

June 2019

# ON&T

Ocean News & Technology

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## ESSENTIAL INTELLIGENCE

The Many Benefits of Jack-up Rigs  
pg.10

Ocean Evolution Raises the  
Standard for Subsea Construction  
Support Vessels pg.18

Shell's Deepwater Appomattox  
Project Begins Production pg.22



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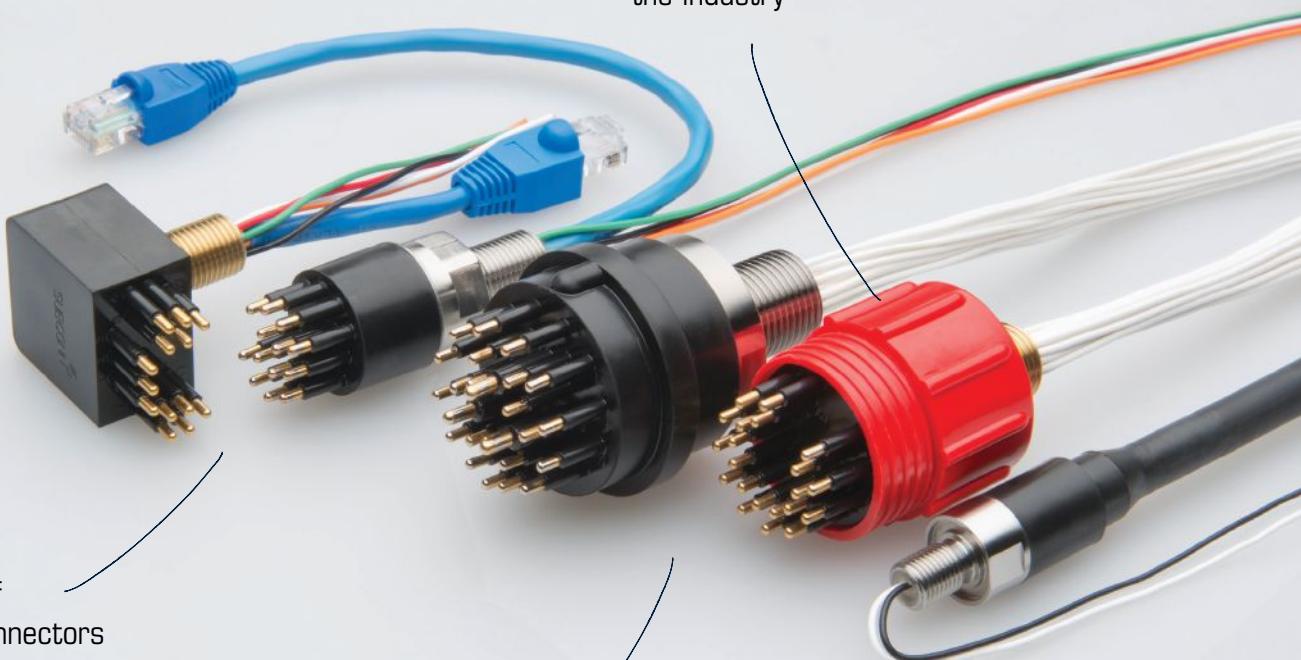
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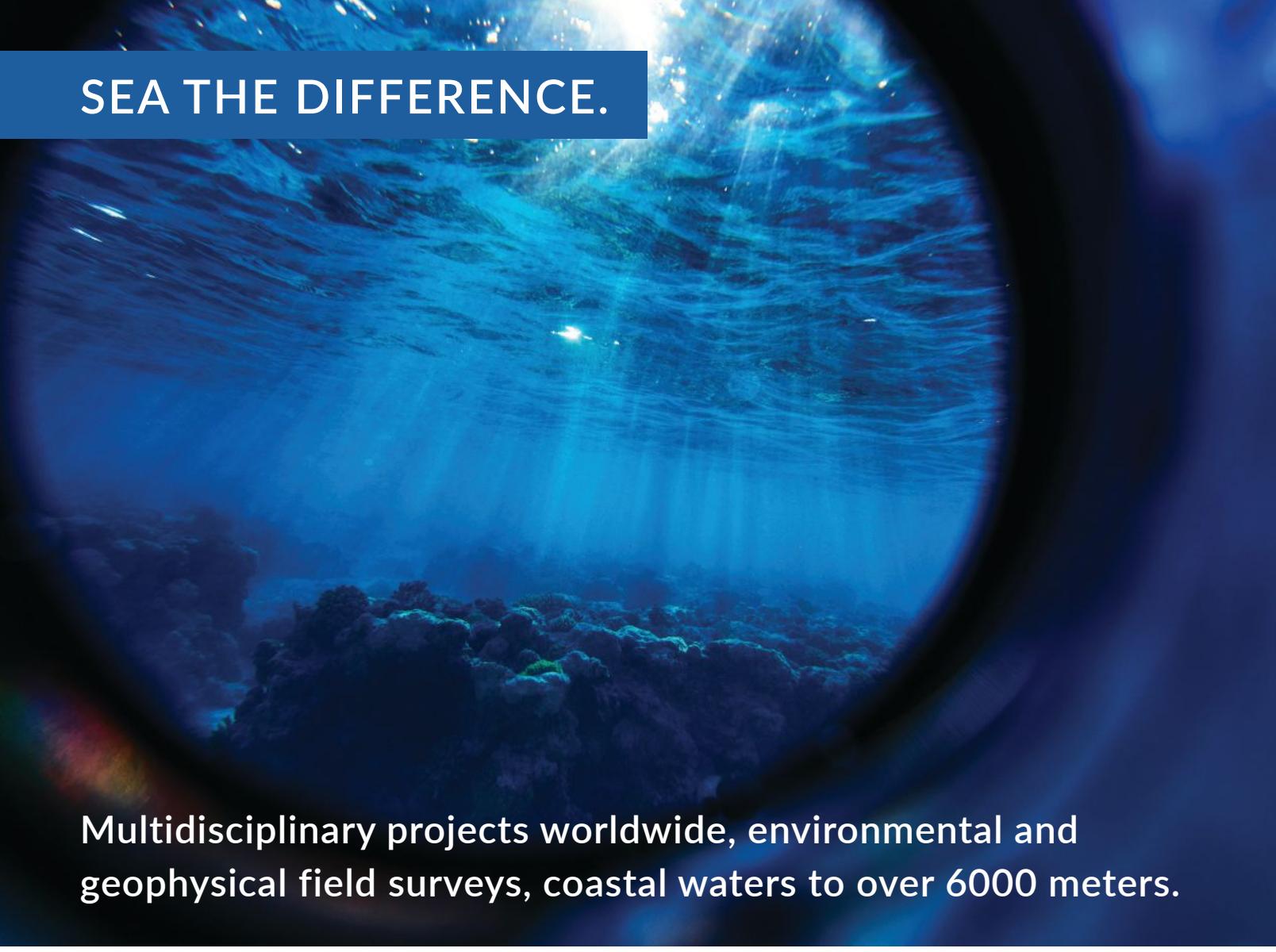
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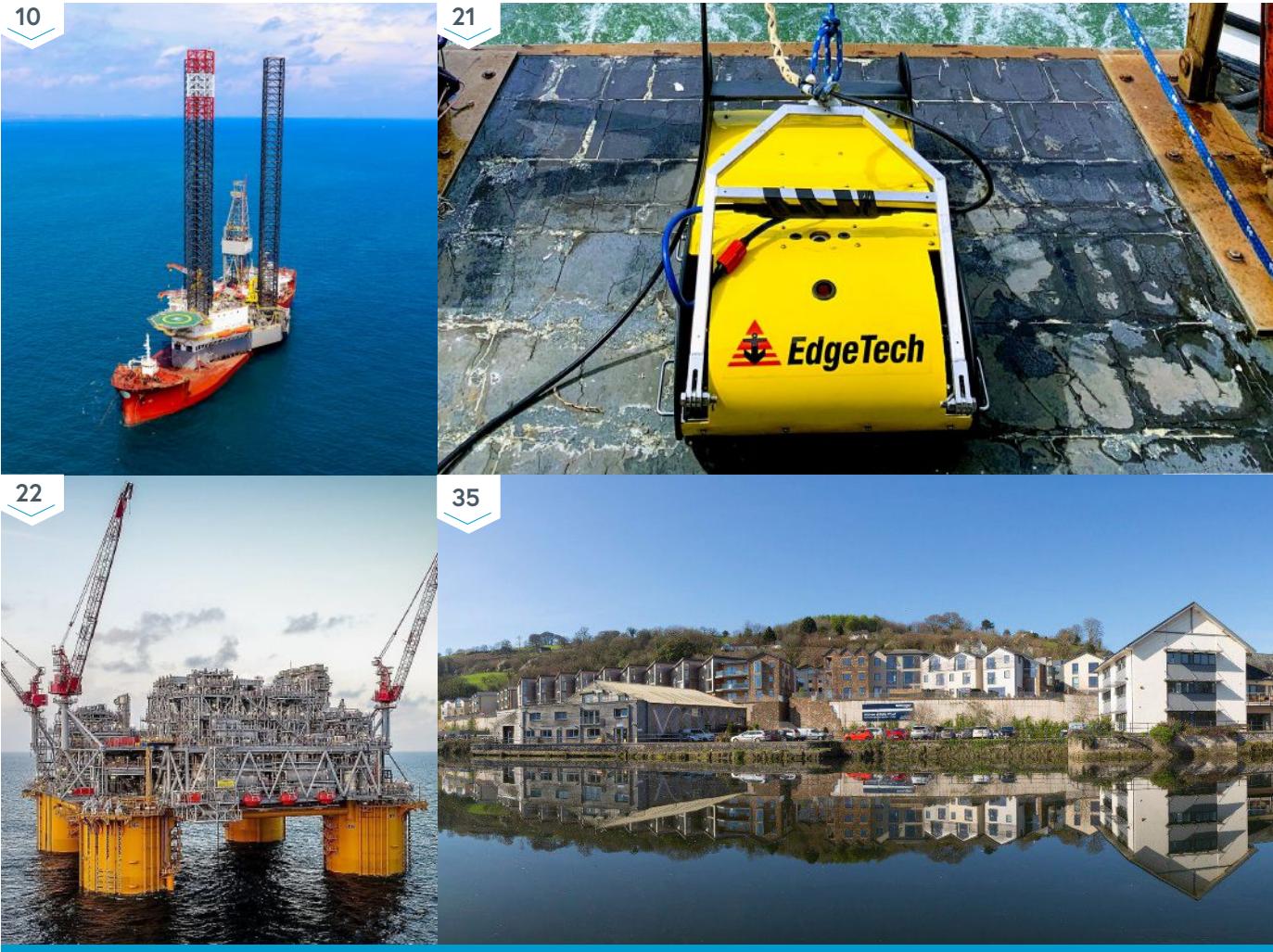
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## FEATURES

