonstration is the second phase of the Renewables for Subsea Power Project; where EC-OG will provide the gateway for wave energy into a subsea hydrocarbon production



» A schematic of the C-Power world first demonstration project. (Image credit: EC-OG)

control system. The project has E&P support from Harbour Energy, with Baker Hughes, Mocean Energy, the Net Zero Technology Centre and Modus completing the consortium. Another active project for EC-OG is in battery storage and energy management for offshore wind platforms, an area which requires modular battery systems for long duration offshore energy storage and auxiliary services.

Projects such as these demonstrate the value that a reliable intelligent battery system can bring to underwater operations, enabling decarbonization and improving reliability. Over the next few years, I expect that we will see rapid technical innovations as the applications for battery storage widen.

We are predicting that battery storage technology will become integrated across the underwater environment, including underwater substations, as well as in maritime operations such as vessel power. There may even be applications in harsh, difficult to power onshore environments and grid services—let's challenge conventional operations and see how far this nerve center technology can take us.

For more information, visit: www.ec-og.com



KONGSBERG WINS FOUR NEW CONTRACTS IN SOUTH KOREA

Kongsberg Digital (KDI) is recently announced four successive contracts with highly respected maritime training centers, schools and universities in South Korea.

In the first quarter of 2021, the successful delivery of K-Sim Offshore and DP simulators to the Korea Institute of Maritime and Fishery Technology (KIMFT) was closely followed by the handover of K-Sim Mooring simulators to the Busan Techno Park foundation, an organization dedicated to the development of mid- and long-term strategies and policies for local industries.

Directly off the back of these high-profile wins, KDI has recently been awarded contracts by two of Korea's most distinguished educational establishments. In June and July respectively, Busan National Maritime High School and Incheon National Maritime High School both commissioned KDI to deliver K-Sim Navigation ship's bridge simulators in Q4 2021.

The four new contracts consolidate a mutually rewarding relationship with South Korean training institutes. This relationship received an earlier boost in 2019, when a full suite of KDI simulator systems was delivered to the Korea Maritime and Ocean University (KMOU) and Mokpo National Maritime University (MMU) for installation on two identical training ships: T/S *SEGERO* and T/S *HANNARA*.

Each of the four customers are united in agreement that KDI Maritime Simulation was awarded the contracts because of the quality, scope, functionality and flexibility of its simulators, in addition to the high level of trust associated with the KONGSBERG

brand. KIMFT, which is a new investor in KDI technology, will be using the K-Sim simulators to train researchers and industry personnel in a complete series of offshore and dynamic positioning operations. Incheon National Maritime High School, another new KDI customer, will be deploying its K-Sim Navigation ship's bridge simulators to provide students with highly realistic training using vessels, objects and equipment that behave and interact as they would in real life.

Meanwhile, Busan Techno Park and Busan National Maritime High School will be expanding their existing range of K-Sim simulators to enhance interoperability. By utilizing add-on features on the advanced and dynamic new devices such as offshore mooring, the oil-spill function and SMART objects, they will have high-fidelity, cost-effective, future-proof simulators on their respective premises which are equipped to seamlessly accommodate new technologies as they emerge.

"These contracts are all very important for KDI, securing our market leading position for maritime training in Asia," said Andreas Jagtøyen, Executive Vice President Digital Ocean, Kongsberg Digital. "South Korea is a key global player in the journey towards Maritime 4.0, with its highly successful ship-building and ship-owning companies. By securing these contracts, KDI has gained valuable partners to support the industry in this venture. This is a country also having a large offshore and fishing fleet, and we are confident that KDI simulator training will be of vital importance in supplying this industry with the best-qualified and most efficient crew and operators for many years to come."



» The delivery of K-Sim Offshore and DP simulators to KIMFT is just one of four scheduled for Korea in 2021. (Image credit: KDI)



C-KORE: BREAKING BARRIERS WITH SUBSEA TDR TECHNOLOGY

C-Kore Systems, a UK company specializing in the development of innovative subsea testing tools, are seeing exciting results from customers around the world who are using their Subsea TDR technology to precisely locate anomalies in subsea electrical networks. Oil and gas operators are locating faults quicker, reducing the downtime of their offshore operations, saving both time and money.

TIME DOMAIN REFLECTOMETRY

Time Domain Reflectometry (TDR) is a technique widely used to locate faults in onshore electrical systems, such as the buried services that run under our streets. Like a sonar but for electrical cables, a TDR fires a pulse of electrical energy down a cable and records any reflections that bounce back. Some reflections are caused by features expected in subsea electrical networks, such as splices and terminations, whereas others are caused by cable faults and damage. The challenges of applying this technique to a length of cable that may be in 3,000 m of water and 20 km from the host facility have, until the development of C-Kore's Subsea TDR tool, limited its value to subsea operators.

Historically, fault finding subsea electrical networks involved the use of a 'down-line' which is essentially an enormous extension cable hundreds, or thousands, of meters long. The down-line is used to connect the subsea installations to the topside TDR test unit where technicians knowledgeable of TDR theory and operation must battle the intricacies of operation and detrimental influence of the downline to obtain any usable data. This is a time-consuming task which often leaves the end user without the answer to the question: where is the fault?

HAND-HELD CONVENIENCE

To overcome these frustrating issues for their customers, C-Kore Systems has developed a fully automated, small hand-held Subsea TDR testing unit to simplify the whole fault-finding process in subsea electrical networks. The C-Kore unit has a wet-mate connector so it plugs directly into the subsea infrastructure. It is programmed ahead of time, so no specialized personnel are needed offshore, an added benefit during the COVID-19 pandemic. The captured information is data-logged by the unit, allowing it to be downloaded later for detailed analysis using C-Kore's proprietary software. This, coupled with C-Kore's renowned data analysis service allows customers to locate their faults with accuracies of around 30 cm. This capability allows offshore operators to quickly identify the faults in their subsea systems, plan their maintenance strategy and swiftly get their offshore fields operating again.



» C-Kore Subsea TDR unit has a wet-mate connector so plugs directly into the sub-sea infrastructure. (Photo credit: C-Kore)



» The hand-held Subsea TDR testing system simplifies the fault-finding process in subsea electrical networks (Photo credit: C-Kore)



» Information is data-logged and analyzed using C-Kore's proprietary software. (Photo credit: C-Kore)

Greg Smith, General Manager for C-Kore Systems is excited about the C-Kore's Subsea TDR and said: "We spent a lot of time optimizing the design of our Subsea TDR unit to make it really simple for our customers to use. The feedback we are receiving is fantastic and the level of detail in the data is tremendous with resolutions better than we had even anticipated. We are truly Simplifying Subsea Testing!"

For further information on this innovative subsea testing technology, visit: www.c-kore.com.

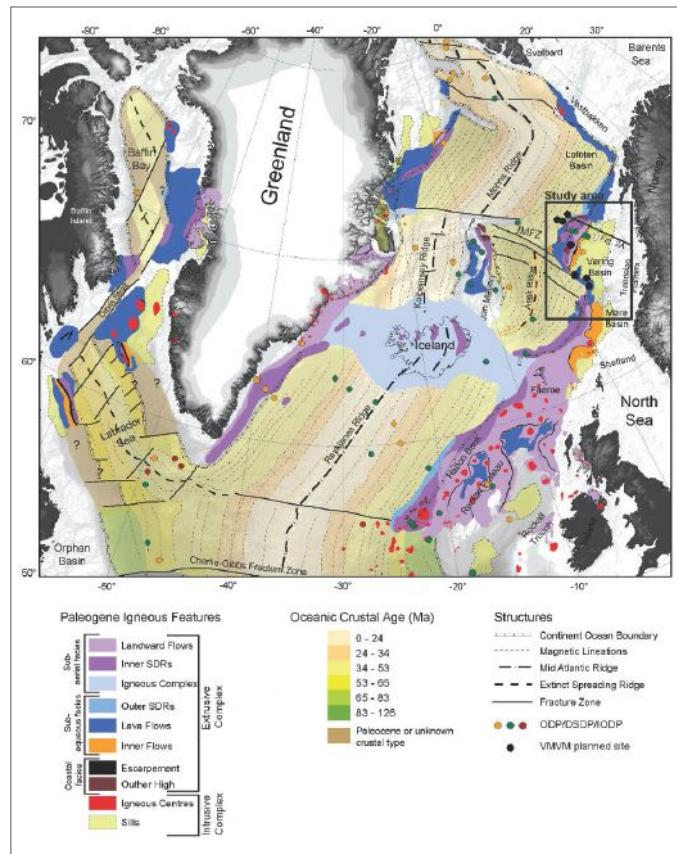
HOW AN OCEAN IS BORN

The theory of plate tectonics is only 50 years old, and it is still poorly understood how continents break apart. This summer, an international team of researchers intends to drill the edge of the Norwegian continental shelf to learn about the opening of the Atlantic Ocean and the vast environmental consequences this had. The expedition is funded by the Integrated Ocean Discovery Program (IODP) and will use the research vessel *Joides Resolution*. The expedition is jointly led by Prof. Sverre Planke from the University of Oslo and Prof. Christian Berndt from GEOMAR Helmholtz Centre for Ocean Research Kiel.

In Iceland, one can still observe the last after-effects of the volcanism that accompanied the opening of the Atlantic Ocean when Greenland and Europe broke apart. Active volcanoes stretch across the country like a string of pearls. Kilometer-long deep fissures with rifts dozens of meters high can be seen with the naked eye. Every year, the Eurasian and American plates move a little further apart. This process started more than 56 million years ago when the North Atlantic was born. Over a period of about one million years, one of the most powerful volcanic eruptions in the Earth's history occurred. According to current knowledge, this volcanism warmed the Earth's climate by about five degrees globally. However, many details of the opening of the Atlantic Ocean between Greenland and Norway are still unknown. Volcanic rocks in the seafloor bear testimony, but they are often difficult to access. In order to gain a better insight into the history of the formation of the Atlantic, an international team of scientists wants to collect extensive sample material by drilling off the coast of Norway with the research vessel *Joides Resolution* this summer.

"The IODP expedition offers a unique opportunity to really understand how the huge volcanic eruptions during the opening of the North Atlantic affected the climate at that time and what lessons we can learn for future climate change," according to Christian Berndt, co-chief scientist of the expedition from GEOMAR Helmholtz Centre for Ocean Research Kiel.

"Our hypothesis is that volcanic and magmatic activity was instrumental in triggering a 150,000-year extreme global warming event known as the Paleocene-Eocene Thermal Maximum. This global warming of 4-5 °C may have been caused by the release of



» Geological map of the northeast Atlantic, with the working area off the coast of Norway marked. (Image credit: Huismans et al. 2019)

greenhouse gases from heated sediments off the coast of central Norway," explains Dr. Morgan Jones from the University of Oslo.

The scientists intend to drill and to obtain sample material from the volcanic rocks that were formed at that time. A total of nine boreholes are planned at depths of up to 800 meters. The drilled material will then be analyzed geochemically and dated. Christian Berndt is convinced that in combination with the wealth of reflection seismic data collected by the oil industry over the last 40 years, the borehole information will provide an unprecedented picture of the formation of a large eruptive province during the opening of an ocean basin. A side aspect to be investigated, is the question how well these rock layers can be used to store carbon dioxide. If this can be done cost-effectively, it may help slow down today's global warming.

The dimensions of the eruption at the time were huge. "We estimate this to be several million cubic kilometers of lava, enough to cover the whole area of Germany with five kilometers of lava," explains Sverre Planke from the University of Oslo, co-chief scientist of the expedition. "As part of this IODP expedition, we would like to figure out why this volcanism was so anomalous. It is a unique opportunity for us to understand the formation of enormous volcanic eruptions from the Earth's mantle and how such magmatism might have triggered global warming and mass extinctions in the past" added the Norwegian scientist.



» The drill ship *JOIDES RESOLUTION*. (Photo credit: Bill Crawford/IODP)

SONARDYNE ADDS FLAG-SHIP NAVIGATOR MODEL TO SPRINT-NAV MINI FAMILY

Energy, defense, and science marine technology company Sonardyne has introduced a range-topping model of its hybrid, underwater and surface vehicle navigation platform, SPRINT-Nav Mini.

The new Navigator version extends the capability of the Guidance model introduced last year, by calculating and providing the position of a remote, autonomous or piloted underwater vehicle, or uncrewed surface vessel, in addition to its velocity, depth and attitude.

Small in size and low in power, SPRINT-Nav Mini is engineered to provide accurate, precise and robust guidance, and also survey

and inspection capabilities, for vehicle platforms that would normally not be able to host high-end navigation systems. These include observation-class ROVs, low-logistic AUVs, manned submersibles, swimmer delivery vehicles and USVs operating in shallow waters.

With field-proven technology transferred from Sonardyne's popular SPRINT-Nav product line, the Mini family combines an INS, AHRS, pressure sensor and 500 kHz DVL in a single subsea housing that is just 215 mm high, 149 mm in diameter and as little as 0.7 kg in water; smaller, lighter, and lower power than any other competing technology in the same class, and lower in



» Expanding the horizons for underwater robotics—Sonardyne's SPRINT-Nav Mini. (Photo credit: Sonardyne)

cost than the individual vehicle sensors it replaces.

SPRINT-Nav Mini continues to work even in challenging environments, such as around surface structures and GNSS denied environments, providing a continuous stream of latitude and longitudes, orientation, velocities, depth, and altitude at up to 200 updates per second to a vehicle's primary control system.

Available in 300 m and 4,000 m depth options, with a class leading maximum DVL altitude of up to 200 m, all SPRINT-Navs are supplied pre-calibrated from the factory, enabling users to install it and get to work easily and quickly. Existing owners of SPRINT-Nav Minis can upgrade their Guidance units to the new Navigator version, remotely in the field.

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OFFSHORE TECHNOLOGIES: SURVIVAL OF THE FITTEST—AND THE MOST ADAPTABLE



By Ben Cannell,
Innovation Director, Aquaterra Energy

For decades, our industry has embraced the classic principles of evolution: responding to changes in its environment to ensure ongoing success. And we have been on an evolving path since drilling began, from navigating the highs and low of oil prices to tackling a global pandemic.

In the North Sea and across the globe, the evolution of offshore technology and learning from our past will play a vital role in reaching net zero goals. In the UK alone, investments to the tune of £416 billion will be required over the next 30 years to meet decarbonization targets. Those who adapt their products and services accordingly will have the best chances of surviving.

And as the saying goes, to stand still in modern-day business is to go backwards. So, like many in the service sector, we continue to explore new ways to adapt our products for future industry trends and priorities.

THE NEED FOR INNOVATION

The physical environment we operate in, be it the North Sea or elsewhere, is not the conventional backdrop for evolution.

It's the industry environment—the commercial and safety imperatives, and more recently, decarbonization goals—that drives the need for innovation and change. It requires the pursuit of technical advances, which often result from the reimaged application of existing products and services. Relatively minor modifications can—and do—lead to major opportunities to meet present-day challenges.

In terms of offshore exploration and production, well-related practices offer some useful examples of industry evolution in action. Many early subsea wells were comparatively small and susceptible to excessive loading (the first step in the evolution of surface wellheads and trees). Early lightweight semisubmersibles and BOP systems for shallow waters were commonplace. Fast forward to today and some of the early wells remain and require abandonment, whilst other new subsea wells need to be installed. The semisubmersibles and BOP systems of the past have evolved into ever larger systems designed for harsh and deeper water applications and are no longer suitable for shallow water operations where excess offset and BOP weight can cause serious structural and/

or fatigue damage to both new and old subsea wellheads and trees.

Thankfully jack-up rigs have also evolved. They are much larger and can operate in much deeper water. The idea of using jack-up rigs, equipped with subsea HP risers and surface BOP, instead of semisubmersibles for subsea well drilling and abandonment, grew in prominence given their capacity to address the loading and fatigue issues, while also reducing operators' costs. Today this trend continues and using jack-ups can provide benefits when addressing additional challenges, including decarbonization goals. A typical mid-range jack-up produces 67.17 tonnes of CO₂e per day, versus a mid-range semisubmersible's 80.61 tonnes of CO₂e per day—every little counts in the race to net zero.