- 10 Is There A Golden Opportunity**  
For Jack-Ups?
- 18 Ocean Evolution Raises the**  
**Standard** for Subsea Construction  
Support Vessels
- 21 EdgeTech's Products:** Innovation  
You Can Trust
- 22 Appomattox:** Shell's Deepwater  
Project In The Gulf Of Mexico  
Defies The Odds
- 35 Valeport Marks 50th Anniversary**  
with New Environmental Range of  
Optical Sensors

## DEPARTMENTS

- 14 OCEAN SCIENCE & TECHNOLOGY**
- 26 OFFSHORE ENERGY**
- 32 SUBSEA INTERVENTION & SURVEY**
- 38 COMMUNICATION & SUBSEA**  
CABLES
- 42 DEFENSE**

## IN EVERY ISSUE

- 10 EDITORIAL**
- 20 PRODUCT FOCUS**
- 48 STATS & DATA**
- 52 EVENTS**
- 54 MILESTONES**
- 59 OCEAN INDUSTRY DIRECTORY**



## ON THE COVER:

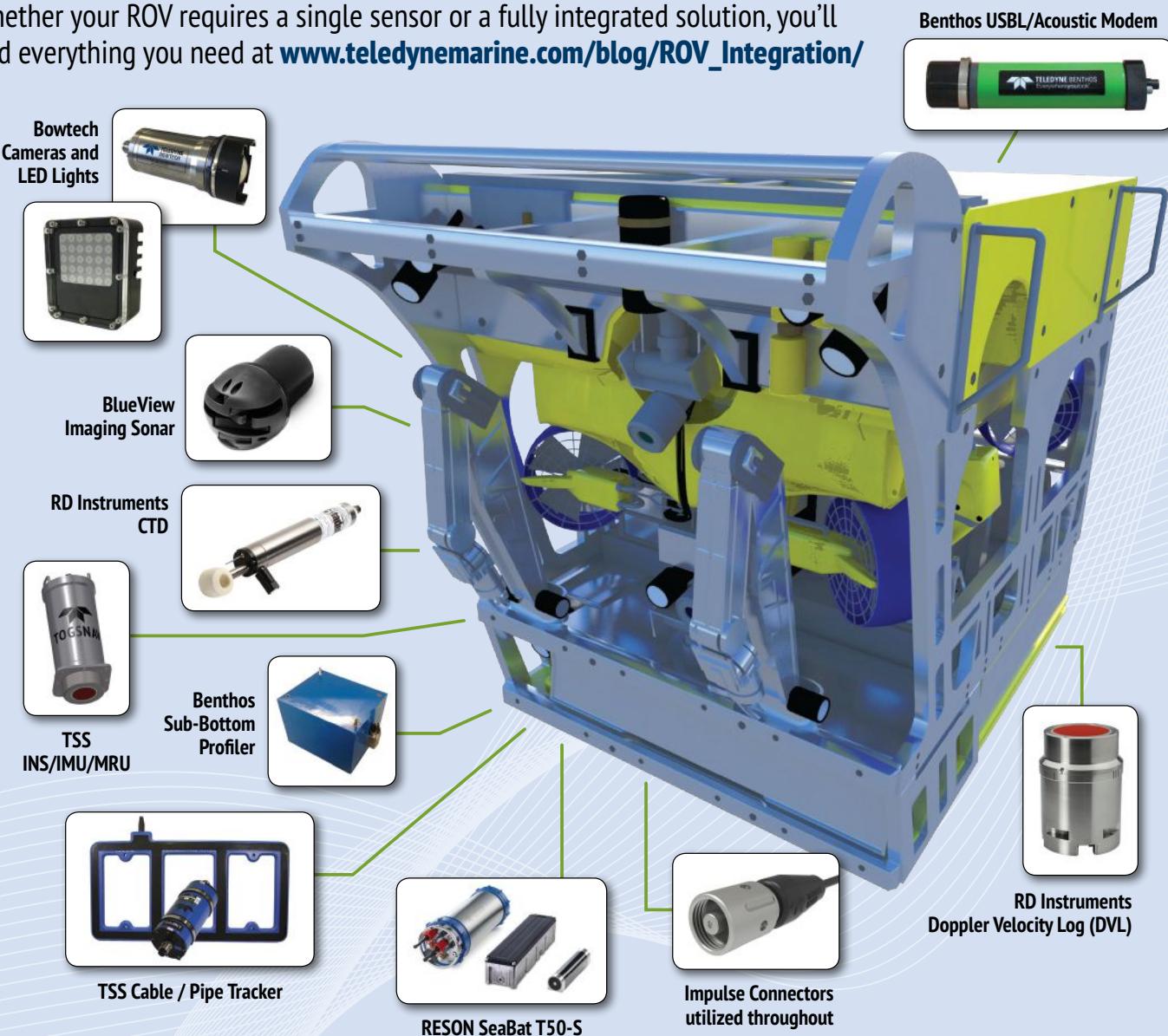
Oceaneering International, Inc., has taken delivery of its advanced subsea construction vessel, *Ocean Evolution*, a U.S.-flagged, Jones Act compliant multi-service vessel (MSV), shown here in the Gulf of Mexico. Image: Oceaneering International, Inc.

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The value of the geophysical industry extends beyond our role of helping to discover the world's energy resources. It is indispensable to exploration and supports the overall oil and gas industry. There is no oil and gas exploration and development without the geophysical industry.

As the composition of our industry has changed, geophysical companies are becoming more specialized and, like our association, now represents a wider breadth of explorers. This is a significant transformation for the industry's sustainability. This downturn has lasted longer, been deeper and more transforming than any other downturn in the past. IAGC has been leading the exploration industry's advocacy efforts through this period and has been a clear voice on behalf of the industry's interests.

IAGC's work in recent years to ensure the industry's freedom to operate and access opportunities not only supports the geophysical and exploration industry but undergirds the breadth of the oil and gas industry. Recognizing this critical role, our Industry Partners (Exploration and Production Companies) are joining the IAGC in record numbers. Our focus remains the same, but our voice is much stronger as we stand united as one voice, geophysical companies and E&P companies. In

## GEOPHYSICAL COMPANIES DRIVE SUCCESS OF EXPLORATION AND DEVELOPMENT

**BY: MAGNE REIERSGARD, CHAIRMAN OF THE BOARD, INTERNATIONAL ASSOCIATION OF GEOPHYSICAL CONTRACTORS (IAGC)**

addition, under the Strategic Framework our board of directors recently approved, the IAGC will pursue accelerating exploration in producing countries and frontier regions in the years to come.

It is critical that we continue to defend the value of our industry to the world and make our positive contribution to the environment known.

Health, safety, security and environment (HSSE) will always be paramount in our industry. Our people are our greatest asset. Our industry takes these issues most seriously and invests in mitigating risks to address them effectively. The IAGC will continue to be a standard-bearer for our industry, improving our HSSE Forums and promoting and sharing best practices to achieve continuous improvement in HSSE performance worldwide.

Finally, as an industry one of the challenges we must meet for the near future is attracting and retaining a skilled workforce. Although we have seen tremendous advances in technology in our industry, we are faced with an aging workforce and a shrinking pool of talent to fill critical positions. Many young people do not see a future in our industry, and we must do something to change that. We must find recruitment, retention and training solutions. This could

be one of the most important business issues facing our industry.

These are exciting times for the geophysical and exploration industry. And, while there are many challenges before us, there are also many great opportunities.

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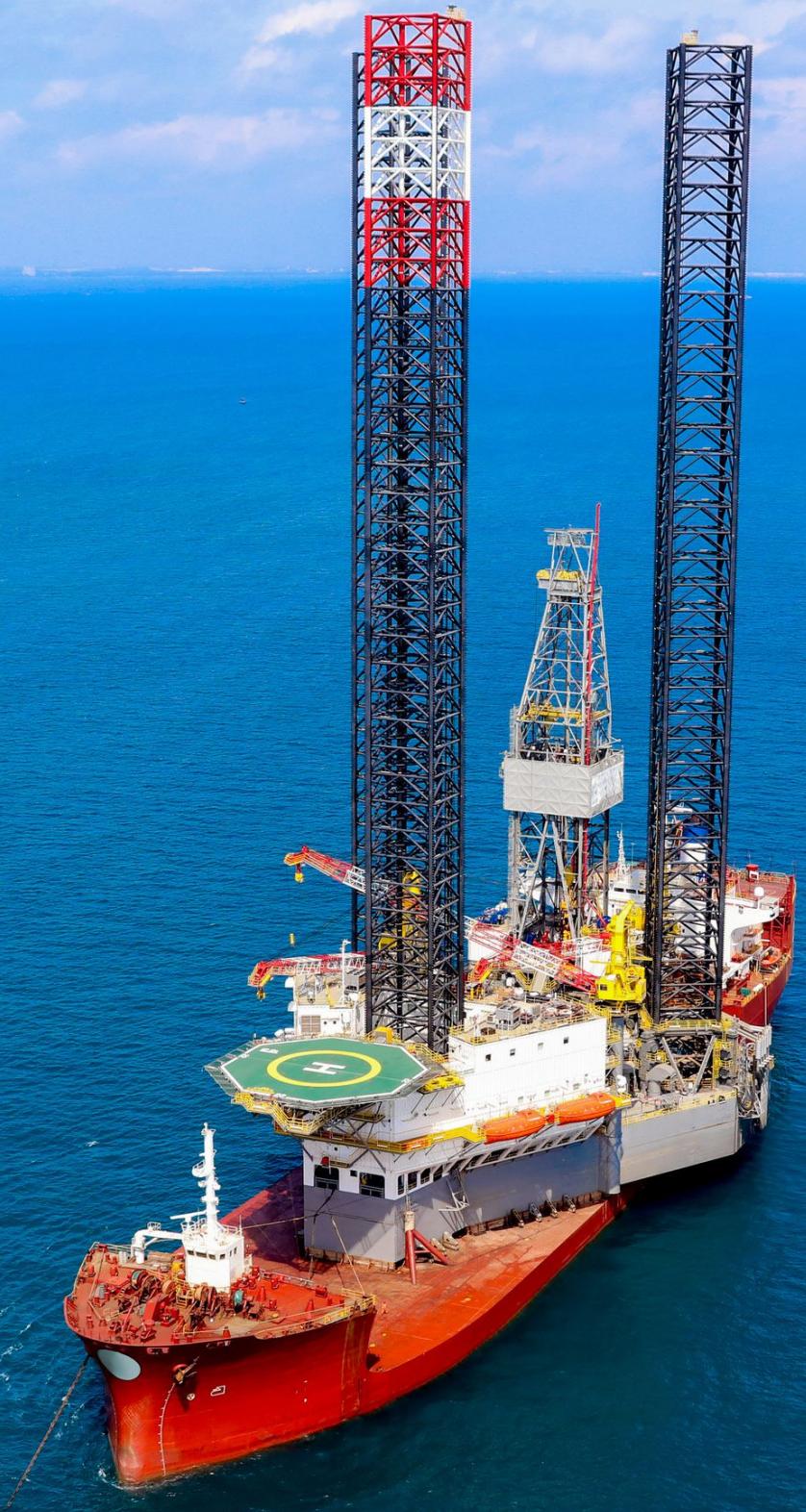
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» A new jackup rig on a heavy lift vessel.

# IS THERE A GOLDEN OPPORTUNITY FOR JACK-UPS?

By Ben Cannell, Innovation Director,  
Aquaterra Energy

As oil prices continue to stabilize, operators are looking for the most efficient drilling and intervention methods to keep their downturn inspired cost savings in place.

Jack-up rigs have long been known as the cheaper alternative to their floating cousins; semi-submersible (semi-sub) rigs or drilling vessels. However, the real operational benefits of the rig's fixed feet design have often been overlooked, when being used for subsea operations.

To date, more than 7,000 subsea projects have been developed worldwide (WoodMac, 2019). Predominantly drilled using semi-subs or drill ships, it is perhaps natural then that there remains an industry-wide tendency to default to these systems for exploration, development, intervention and decommissioning on subsea wells.

Opting for the right choice of rig infrastructure for these jobs is now more difficult than ever. With extensive subsea architecture, ultra-deep drilling, aging infrastructure, and not to mention cost all part of front-end considerations, decision-making models can be complex.

## CHOOSING THE RIGHT RIG

So, when would a jack-up be the right way to go?

To understand this, it is helpful to look at well history. In the early 1970s and 80s, industry Blow Out Preventer (BOP) systems were comparatively light compared to today's models.

As the industry moved into deeper water depths, and as safety regulations changed, the BOPs got much bigger and more complicated. Now, it is not uncommon for them to weigh upwards of several hundred tons.

Flip to today and these are the wells which are now beginning to be decommissioned, or which require significant intervention. The default position when carrying out abandonment on a well that might have been drilled many years ago, originally by a semi-sub, is to bring the exact same type of installation back to do the job. This, however, will have one major downside. It's now a significant challenge to even get the wellhead to support the weight of a modern BOP system, when using a semi-sub, or the loads imparted by vessel movement and offset.

The same is true for a newly drilled well. A subsea drilling engineer may be familiar with operations using a semi-sub, but perhaps unaware of the benefits of using a jack-up, or have the technical and interface knowledge to make a project successful. It results in a default position of using a semi-sub – even if a more cost effective and technically superior solution is available.

## A NIMBLE CHOICE?

So, is the nimble jack-up a better choice than semi-subs?

The truth is that there are benefits and drawbacks of both, but, the capabilities of jack-ups have often been outshone by the familiarity of semi-subs for subsea well projects.

Jack-up rigs have evolved considerably since their early days in the late 1970s. With technological and infrastructure advances, such as subsea high-pressure riser systems, accessing subsea wells via this type of rig is now much safer and more simplistic than ever.

Today, it is commonplace that jack-ups operate worldwide in water depths of over 100 metres and in some cases, up to 150 metres - meaning that there are more than 2,500 subsea wells easily accessible using this type of rig today and even more planned for the future (WoodMac, 2019).

Jack-ups also now have access to a sophisticated equipment and engineering industry that can support their operations. There are several companies, such as Aquaterra Energy, who have suitably qualified equipment, high quality sealing and an inventory of



» Today's blowout preventers can weigh several hundred tons.

support infrastructure, as well as turnkey interface management and engineering support. A far cry from the 'cobbled together' perception of the risers and ancillaries that used to be prevalent.

## RIDING THE WAVES

One significant advantage of a jack-up is its ability to withstand bad weather or poor conditions once fixed on a location. Because it has a surface BOP with a subsea riser system, and because a jack-up rig is fixed stationary above the wells, the offset of waves and vessel responses is very low. Therefore, any tension or stresses on the riser system, subsea and surface equipment is also going to be much lower than that of a semi-sub. In fact, jack-up rigs with subsea high-pressure riser systems can be used, without interruption, in conditions exceeding 50-year extreme storms, and waves over 30 metres.

By comparison, a semi-sub, because it is a floating vessel, can only withstand wave heights of around 2-3 metres before it will have to stop operations completely and potentially unlatch or move off well centre. This results in considerable operational downtime when working in shallow water environments, where these impacts are greatly magnified. This can significantly increase cost due to additional rig rental time.

Another fundamental factor that is critical to considering which rig is best suited to your operations is subsea architecture. In areas like the UKCS, where operations have taken place over decades and extended incrementally, there simply needs to be enough space for the jack-up to place its legs on the seabed. It's important to note that the sea floor has to be able to take the weight of the legs, which sounds like a dramatic consideration, but it is possible to break through and create instabilities if it cannot bear the load. This is something that is easily assessed via riser or conductor analysis services.

Both rig types will transfer motion generated by environmental conditions to the subsea well. However, the motion of a semi-sub, even during benign wave conditions, can significantly reduce the fatigue lifetime and exceed allowable operating parameters of critical subsea well equipment, including the wellhead housing welds. A jack-up rig, with a high-pressure riser system, can provide a more environmentally stable solution that can reduce fatigue damage from drilling, and withstand combined well control, 50-year storm and tension failure events.

## OTHER ENVIRONMENTAL CONSIDERATIONS

In terms of impact on the environment, there is little difference between the two rig options. Although it is possible that a semi-sub's slip joint can wear relatively quickly due to the motion of sea conditions mentioned previously. When worn or damaged there is a potential for environmental spills via these joints.