AN EVOLUTIONARY TEMPLATE

At the same time, this approach required the support of a type of structural and pressure-retaining barrier (subsea HP risers) to provide a conduit between the subsea wellhead or tree and surface BOP. And so our technical experts landed on the idea of repurposing casing and conductor-type pipes for the task several



» Aquaterra Energy's Sea Swift platform: adaptable and modular, Sea Swift is the minimum facility offshore platform for rapid returns in shallower waters. (Photo credit: Aquaterra Energy)



» Aquaterra Energy installing a high-pressure riser system. (Photo credit: Aquaterra Energy)



» Aquaterra Express in action: A large inventory of rental tools and equipment available to support a wide range of offshore well and riser operations. (Photo credit: Aquaterra Energy)



» Aquaterra Energy's market-leading riser system connector that's NT-2 compatible, called the Aquaterra Quick Connect (AQC). (Photo credit: Aquaterra Energy)

decades ago. These products were not specifically designed for the application and had some technical and operational constraints, but it proved possible to formulate a fit-for-purpose, viable solution. Further refinements have been made to our products since to make them simpler and more efficient in deployment.

This evolutionary template has continued to demonstrate its value, not least in the context of our surface riser connector, the Aquaterra Quick Connect (AQC). The initial development of the AQC was based on the attributes of robustness, cost-savings for customers and reliability. The hydraulic option means it can be made-up in under five minutes and it can also be the subject of multiple breakouts for inspection and repair. Based on previous service report data, this creates savings of around one day of rig time, per unit, per well, so significantly optimizes project costs and supports carbon efficiency efforts.

In an international industry where jack-ups are growing in status as a subsea well option, those same qualities have been protected as we've adapted our connector capabilities further. For the first time there is a connector that has been specifically designed for the jack-up subsea market that addresses the limitations and constraints of the reproposed casing and conductor systems in the evolutionary past. We believe our AQC-SR is the first connector in the market specifically designed for this type of application, one that's undergoing qualified testing for robust standards. Its fatigue performance, for example, renders it highly suitable for the subsea environment whilst being specifically designed to be made up and broken out many hundreds of times, while still maintaining a gas tight seal.

However, there is still a gap in terms of an internationally recognized standard for subsea riser operations from jack-up rigs. But again, the principle of evolution has come into play, and we've worked in partnership with customers to develop a subsea riser for jack-up rigs best practice document, which carefully stitches together parts of relevant codes to present a coherent approach from planning and analysis, through to offshore operations. In terms of product development, we've embraced the adaptability agenda by reshaping our connector capabilities into a natural evolutionary step to create a completion and workover riser system using the same DNA from the AQC-SR connector—it too ties together those same fatigue-resistance and make-and-break qualities for a new and evolving lightweight intervention vessel market in the shape of the AQC-CW.

THE POWER OF TECHNICAL INNOVATION

Our strategy takes account of the ever-changing economics of offshore operations, and constantly reviews the existing suite of technological solutions to see how they can add value in different ways. Technical innovation has always been a central feature of our industry, and the best of those advances endure through industry change. It goes without saying that transformation should continue to be embraced in our sector, especially as we grasp opportunities to support and ultimately help deliver the energy transition. Those who continue to celebrate fresh thinking are those who will continue to evolve—surviving the natural selection of our new energy landscape.



» Since 1996, the Sleipner field has been used as a facility for carbon capture and storage by Equinor. (Photo credit: Equinor)

SMART MONITORING CRUCIAL FOR EFFECTIVE LONG-TERM CARBON CAPTURE AND STORAGE

LYTT, a provider of real-time operational insights to oil and energy operators through a fiber optic sensor and analytics platform, and SINTEF, an independent institute for applied research that creates innovative energy solutions, are collaborating to demonstrate the effectiveness of novel technology to monitor CO₂ transport and migration in storage reservoirs.

Carbon Capture and Storage (CCS) will be a vital tool for keeping global carbon emissions to a minimum and even provide net CO₂ removal. This is particularly critical for traditional energy asset owners as they balance their pivotal role in the energy production supply chain with a growing recognition of their power to help mitigate the climate crisis. A key area of focus is demonstrating the permanent effectiveness of CCS solutions.

Although CCS technology has existed since the 1980s, with successful projects such as Sleipner on the Norwegian Continental Shelf (in operation since 1996 and safely storing one million tonnes of carbon annually with no leaks), CCS is not being as widely or as quickly adopted as it needs to be to support decarbonization. Additionally, as well as offshore, onshore facilities need to be developed, requiring broader trust in the safety of CCS.

SINTEF and LYTT have, through their long-term collaboration, developed and validated the latter's cost-efficient analytics technology applied to distributed acoustic sensing (DAS) of oil and gas wells. This was based on extensive laboratory testing at SINTEF's Multiphase Flow Laboratory.

LYTT and SINTEF found tracking dynamic multiphase flow to be a key issue when monitoring the long-term effectiveness of CCS solutions. For underground storage of CO₂, understanding the storage site is

crucial. However, the collaborators have highlighted that following the journey of CO₂ from ground level to storage, such as during injection, is also critical and can be realized through investment in innovative subsurface intelligence gathering tools.

Christian Brekken, Project Manager at SINTEF Multiphase Flow Laboratory, said: "CCS will play an increasingly important role in facilitating a low carbon society as the 2050 deadline draws closer. Working to accelerate the adoption of CCS is therefore a critical piece of the emissions reduction puzzle, and advances in monitoring will help build trust in the technology to pave the way for a net zero future."

Nils Røkke, Executive Vice President Sustainability, SINTEF, added: "Limiting global warming to well below 2°C is fundamental for all industries—particularly energy. From current levels, the CCS market must scale by the hundreds by 2050 to help keep the world on track and limit the effects of the climate crisis. Storage capacity will be needed at scale and in different geological settings—both offshore and onshore."

Tommy Langnes, Co-Founder, LYTT, concluded: "The possibilities of CCS have been opened up due to innovations in oil and gas, which is an industry that has long pioneered the application of new technology. LYTT's offering centers on a framework of novel fiber optic sensor feature extraction and pattern recognition algorithms which have been industrially proven to help improve operational efficiency, reduce cost and manage risk. LYTT is working to develop a CCS monitoring solution to ensure the integrity and performance of CCS systems, monitor containment and de-risk the process. We look forward to continuing our collaboration with SINTEF to build industry trust in CCS as a permanent climate change solution."

DNV UPDATES STANDARD FOR FLOATING WIND TURBINE STRUCTURES

DNV, the independent energy expert and assurance provider, has updated the DNV-ST-0119 standard for floating wind turbine structures. The updated standard includes numerous technical improvements that allow the industry to further optimize floating wind turbine structures while maintaining a sufficient level of safety.

The main change is a completely revised section on floating stability. In addition, various clarifications and updates have been implemented throughout the standard. The improvements are based on industry feedback as well as DNV's own gap analyses and experience from projects.

"With the need for decarbonization ever more urgent, floating wind has the potential to make a significant contribution. It could represent as much as 2% of global power supply by 2050," said Kim Sandgaard-Mørk, Executive Vice President for Renewables Certification at DNV. "Sharing of lessons learned in acknowledged industry standards, such as those from DNV, are crucial for establishing an efficient fabrication supply chain, increased affordability and scaling up of floating wind deployments."

"Reducing costs and at the same time increasing confidence remain the key issues for floating wind," added Kimon Argyriadis, Director for Floating Wind Certification at DNV. "Experience shows that certification against an acknowledged and up-to-date industry standard, is the most trusted way to deliver stakeholder confidence. It indicates that risks have been understood and minimized, ensuring quality and reliability of emerging floating wind projects."

DNV has taken a leading position on developing requirements for floating wind turbine structures. Inspired by the first full-scale turbine, Hywind Demo, DNV issued its first guideline in 2009. This was later developed into a full-fledged standard in collaboration with ten partners and issued in 2013. Building on experience from prototypes, research projects and the world's first floating wind farm, Hywind Scotland, a new update was issued in 2018. The latest version of the standard, DNV-ST-0119, concentrates on clarifying certain issues and making the floating stability requirements more suited for floating wind.

Both the service specification for certification of floating wind turbines, DNVGL-SE-0422 from 2018, which covers the development stages of floating wind concept towards farm deployment, and the 2020 published class rules, DNVGL-RU-OU-0512, refer to the standard for technical requirements.

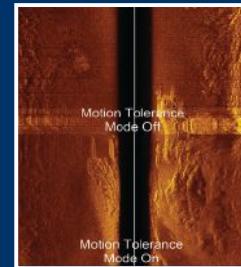


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MASS-ASSEMBLY FLOATING WIND CONSTRUCTION 'VITAL' IN REDUCING OFFSHORE WIND ENERGY UNIT COSTS

A project-by-project mentality in the offshore wind sector is stifling progress towards net zero, according to lean manufacturing specialist FloatWind Ltd. Instead, by applying tried-and-tested lean manufacturing and just-in-time techniques, FloatWind believes the industry can lower the leveled cost of energy (LCOE) and accelerate the use of floating offshore wind as a vital renewable technology in fighting the climate crisis.

Today, every offshore wind project is designed and built differently with bespoke parameters, including type of turbine, foundation requirements, site layout, deployment ports, and contractors. This variance from project-to-project requires large amounts of working capital, slowing project investment across the industry. It also blocks economies of scale, inhibits quality management for project construction, and extends construction schedules—cumulatively costing billions of dollars in wasted time and investment.

FloatWind points out that there is a real opportunity for the offshore wind industry to revolutionize how green renewable energy is deployed globally. Learning from other industries by standardizing and automating current manufacturing and assembly processes will lower the cost of energy and enable a faster transition away from fossil fuel energy sources.

Robert Speht, Co-Founder & CEO of FloatWind said: "In an era where we are all collectively striving for net zero, adapting and learning from best practice in other sectors is key. Industries such as automotive and aerospace recognize that moving away from a batch production process to mass assembly is vital in enabling the reduction of costs and improving the speed of deployment. This in turn leads to reaching net zero quicker, better investment returns,



» *FloatWind Ltd is a leader in lean manufacturing solutions for the offshore wind sector. (Image credit: FloatWind)*

and consumers benefiting from better energy prices sooner; the potential for the offshore wind market is incredibly exciting."

FloatWind contests the current perception that floating turbines are a futuristic technology only suitable for deeper water deployment. The company believes a standardized, ready-to-float solution suitable for deployment in shallow and deep water can provide an answer. As the industry strives for the lowest CAPEX and highest possible ROI, FloatWind's Ready-to-Float concept is assembled at the harbor side and installed using readily available ocean-going tugboats which tow the turbine to location and simply tether it in place. Even for shallower wind farms, this will provide a faster, more cost-effective and safer alternative to current assembly at sea approaches that require costly jack-up and installation vessels.

Gary McIntyre, Lean Manufacturing Specialist at FloatWind added: "Offshore wind projects worldwide are now a US\$900 billion pipeline and rising. Floating wind is consistently cited as the next frontier, but as the industry gains momentum, more needs to be done to boost investor confidence and reduce costs. There is no doubt that offshore wind can benefit from tried-and-tested lean manufacturing and just-in-time techniques from other industries. The mass-assembly approach has the ability to accelerate the achievement of net zero targets and reduce the amount consumers pay for energy. Now is the time to revolutionize and FloatWind is at the forefront of leading that charge."

SHELL TO INVEST IN TIMI GAS DEVELOPMENT PROJECT OFFSHORE MALAYSIA

Sarawak Shell Berhad (SSB), a subsidiary of Royal Dutch Shell plc, announced that it has taken a final investment decision (FID) on the Timi gas development project and, together with its partners PETRONAS Carigali Sdn Bhd and Brunei Energy Exploration, look forward to delivering this for Malaysia.

The Timi field is situated approximately 200 km off the coast of Sarawak, in Malaysia. The Timi development features SSB's first wellhead platform in Malaysia that is powered by a solar and wind hybrid renewable power system. This unmanned platform is approximately 60% lighter than a conventional Tender

Assisted Drilling (TAD) wellhead platform. This project also includes the drilling of two wells.

"Timi, which is powered by a solar and wind hybrid power system, demonstrates Shell's capabilities to innovate and deliver safe, reliable, and sustainable projects, in line with our commitment to achieve net-zero emissions by 2050 in step with society. Shell is pleased to be able to progress this project in a competitive and responsible manner, as part of the vital role Upstream plays in delivering Shell's strategy and in support of economic growth in Malaysia," said Wael Sawan, Shell Upstream Director.

The Timi development is designed to reach up to 50,000 barrels of oil equivalent per day (boe/d) peak production and will evacuate its gas to the F23 production hub via an 80 km pipeline while supporting the future growth in the central Luconia area, off the coast of Sarawak.

As one of the pioneers in building the country's energy industry, Shell Malaysia aims to lead in the country's energy transition by increasing investment in lower carbon energy solutions, while pursuing competitive and carbon resilient Upstream investments.

FEDERAL OIL & GAS LEASING PROGRAM TO RESUME IN OCTOBER

The United States recently appealed the preliminary injunction entered by the district court in Louisiana v. Biden, which enjoined the Department of the Interior from implementing the pause in new federal oil and gas leasing as set forth in Section 208 of Executive Order 14008. The federal onshore and offshore oil and gas leasing program will continue as required by the district court while the government's appeal is pending.

On August 24, as required by the court, the Department of Justice (DOJ) filed a brief advising the district court of the steps taken by the Interior Department to comply with the preliminary injunction, including next steps in the offshore and

onshore oil and gas leasing processes. Accordingly, the government advised the district court of the following schedule demonstrating compliance with the district court's injunction:

- The Bureau of Ocean Energy Management (BOEM) will submit the Record of Decision for Lease Sale 257 in the Gulf of Mexico to the Federal Register by the end of August. The sale notice for Lease Sale 257 is expected to be published in September. By law, the lease sale may not take place sooner than 30 days after publication of the sale notice. This fall, BOEM also will issue and take comments on a Draft Environmental Impact Statement analyzing Lease Sale

258 in Cook Inlet.

- The Bureau of Land Management (BLM) state offices will post for scoping parcels included in Quarter 1 and Quarter 2 2021 leasing deferrals by the end of August. Following a 30-day scoping period and taking into account comments received, the BLM will undertake environmental reviews of parcels for potential leasing. Following this review, state offices will identify any eligible parcels and applicable stipulations in lease sale notices posted later this year.

In complying with the district court's injunction, the Interior Department will continue to exercise the authority and



discretion provided under law to conduct leasing in a manner that fulfills Interior's legal responsibilities, including to take into account the programs' documented deficiencies.

The Interior Department continues to review the programs' noted shortcomings, including completing a report. The Department also will undertake a programmatic analysis to address what changes in the Department's programs may be necessary to meet the President's targets of cutting greenhouse gas emissions in half by 2030 and achieving net zero greenhouse gas emissions by 2050.

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» The first jacket superstructures destined for Scotland's largest offshore wind farm. (Photo credit: Seaway 7)

SEAWAY 7 HELPING SCOTLAND'S LARGEST OFFSHORE WIND FARM TAKE ANOTHER STEP FORWARD

The delivery of what will be Scotland's largest offshore wind farm has taken another major step forward as the first jacket superstructures, destined for the 1.1GW Seagreen project arrived at Port of Nigg in Cromarty Firth, ahead of their upcoming installation in the deep waters of the North Sea, 27 km off the Scottish coast near Angus.

The jacket components, which are to be installed as part of the foundations for the giant 1.1GW Seagreen Offshore Wind Farm, were welcomed to Global Energy Group's Port of Nigg by representatives of project owners TotalEnergies and Scottish renewable energy developer SSE Renewables, along with main contractor Seaway 7.

The delivery kickstarts the upcoming campaign to install all 114 wind turbine foundations at the offshore project site off the Angus coast, beginning in October. After jacket foundations are installed, Vestas V164-10 MW turbines will be positioned on each of the turbine bases.