With a jack-up utilising a subsea riser system, all of the component parts use metal for premium gas-tight seals, so there is less risk of such an event occurring. This is especially important as newer developments push into ever more environmentally sensitive areas.



» More than 2,500 subsea wells using jackup rigs today, with even more planned for the future.

Despite some clear-cut capabilities and distinct advantages, it is not unusual to find some projects using both a jack-up and a semi-sub, when one or the other would do for the entire scope. For example, an operator might add one subsea well and tie it back via a semi-sub, but then rent a jack-up to drill the subsea well, put in a new tree, and then they'll move the jack-up to over the platform to complete a workover.

#### DOES IT ALL COME DOWN TO COST?

Undoubtedly cost is a huge factor. According to WoodMac reports, in 2019, the average global blended cost of a mid-water floater is around \$223,000 USD per day (p/d). In the next few years, operators will be looking at a sizeable investment with predictions of over \$310,000 USD p/d by 2023.

However, if you can use a jack-up for the same application, at 2019 rates the average global blended cost would be just \$136,000 USD p/d, that's an \$87,000 daily saving on the rig rates alone.

Therefore, over a 120-day drilling campaign (ignoring the fact that in shallow water a semi-sub will also likely have significant

operational down time due to the limited operating window making the cost delta even more extreme) an operator could save \$10.4 million by simply using a jack-up. Apply this methodology to the number of development wells forecast over the next five years and the industry would make savings of more than \$3.2 billion (a total of 316 subsea trees are forecast to be ordered over the next five years, which are located in water depths of 150m or less (WoodMac, 2019)). This figure would be even higher if you were to include the number of existing wells that will need intervention or abandonment works.

So, although rental and setup costs of a jack-up rig are much less than semi-sub rigs, it's clear that the primary advantages of using them for your project go significantly beyond just cost. With the right equipment partner, it is more viable than ever to manage the interfaces between the seabed and the surface, and ensure that the engineering expertise and management is in place to allow the operation to take place safely and efficiently.

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# FIVE DEEPS EXPEDITION

## CONQUERS CHALLENGER DEEP WITH MULTIPLE HISTORIC DIVES



» A technician checks the submarine DSV Limiting Factor aboard the research vessel DSSV Pressure Drop above the Pacific Ocean's Mariana Trench. / Photo Credit: ©Tamara Stubbs

For the fourth time, the Five Deeps Expedition has successfully dived to the bottom of one of the world's five oceans. The team completed a mission to reach what is commonly known as the deepest point on planet Earth: Challenger Deep within the Mariana Trench. Victor Vescovo set a new deep-diving record and is the first human to make multiple dives, solo, to its hadal depths in the DSV Limiting Factor (Triton 36000/2 model submersible) the world's deepest diving, currently operational submarine. The expedition reached a maximum depth of 10,928 meters<sup>1</sup> / 35,853 feet deep, 16 meters/52 feet deeper than any previous manned dive.

The last visit to the bottom of Challenger Deep was made in 2012 by filmmaker and explorer James Cameron, who reached a depth of 10,908 meters on a dive in his submersible, the *Deepsea Challenger*.<sup>2</sup> Prior to Cameron's dive, the first ever dive at Challenger Deep was made by the *Trieste*, a US Navy deep submergence bathyscaphe, in 1960 to 10,912 meters by Lieutenant Don Walsh and Swiss scientist Jacques Piccard.<sup>3</sup> Both the *Trieste*

and *Deepsea Challenger* only descended to the bottom of Challenger Deep once.

Between April 28 and May 5, 2019, the *Limiting Factor* completed four dives to the bottom of Challenger Deep and one final dive on May 7, 2019 to the Sirena Deep which is also in the Mariana Trench, approximately 128 miles to the northeast. Two of the dives, including the deepest one made on April 28, were solo dives piloted by Vescovo.

### THE FULL DIVING PROGRAM DURING THIS PHASE OF THE OVERALL EXPEDITION CONSISTED OF:

**1. Dive #1** (April 28, 2019): Solo dive to bottom of the 'Eastern Pool' of the Challenger Deep to 10,928 meters (Victor Vescovo, Pilot). The expedition has calculated that this was the deepest dive by any human in history (see the footnote, page 1, for the methodology and rationale used in making this assessment). Four hours (248 minutes) were spent on the bottom exploring the basin, which is now

the longest period of time ever spent on the bottom of the ocean by an individual.

**2. Dive #2** (May 1, 2019): A second, solo dive to the bottom of the 'Eastern Pool' of the Challenger Deep to 10,927 meters (Victor Vescovo, Pilot). Three hours (217 minutes) were spent on the bottom including extensive exploration of the southern, rocky slope of the Deep.

**3. Dive #3** (May 3, 2019): DNV GL Commercial Certification Dive and Lander Salvage in the 'Eastern Pool' of the Challenger Deep (Patrick Lahey, Pilot; Jonathan Struwe, Specialist). This was the deepest marine salvage operation ever attempted and was successful. A Five Deeps Expedition scientific lander was stuck on bottom during the previous dive (#2) and was freed and recovered from 10,927 meters by direct action of the manned submersible. The submarine also passed all of its qualification tests and commercial certification by DNV GL was granted. This makes the *Limiting*



» The Skaff lander floats next to the research vessel DSSV Pressure Drop above the Mariana Trench.  
Photo Credit: ©Reeve Jolliffe



» The submarine DSV Limiting Factor floats near the research vessel DSSV Pressure Drop above the Pacific Ocean's Mariana Trench / Photo Credit: ©Tamara Stubbs

Factor the first full ocean depth-capable submersible to meet commercial safety standards and be granted commercial operating certification. (All previous submersibles achieving this depth historically were considered "experimental.") Approximately 2.5 hours (163 minutes) were spent on the bottom by the sub and 2.5 days by the lander.

**4. Dive #4** (May 5, 2019): Scientific Dive in the 'Central Pool' of the Challenger Deep (Patrick Lahey, Pilot; John Ramsay, Sub Designer). Video surveying and biological samples were collected by the submersible and its landers for scientific analysis. The major focus was to investigate the north and southern edges of the subduction zones in the Challenger Deep. Time on bottom was approximately three hours (184 minutes).

**5. Dive #5** (May 7, 2019): Scientific Dive in the Sirena Deep which is part of the Mariana Trench (Victor Vescovo, Pilot; Dr. Alan Jamieson, Chief Scientist). First

manned descent to the bottom of the Sirena Deep, which focused on geological, biological, and video survey and collection in the trench basin. Time on bottom was three hours (176 minutes) and the deepest piece of mantle rock ever recovered from the surface of the western slope of the Mariana Trench was collected.

The Five Deeps Expedition is being filmed by Atlantic Productions for a five-part Discovery Channel documentary series due to air in late 2019.

On board the DSSV *Pressure Drop* for this historic accomplishment was legendary American oceanographer, explorer and marine policy specialist, Dr. Don Walsh (Captain, USN Ret.), who made the first successful decent into the Mariana Trench in 1960. The maximum depth achieved was measured and later corrected to be approximately 10,916 meters.

"Victor Vescovo's imagination and fierce curiosity; Triton Submarines technical brilliance, and the outstanding performance of

## END NOTES

1 DNV GL has certified a depth reference datum of 10,927 meters +/- 8 meters (with a 6.5 meter standard deviation and 95% confidence interval) at a lander location visited by the submersible on its May 1 dive. However, the submersible's two onboard, calibrated sensors registered a slightly higher pressure, and thus, lower depth on its dive of April 28. It is the expedition's estimation that based on all available data including a depth range provided by the ship's EM124 sonar, that the deepest dive was to 10,928 meters (+/- 10.5 meters) on April 28 by Vescovo during his four-hour exploration of the Challenger Deep's relatively flat "Eastern Pool." The data will be further analyzed and possibly revised in the future, as occurred with both prior dives to the bottom of the Challenger Deep by Trieste (1960) and Deepsea Challenger (2012).

2 Direct communication by J. Cameron to the Five Deeps Expedition regarding his lowest depth, 4/20/19.

3 Dietz, Robert S. and Jacques Piccard. Seven Miles Down: The Story of the Bathyscaph *Trieste*. Putnam, 1961, p.

the officers and crew of mother ship *Pressure Drop* all converged to make this expedition a huge success. And I was there to see it," said Dr. Don Walsh (Captain, USN Ret.).

As with every other previous expedition dive, the team extensively measured and mapped the operating area with a Kongsberg EM124 sonar to pinpoint the desired dive sites. Once on the bottom, Vescovo or the two-person sub team of pilot and specialist usually spent 3-4 hours on the bottom conducting their survey and science missions. On average, it required 3.5 hours for the submersible to reach the bottom of the Challenger Deep and 3.5 hours to ascend. The average total mission duration lasted from 11-12 hours including one hour combined for launch and recovery of the sub from the surface, well under the submersible's required life support endurance of four days with two persons onboard.

For updates on the expedition, visit [www.fivedeeps.com](http://www.fivedeeps.com).