The foundation installation campaign will last for a period of around 12 months and is supporting up to 141 skilled

jobs at Port of Nigg associated with the marshalling, storage, and logistics for the foundation components.

The jobs include work for 93 permanent roles already on-site as well as an additional 48 new roles which have been created at the port to support the Seagreen project, delivering a green jobs boost to the Scottish Highlands.

SSE Renewables is leading the development and construction of the joint venture project, supported by TotalEnergies, and will operate Seagreen on completion. When complete in 2023, the 1.1GW Seagreen Offshore Wind Farm will be Scotland's largest, and the world's deepest, fixed-bottom offshore wind farm.

Paul Cooley, Director of Capital Projects at SSE Renewables said: "This is a landmark occasion and a fantastic opportunity to draw attention to not only the progress that the Seagreen project is making but also the benefits that Scotland's largest wind farm is bringing to Scotland's economy and supply chain."

"At SSE Renewables we're proud to be leading the construction

of Seagreen and the benefits it is bringing to Scotland. The jobs boost at Port of Nigg associated with the installation of Seagreen's foundations is great for the local area and the Highlands as a whole and builds on our excellent track record at SSE Renewables of supply chain support in Scotland."

Steve Rose, Director of HSE at TotalEnergies E&P UK said: "We're delighted that the Seagreen project has reached this milestone. To see these jackets ready to be installed and become part of Scotland's largest wind farm is a real thrill."

"The Seagreen offshore wind farm shows TotalEnergies' ambition to accelerate its transition to a broad energy company. We've been investing in Scotland for fifty years and offshore wind projects such as Seagreen shows how this relationship is beginning an exciting new chapter."

Also on hand to welcome the jackets was Lloyd Duthie, Managing Director for EPCI Projects at Seaway 7. Seaway 7 is managing the engineering, procurement, construction, and installation of Seagreen's 114 wind turbine generator

foundations and approximately 300 km of associated inter-array cables.

Lloyd Duthie said: "Today is a significant milestone for everyone involved in constructing Seagreen, as well as Scotland's communities, who will benefit from its renewable energy. Seaway 7 has been active in the UK Renewables sector for over a decade and are pleased to continue supporting the ongoing energy transition in Scotland from our office in Aberdeen."

Chief Operating Officer for Global Energy Group, Ian Cobban said: "We are delighted to welcome the jackets for the Seagreen project to our Port of Nigg facility. We are in the process of constructing an impressive, dedicated ring crane on our quayside to enable the loadout of these structures, supported by our onsite logistics and vessel support teams. The Seagreen jackets mark the 3rd project of this kind to be carried out from the Port of Nigg, highlighting our continued focus on developing the site to support the future of the UK Offshore wind market. We look forward to working closely with all parties in the successful execution of the storage, marshalling and loadout of the jackets before their onward journey to the field."

THE SOLVEIG FIELD IN THE NORTH SEA GETS READY TO START PRODUCTION

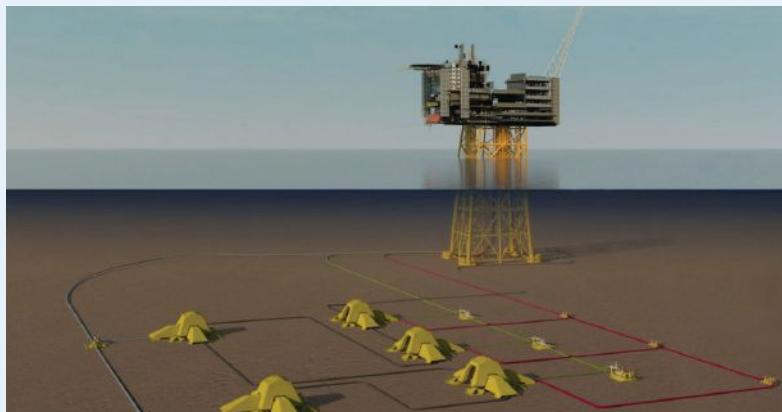
The Norwegian authorities have granted consent for start-up of the Solveig field in the North Sea. Operator Lundin plans to start up the field this autumn.

Solveig will produce from subsea production facilities tied into the Edvard Grieg field, 15 kilometers away. The oil and gas will be processed there before further transport.

Phase 1 consists of three wells for oil production, along with two wells that will be used to inject water. The field is expected to produce up to 2041.

The investment decision for Phase 2 will come later, based on experience and information from Phase 1.

The Plan for Development and Operation (PDO) estimated recoverable reserves from Solveig at 9.2 million standard cubic meters (Sm³) of oil equivalent in Phase 1. This is distributed between 6.98 million Sm³ oil (44 million bbls), 1.44 billion Sm³ sales gas and 0.42 million tonnes NGL.



» This autumn, the Solveig field will start production from subsea facilities tied into the Edvard Grieg field in the North Sea. (Image credit: Lundin)

The PDO estimated total investments in Phase 1 at approximately NOK 6.5 billion (2019-kroner).

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» The TCP Riser can be installed quickly by existing flex-lay or reel-lay vessels. (Photo credit: Strohm)

GAME-CHANGING JIP SET TO TRANSFORM DEEPWATER RISER MARKET

Strohm has announced a game-changing joint industry program (JIP) with Petrobras and Shell for its Thermoplastic Composite Pipe (TCP) Flowline and Riser technology. The contract, which Strohm values as sizeable, has the potential to revolutionize the deepwater flowline and riser market in Brazil and beyond with a corrosion-free solution that has a 30-year design life. It is the world's most advanced programme to bring TCP Flowline and Risers offshore under actual field conditions.

The four-year award coincides with a large plant expansion which is well underway at Strohm's premises in The Netherlands as part of its ongoing growth strategy. The JIP has also extended its footprint in Brazil triggering a raft of local engineering appointments and a new Rio de Janeiro office.

The region's prolific pre-salt provinces have some of the most productive wells in the world. Typically, deepwater fields such as these, are produced through dynamic risers connected to floating production storage and offloading (FPSO) vessels. Recently, conventional flexible flowline and risers have been reported to exhibit premature integrity issues due to corrosion, leading to regular replacement which is costly and leads to deferred production.

Strohm's TCP Flowline and Riser is a disruptive new product that is corrosion-resistant with a three-decade design life. It has a superior fatigue performance and is light weight compared to steel resulting in a cost effective free-hanging catenary configuration once installed.

TCP was introduced to the market by Strohm in 2010 and since then, Strohm has built the world's largest track record for TCP Flowlines and Jumpers. The TCP Flowline and Riser JIP builds on earlier work performed in Brazil and commences this month (August) when the global pioneer will develop, qualify and test its composite pipe technology with the two operators to make it fully field proven and commercially available to the Oil & Gas Industry. The unique programme will manufacture and pilot the installation of two TCP systems, one for TCP Flowlines and the second for

TCP Risers. This will result in the industry's first programme to mature the TCP Riser to TRL-6 (API 17N), proving it is an enabling technology and ready for deployment.

Strohm CEO Oliver Kassam, said: "This is a very significant and exciting moment as we join forces with Petrobras and Shell to qualify our TCP Flowline and Riser and see the prototypes installed in deepwater by 2024.

"TCP has the potential to transform the global deepwater flowline and riser market and unlocks a huge potential for us in Brazil. The Brazilian pre-salt cluster currently has 20+ FPSOs in operation and each one is supporting numerous risers, providing a huge opportunity for us in the replacement market. In addition, the country also invests circa \$1 billion in risers to support new FPSO operations each year, and this is set to climb in line with its ambition to become the world's fourth largest oil producer by 2029. This JIP confirms that TCP is well positioned to be a game changer for the deepwater sector and for Strohm. We are on track to fulfil our vision of being the leading provider of non-corrosive solutions and supporting our strategy to provide products that deliver a significantly lower carbon footprint."

The TCP Riser is low in its carbon footprint as it is spoolable and prepared in long lengths resulting in lower transportation and installation costs. The riser is installed using vessels currently available in the market, and as it does not require any buoyancy elements during installation, costs are significantly reduced leading to an overall saving. As a consequence, CO₂ emissions are greatly reduced. It is also 100% recyclable.

Henk de Boer, Strohm's chief technology officer, added: "We've worked closely with Petrobras and Shell to understand their requirements for installation, subsea configuration as well as fluids, pressures and design life requirements. The result is a TCP Riser technology that is insensitive to CO₂ and H₂S, can be installed with existing vessels with modest modifications and support the free hanging catenary configuration, negating the need for buoyancy elements, a big cost driver in deepwater."

As part of the programme, engineering activities and pipe testing will be carried out in The Netherlands and Brazil, and full-scale prototypes will be manufactured and installed offshore Brazil.

Juliano Dantas, Petrobras Chief of R&D, said: "We believe that this JIP built in collaboration with Strohm is well suited to successfully bring the TCP Riser technology to the field. This JIP fits in our strategy of deployment driven development; it is our aim to be able to offer the TCP Riser as a solution to our projects within Petrobras as quickly as possible."

Olivier Wambersie, designated Shell GM Brazil Technology, said: "We have been working closely with Strohm for many years. We are really keen to see this program leading to the world's first application of TCP Flowline and Riser for deepwater Pre-salt conditions. Not only will it address the asset integrity challenges, it will also bring a positive impact on the Carbon Intensity of our operations. Me and my team are looking forward to be working with all parties involved."

JW FISHERS' MAGNETOMETERS HELP DIVE FOR WWI WRECKS OFF SOUTH AFRICA

Why do people enjoy searching for shipwrecks? Perhaps it is for fame, fortune, historical significance, or general curiosity. Some divers simply want to enjoy the beauty of the sea and enjoy the challenge.

According to NOAA, archaeology is the science of learning about past human behavior by examining the physical remains left behind by people of the past. Archaeological remains—including sites, structures, features, and artifacts—provide tangible links to our collective human history and are glimpses into the social, economic, and cultural evolution of our ancestors. Many sites like graves and temples are deliberate, however, shipwrecks are typically accidental and therefore show the past as it really was. Unlike sites on land, many ships sink and are often left undisturbed. As such, shipwrecks are like time capsules, preserving a single moment in time.

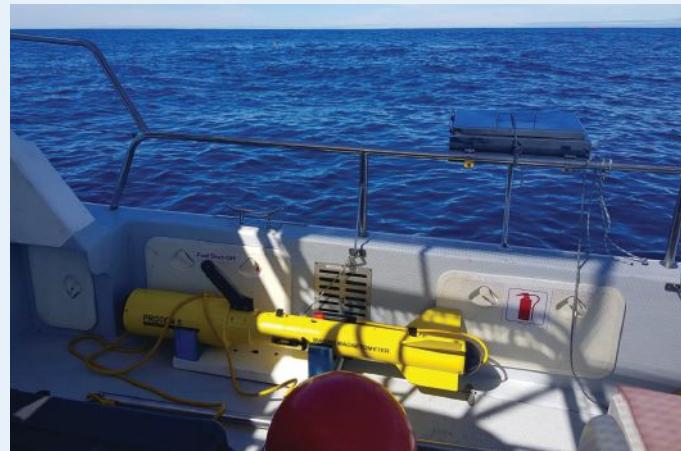
By studying them, archaeologists can begin to understand the past. While archaeological research teaches us much about how sea travel has influenced the course of human history, scientists are also beginning to learn how sunken ships influence ecology in the deep-water marine environment. From the transfer of organisms from one body of water to another as the ship was transiting, to serving as places where marine life can colonize once a wreck has come to rest on the seafloor. The study of wrecks also teaches us important lessons about how currents, weather, technology, and human error can impact the environment.

What are the right tools for the job when searching the vast waters for shipwrecks? Magnetometers are "must have" equipment for the serious deep-sea researcher. Magnetometers detect variations in the Earth's magnetic field caused by iron or other magnetized material such as brick or rock. The main feature that distinguishes this from the benefits of a side scan sonar is that a magnetometer can detect objects buried under the ground while sonar only portrays what is on the surface. JW Fishers' Proton 5 magnetometer is used across the globe to locate sunken wrecks, aircraft, vehicles, and other critical objects.

A small dive club, The Wreckless Divers, currently use JW Fishers' Proton 5 magnetometer for their most important searches. The group consists of technical divers operating at depths of around 120 meters. Some dive on rebreathers while others rely on open circuit scuba. The team is based in Cape Town, South Africa. One area, Cape Point, divides the Atlantic and Indian oceans and is also known as the Cape of Storms. One team member states "there are plenty of shipwrecks along our coastline and the exact locations of most are unknown." According to one of the founders, Bruce Henderson, the group's mission is as follows:

There is an enormous number of shipwrecks off our coast dating from the 1700's through the early 1900's and even more recent wrecks. Many of the exact locations are unknown. We are very keen to find the more interesting of these wrecks and dive on them to confirm the identify, location and condition. In particular, a German 'merchant raider' called "The Wolf" laid mines off Cape Town during World War I and sank at least 4 major merchant

vessels. None of these wrecks have been located. We have begun a methodical search for these wrecks. To date we have found an old fishing trawler and a whole bunch of magnetic rocky outcrops. But it's been fun, and we will persevere until we find the wrecks that we are after.



» Proton 5 Magnetometer on deck. (Photo credit: JW Fishers)

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OCEANALPHA DELIVERS UNMANNED USV FOR PIPELINE INSPECTIONS

A 4.5-meter-long unmanned surface vessel (USV) from OceanAlpha, a leading USV manufacturer based in Hong Kong, was successfully delivered to HGIS, a geophysical and surveying solutions service provider based in Brunei. The USV will be deployed to inspect offshore oil and gas pipelines of Shell Patrol company.

INGENIOUS DESIGN FOR OIL AND GAS

Efficiency has always been a key pursuit for the oil and gas industry, and remote technology will prove instrumental to near future prospects given the impacts of COVID-19 and the progress of globalization. "This's why we decided to develop the M40P, an unmanned surface platform dedicated to servicing the oil and gas industry. There is a huge opportunity to drive efficiency, safety and cost savings by using unmanned vessels," said Ran Zhang, general manager of OceanAlpha.

Specifically designed for long-term operations in offshore oil and gas fields, the M40P is powered by electricity, while its battery life can be extended by using the diesel-electric generator within. This helps it to achieve 24-hour endurance at

a typical survey speed 4-5kn, or 72 hours at 2-3kn. The USV is also equipped with an automatic winch that allows it to carry out towing operations in deeper waters.

NEW BUSINESS PRACTICE UNDER PANDEMIC

Due to travel restrictions caused by the pandemic, the deal was closed and delivered using remote communication. The round-the-clock service provided by OceanAlpha's engineering team, providing timely responses and easy-to-follow guidelines, guaranteed a successful remote demonstration, examination, training, and on-site testing.



» OceanAlpha's M40P has been developed specifically for the offshore oil and gas industry
(Photo credit: OceanAlpha)

BOURBON SUBSEA COMPLETES INSTALLATION OF THE TETRASPAR DEMONSTRATOR FWT

After mooring lines installation in June, towing and hook up in July, Bourbon Subsea Services completed the offshore installation of the 3.6 MW TetraSpar Demonstrator Floating Wind Turbine at Metcentre Test

site in Norway, by laying and connecting the power cable earlier this week. The wind turbine will be commissioned in the coming weeks.

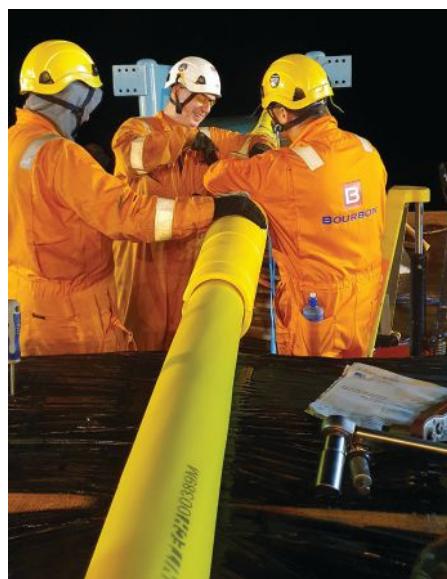
Once again, this successful project demonstrates Bourbon Subsea Services' expertise in managing Floating Wind Turbine (FWT) installation projects and its ability to propose innovative solutions to achieve new complex technical challenges while maintaining low costs. After having installed most of the semi-submersible Floating Wind Turbines from 2.5 MW to 8.3 MW in Europe since 2011, Bourbon consolidates its leadership in the market and strengthens its track record with the installation of the first FWT prototype based on the innovative SPAR concept, designed by Stiesdal Offshore Technologies.

When installing a new FWT prototype, Bourbon Subsea Services' team not only develops solutions aiming to meet the new technical challenges related to a specific design but also makes sure that the

proposed methodology is easily replicable to match the constraints of clients' future commercial projects.

Henrik Stiesdal, inventor of the TetraSpar concept and Chairman of TetraSpar Demonstrator's board of directors, said: "We value the expertise of Bourbon engineers. Their experience with floating wind is already impressive and with Bourbon's contribution, we and our partners have been able to execute the cable installation safely and within budget."

"Each new technology needs creativity and innovation to mitigate risks and deliver in time. This project was a challenge, and we are very proud to have taken it up for TetraSpar Demonstrator ApS, a joint company between Shell, RWE, Tepco and Stiesdal. As an international company based in France, we are now looking forward to the pre-industrial floating wind farms particularly in France, UK, Portugal, Spain, Norway, Japan and South Korea," added Patrick Belenfant, CEO of Bourbon Subsea Services.



» Bourbon is a specialist managing Floating Wind Turbine (FWT) installation projects. (Photo credit: Bourbon Subsea Services)

CSA OCEAN SCIENCES AND GEO MARINE INK STRATEGIC ALLIANCE

CSA Ocean Sciences Inc. (CSA), an international provider of marine environmental and geomatics services, has teamed up with GEO Marine Survey Systems (GEO Marine), a global provider of quality geophysical products, software, and personnel, to offer a turnkey survey solution to the offshore industries in the Northeast United States.

This strategic alliance will provide the U.S. offshore renewables, marine engineering, government, and oil and gas markets with access to UHR seismic equipment and surveyors. The equipment will be housed at CSA's Rhode Island facility, which offers direct vessel access to the heart of the U.S. renewable market. Commenting on the new partnership, Gordon Stevens, Vice President and General Manager for CSA, said: "Having recently completed a successful 90-day campaign for a major offshore renewable

energy company, during which this seismic equipment performed flawlessly aboard our newly outfitted *R/V Dolphin*, it made perfect sense to extend our partnership with GEO Marine to continue offering this bundle of cutting-edge technology to the Northeastern offshore industries."

The equipment can be rented with an operator direct from GEO Marine and installed onto a vessel of opportunity or chartered with the *R/V Dolphin* where fit-for-purpose mounting and operational apparatus have been fabricated and are permanently installed for efficient mobilization and operation. More about the vessel's capabilities, which is HSSE approved by major offshore wind developers, can be found here:

<https://vimeo.com/586743652>

Olivier Monrigal, Operations Manager for GEO Marine, added: "Working with CSA and having the equipment in the US to support all projects not only helps mobilization costs for future projects, but also gives more companies exposure to our superior products."



» Innovative research vessel and UHR seismic equipment to offer turnkey marine survey solution in Northeast US. (Photo credit: CSA Ocean Sciences)



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CHECK THE TECH

SEATREC: HARVESTING CLEAN, RENEWABLE ENERGY FROM THE OCEAN'S TEMPERATURE DIFFERENCES

Energy is a key challenge for offshore and underwater operations, which currently rely on fossil fuels and cumbersome, maintenance-heavy batteries.

Seatrec is the first company to develop a commercially viable technology that produces clean, renewable power from the ocean's temperature differences to remove energy as the bottleneck for sustainable and economical underwater and offshore operations.

Founded in 2016 by ex-NASA scientist Yi Chao, the company's technology is already powering autonomous profiling floats so ocean researchers can extend the life of their equipment, power more sensors, and collect data faster with lower costs and zero emissions and waste.

Seatrec's patented technology uses Phase Change Materials (PCMs) to harness the ocean temperature differences between warmer water at the surface and colder water at the depths. Every time a float

or glider surfaces, as part of its mission to transfer data back to shore through a network of satellites, PCMs are melted from solid to liquid, expand their volume (~10%), and create a hydraulic pressure that spins a motor and generates electricity.

Seatrec is expanding the use of PCMs to include liquid-to-gas phase change, as granted in its 2019 patent, to increase energy output. The additional energy opens the door to a broad range of commercial applications from underwater charging stations to offshore aquaculture and seafloor mining.

"We've proven the value of our clean, renewable energy harvesting technology with pilot sales to our beachhead market of research and defense," explains Mr. Chao. "Now, we're refining our minimum viable product with a goal to scale up commercial sales and expand the reach of our technology to power key applications in the commercial offshore markets that will drive the Blue Economy."

The Blue Economy—sustainable, ocean-centric commerce—is expected to generate more than \$3 trillion in global economic impact and support more than



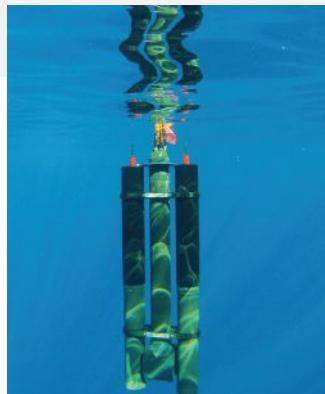
» Dr. Yi Chao founded Seatrec in 2018 after 20+ years at NASA's Jet Propulsion Laboratory pioneering the use of satellites and computer models to study the ocean. (Photo credit: Seatrec)

40 million jobs around the world, according to the Organization for Economic Co-operation and Development (OECD). Aquaculture alone is projected to grow into a \$274 billion per year market by 2025.

Seatrec demonstrated the commercial value of its technology by recently winning two \$10,000 prizes under the Powering the Blue Economy: Ocean Observing Prize administered by the U.S. Department of Energy and NOAA. One of the prizes awarded during the DISCOVER Competition phase was split with Northrop Grumman for the joint Mission Unlimited UUV Station concept.

The company is also addressing the emerging need to power applications in the Arctic by further developing its thermal energy harvesting technology to convert the air-sea temperature difference into electricity.

For more information, visit: www.seatrec.com



» Dr. David Fratantoni (L) and Michael Zedelmair (R) conduct sea trials of a Sea-Bird Scientific Navis Profiling Float with twin Seatrec SL1 thermal energy harvesting units. (Photo credit: Cole Arrington)

» A Sea-Bird Scientific Navis Profiling Float draws clean, renewable power from twin Seatrec SL1 thermal energy harvesting units. (Photo credit: Seatrec)

DOF SUBSEA SECURES FURTHER CONTRACT AWARDS IN APAC REGION

DOF Subsea has announced multiple contract awards in the Asia Pacific region providing significant utilization for resources and vessels in Q3 and Q4 2021 and securing solid backlog into the first half of 2022.

Onshore works are underway for several offshore campaigns that will utilize the CSV *Skandi Hercules* and the onshore and offshore teams from Q3, 2021 into Q1, 2022. The first campaign will support maintenance activities at an offshore facility in the Timor Sea for a short duration. Following this, the vessel and team will be deployed on several construction and pre-commissioning support campaigns off the Northern Australian coast.

Onshore works are also underway for several offshore campaigns that will utilize the DSV *Skandi Singapore* in saturation diving mode in the region during 2022.

A further key contract award will utilize high specification vessel and related subsea services to undertake a significant pre-commissioning and commissioning support campaign off the Northern Australian coast. This campaign is expected to commence in Q1, 2022 with onshore preparation activities underway.

Collectively, these contract awards secure in excess of eight months vessel utilization and include the provision of project management, engineering and all associated fabrication (subcontracted), subsea and marine services.

Mons S. Aase, DOF Subsea's CEO, said: "I am very pleased to announce these contract awards in the APAC region that build on our reputation as a trusted provider for integrated subsea operations across multiple disciplines. We look forward to working with our clients to deliver safe and efficient projects."



» *Skandi Hercules*.
(Photo credit: DOF Subsea)



Ocean Sensor Systems

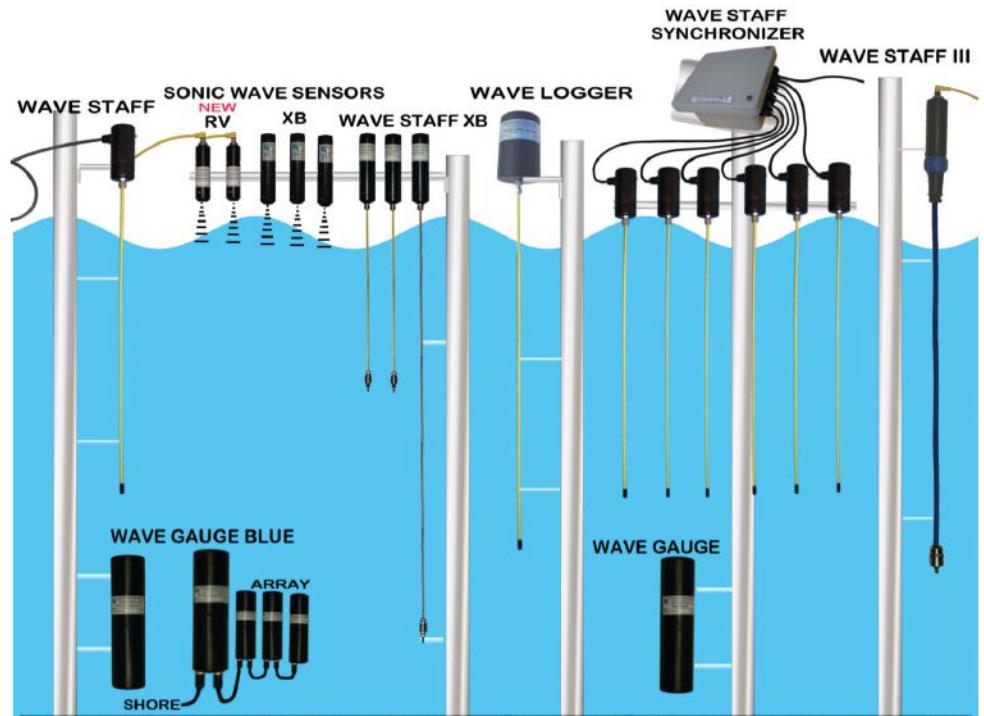
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» Nexans cable installation vessel during a cable laying operation. (Photo credit: Nexans)

NEXANS AWARDS iSURVEY MAJOR CONTRACT

Nexans was recently awarded iSURVEY a multi-year contract with options to be extended, initially worth in the order of NOK 150 million.

iSURVEY, a leading provider of survey and positioning services for the offshore energy sector, will support Nexans' offshore high voltage cable installation projects on a global basis.

The new contract will cover survey support for the newly launched, state of the art, cable installation vessel, CLV Nexans Aurora and other installation/support vessels engaged by Nexans, including the well proven C/S Nexans Skagerrak.

iSURVEY CEO, Øivind Røegh, commented: "When Nexans wishes to renew their contract with iSURVEY, a contract that iSURVEY has held since 2007, it shows the value of our efforts to build specialist competence, capacity and develop new technology to support their operations."

SUBSEA EXPO 2022 TO HELP BUSINESSES WIN A SLICE OF THE \$3 TRILLION BLUE ECONOMY

Subsea UK is urging the industry to come together for next year's Subsea Expo to explore the "oceans of opportunity" in the blue economy.

Subsea Expo, Europe's largest exhibition and conference focused on the underwater industry, is set to be one of the first post-pandemic, large scale physical events back on the international calendar.

The three-day flagship exhibition and conference will go ahead at Aberdeen's P&J Live from February 22, 2022.

Under the theme *Oceans of Opportunity—Harnessing the Opportunities in the Blue Economy*, the event will center around high-level discussions on how the UK's underwater engineering industry can capitalize on the global blue economy, estimated to be worth \$3 trillion by 2030.

Organizers, Subsea UK, are planning a packed three days of debate on key industry topics including the push towards net zero, the development of carbon capture, utilization and storage, hydrogen technologies, and smart innovation. The event will also examine how the underwater industry can take advantage of its world-leading expertise in skills and technology to successfully compete for market share in other emerging sectors of the blue economy.

A call for papers has been issued but there is still time to put forward abstracts to speak at the event with the deadline of October 29, 2021.

Neil Gordon, Chief Executive of Subsea UK, said: "Against the backdrop of a global pandemic and the acceleration of the race to net-zero, our future looks very different now than it did at the start of last year. If the recent disruption has taught us anything, it's that we must continue to evolve and adapt to meet the challenges and capitalize on the opportunities.

"Subsea Expo provides an excellent platform for finding out more about mature and emerging markets and for making connections that can lead to cross-sector collaborations which will be key to developing solutions to the challenge in both the blue economy and the energy transition.

"The scale of opportunity presented by the blue economy and the green recovery is

unprecedented and with the UK underwater industry's market-leading position, we are well-placed to capture a large slice of the prize."

Making sure that the UK underwater industry is in a position to capitalize on this opportunity is the main driving force behind the creation of the Global Underwater Hub (GUH). Subsea UK is transitioning into a new, strategically-focused organization which aims to transform the industry, accelerate the transition to net-zero and create new jobs and exports.

Led and governed by industry, with £13 million from the UK and Scottish Governments, the GUH will deliver significant export growth and attract new inward investment, promote cross-sector collaboration and innovation to develop solutions to underwater challenges, develop skills and capabilities to drive competitive advantage and support the growth of new and existing UK underwater businesses.

The GUH will provide access to the largest, cross-sector underwater community in the world and offer commercially driven market intelligence, expertise, contacts and specialist support to accelerate business growth and build value in the UK's underwater industry.

With a physical presence in regions with the largest clusters of underwater activity, the GUH will work with companies, organizations, industry bodies, technology and innovation centers and academia across the length and breadth of the UK.

Mr. Gordon added: "The GUH will be fully operational when Subsea Expo comes around and this will provide companies with market intelligence and insight to develop clear routes, helping them to make the right decisions about growing their business. As a new organization with greater resources, we'll be able to support more underwater businesses in getting after the opportunities in the blue economy."



» Neil Gordon,
Chief Executive of
Subsea UK

NEW US-EUROPE PARTNERSHIP SET TO ADVANCE USV APPLICATIONS FOR DEFENCE AND MARINE SURVEY APPLICATIONS

Marine technology specialist Subsea Europe Services and Unmanned Surface Vessel (USV) innovator MARTAC have signed an extensive partnership agreement for cooperation on the delivery of unmanned and autonomous marine survey platforms.

The partnership unites Florida-headquartered MARTAC's extensive USV portfolio for defense, commercial and scientific applications with Subsea Europe Services' hydroacoustic sensors, platforms and solutions expertise, which is available through its established European rental pool, sales and support channels.

The partners aim to make MARTAC's high-performance USVs more accessible for defense and marine surveying applications in Europe, with Subsea Europe Services providing added value through deep integration between the USVs and its own integrated technologies, which are designed and proven to simplify and optimize marine data acquisition.

The initial focus is on MARTAC's new fully electric MANTAS T12, a 3.6 meter 'X-Class' vessel, mobilized with Subsea Europe Service's integrated Hydroacoustic Survey System (iHSS). The combination unlocks unprecedented speed, agility and operational capabilities that can transform the marine survey workflow to improve data quality and reduce costs.

The MANTAS T12 is a next generation USV offering new levels of operator control flexibility with full and semi-autonomous, and human-in-the-loop operations. With optional solar power, its open architecture and modular design allow rapid integration of new sensors and communication technologies to meet diverse mission requirements.

The first MANTAS T12 integrated Hydrographic Survey Platforms will be made available for the European survey industry by Subsea Europe Services at the start of 2022.