# GEBCO-NIPPON FOUNDATION ALUMNI TEAM WINS SHELL OCEAN DISCOVERY XPRIZE

The GEBCO-Nippon Foundation Alumni Team has won the Shell Ocean Discovery XPRIZE, prevailing against talented teams from around the world to claim the top prize of \$4 million. The award was presented on 31 May 2019 at a ceremony at the Musée Océanographique de Monaco, in the presence of leading international ocean experts, by Anousheh Ansari, CEO of XPRIZE.

The team includes 16 alumni of The Nippon Foundation-GEBCO Postgraduate Training Program at the University of New Hampshire (UNH). Their entry was funded by The Nippon Foundation, a Japanese private non-profit, and utilized the SEA-KIT Uncrewed Surface Vessel (USV) *Maxlimer*, alongside the Kongsberg Maritime HUGIN Autonomous Underwater Vehicle (AUV) System. The team's concept for efficient, safe and cost-effective seafloor mapping was based around the Kongsberg Maritime HUGIN AUV, rated to operate at depths of up to 4,500 meters, supported by the SEA-KIT USV, which has the ability to autonomously launch and recover the AUV and acts as a communication link during subsea survey operations.

The prize money will be reinvested by The Nippon Foundation into the development of future ocean mapping initiatives.

The team venture was based at UNH, where they worked with partners including the Sasakawa Peace Foundation, Hushcraft Ltd., Ocean Floor Geophysics Inc., Earth Analytic, Teledyne CARIS, Raitt Orr and Associates, ShipOwners, and OmniAccess, as well as equipment supplier Kongsberg Maritime AS.

In the final round, the GEBCO-NF Alumni Team traveled to Kalamata, Greece, to compete in a 24-hour ocean mapping challenge. This involved producing a 5m horizontal resolution bathymetric map, as well as high-definition images of biological, archaeological, or geological features of the ocean environment. The team mapped



» The winning concept paired a SEA-KIT USV with a Kongsberg Maritime HUGIN AUV. Photo credit: XPRIZE.

278 km<sup>2</sup> and produced ten high-resolution images which were selected using the Kongsberg REFLECTION software package from standard HISAS imagery. Additionally, eight 3D surfaces of the seafloor were produced using Fledermaus software. Kongsberg EM304 multibeam data was uploaded online and team members at UNH cleaned and produced nine point cloud images using Qimera.

The team's SEA-KIT vessel USV *Maxlimer* was named after UNH Nippon Foundation-GEBCO Postgraduate Training Program alumna Maxlimer Anziani Vallee, who sadly passed away following a car accident in January 2017. Since being used in the team's XPRIZE entry, the vessel has completed the world's first international commercial uncrewed transit, successfully traversing the world's busiest shipping lane to deliver a box of oysters from the UK to Belgium on 7 May 2019.

## Other XPRIZE News Includes:

- The \$1M NOAA Bonus Prize winner is Ocean Quest based in San Jose, California, comprised of junior high students from around the world and the youngest team to compete in a XPRIZE challenge. Runner-up is Tampa Deep Sea Xplorers. This prize was given to teams that successfully developed technology that could detect a chemical or biological signal underwater and autonomously track it to its source.
- Additionally, even though they did not meet the criteria of the competition, judges unanimously recommended a \$200K "Moonshot Award" for Team Tao from the UK for its unique approach to seafloor mapping.
- XPRIZE announced a partnership with Seabed 2030, a collaborative project between The Nippon Foundation and GEBCO to inspire the complete mapping of the world's ocean by 2030 and to compile all bathymetric data into the freely-available GEBCO Ocean Map.

To learn more, visit  
[WWW.GEBCO-NF.COM](http://WWW.GEBCO-NF.COM)



» Team GEBCO-NF Alumni has won the \$7 million Shell Ocean Discovery XPRIZE. Photo credit: XPRIZE.

## NEW COLLABORATION TO SUPPORT ADVANCES IN 3D PRINTING

DNV GL and Nanyang Technological University, Singapore (NTU Singapore) are supporting academic advances in additive manufacturing – the process of 3D printing – for the maritime, oil and gas and other industries, through a four-year research collaboration agreement.

Two new doctoral student positions are being created through the Industrial Postgraduate Program, supported by the Singapore Economic Development Board (EDB) and DNV GL. A further full time Research Fellow post is also being created at NTU's Singapore Centre for 3D Printing. The research agreement will focus on developing industry standards, quality assurance processes, certification and supply chain tracking for the additive manufacturing sector.

"Additive Manufacturing has the potential to disrupt companies active in design, production, certification and supply of goods. But it can also shape a new ecosystem around those goods. Our collaboration agreement with NTU provides opportunities for the additive manufacturing supply chain to instill greater trust in this fast-emerging technology through DNV GL's developing services in this sector," said Dr. Pierre C Sames, Senior Vice President and Director of DNV GL Group Technology and Research.

Market researchers SmarTech Publishing forecast that 3D printing will become a USD450 million market in the oil and gas industry by 2021, rising to USD1.4 billion by 2025. The investment in academia comes after DNV GL engaged in a joint industry project to study the feasibility of 3D printing in the maritime industry earlier this year, alongside 10-member companies from the Singapore Ship Association.

They will collaborate on the potential use of spare parts produced by 3D printers to help the capital-intensive maritime industry to cut costs and downtimes. Initiated by the Maritime and Port Authority of Singapore, the JIP aims to establish what commonly ordered parts are highly feasible for 3D printing with or without certification respectively.

Professor Chua Chee Kai, Executive Director of the NTU's Singapore Centre for 3D Printing (SC3DP) said: "This partnership between NTU and DNV GL comes at an inflection point for additive manufacturing in the maritime and offshore industry, where a deeper understanding of design, materials, and processes will facilitate the creation of more comprehensive guidelines for the qualification, and the certification of components produced by additive manufacturing. The combination of NTU's expertise in additive manufacturing research and DNV GL's experience in risk management and quality assurance services will pave the way for wider adoption of the technology in the maritime and offshore sector."

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# OCEAN EVOLUTION RAISES THE STANDARD FOR SUBSEA CONSTRUCTION SUPPORT VESSELS

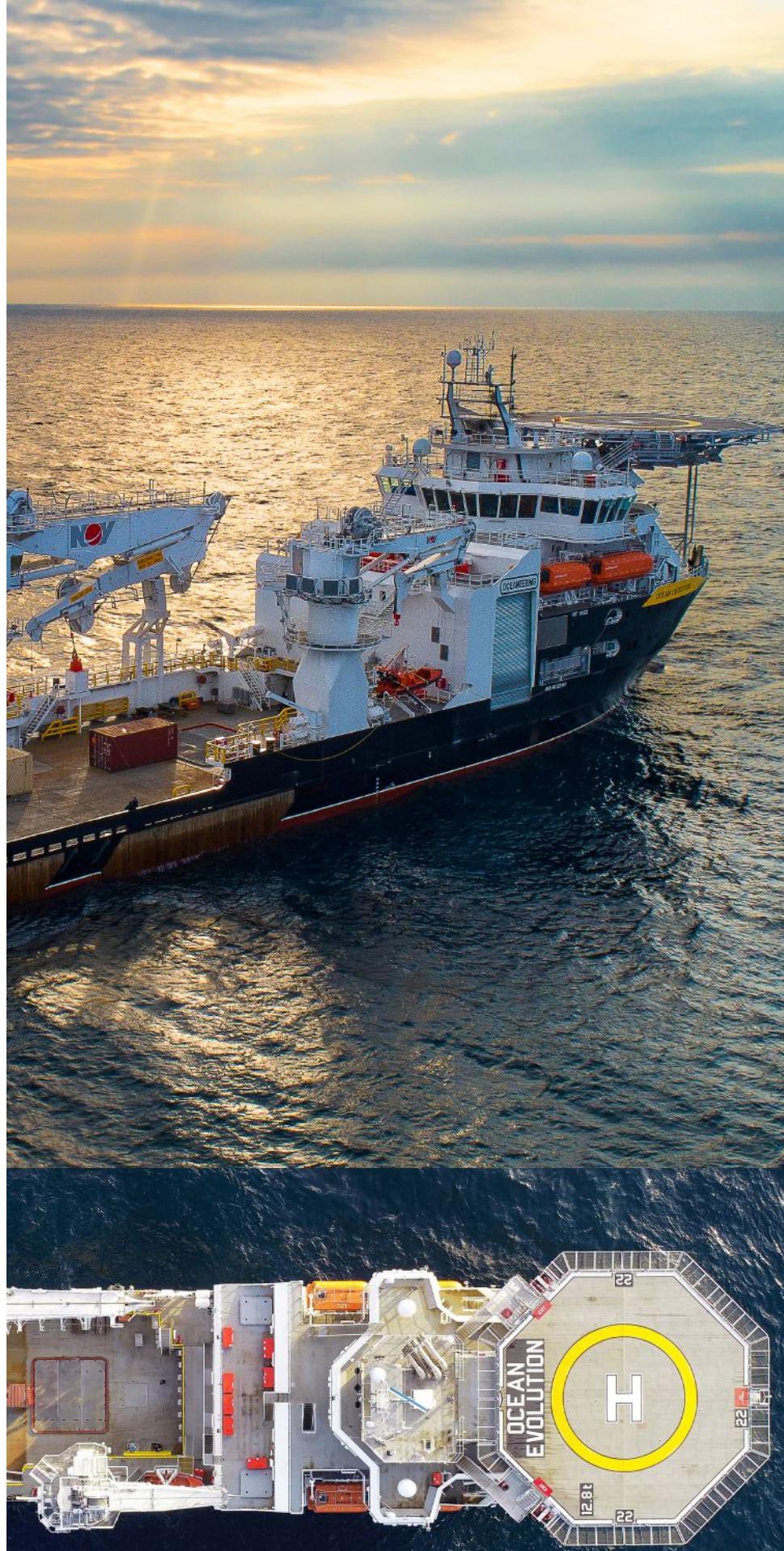
Oceaneering International, Inc. ("Oceaneering") held a christening ceremony at Pier 21 in Galveston, Texas, for its advanced subsea construction support vessel, *Ocean Evolution* in May 2019.