"The MANTAS T12 is the ideal system for Subsea Europe Services' to deliver on its ambition of enabling organizations without in-house resources to acquire and extract value from their own marine data by simplifying, standardizing and automating marine survey



» Subsea Europe Services will configure and integrate survey technologies into an integrated Hydrographic Survey Platform to ensure that the Mantas T12 is easy to operate and has the capability to acquire high quality marine data. (Photo credit: Subsea Europe Services)

sensors, platforms and solutions," said Stephen Ferretti, Chief Marketing Officer, MARTAC. "We're confident of the added value our new partner can bring and looking forward to seeing the MANTAS system perform in European markets."

The payload flexibility integral to MANTAS vessels reduces the complexity of deploying hydrographic systems and related equipment, paving the way for expedited delivery of turnkey marine survey systems across Europe. Further, the MANTAS system and installed technology are supported by Subsea Europe Services as a single source, ensuring any service issues can be addressed at the solution level for faster resolutions.

"The partnership with MARTAC is an important part of our efforts to bring down the cost of high-quality marine data by making the sensors, platforms and solutions that collect it at sea much easier to access and operate," said Sören Themann, CEO, Subsea Europe Services. "MARTAC USV's are highly regarded in defense circles due to incredible resilience, speed and flexibility, so besides working with the European Navies, we're looking forward to bringing the USVs and our integrated solutions closer to commercial and scientific users in Europe."

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ROTECH SUBSEA COMPLETES NORTH SEA CABLE DE-BURIAL

Controlled flow excavation (CFE) and suspended jet trenching specialist, Rotech Subsea, has completed major de-burial and post-lay trenching works on a key interconnector cable in the southern North Sea for a leading cable player.

Rotech Subsea's next generation TRS2 controlled flow excavator was mobilized in Q2, 2021 to complete a scope of work consisting of de-burying damaged cable to allow for an omega loop to be laid then trenched in. The cable was de-buried to a minimum of 3 m depth with the newly laid cable trenched to client specification of 2 m ToC.

Rotech Subsea—and their more powerful Controlled Flow Excavation (CFE) kit—was called in after older Mass Flow Excavation (MFE) technology had struggled to de-bury the cable on an earlier repair.

Rotech Subsea Director of Subsea, Stephen Cochrane, commented: "Rotech Subsea

were delighted to have been selected for this critical interconnector IRM scope. Our TRS2 controlled flow excavator was selected to carry out the scope of work due to its high flow capabilities of 8,000 l/s allowing for a large amount of material to be dispersed and also allow for the trench to remain open for sufficient time to pull out the cable. The project was a complete success with the client delighted by the TRS2's technical capabilities. Rotech Subsea's CFE suite of tools is firmly established as the method of choice for cable trenching in Europe and beyond. The enhanced capabilities of our Suspended Jet Trencher RS tools mean they can provide deeper and narrower trenches than ever before, with trenching speeds more than double that of competing Mass Flow Excavation tools such as contact trenching systems and ploughs."

Rotech Subsea's TRS2 subsea spread of equipment was mobilized on a support

vessel, with the job completed in June 2021. The Rotech CFE spread operated in water depths of up to 42 m LAT. Soil conditions in the area were sand with the presence of clay in some areas.

The TRS2 successfully de-buried the cable to client specification with one pass at progress rates of 1 m/min - 3 m/min. Burial of the cable was successfully achieved in two passes at a rate of approximately 4 m/min. The exceptional performance capabilities of the TRS2 led to a saving on total project costs for the client, who Rotech Subsea looks forward to collaborating with again.

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 TRS2 controlled flow excavator was selected to carry out the scope of work. (Photo credit: Rotech Subsea)

SCOTTISHPOWER BACKS PROSERV OFFSHORE WIND CABLE SOLUTION

Global controls technology company Proserv Controls has received industrial sponsorship for its disruptive subsea cable condition monitoring system for the offshore wind segment, ECG™, or Electro Cable Guard, from ScottishPower Renewables (SPR).

SPR is part of the ScottishPower group of companies operating in the UK under the Iberdrola Group, one of the world's largest integrated utility companies and a leader in wind energy.

The sponsorship agreement will see SPR provide its expertise and resource both from a cable owner and operator perspective, bringing vital knowledge into the project to assist in the on-going development and ultimate functionality of ECG. SPR's input will greatly help the future commercialization of the system, with its close understanding of the key requirements of the industry across asset owners and developers.

ECG has been initiated and driven by Proserv with critical support from its consortium partners Synaptec, a power system monitoring leader, and cable engineering specialists BPP Cable Solutions. The system offers a paradigm shift in present market offerings around condition monitoring of both inter array and export cables.

The consortium has adopted a holistic approach to building its solution, incorporating multiple parameters such as distributed temperature, acoustic and electrical sensing, with synchronous, real-time monitoring across an asset and continuous automated data analysis.

Machine learning will be integrated into the system, so that, once fully engaged, minute anomalies in performance, even within normal operating boundaries, will be detected, potentially indicating future issues requiring remedial action.

It is anticipated that the capabilities of ECG will lead to huge advances in the way subsea cables are managed, significantly



reducing the incidence of faults and failures on offshore wind farms in the future.

Proserv's Business Development Director – Renewables, Paul Cook stated: "This industrial sponsorship commitment from ScottishPower Renewables is a vital step forward for our ECG project. To have such key end user support throughout the development ensures that our subsea cable monitoring solution sits front and center of what the industry needs and wants. SPR recognizes there is a critical requirement for an innovation in the offshore wind industry that monitors cables using a methodology that goes way beyond what is available today within the market."

Proserv's agreement with SPR comes months after the ECG project received two thirds of its £1.5 million development costs, totaling £1 million, via a Smart Grant from Innovate UK, the UK's Innovation Agency. The funding program is offered to the "best game-changing and commercially viable innovative or disruptive ideas." The remaining sum is being supplied by the respective members of the consortium.

As the ECG project moves forwards, it is anticipated that the technology will be demonstrated on a UK commercial scale wind farm in Q2/Q3 2022.

Davis Larssen, Chief Executive Officer, Proserv Controls, added: "The transition to a more varied and sustainable energy mix is moving forwards rapidly and it is vital companies like Proserv harness its heritage and know-how in subsea controls to innovate exciting new technologies. ECG represents the perfect example of the sharing of cutting-edge expertise, across a consortium, to build a solution that will offer a transformation in offshore wind subsea cable health monitoring capabilities." www.proserv.com

VYSUS GROUP ANNOUNCES NEW CABLE ASSURANCE SERVICES FOR SUBMARINE CABLE INSTALLATIONS

Vysus Group is offering a new Cable Assurance service, designed to optimize collation of cable installation project data and information, enabling detailed identification and quantification of risk at granular intervals along the length of an as-installed submarine cable. The objectives of Cable Assurance are to reliably guide future operational insurance premiums and maintenance spend and to inform the design and costings of future similar projects.

Based upon over 10 years' experience acquiring automated data in real time from construction, trenching, survey and drilling vessels within its IRIS project and data management web application, Vysus Group has developed a new IRIS module called CableQC to support its Cable Assurance service.

CableQC combines the wealth of available real-time digital sensor data from installation vessels, cable lay and

trenching systems together with survey data and project reports, identifying key installation performance indicators which may influence the assessed risks associated with an as-installed submarine cable.

CableQC is currently being used on a major submarine power cable interconnector project in North West Europe.

FET AWARDED ROV PROJECT TO SUPPORT CABLE WORK

Forum Energy Technologies, Inc. (FET) announced that it has been awarded a contract to provide a life extension (Lex) upgrade on one of its Perry ST200 Trenchers.

The Lex upgrade will be completed for a Western Hemisphere telecommunications equipment company. The enhanced asset will support the installation and maintenance of subsea cables that are a vital component of an international communications network.

This project marks FET's second life extension upgrade for an ST200 trencher and follows on from the successful sea trial of the first upgrade last year.

FET's Lex service provides remotely operated vehicle (ROV) operators with a cost-effective solution to ageing subsea vehicles and technology obsolescence by increasing the asset's life, in some cases more than a decade.

As part of the work scope, FET will completely remove all obsolete components and associated parts within the control system and replace them with the latest evolution in control system hardware and software. The

upgrade benefits from over 60 years of ROV development at FET, and will provide increased reliability and improved support, while also minimizing downtime.

FET has produced more than 800 Perry and Sub-Atlantic ROV systems over the past six decades. All vehicle manufacturing is certified and compliant to ISO 9001 and 18001 to provide safety and reliability assurance.

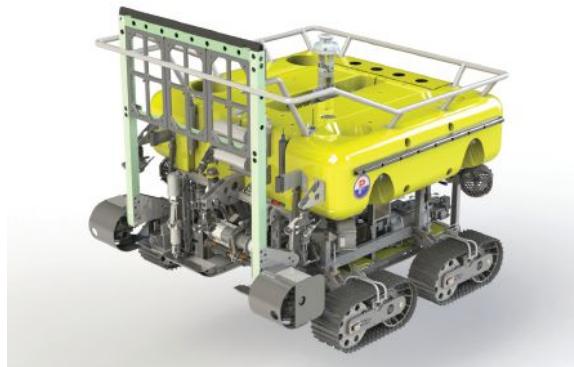
The latest Lex upgrade is based on the newest developments in work-class ROV and trencher technology. These vehicles feature significantly enhanced performance

across the full range of demanding intervention, survey and trenching tasks without compromising the outstanding reliability which the original Triton vehicles are known for.

Kevin Taylor, FET's Vice President - Subsea Vehicles, said: "We recognized the opportunity to provide a more cost-efficient solution to ageing vehicles while still delivering the high quality, robust assets that FET is renowned for. This award underlines our ongoing commitment to delivering new and innovative technological solutions to the subsea industry across the blue economy. "This is the second life

extension upgrade for this client in the last 12 months and it's fantastic to see customers continue to recognize the reliable performance our trenchers deliver and the operational sustainability the Lex service provides."

The upgrade will be carried out at FET's facility in Bryan, Texas, using components manufactured at FET's UK facility in Kirkbymoorside, Yorkshire. It is expected to be delivered in the third quarter of this year.



» FET will provide a life extension (Lex) upgrade on one of its Perry ST200 Trenchers. (Image credit: FET)

NOVACAVI PROVIDES CUSTOM CABLE FOR FLOATING ENERGY ISLAND

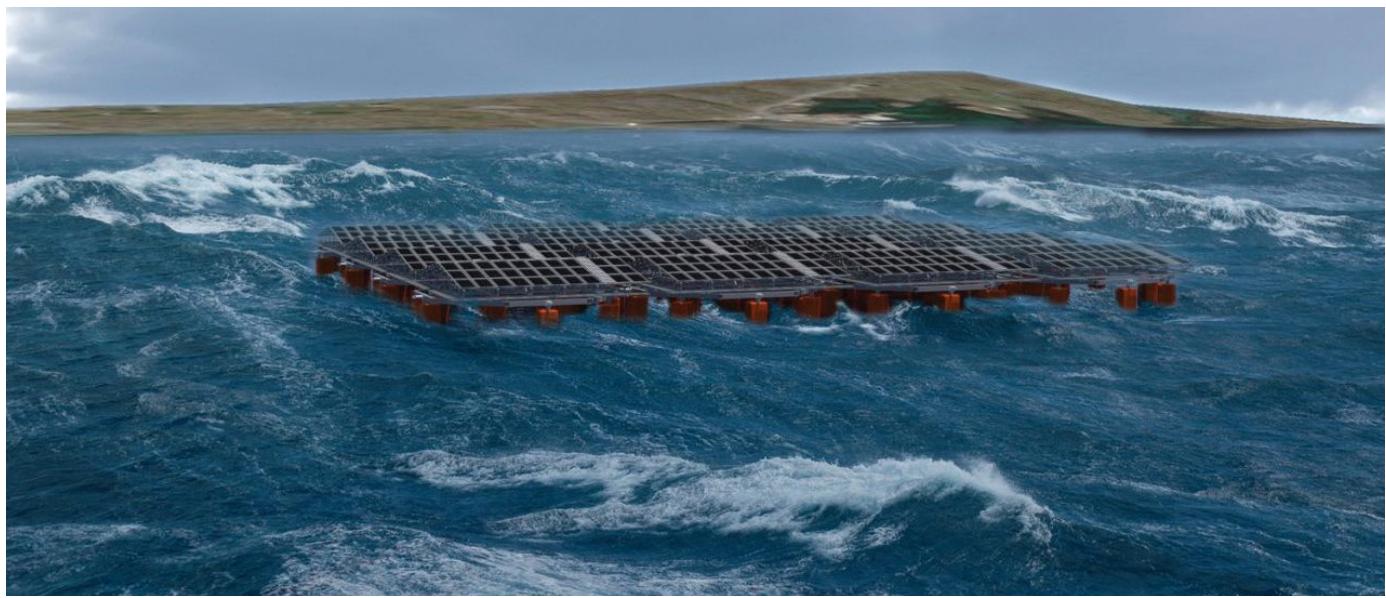
Novacavi has specially developed a submarine power cable with optical fibers for the first sea-scale prototype of a floating energy archipelago, an innovative idea for a sustainable use of marine renewable energy by Italy's CNR-INM (National Research Council-Institute for Marine Engineering).

With a reinforced configuration, this cable has been designed for the first laboratory at sea in Italy at the port of Naples (co-managed by CNR-Diitet and Unicampania University).

It will integrate the part of transmission of electricity from land to platforms at sea, the part of transmission of electricity generated at sea to land and the part of digital signal transmission while at the same time it will guarantee excellent resilience to the forces to which it subjected.

NOVACAVI is proud to contribute to the realization of this Electrical System Research project funded by Ministero dello Sviluppo Economico (Ministry of Economic Development or MiSE) and coordinated by the Department of Engineering Diitet of the CNR, a strategic research project for the industrial system of the offshore renewable energy sector.





NEXANS PROVIDES CABLE FOR EQUINOR FLOATING SOLAR PLANT

Nexans has been awarded by Equinor a contract to supply power export cable for its innovative floating solar pilot offshore Frøya in Norway.

The pilot project is scheduled to come online in December 2021 and will be the world's first floating solar plant operating in rough offshore waters.

The Frøya floating plant will measure 80 m x 80 m, with a height of less than 3 m above the sea surface, hosting an array of solar panels capable of producing up to 1 megawatt.

Utility-scale floating solar power is currently one of the fastest growing renewable technologies as governments and investors around the world explore every possibility for safer, sustainable

and decarbonized energy. This is expected to drive almost 10 gigawatt of new floating solar deployment by 2025.

Nexans will supply 22 kW export cable of 5 km to connect the floating platform from shallow waters to land. The most challenging aspect for the cable construction is to handle the dynamic loadings as the connection at the platform end pitches up and down with the waves. Nexans is utilizing a three-core cable design of a type well proven in offshore wind farm and fish farming installations. The cable will be manufactured at Rognan plant in Norway.

Krister Granlie, Nexans Vice President of the Submarine Telecom and Special Cables Business Unit, said: "Our mission for Nexans is to electrify the world. That means exploring every possible opportunity to help develop new sources of green energy. So, we are delighted to be working once again with Equinor on a truly exciting project that further extends the boundaries of what might be possible in generating renewable energy offshore."

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FEATURE

DRONES AND STARLINK: COMBINING SATELLITE CONSTELLATIONS WITH UNMANNED NAVY SHIPS

By Brandon Wall and Nicholas Ayrton

As times change, they demand that military doctrine and strategy change with it. Key to this is ensuring that the American military is ready to act anywhere and with short notice, requiring that it embrace the latest technologies to overcome the latest operational problems. From the reaper drones of the American wars in the Middle East to the Azeri drones that came to define the war in Nagorno-Karabakh, land-based drones are rapidly shaping the battlefields of the modern world. But the maritime domain has yet to fully embrace the use of drone technology.

The area of maritime drones seems to be a field where the civilian sector is more rapidly embracing new technology compared to the military. Norwegian company Kongsberg Maritime has recently concluded initial tests of an unmanned cargo container ship, making its first delivery to a fertilizer company, while South Korean technology giant Samsung is also investigating crewless vessels as a means to cut down on labor and maintenance costs to better stand against its Chinese competitors. It is in this second area of potential for advancements in cost-cutting and smaller crew requirements that the United States Navy (USN) could benefit most due to the increasing problem of an aging fleet of transport ships in need of replacement, as well as a personnel shortage that has only gotten more dire with time.



» A stack of Starlink internet satellites just before a launch.
(Photo credit: SpaceX)

UNMANNED SOLUTIONS TO LOGISTICS PROBLEMS

The dire state of naval logistics is hardly anything new, with General Stephen Lyons, current head of USTRANSCOM having said that in the event of a major conflict, there would not presently be sufficient naval sealift capacity to supply the United States military. Indeed, the capacity of the Navy is presently stretched so thin that, by its own admission, it would be unable to defend the military's maritime supply lines in the event of a large-scale conflict. This is compounded by the nearly obsolete ships that are still in service and declining in numbers. In addition to this, the USN has been facing an ongoing shortage of sailors, falling several thousand below its targeted number year after year. This has led only to more problems, as currently serving sailors are then forced to pull extra weight, leading to overworking, lack of rest, and a generally less effective fighting force. In this area, one then finds a maritime logistics force in need of a modernization effort, coupled with a Navy that needs to either find more recruits or cut down on the number of jobs it needs sailors to fill.

Here unmanned maritime vessels offer a solution, allowing for the logistics ships of tomorrow to be built more cheaply and not requiring bulky spaces for crew compartments, food, water, and other aspects. More efficient designs could better fulfill their mission of carrying supplies where they need to go. Further, if naval logistics could be rendered more autonomous, this would theoretically allow for a much smaller number of sailors to command a much larger fleet of supply vessels, perhaps permitting a single sailor to monitor several largely autonomous ships, with direct control being needed only in particularly critical moments.

While the USN does appear to be looking into autonomous vessels, the focus seems to be on relatively small vessels, only around the size of a corvette, not on the large logistics vessels that would seem to be the most well-suited for automation and heavily demanded in sustained conflicts. While tests with these vessels have been promising, being able to operate without human intervention for all but the most delicate phases of their missions, the Navy's program still lacks the ambition needed to truly capitalize on the potential for an unmanned naval logistics force. It is currently focusing more on small, rapid-response supply

vessels, while continuing to neglect the larger vessels that would be needed for a large-scale conflict.

STARLINK AND COMMANDING DRONE FLEETS

Extending beyond logistics, there also exists the potential for maritime drones and unmanned ships to be more involved in the observational and informational sides of warfare. Indeed, if admittedly biased sources out of the People's Republic of China (PRC) are to be believed, then the U.S. is already making limited use of maritime intelligence drones, with one having supposedly been captured while operating off the coast of Jiangsu province to the north of Shanghai. If this is to be believed, then it offers the possibility of further using small, risk-worthy maritime drones to conduct surveillance, such as for general intelligence gathering or targeting for fires. A small fleet of semi-autonomous drones could also act as a screening force for operations, acting to provide an extended sensor net and provide greater tactical awareness, be they for combat operations or as an early warning system for unescorted logistics fleets.

However, with these hypothetical drone systems, whether in the form of logistics vessels, intelligence gatherers, or as a sensor net, there still exists the crucial question of establishing a reliable method of controlling them, since even an otherwise autonomous vessel may encounter a situation where a human operator must provide input. Current military communication satellites, while advanced, are also chronically overburdened and fighting for bandwidth with what little is available having to be rationed out to only the most crucial of systems and operations.

Enter Starlink. SpaceX's new Starlink satellite constellation provides many options for military communications, provided the network could be rendered secure enough. The Starlink constellation currently consists of over 1,600 satellites, with plans to have thousands more of the mass-produced small satellites in low Earth orbit in the coming years. If successful, such a program would be theoretically able to provide easy and reliable connectivity for a globally-operated network of maritime drones that could be set up with only minimal infrastructure, allowing for large numbers of these units to be commanded.

The main issues are testing if the basic premise could function and if the system could be rendered secure. The first issue is whether a commercial system currently designed to provide connectivity to a variety of static locations could work as a command-and-control network for a fleet of autonomous vessels traversing the world's oceans. Similarly, the United States Air Force has already begun the process of testing if Starlink technologies could function onboard a moving aircraft, likely a far more difficult task than connecting a relatively slow-moving ship onto which one could fit a larger array of communications equipment.

Secondly, concerns have been raised about the security of Starlink for military applications, as the network relies on communication with several ground-based hubs to function, while the military tends to prefer direct satellite-to-satellite optical communications. However, this too seems to be a solvable problem, with ten Starlink satellites with intra-network communications capability having been launched into a polar orbit this past January. Indeed, SpaceX has recently confirmed that all future Starlink satellites will be launched with the capability to use laser communication

systems between satellites. If SpaceX could successfully work with the Defense Department, it could be feasible to bring the network's security up to the standards needed to coordinate a fleet of maritime drones.

CONCLUSION

It is these two emerging technologies, maritime drone vessels and large satellite communication constellations, that could allow for the Navy to solve some of its ongoing issues and permit the creation of a more nimble, lean, and modern force able to better confront the rising security threats facing the United States in the years and decades to come.

Brandon Walls is an undergraduate student at the University of California, Davis.

Nicholas Ayrton is a U.S. Navy veteran and current undergraduate student at the University of Arkansas.



» A batch of 60 Starlink satellites awaiting deployment. (Photo credit: SpaceX)



HUNTINGTON INGALLS INDUSTRIES AWARDED \$273 MILLION U.S. NAVY MAINTENANCE CONTRACT

Huntington Ingalls Industries' Technical Solutions division has been awarded a five-year contract with a total value of \$273 million to support the U.S. Navy's carrier engineering maintenance assist team, surface engineering maintenance assist team for west coast surface ships, and other maintenance and material readiness programs.

"Continuous modernization and sustainment of our nation's fleet is essential to our national security," said Garry Schwartz, president of Technical Solutions' Defense and Federal Solutions business group. "HII is honored to extend our 40-year partnership with the U.S. Navy in support of these critical defense assets, and to continue leveraging our expertise to maximize efficiency and cost-savings in the future."

Work performed on the contract will support maintenance and planning for the overhaul and repair of equipment and systems including hull, mechanical and electrical; aviation equipment and systems; command, control, communications, computer and intelligence; and combat support systems. The programs follow a "find, fix and train" philosophy with assessments, maintenance, and training to enhance sailor self-sufficiency and maintenance capabilities while ensuring platforms remain mission capable. Work will be performed within the U.S. and internationally during operational deployments.

Huntington Ingalls Industries is America's largest military shipbuilding company and a provider of professional services to partners in government and industry. For more than a century, HII's Newport News and Ingalls shipbuilding divisions in Virginia and Mississippi have built more ships in more ship classes than any other U.S. naval shipbuilder. HII's Technical Solutions division supports national security missions around the globe with unmanned systems, defense and federal solutions, and nuclear and environmental services. Headquartered in Newport News, Virginia, HII employs approximately 41,000 people operating both domestically and internationally.

GENERAL DYNAMICS NEW UUV CENTER OF EXCELLENCE

In a ceremony at General Dynamics Mission Systems' Taunton facility, company officials as well as representatives from the U.S. Navy formally opened the General Dynamics Mission Systems Unmanned Undersea Vehicle (UUV) Manufacturing and Assembly Center of Excellence.

The repurposed manufacturing space at General Dynamics Mission Systems' Taunton facility will provide manufacturing, assembly, integration and testing capabilities for General Dynamics Mission Systems' Knifefish and Bluefin Robotics UUVs. Knifefish is a medium-class Mine Countermeasure (MCM) UUV that provides enhanced mine-hunting capability by detecting, classifying and identifying both buried mines and mines in high clutter environments. The company's family of Bluefin Robotics products consists of UUVs and related technologies that provide an array of underwater sensor capabilities for defense, commercial and scientific customers worldwide.

The UUV center of excellence will utilize a portion of Taunton's 500,000+ square feet facility. In addition to the UUV center of excellence, the Taunton facility develops several communications capabilities for the U.S. Army as well as provides engineering, manufacturing and production support for many General Dynamics Mission Systems programs.

"Opening this manufacturing and assembly facility allows us to leverage the highly skilled and extremely experienced Taunton workforce. This skill set found in our Taunton employees is exactly the type of expertise we need to manufacture highly reliable UUVs," said vice president and general manager of General Dynamics Mission Systems' Maritime and Strategic Systems business, Carlo Zaffanella. "We have expanded our maritime operations to include the Taunton UUV Manufacturing and Assembly Center of Excellence to produce our existing best in class small and medium UUVs and allow for additional expansion space for growth on future UUV programs of all sizes. This location was specifically selected to provide additional capacity that will allow for larger scaling and optimization of UUV production with purpose-built manufacturing cells, fixtures, and special test equipment, while maintaining proximity to our Bluefin Robotics Engineering Team in Quincy."



» Upgraded Taunton, Massachusetts facility reflects significant investments into unmanned underwater vehicle technology and manufacturing. (Photo credit: General Dynamics)



ASSURED SOLUTIONS FOR OFFSHORE CHALLENGES

OSI is a Project Management company with a track record of partnering with government and commercial clients around the world to design and deliver turnkey integrated solutions for the clients' complex marine domain challenges. OSI has expanded into the US Department of Defense and in concert with our affiliate companies offers integrated undersea solutions including systems design, fabrication, integration and testing, operations and sustainment.

"OSI's capacity to apply skilled engineers, scientists and fabricators allow us to provide Rapid Prototyping Products to our clients for manned and unmanned systems," according to Dan McLeod, OSI's VP Defense Markets.

Established in 2000, OSI's founding mission was to supply the burgeoning submarine fiber optic cable industry with expert network planning, development, and maintenance services. With over 200 international projects successfully completed over the past two decades, more recently OSI broadened its core offering to include the integration of custom subsea engineering and marine operations.

CROSS-SECTOR TECHNICAL EXPERTISE

As a small business integrated contractor, OSI specializes in end-to-end project management, supplier integration, engineering design, and the development of complex technical solutions for a range of industries including the defense, offshore energy, ocean science, subsea telecommunications, and seabed mining markets. OSI's ability to execute from concept to mission completion is underpinned by a triad of design and fabrication capabilities, expert

subsea engineers, and expert deployment experience, all instrumental to the firm's full-service offering.

"OSI's experience of working on major subsea technology and installation projects over the years has enabled the team to garner a unique skillset focused on developing reliable, discreet and fit-for purpose responses to the fast-evolving requirements of at-sea operators," said Perry Wright, OSI's General Manager.

SMALL COMPANY, BIG RESOURCES

Supported by high caliber affiliates—a consortium of companies that has served the ocean and offshore industries for over five decades—OSI's expanded capabilities include, but are not limited to, multidisciplinary marine survey; project permitting; subsea asset design and prototyping; seafloor installation and integration; and comprehensive test and evaluation programs.

OSI is also able to propose practical solutions in a timely and cost-effective manner thanks to the direct access to a rapidly deployable pool of equipment, including multipurpose support vessels, high specification deck handling systems (A-frames, LARs, cranes, winches, HPUs, and sheaves), advanced robotics (a fleet of autonomous surface vehicles), and other technologies essential for the scaling and acceleration of multi-stakeholder projects.

Further, the company's international footprint, with offices throughout the United States (Texas, Florida, Massachusetts, California, Louisiana, and Rhode Island) and regional hubs in Brazil, Trinidad, Cyprus, and Qatar—

and a client roster beyond—makes OSI ideally positioned to partner on cross-border initiatives.

INTEGRATED PRODUCT DEVELOPMENT & TESTING

Whether working with a US defense agency to identify applications for the next-generation of autonomous and unmanned maritime systems, prototyping a seabed-based monitoring device for an offshore energy major, or partnering with an international telecoms carrier to plan, design, procure, and install a subsea fiber optic network, OSI's capacity to act concurrently as a prime in the development of pioneering technology platforms and as the provider of at-sea deployment services is a critical differential for defense, government, and commercial clients.

"The development of robust, failproof subsea systems—driven by increasingly sophisticated AI capabilities—is set to completely rewrite the marine operator's user manual over the coming decade, so OSI is continually investing in our research, development, and testing capabilities to meet these demands from the public and private sectors," added Mr. Wright.

OSI is headquartered in Florida, where the team of experienced subsea engineers and system procurement specialists is supported by considerable onsite electrical and mechanical fabrication resources—including an integration facility fitted with modern CNC machinery, mills, and certified welding—and multiple facilities to support integration and testing of equipment and systems. For more information, visit: www.oceanspecialists.com

SPERRY MARINE DEBUTS ADDITIONAL MILITARY LAYERS ON VISIONMASTER RADAR AND ECDIS

Sperry Marine has strengthened its portfolio of military navigation solutions with the release of Additional Military Layers (AML) for its VisionMaster series of Radars and ECDIS.

The AMLs have been developed to allow defense and naval users to take advantage of Sperry's commercial radar systems on demanding military assignments on small and large vessels. The latest enhancement supports the display of AMLs created to support both command and control and provide digital navigation systems that ensure the best situational awareness available for marine operations.

By combining the navigational features and functions from VisionMaster with enhanced features and high performance

configurations, VisionMaster Naval Radars and ECDIS offer high specification military functionality with a lower total cost of ownership than many naval systems.

"In recent years, navies have had to balance performance requirements against tight budgetary control at a time when the scope and number of missions has increased," said Christophe Rios, Global Line Manager, Radar and Chart Displays at Sperry Marine. "The VisionMaster series of radars and ECDIS has been developed using the latest technology to keep costs under control but still with a choice of configurations and options needed for any type, size and class of vessel."

The VisionMaster Radar and ECDIS include a number of enhancements designed for

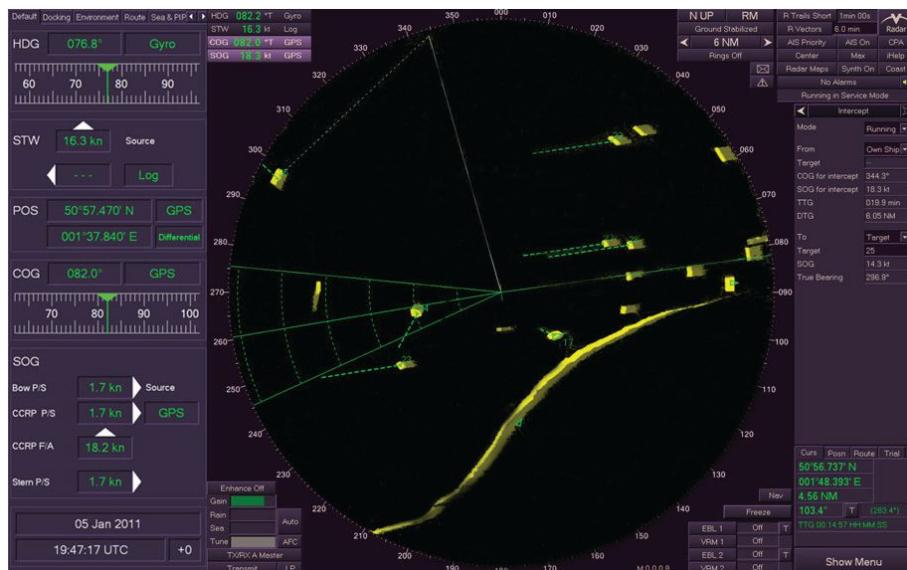
naval operations. Among the features is 'Red First Strike' functionality, providing an immediate indication of fast-moving targets, such as fixed and rotary wing aircraft and fast attack craft, by highlighting them in red.

A Target Intercept feature allows the operator to plan and execute intercept maneuvers between one vessel and another including from 'ownship' or from one tracked target or AIS target to another. This improves the operator's reaction time by simplifying the identification of any potential threat.

If it becomes necessary to impose radar silence during a mission, the operator can use the 'Freeze Frame' function to display a frozen picture of the radar situation immediately before the radar silence was imposed.

To overcome the challenge of station-keeping and monitoring surrounding vessels, the radar operator is able to set up a sector for each vessel nearby which will allow them to see at a glance if any vessel has moved out of its correct position.