The vessel is equipped with two Oceaneering work class ROV systems. One 220 hp Millennium® Plus and one 250 hp NEXXUS systems are onboard each with active heave compensated launch and recovery systems installed in a custom indoor hanger for port and starboard launch. Integrated survey and communication systems round out permanently installed equipment that provide positioning and data services for all operations.

The vessel's home port will be in Port Fourchon, Louisiana. Its first project is scheduled to begin in June.

The *Ocean Evolution* is the most advanced U.S.-flagged, Jones Act-compliant multi-service vessel (MSV) in the market. Its capabilities are headlined by its 250 mT active heave compensated (AHC) crane, two work-class remotely operated vehicles (ROVs) with AHC launch systems, survey systems and subsea tooling all built for work in up to 4,000 m water depths.

The vessel serves the deepwater stimulation and intervention market with its well stimulation and well intervention design, ABS Well Stimulation and Well Intervention (WS/WI) ready notation and under deck capacity to store special products.





Photos courtesy of Oceaneering International, Inc.

# CHECK THE TECH!

## ROKDOC 6.6.1: A RESERVOIR MONITORING TOOL WITH A 4D EDGE

Ikon Science's suite of RokDoc tools has been developed in collaboration with major oil companies and academic experts since 2001. Used to analyze well and seismic data, determine value and apply quantitative methods to predict rock, fluid and pressure properties, these tools are valuable resources for oil and gas Exploration and Production (E&P) companies to looking to improve efficiencies, reduce costs and maximize their Return on Investment (ROI).

RokDoc 6.6.1, which was released in late 2018, includes a new RokDoc 4D Reservoir Monitoring product unlike anything else on the market. RokDoc Reservoir Monitoring supports corner point grid data, allowing the integration of static (geomodel) and dynamic (flow simulation) property models into 3D/4D shared earth models that can be utilized for 4D time lapse feasibility and 'close the loop' workflows. Using this comprehensive toolset, asset teams can collaborate on updating geomodel and simulation data with information from 4D seismic and other sources.

4D seismic can be the key to improved oil recovery by answering critical questions, such as are

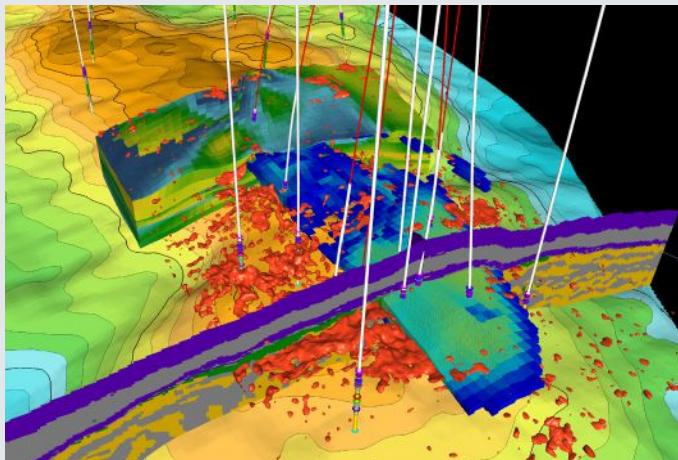
injector-producer pairs working as expected? Are there any pressure build-ups? Is reservoir delivery going according to plan? Is the reservoir simulation accurate between the wells?

In mature fields, it can help answer if there are any undrained compartments, whether there exists any by-passed or attic oil, where infill wells should be drilled, and how water flood can be optimized.

"Ask geoscientists and drillers, and they will tell you, unsurprisingly, that the subsurface is modelled and drilled in depth, even though seismic inversion results are ubiquitously delivered in two-way time" said Michel Kemper, Ikon Science's, Chief Scientist. "With more and more depth indexed seismic these days, we are leading the way to novel workflows for a fully depth native seismic to geomodelling to simulation workflow".

### The more you know

Ikon's machine learning approach to quantitative interpretation involves the capture, aggregation and management of rock



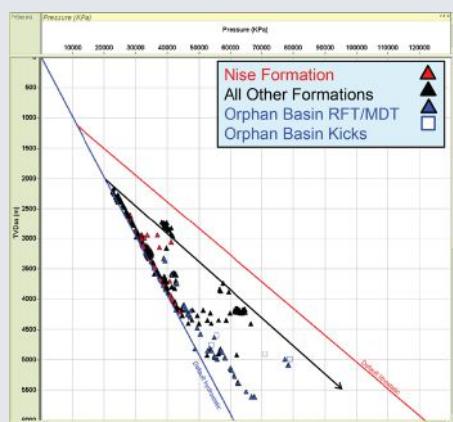
» Reservoir characterization with RokDoc 4D with Co-Viz.  
Image: Ikon Science.

property information in a corporate knowledge management system, making it possible to identify, extract and deliver high-quality data for training of machine learning (ML) algorithms that can be rapidly deployed across assets delivering novel solutions to subsurface E&P and drilling challenges.

RokDoc's 6.6.1 numerous usability and workflow improvements for the handling of large well datasets, with the addition of new multi-well selection capabilities across the software. End users can now move seamlessly from well-based rock physics, pressure and geomechanical analysis of conventional and unconventional reservoirs through to datadriven, 3D seismic reservoir characterization, delivering 3D analytical geomechanical, petrophysical and elastic property models in a single, unified platform.

December saw the release of a new series of certificated, online e-learning courses allowing users worldwide to access RokDoc software training courses. RokDoc 6.6.1 added enhanced seismic wiggle trace drawing and the ability to create difference gathers for the analysis of e.g. 4D time-lapse production related effects or to assess seismic data before and after pre-stack data conditioning workflows.

In the RokDoc 2D and Attrimod seismic modelling tools, users can now plan wells in both onshore and offshore environments with full control over datums.



» An example illustration from a RokDoc training course on operations risks. This example shows kick data indicating the potential for high pore pressure in the deep-water off Mid-Norway. Modeling tools from RokDoc can help assess this risk.



## EdgeTech's Products: Innovation You Can Trust

EdgeTech—a global leader in high resolution sonar imaging systems, acoustic release systems and underwater technology—continues to make great strides with their product lines.

Following a number of exciting new product announcements in 2018, EdgeTech has been busy fielding systems in 2019. New products were introduced in all of the following product lines: side scan sonar, sub-bottom profiler, bathymetry, combined sonar systems and acoustic releases.

In the side scan sonar product group, the new 4205 began shipping in 2019. It is available in either a tri-frequency side scan sonar configuration or motion tolerant and multi-pulse configuration. The tri-frequency version allows surveyors the option to operate any two frequencies simultaneously from the tri-frequency system. The 4205 motion tolerant configuration with multi-pulse provides surveyors the ability to operate either at faster survey speeds or in more adverse weather conditions while still obtaining high quality underwater imagery.

Building on the long running success of the EdgeTech sub-bottom profiler product line, the new EdgeTech 3400 provides users many enhancements to current sub-bottom profiler systems. The system generates high resolution images of the sub-bottom stratigraphy in oceans, lakes, and rivers and provides excellent penetration in various bottom types. The EdgeTech 3400 comes in a dual 2-16 kHz transducer configuration. The towfish is configured with new PVDF receiver arrays segmented for standard sub-bottom profiling operations or a unique "pipeliner" mode for optimal location and imaging of buried pipelines.

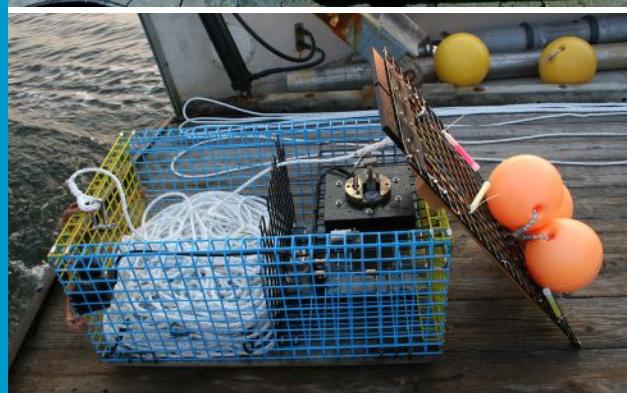
The new 6205s is the only shallow water wide swath bathymetry system to now offer EdgeTech's motion tolerant side scan sonar feature for operation in more adverse weather conditions. The EdgeTech 6205s is a fully integrated boat/pole-mounted Swath Bathymetry and Dual Frequency Side Scan Sonar System that produces real time, high resolution, side scan imagery and three-dimensional maps of the seafloor.