"It is clear from growing demands of the role they play that the next generation of smaller naval assets will have to move up the value chain in terms of capability, providing a very powerful platform for a variety of missions," said Per M. Soerensen, Business Development Director International Defense, Sperry Marine. "Linking the requirements of tactical operations with higher specification equipment can provide an increased level of navigational performance and improve the human-machine interface."



» VisionMaster's Additional Military Layers include a Target Intercept feature which allows the operator to plan and execute intercept maneuvers between one vessel and another. (Image credit: Sperry Marine)

GREENSEA STRENGTHENS SUPPORT OF SPECIAL OPS PROGRAM

Greensea Systems recently announced the appointment of Luis Mejia as Program Manager for SOF Technologies to support Greensea's continued growth in the military sector. Mejia served in the US Military as a combat diver in Special Operations Forces (SOF) for more than 23 years and found the position at Greensea while participating in The Honor Foundation, a non-profit organization

assisting with the transition of SOF service members to the civilian sector.

"Greensea is committed to making the RNAV2, our navigation and control product used in the STIDD Diver Propulsion Device (DPD), the best possible tool for a combat diver. This involves really understanding the RNAV2 from the user perspective," said Ben Kinnaman, Greensea CEO.

"Who better to lead development and train users than someone who intimately understands the combat experience."

"I'm excited about the transition that I've made from active duty to Greensea," said Mejia. "Greensea has a culture and customer base that feels familiar, which I appreciate. I talk to and train people who have the same daily challenges that I had."

ECO WAVE POWER IN COLLABORATION WITH THE ISRAELI MINISTRY OF DEFENSE AND NAVY

Eco Wave Power Global recently entered into a collaboration agreement with the Procurement Administration in the Israeli Ministry of Defense for the Israeli Navy, to examine the feasibility of installing the Eco Wave Power technology in the Bases of the Navy.

According to the terms of the agreement, Eco Wave Power will immediately begin the procurement and deployment of wave measuring systems to collect extended wave data, in one to three potential locations in the Navy bases, while the Navy will secure all permits for the deployment of the wave measuring equipment.

The Navy's specialized diving team will install the measurement equipment in the territorial waters of the Navy's bases. At the end of the measurement period, Eco

Wave Power will share the information collected with the Navy, which, in turn, will test the applicability of the technology in line with the prevailing waves in the selected sites. Then, Eco Wave Power and the Navy will jointly analyze the results, and create energy production forecasts, based on such analysis.

Upon identifying the most suitable locations for the installation, and provided that the technology is found to be feasible for the proposed locations, the Navy and Eco Wave Power will use their best efforts to work towards the next step of the collaboration, which is the potential deployment of the Eco Wave Power technology for production of clean electricity for the Navy bases.

Inna Braverman, Chief Executive Officer of Eco Wave Power stated: "We are very



» Measurement equipment installation in Gibraltar. (Photo credit: Eco Wave Power)

pleased to announce this collaboration with the Israeli Ministry of Defense and the Israeli Navy, who are global leaders in cutting-edge technologies. This is an extremely important collaboration as it indicates the potential for future contracts with Navy bases worldwide, which can become significant participants in the global fight against climate change, while representing a new market segment for wave power."



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COMMODITY MARKET VOLATILITY CONTINUES

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

Crude Oil:

Crude oil markets remain turbulent due to surging worldwide Delta variant COVID-19 cases causing governments to reimpose economic restrictions. When these cases began climbing in late July, commodity markets started worrying about the healthy economic recovery forecasts suggesting strong demand for energy. Whenever markets concern themselves with whether conventional forecasts need to be thrown in the trash heap, commodity prices suffer. That is exactly what has happened to oil prices.

After extensive negotiations between Abu Dhabi and Saudi Arabia, leading OPEC producers, the OPEC+ group agreed to begin restoring the output it was forced to cut in the spring of 2020 when COVID-19 caused a global economic collapse. OPEC+ plans to restore 400,000 per day each month until spring 2022, at which time the full production cut will be restored. At that point, the U.S. will be the only oil supplier not back to pre-pandemic levels.

Despite no U.S. production recovery, the global oil market should be adequately supplied in 2022. That is not the commodity market's focus currently. It is worried about the impact from Hurricane Ida that slammed Louisiana and its oil and gas infrastructure. Producing and refining operations are out of service for an unknown time. Refineries in Louisiana supply 13 percent of the nation's gasoline supply. The storm damage will disrupt energy demand and economic scenarios. Overall, Ida has created unknowns, and we know commodity markets hate unknowns.

Although WTI has fallen from the upper \$70s a barrel price range to as low as \$63, prices have bounced back to \$70. Oil in the \$65 to \$70 a barrel range is profitable—upper \$70s even more so. Producers continue exercising financial discipline, only putting 50 oil drilling rigs back to work since June when oil prices broke the \$70 barrier. Although higher, the oil rig count is down 325 rigs from 2019's level.

Commodity traders remain focused on near-term price volatility, which allows them to trade profitably. Oil company executives and energy strategists, however, are interested in long-term issues. The overriding one: When does global oil demand peak? The second question: How rapidly will oil consumption fall? The answers will impact where oil prices trade over the next several years. The UN's COP26 climate change meeting in early November may provide some perspective. Will governments commit to end oil's use or only pledge to do so? How sincere will these pledges be? Oil price volatility is unlikely to end anytime soon.

Natural Gas:

In our last column, we asked whether natural gas, breaking through the \$4/Mcf barrier, was entering a new era? We suggested only time would provide the answer. We now have our answer: Yes. Natural gas futures prices are trading at \$4.65/Mcf as this column is written.

Natural gas prices reflect the reality that storage is not filling as rapidly as expected earlier, and now prospects are we will finish the injection season with a meaningful supply deficit to last year. Gas storage is 579 Bcf behind last year's storage volume, but more troubling is that it is 222 Bcf behind the 5-year average. We don't know about the upcoming winter. Will it be another warm one, in keeping with global warming, or will it be cold? Even warm winters can experience polar vortexes that plunge large portions of the United States into extremely cold temperatures, draining gas storage rapidly. The storage situation presents a troubling outlook at the start of September.

With Europe also experiencing a natural gas supply shortage, continental gas prices are at record highs. Gas usage in Europe is up, as renewables, primarily wind, have failed to deliver anticipated power supplies due to low wind speeds. This has forced European utilities to restart coal-fired power plants, besides using more gas peaking capacity.

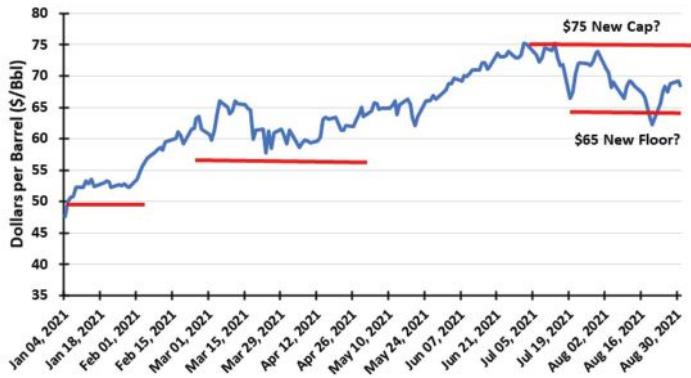
Compounding the European gas market is that domestic supplies—the North Sea and the Netherlands—are in decline. That means greater dependence on Russian gas supplies. Although capacity to deliver gas to Europe will increase when the Nord Stream 2 pipeline connecting Russia and Germany is completed, the problem is Gazprom has not ramped up its production. More delivery capacity handling the same volumes only means reduced pipeline capacity utilizations.

In the meantime, Europe is competing with Asia and China for U.S. LNG supplies from the U.S. Despite higher domestic gas prices, U.S. LNG shippers stand to earn greater profits supplying world markets. It explains why more LNG volumes are being shipped, and new terminals are operating, and more are planned.

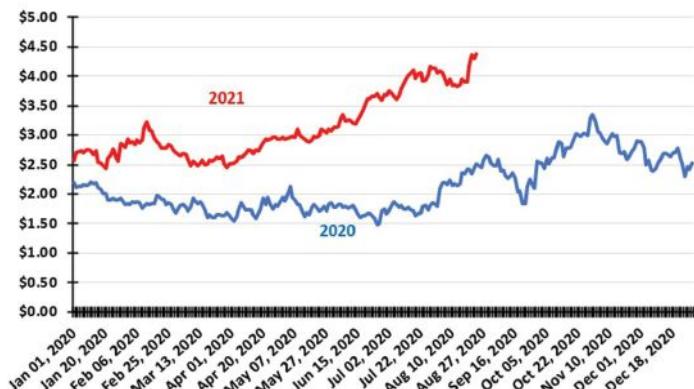
Cat 4 Hurricane Ida has ravished Louisiana, shutting down Gulf of Mexico gas supply until damage assessments can be made and repairs completed. For a while, there will be reduced supplies of natural gas for domestic consumption and LNG shipments. This will likely push natural gas prices up. Higher prices are needed to drive reluctant E&P companies to restart more gas-oriented drilling rigs and boost production. The problem is that new drilling efforts will not deliver more supply for 4-6 months after rigs start drilling. A new worry is that some producing basins may be entering declines with long-term supply implications.

For all the attention paid to crude oil prices with their global implications, the under-appreciated fuel is natural gas. It is a key player in our fight against climate change by displacing coal in electric generation, delivering supply to world markets, and supporting our petrochemical industry, as well as heating American homes this winter. Natural gas may soon be getting the respect it lacked during the past decade.

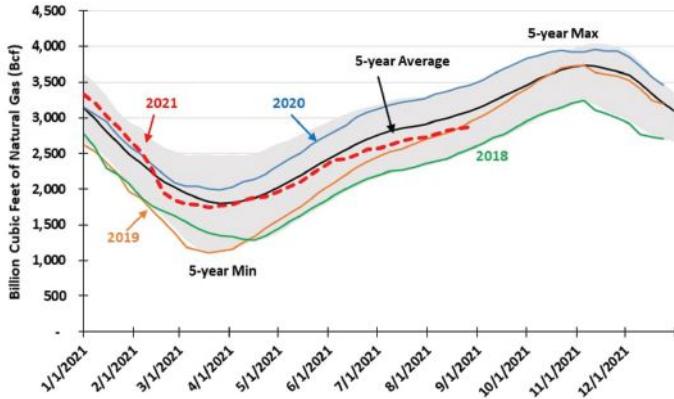
Daily Oil Futures Prices During 2021



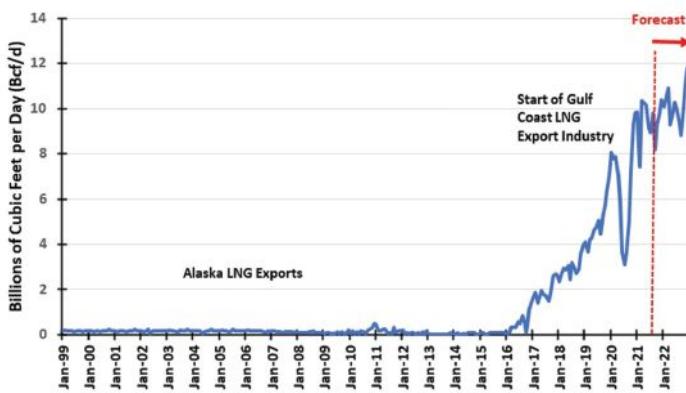
2021 Gas Prices Soaring Above \$4/Mcf Level
Marking Dramatic Change In Sentiment



Gas Storage Falling Further Below 5-Year Average Driving Prices Higher



U.S. LNG Gross Exports 1999-2022





AMERICAS

Offshore Wind Executive Summit
Galveston, TX » October 5
www.offshorewindsummit.com

SIPEX
Virtual » October 5-7
<https://surinameoilexpo.com>

ACP Offshore WINDPOWER
Boston, MA » October 13-15
<https://cleanpower.org/offshore-windpower-2021/>

Offshore Well Intervention GoM
Houston, TX » November 8-9
www.offsnet.com/owi-gom

BlueTech Week
Virtual » November 15-19
www.tmbluetech.org/bluetech-week

WorkBoat
New Orleans, LA » December 1-3
www.workboatshow.com

PTC
Honolulu, Hawaii » January 16-19, 2022
www.ptc.org

Floating Wind Solutions
Houston, TX » March 1-3, 2022
<https://floatingwindsolutions.com/fws-22/>

Canadian Underwater Conference & Exhibition
Halifax, Canada » March 27-29, 2022
www.underwaterconference.ca

EUROPE

Ocean Business
Southampton, UK » October 12-14
www.oceanbusiness.com

Offshore Energy
Amsterdam, The Netherlands » October 26-27
www.offshore-energy.biz/offshore-energy-2021/

Eastern Mediterranean Conference
Cyprus » November 10-12
www.emc-cyprus.com

Ocean Energy Europe
Brussels, Belgium » December 6-7
www.oceanenergy-europe.eu/annual-event/oee2021

Windpower Finance & Investment Summit
London, UK » December 7-8
<https://windfinancesummit.com>

Undersea Defence Technology (UDT)
Rostock, Germany » December 15-17
www.udt-global.com

Subsea Expo
Aberdeen, UK » February 22-24, 2022
www.subseaexpo.com

EEGR Southern North Sea
Norwich, UK » March 2-3, 2022
www.subseaexpo.com

Oceanology International
London, UK » March 15-17, 2022
www.oceanologyinternational.com

OTHER REGIONS

Offshore Well Intervention West Africa
Virtual » October 12-15
www.offsnet.com/owi-wa

ADIPEC
Abu Dhabi » November 15-18
www.adippec.com

Telecoms World Asia
Virtual » November 16-17
www.terrapinn.com/conference/telecoms-world-asia/index.stm

Offshore Well Intervention Australia
Perth, Australia » November 23-24
[https://offsnet.com/owi-aus](http://www.offsnet.com/owi-aus)

Asia-Pacific Deep Sea Mining Summit
Singapore » December 8-9
www.asia.deepsea-mining-summit.com

OTC Asia
Kuala Lumpur, Malaysia » March 22-25, 2022
<https://2022.otcasia.org/>

SubOptic
Bangkok, Thailand » April 4-7, 2022
www.terrapinn.com/exhibition/suboptic

Mediterranean Offshore Conference
Alexandria, Egypt » October 18-19, 2022
www.moc-egypt.com

MONTH & DEADLINES	EDITORIAL FOCUS & SHOW DISTRIBUTION	TECHNOLOGY & INDUSTRY FOCUS	2021 EDITORIAL CALENDAR
JANUARY Editorial: Dec. 28 Ad: Jan. 14	» The Essential 2021 Offshore Toolkit	Technologies: ROV tooling & control, Subsea cables, Remote inspection, Supply vessels, turbines, tethers, and more. Industry Focus: Offshore Energy & Renewables, Marine Survey, Scientific, Defense	
FEBRUARY Editorial: Jan. 25 Ad: Feb. 11	» Ocean Observation	Technologies: Buoys, ADCP, Data Software, Sensors, Drifters, Gliders, and more. Industry Focus: Marine Survey, Scientific, Offshore Energy & Renewables	
MARCH Editorial: Feb. 22 Ad: Mar. 11	» Unmanned Vehicles & Marine Robotics » Distribution: GIPEX ☰ / June 28-30	Technologies: USVs, AUVs, ROVs, Aerial drones, Control systems, Seafloor residency, and more. Industry Focus: Offshore Energy, Marine Survey, Defense, Academic, Subsea Infrastructure	
APRIL Editorial: Mar. 22 Ad: Apr. 08	» Defense & Security	Technologies: Autonomous Navigation, Comms & Telemetry, Magnetometers, GIS, Sonar, and more. Industry Focus: Subsea Defense, Government, Offshore Energy, Subsea Infrastructure	
MAY Editorial: Apr. 19 Ad: May 06	» Marine Renewables » Distribution: SIPEX ☰ / June 1-3 Floating Wind Solutions / June 28-29 Int'l Partnering Forum / Aug. 24-26 H2O Conference ☰ / June 7-10	Technologies: Turbines, Subsea Cables, Inspection Drones, Subsea Batteries, Grid Integration, Connectors, and more. Industry Focus: Offshore Wind, Wave Energy, Tidal Energy, Alternative Offshore Energy	
JUNE Editorial: May 17 Ad: June 03	» Bathymetric Mapping & Hydrographic Survey Marine Tech Expo ☰ / July 12-13	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 » Distribution: Global OCEANS / Sept. 20-23 Seanergy ☰ / Sept. 21-24 US Hydro ☰ / Sept. 13-16	Technologies: Seabed samplers, Mining machines, Geotechnical tooling, Seafloor imaging equipment, and more. Industry Focus: Offshore Energy, Marine Mining, Scientific	
SEPTEMBER Editorial: Aug. 23 Ad: Sep. 09	» Offshore Build, Inspection & Maintenance » Distribution: Ocean Business / Oct. 12-14 Offshore Energy / Oct. 26-27 ACP Offshore Windpower / Oct. 13-15	Technologies: Inspection drones, Turbines, Subsea cables, Power substations, Battery technology, Grid integration, Connectors, and more. Industry Focus: Offshore Operations & Maintenance, Offshore Energy & Renewables	
OCTOBER Editorial: Sep. 20 Ad: Oct. 07	» Submersibles » Distribution: Ocean Energy Europe / Dec. 6-7 UDT / Dec. 14-16	Technologies: Manned submersibles, Navigation systems, ROVs, Submarines, Resident Subsea Vehicles, and more. Industry Focus: Offshore Energy, Defense, Academic, Marine Mining	
NOV./DEC. Editorial: Oct. 18 Ad: Nov. 11	» Subsea Engineering & Infrastructure	Technologies: Subsea drills, Prospecting tools, Deck handling equipment, and more. Industry Focus: Offshore Energy, Defense, Marine Mining, Government	
SPECIAL ISSUE Editorial: Nov. 18 Ad: Dec. 1	» The Future of Ocean Technology	Tech and Industry Focus: Our Special Edition unites an exclusive roll call of industry thought leaders to discuss the innovative breakthroughs set to redefine how we work in marine environments over the coming decade.	