EdgeTech's new combined sonar platform is the 2300 system. This deepwater system integrates the highly successful line of side scan sonars, sub-bottom profilers and (optional) MPES bathymetry into one fully integrated 2,000-meter rated system.

In the acoustic release line, EdgeTech recently introduced the Ropeless Fishing System with embedded acoustic release technology developed to eliminate vertical lines connecting a surface buoy to bottom fishing gear. The system was designed from the ground up with the input of fishers with the intent of alleviating possible whale entanglement and other negative effects of seafloor-to-surface fishing and trap lines.



» EdgeTech 3400: Portable Sub-bottom Profiler



» EdgeTech ropeless fishing system with embedded acoustic release



4205: Tri-Frequency / Motion Tolerant Side Scan Sonar System »

To find out more about the EdgeTech product line, visit [WWW.EDGEYTECH.COM](http://WWW.EDGEYTECH.COM)



| FEATURE |

# APPOMATTOX: SHELL'S DEEPWATER PROJECT IN THE GULF OF MEXICO DEFIES THE ODDS

By Thomas Francis, Americas Editor, Shell

Royal Dutch Shell plc, through its subsidiary Shell Offshore Inc (Shell) announced on 23 May 2019 that production has started at the Shell-operated Appomattox production system months ahead of schedule, opening a new frontier in the deep-water U.S. Gulf of Mexico.

"That Appomattox was safely brought online ahead of schedule and far under budget is a testament to our ongoing commitment to drive down costs through efficiency improvements during execution," said Andy Brown, Upstream Director, Royal Dutch Shell. "Appomattox creates a core long-term hub for Shell in the Norphlet through which we can tie back several already discovered fields as well as future discoveries."

» Appomattox is expected to produce some 175,000 barrels of oil and gas equivalent per day. Photo courtesy of Shell.

Appomattox is Shell's largest floating platform in the Gulf of Mexico. With a displaced weight of 120,000 tons, it's larger than an aircraft carrier. The Appomattox development will initially produce from the Appomattox and Vicksburg fields, with first oil by the end of the decade and average peak production estimated to reach approximately 175,000 barrels of oil equivalent per day. The Appomattox hull, weighing 40,000 metric tons, is the largest floating production system that Shell has ever built.

## BUILDING DURING A DOWNTURN

In late 2014, as the price of oil tumbled, seasoned engineers drafting plans to build a new deep-water oil and gas project in the US Gulf of Mexico told their younger, more anxious colleagues not to sweat it.

This is a cyclical industry, they said. And the cycle will swing back, like it always does.

The future of the Shell project, Appomattox, seemed to depend on it. The biggest offshore project for Shell in the Gulf of Mexico, and one of the region's deepest, Appomattox would be designed to produce 175,000 barrels of oil and gas equivalent a day, drilling in waters 2,200 metres deep (7,400 feet). But it was initially shaping up to be costly.

By industry standards, this was the kind of project that is vital to energy supplies needed to drive the global economy for decades to come.

"Our models project a massive supply gap around 2025, where demand will outpace supply," says William Turner, a senior analyst at Wood Mackenzie, the research and consultancy firm. "And onshore production just doesn't produce the volumes they do offshore."

But the lower the price of oil, the harder it would be to make Appomattox profitable.

As the oil price continued to fall through 2015, it became clear this was much more than a short-lived downturn.



» Constructed in Geoje, South Korea, Appomattox made its way to Ingleside, Texas in 2017 where the host platform and subsea infrastructure were added. By constructing during an oil-price downturn, Shell provided valuable jobs to these areas. Photo courtesy of Shell.

Industry experts, from analysts to oil company executives to media commentators, began to talk of "the new normal". The grim economic conditions posed a threat not only to Appomattox, but to a Gulf Coast economy heavily reliant on the oil and gas industry.

The Appomattox team had to prove that in the era of low-price oil there was still a place for major projects - and that it was possible to cut costs without compromising safety.

The economic outlook would only get worse. In January 2016, the price of oil fell below \$30. This was less than one-third what it was when Appomattox was conceived. Across the offshore industry, investment plans were being scrapped.

And across the Gulf Coast, those who worked on offshore oil production feared for their livelihoods, with good reason. Some 350,000 oil and gas workers were laid off worldwide in the two years following the collapse of the oil price, with job losses near 100,000 in Texas alone.

In neighboring Louisiana, the number of energy workers sank to its lowest in 25 years. The historic downturn caused layoffs from Canada to Brazil, from the North Sea to Malaysia.

## FOCUSING MINDS

The old certainties had fallen away and the Appomattox team knew they had a fight for survival on their hands.

"The one psychological upside is that it becomes absolutely clear to people at all levels and across the supply chain that we have to win this cost-reduction fight if we're going to stay in business," recalls Appomattox Project Manager Marno de Jong.

Project team members at all levels were strongly encouraged to look critically at costs that had previously been unchallenged.

Wells engineering manager Adrian Chesters remembers brainstorming workshops with up to 100 workers, estimating that together they must have had 1,500 years' experience in deep-water operations.

Their brief: to be skeptical of what they knew, to open their minds to new efficiencies and to risk proposing bold, unconventional ideas, while at no time cutting corners on safety.

"Every time someone would have an idea for what we could do to cut costs, we would look at the potential risks," says Chesters. "And if there were safety risks that could not be mitigated, that idea did not go anywhere. Safety was our number one priority."

When it came to reducing cost, there was no single "Eureka!" moment, no silver bullet. The Appomattox team went after all costs irrespective of size - chasing hundreds of ideas for saving money that together might add up to billions of dollars.



» Shell's Appomattox hull site lead, Sid Johnston (left) and construction lead, Irving Tyler (right) talk during construction of the massive deep-water project. Photo courtesy of Shell.



» Broadmoor provided the construction of the architectural outfitting for the module, which included the interior living spaces (approximately 50 bedrooms), athletic facility, conference rooms, professional kitchen, dining room, laboratory spaces, and numerous storage systems. Photo courtesy of Broadmoor.

## FINDING NEW METHODS

Drilling wells, for example, represents one of the steepest costs in a deep-water project - and Appomattox was to have 20 wells. But the wells team managed to halve the typical cost of drilling wells, realizing huge savings.

One key technique they adopted was what is known as batch drilling - several wells drilled at once, in assembly line fashion. The rig drills just through the surface at several locations, then returns to drill the middle section of each well, and so on.

It may seem only a slight modification, but this efficiency led to significant savings in both time and money. This is speedier than the traditional process of building up one well completely, then moving to the next.

This approach made it possible to reduce time spent drilling, significantly cutting expense.

## THE NEED FOR DATA

By pulling data along every step of the complex wells process, workers scrutinized the number of minutes and dollars spent on tasks until they had devised the most efficient system possible.

"We celebrated and recognized those people when they delivered," says Chesters. "It's surprising how that lights a fire within the team, an enthusiasm for chasing more ideas that will lower costs."

Another technique involved so-called mattresses. Where new pipelines cross existing pipelines, these concrete mattresses are used to separate and protect the two pipelines.

Although traditionally thought of as standard designs, the Appomattox team found new ways to make them stronger and more effective, reducing by hundreds the number of mattresses needed.

In addition to saving the project nearly \$50 million, it meant fewer crane lifts, making the project safer.

"What we found was that many of the efforts to reduce cost also reduced our safety exposure offshore, decreasing the potential for people to get injured," says Mike Dupre, principal engineer for pipelines.

While the project team's focus was to reduce initial capital costs, another priority was to minimize costs over the life cycle of Appomattox and to reduce the environmental impact of powering operations offshore.

Onshore plants and refineries commonly use an ultra-efficient technology called combined cycle power generation, where the heat from a gas turbine exhaust is used to power a steam turbine-driven electric generator.



The Appomattox team would be the first to apply this approach in the Gulf of Mexico, allowing Appomattox to remain well below regulatory nitrogen oxide emission levels while reducing one of the biggest operating expenses: fuel.

## EMOTIONAL INTELLIGENCE

It was not all about innovation and processes. People under great pressure to deliver needed encouragement. It was important, for example, to find ways to support contract workers facing uncertain employment prospects.

As the project developed, the offshore industry continued to face a dearth of investment, and things remained gloomy. Large projects such as Appomattox provide essential jobs for many communities on the Gulf Coast. Dupre says that if Appomattox had not gone forward, "some companies might have gone under."

"So then the question is, how do you keep guys motivated to work quickly when they're going to be out of a job at the end?" says Mark Kite, Shell construction manager for Appomattox.

Contractors and the Shell team worked closely together to reduce costs and maintain efficiency while preserving jobs.