SEA CHANGE, THE WORLD'S FIRST COMMERCIAL VESSEL POWERED 100% BY HYDROGEN FUEL CELLS

All American Marine, Inc. (AAM) and the vessel owner SWITCH Maritime (SWITCH) recently announced the launch and operational trials of Sea Change, a 70-foot, 75-passenger zero-emissions, hydrogen fuel cell-powered, electric-drive ferry that will operate in the California Bay Area. This will be the first hydrogen fuel cell vessel in the US, representing a monumental step in the US maritime industry's transition to a sustainable future. The ferry was developed and constructed to demonstrate a pathway to commercialization for zero-emission hydrogen fuel cell marine technologies. While still working on permitting hydrogen fuel systems for maritime vessels with the U.S. Coast Guard, the completed ferry will exhibit the viability of this zero-carbon ship propulsion technology for the commercial and regulatory communities.

The project is funded by private capital from SWITCH, an impact investment platform building the first fleet of exclusively zero-carbon maritime vessels to accelerate the decarbonization and energy transition of the US maritime sector. "By working closely with the U.S. Coast Guard, with innovative technology partners, and with best-in-class shipyards such as All American Marine, we can make the transition to decarbonized shipping a reality today," said Pace Ralli, Co-Founder and CEO of SWITCH. "We don't have to wait." SWITCH's mission-driven platform seeks to work with existing ferry owners and operators around the country to help facilitate their adoption of zero-carbon vessels to replace aging diesel-powered vessels, leveraging significant experience from the technologies used in the build of this first ferry.

AAM is a leading builder of hybrid-electric vessels in the United States and was chosen to complete this project because of their experience building unique, high-quality vessels. AAM's new state-of-the-art shipyard has an expanded capacity and production capabilities for additional, larger and more complex vessels. The

construction and completion of Sea Change further exemplify AAM's position as a leading technological innovator in the North American marketplace, and a leading manufacturer of vessels with custom propulsion and design characteristics to create the best performing vessel in its given class.

"Hydrogen-fuel cell technology will prove to be a robust alternative to conventional powertrain technologies," said Ron Wille, AAM President & COO. "AAM is continuing our tradition of building vessels on the leading edge of technology using advanced propulsion methods, which is why we are so proud to have completed construction on such a revolutionary vessel."

The vessel is equipped with a hydrogen fuel cell power package provided by Zero Emissions Industries (formerly Golden Gate Zero Emission Marine), comprised of 360 kW of Cummins fuel cells and Hexagon hydrogen storage tanks with a capacity of 246 kg. This system is integrated with 100 kWh of a lithium-ion battery provided by XALT and a 2x 300 kW electric propulsion system provided by BAE Systems. The hydrogen fuel cell powertrain system affords the same operational flexibility as diesel with zero emissions and less maintenance. The vessel design originates from Incat Crowther, and the construction supervision and management are led by Hornblower Group.

This project has received important municipal support including a \$3 million grant from the California Air Resources Board (CARB), administered by the Bay Area Air Quality Management District (BAAQMD), that comes from *California Climate Investments*, a California statewide initiative that puts billions of Cap-and-Trade dollars to work to reduce greenhouse gas emissions, strengthen the economy, and improve public health and the environment – particularly in disadvantaged communities. Additionally, the project received the first ever loan guarantee under BAAQMD's Climate Tech Finance program, which seeks to reduce greenhouse gases by accelerating emerging climate technologies. In partnership with the California Infrastructure Economic Development Bank and the Northern California Financial Development Corporation (NorCal FDC), the Climate Tech Finance team led a technology qualification and greenhouse gas analysis that deemed SWITCH eligible for a loan guarantee. This loan guarantee supported SWITCH in securing a \$5 million construction and term loan with KeyBank, which enables SWITCH to bring this important project to completion.

Our team would like to thank all the individuals, companies, and agencies that have helped make this vision a reality, especially during the challenging times of the COVID pandemic. Special thanks to the United States Coast Guard Marine Safety Center (MSC), USCG Office of Design and Engineering Standards (CG-ENG), USCG Sector Seattle, USCG Sector San Francisco, who continue to support the permitting and development of sustainable maritime technologies that put the U.S. maritime sector at the forefront of global innovation.



» The launch of Sea Change. (Photo credit: AMM)



» The fleet of SOVs will be delivered to the Dogger Bank offshore wind farm on long term contracts. (Image caption: North Star Renewables)

NORTH STAR RENEWABLES SECURES £96 MILLION CAPITAL TO BUILD RENEWABLES FLEET

North Star Renewables has cemented its position as the market leading provider of marine offshore infrastructure support services in the UK after finalizing a funding package of £96 million (\$135 M) to build its new renewables vessel fleet.

The secured loan from multi-national financial services organization Allianz Global Investors (AllianzGI), supplements North Star's own balance sheet and equity commitments from its 100% shareholder, Basalt Infrastructure Partners, to fund the build of three new Service Operations Vessels (SOVs), which will be delivered to the Dogger Bank offshore wind farm on long term contracts of 10 years firm plus options. The deal represents AllianzGI's first investment in the SOV sector.

Once completed, Dogger Bank will become the world's largest offshore wind farm, capable of powering six million British homes. It is currently under construction by joint-venture partners Equinor, SSE Renewables, and Eni. The contract with Dogger Bank will create 130 long-term jobs in Scotland and the North East of England during the operations phase of the wind farm.

North Star CEO, Matthew Gordon, said: "This investment from AllianzGI is a first for our industry and attracting project finance from such a well-respected, global investor demonstrates the confidence in our capabilities to deliver and operate our new SOVs which have been a transformational step for the company in terms of our energy transition.

"This is the beginning of a third phase for our business. North Star started out in the fisheries industry 135 years ago before diversifying into the oil and gas sector in the 1970s. Our new, unique SOV design has kick started this very exciting new chapter for the business in renewables and we plan to continue building on this momentum. We are highly motivated and driven by our ability to innovate through our technology partners, and our ambition to deliver best-in-class vessel solutions for the offshore wind market in the UK and abroad."

Chief strategy officer at North Star, Fraser Dobbie, added: "Renewables is a fast-growing market, and with the first trio of our SOVs being built and leased out for a decade, we are in a very strong position to expand our fleet and realise our full potential in this area. We have the capabilities to rapidly scale up our teams in Aberdeen, Lowestoft and Newcastle to oversee future SOV and daughter craft newbuilds. And with more than 40 years' experience of supporting North Sea installations, we have a very talented pool of experienced seafarers to draw upon."

North Star's SOVs are high performance, sustainable vessels capable of supporting net-zero goals. They provide comfortable, floating-hotel style accommodation to offshore wind turbine technicians and a centralised logistics hub to travel to and from work each day across a "walk-to-work" gangway, or transfer via a smaller daughter craft vessel. The SOV is also configured to handle cargo and act as a warehouse.

North Star Renewables is part of North Star Group, which also comprises North Star Shipping and Boston Putford. As well as providing continuous infrastructure support services across more than 50 UK Continental Shelf installations, the Group also provides vessel maintenance services.

Marie Madelin who led the execution of the investment for AllianzGI commented: "We are delighted to have had the opportunity to work with North Star to invest 100% of the debt funding to finance the construction and operation of this fleet of sustainable state-of-the-art support vessels. The SOVs will be embedded in the Dogger Bank offshore windfarm's O&M value chain while under long term charters to the project SPVs, thus playing a critical role in the UK's energy transition. Our clients are enthusiastic funders of infrastructure investment globally which facilitates decarbonization. In this case, their capital will support North Star's transition from predominantly servicing the oil and gas industry to servicing renewable energy generation. This investment adds to our growing portfolio of renewable energy and energy transition enabling infrastructure assets."

The first of North Star's SOVs are scheduled to arrive at Port of Tyne in Summer 2023.

The transaction was supported by advisers including DC Advisory, Watson Farley Williams and Ashurst.



THE ON&T PODCAST

SEASON 2 / EPISODE 8

CEPHALOPODS AND THEIR POSSIBLE APPLICATION FOR TECHNOLOGY

Dr. Roger Hanlon is a diving biologist who studies rapid adaptive coloration in cephalopods (squid, cuttlefish, octopus) and fishes. Learning the mechanics and functions of color changes has led to collaborations with materials scientists and engineers to develop new classes of materials that change appearance based on the pigments and reflectors in cephalopod skin.

This bio-inspired approach to engineering involves various high-tech and emerging technologies such as advanced microscopy instrumentation, spectrometers, HyperSpectral Imagers, autonomous underwater vehicles, etc.

Dr. Hanlon regularly combines art and science in his research, and he has ongoing collaborations with faculty and students at Rhode Island School of Design. Hanlon, along with dozens of grad students, postdocs, and collaborators, has published 235 peer-reviewed scientific papers in scholarly journals. He has conducted many detailed field studies worldwide with the aid of diving citizen scientists and film crews, and he is a proud Associate Member of the Boston Sea Rovers.

Dr. Hanlon is a Senior Scientist at the Marine Biological Laboratory in Woods Hole, Massachusetts, and Professor (MBL) of Ecology and Evolutionary Biology at Brown University. He was trained in marine sciences at Florida State University and the University of Miami and studied sensory biology and animal behavior as a NATO postdoctoral fellow at Cambridge University in England.

Active public outreach featuring aspects of science, art, and technology of these charismatic marine animals has been conducted with TED 2019, BBC, NOVA, Discovery, National Geographic, TEDx 2015, New York Times, and others.



» Dr. Roger Hanlon believes that cephalopods' adaptive coloration abilities could help engineers develop groundbreaking marine technology for a broad range of applications.



» Alan McQuade

KEY PROMOTION MARKS 10-YEAR ANNIVERSARY FOR ICR

ICR Integrity (ICR), a leading global provider of specialist maintenance and integrity solutions, has announced the promotion of Alan McQuade to Group Managing Director.

Alan joined the company in 2018 as Chief Financial Officer and has played a pivotal role in developing the company's strategy for the global energy market laterally as Chief Financial & Strategy Officer.

His promotion coincides with Chief Executive, Willie Rennie, moving into a consultancy role as he steps down from his position to pursue other interests.

Originally Chief Executive of now ICR-owned Walker Technical, Willie has strengthened the business and helped it to adapt to the challenges posed by the pandemic during his return to the company over the past 20 months. He will provide on-going consultancy support to the end of 2021 to assist with growth initiatives including building international presence, further diversifying into new markets and sectors, and supporting the company's global hubs and partners.

Willie commented: "Although stepping away from my role at ICR, I remain completely invested in the business and team who I have worked with over many years. It has been a privilege to sit alongside the ICR Management and staff and I am confident Alan will use the solid foundation to further expand and grow the business both in the UK and internationally."

Alan said: "I'm delighted to be moving into the role of Group Managing Director, especially poignant as we celebrate 10 years in business as ICR. We are very grateful for everything Willie has achieved in driving the business's strong capability in difficult market conditions whilst positioning it for future growth. We are really excited for the opportunities ahead with further international partnerships now established increasing our local presence, securing long term hire contracts for our rental businesses, increasing the service capabilities to meet growing demand in onshore and renewables markets and launching our full lifecycle OMNI asset integrity software."



C-KORE EXPANDS ITS HORIZONS

The reputation of C-Kore subsea test tools for quickly and accurately locating existing faults in subsea circuits, and for monitoring the integrity of new umbilicals during installation, continues to spread around the globe. Over recent months the UK based company, C-Kore Systems Ltd, has added Angola, China, Canada, and Israel to the list of countries where their tools have been successfully deployed.

Customers in more than 20 countries are now benefiting from the robust performance of the devices which were developed to help oil and gas operators and contractors reduce expensive subsea intervention time. The most recent deployments have

involved both C-Kore's Cable Monitor tool, which tests the insulation and continuity integrity of subsea circuits, and their Subsea Time Domain Reflectometer, which can pin-point the location along the cable where the fault has occurred.

Building on a well-established position in their domestic market as the leader in subsea cable test equipment, C-Kore has seen its export markets flourish in recent years and the company won their second Queen's Award for Enterprise in 2021, this time in the international trade category.

The compact size and versatility of the C-Kore tools make them readily

transportable. At a time of a global pandemic and severely restricted international travel, the simplicity of operation has made the tools an obvious choice for time-critical interventions in all corners of the world. The comprehensive training provided by C-Kore prior to the subsea mission, together with the intuitive user interface, has enabled customers in all countries to use the tools efficiently and successfully without mobilizing specialist personnel from the UK. This has resulted in both a significant cost saving for the customer and a reduction in carbon footprint.

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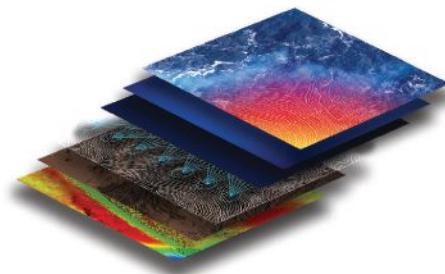
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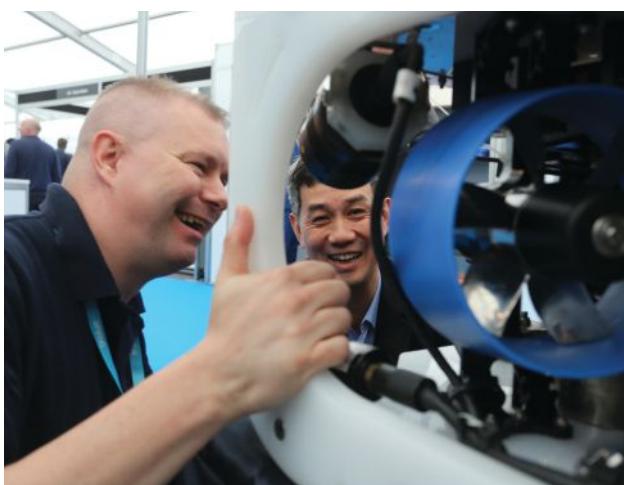
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