## UP AND RUNNING

Appomattox has recently celebrated "first oil" – the initial flow of oil from the reservoir beneath the ocean floor to undersea pipelines. Conscious of the project's scale – and of its financial risk – the Appomattox team ultimately reduced costs on the project by over 40% after it was approved for construction.

Marno de Jong believes Appomattox has set a new standard. "The success we had in the development of this project has provided a model for how we find cost savings while building efficiencies into offshore projects of the future," he says.

# MAERSK DRILLING TO LAUNCH FIRST HYBRID, LOW-EMISSION RIG



» Maersk Intrepid.  
Photo credit: Maersk Drilling

Combining hybrid power, data intelligence and cleaning technology, the Maersk Intrepid will push the boundaries for low-emission drilling on conventionally powered offshore rigs.

A new technological standard for low-emission drilling on the Norwegian Continental Shelf. This is Maersk Drilling's ambitious target for the ultra-harsh environment jack-up rig Maersk Intrepid which is entering a series of upgrades to convert it to a hybrid rig with low levels of NOx emissions, adding data intelligence to further reduce energy consumption and CO2 emissions. The upgrades are being carried out in cooperation with Maersk Intrepid's current customer, Equinor, which has introduced compensation formats to stimulate emission reductions.

"The Maersk Intrepid project is the result of asking a simple yet challenging question: What would be the most efficient technological approach to minimizing emissions from a rig in the short term? The resulting ideas have been very positively received by Equinor and will contribute to Equinor's long-term emission targets. It should be noted that the upgrades will not only produce a low-emission profile for

the rig; they will also result in cost savings for our customer due to lower energy consumption, so this is business and low-emission targets working hand in hand," says CCIO Morten Kelstrup of Maersk Drilling.

## A Benchmark To Build From

Maersk Drilling has successfully applied for project funding through the NOx Fund, a Norwegian industry fund dedicated to reducing NOx emissions. The fund is contributing a grant of up to 80% of project costs, subject to verification of the emission-reducing upgrades, and has high hopes for the coming upgrades of Maersk Intrepid which it sees as a benchmark for the offshore industry.

"The NOx Fund has requested these types of emission reduction projects for a long time, and finally they are being realized. Here Maersk Drilling takes the lead by showing that cost-efficient measures to significantly reduce NOx can be combined with reduced CO2 emissions and improved fuel efficiency. Hopefully we will see more of these and similar solutions on board rigs going forward," says Tommy Johnsen, General Manager of the NOx Fund.

The first upgrade of Maersk Intrepid will be the installation of batteries for the hybrid power solution which is expected to be completed in July this year. The full implementation of all low-emission upgrades is expected to be completed by the end of 2019, and Maersk Drilling will use the learnings from Maersk Intrepid to evaluate how to proceed with potential upgrades to reduce emissions from other Maersk Drilling rigs.

"We observe a strong drive from both authorities and the industry on energy efficiency and emissions. With this combined solution, Maersk Intrepid will provide important data and learnings to build from," says CCIO Morten Kelstrup of Maersk Drilling.

Maersk Intrepid is an ultra-harsh environment XLE jack-up rig which was built in 2014. It is currently contracted to Equinor for operational support on the Martin Linge field offshore Norway.

To learn more, visit

[WWW.MAERSKDRILLING.COM](http://WWW.MAERSKDRILLING.COM)

# WORLD'S LARGEST COMMERCIAL OCEAN CURRENT ENERGY PROJECT TO BE DEVELOPED OFF FLORIDA

OceanBased Perpetual Energy, LLC has signed a Memorandum of Understanding (MOU) with Florida Atlantic University's Southeast National Marine Renewable Energy Center (SNMREC) to assist the company to develop the world's largest commercial ocean current energy project.

The goal of the project, which plans to focus on an area off the southeast coast of Florida, will be the installation of hundreds of megawatts (MWs) of ocean current generating equipment. The equipment is planned to be installed below the sea surface, below the deepest drafts of any seagoing vessels, and connected to the U.S. transmission system.

The initial phase of OceanBased's project will focus on verifying compatibility between generation and subsea transmission equipment. Installation of up to 1MW of shore-connected capacity is expected to follow, reaching up to 20MW within as few as five years.

"Wind has long time been the star of the show when it comes to renewables, but we believe there is a vast untapped resource in our oceans to be the next great frontier of renewable energy. In fact, the U.S. Department of Energy estimated that the Gulf Stream can produce up to 45 terawatt hours per year of generation for Florida. That's as much as 2-3 of Florida's nuclear generation plants. The Gulf Stream's unique characteristics among renewables as a constant energy resource is what prompted

us to choose this location," said Nasser M.N. Alshemaimry, Chairman and CEO of OceanBased, a serial entrepreneur with decades of experience building companies in diverse sectors.

SNMREC is one of three centers designated by the U.S. Department of Energy to assist companies with the responsible development of marine renewables. Also designated as a State of Florida Center of Excellence, for nearly a decade FAU researchers have been tackling questions related to the success of marine renewables such as resource characterization, environmental interactions and technology gaps.

"This agreement helps to formalize our mutual interest in accelerating marine renewable commercial projects in the U.S.," said Gabriel Alsenas, director of SNMREC. "We especially like to see this type of commitment from private sector project developers as a sign that our efforts to stimulate new markets with our research efforts is paying off."

In 2019, OceanBased joined SNMREC's Preferred Partner Program, which provides the company with access to customized guidance for its project scoping and market development needs. SNMREC plans to provide OceanBased with technical, strategic, and regulatory support, vital to the project's success.



## MARYLAND'S CLEAN ENERGY JOBS ACT QUADRUPLES STATE'S OFFSHORE WIND COMMITMENT

On 22 May 2019, Maryland Governor Larry Hogan announced that he would let the state's Clean Energy Jobs Act, passed overwhelmingly by both houses of the legislature, become law. The governor made the announcement in a letter to Senate President Thomas V. "Mike" Miller, indicating he will allow *Senate Bill 516 — Clean Energy Jobs* to take effect without his signature, expressing concerns.

"Despite its name, this bill is not clean enough, nor smart enough, nor does it create the intended jobs within Maryland," wrote Governor Hogan,

CEJA increases the state's Renewable Portfolio Standard (RPS) from 25% to 50% by 2030 and mandates a total of 1,200 MW of new offshore wind solicitations beginning in 2020, effectively quadrupling the state's current offshore wind commitment.

After the legislature passed the bill, the Business Network for Offshore Wind, penned a joint letter to the Governor along with Network members Ørsted, US Wind and TradePoint Atlantic urging Maryland to act now, rather than delay the bill.

In a statement on his government website, Gov. Hogan called for an even more ambitious state goal of 100% clean energy by 2040. This proposed clean energy portfolio would include nuclear energy in addition to the more traditional renewable sources such as wind, solar and hydropower.

"At this time," says Liz Burdock of the Business Network for Offshore Wind, "it is unclear if or how Gov. Hogan's proposed 100% clean energy target might further grow the state's offshore wind market, but the Network will continue to track this issue for our members and educate the state's policymakers about the value of offshore wind."

## WINDSERVE MARINE AWARDED CREW TRANSFER VESSEL CONTRACT FROM ØRSTED

Ørsted, a global leader in offshore wind, and WindServe Marine, LLC, a premier offshore wind support services provider, have entered into a partnership to construct two purpose-built offshore Crew Transfer Vessels (CTVs), which will transport personnel for construction, maintenance, and operation from port to offshore wind farms.

The first CTV will be built by U.S. Workboats in Hubert, North Carolina and utilized for Ørsted's Coastal Virginia Offshore Wind Project, followed by subsequent service on Northeast projects. The second CTV will be built by WindServe's affiliate shipyard, Senesco Marine, in North Kingstown, Rhode Island, specifically for Ørsted's and Eversource's Revolution Wind project located off the southern New England coast.

The CTVs will be a high-speed, custom design from BMT Group, a leading international design, engineering, science and risk management consultancy, built specifically for East Coast sea conditions. BMT has extensive offshore wind experience and a large portfolio of offshore wind vessels, with 49 CTVs currently operating in Europe. This state-of-the-art design is one of the most comfortable and versatile in the industry. Classed by DNV-GL, a leading provider of risk management and quality assurance services, these CTVs will meet the highest of build standards needed in the offshore wind industry.

The first CTV is already under construction with delivery anticipated early next year. U.S. Workboats specializes in aluminum catamaran construction and has experience in full-service construction of high-speed ferries, pleasure boats, fishing vessels, research vessels and a variety of



other aluminum workboats. The shipyard's 160,000 square foot indoor fabrication building enables it to deliver multiple vessels a year with staggered build schedules.

Construction of the second CTV will commence in late 2020. Senesco Marine has been constructing state-of-the art vessels, including articulated tug and barge (ATB) units, escort tugs, deck barges and floating dry-docks for over 15 years, and its Quonset Point, Rhode Island facility employs hundreds of local skilled employees. The facility offers 220,000 square feet of indoor fabrication space, with a fully segregated aluminum manufacturing area. Ørsted's order of these new CTVs will help create and sustain in-state jobs for over 40 local tradespeople, engineers and managers.

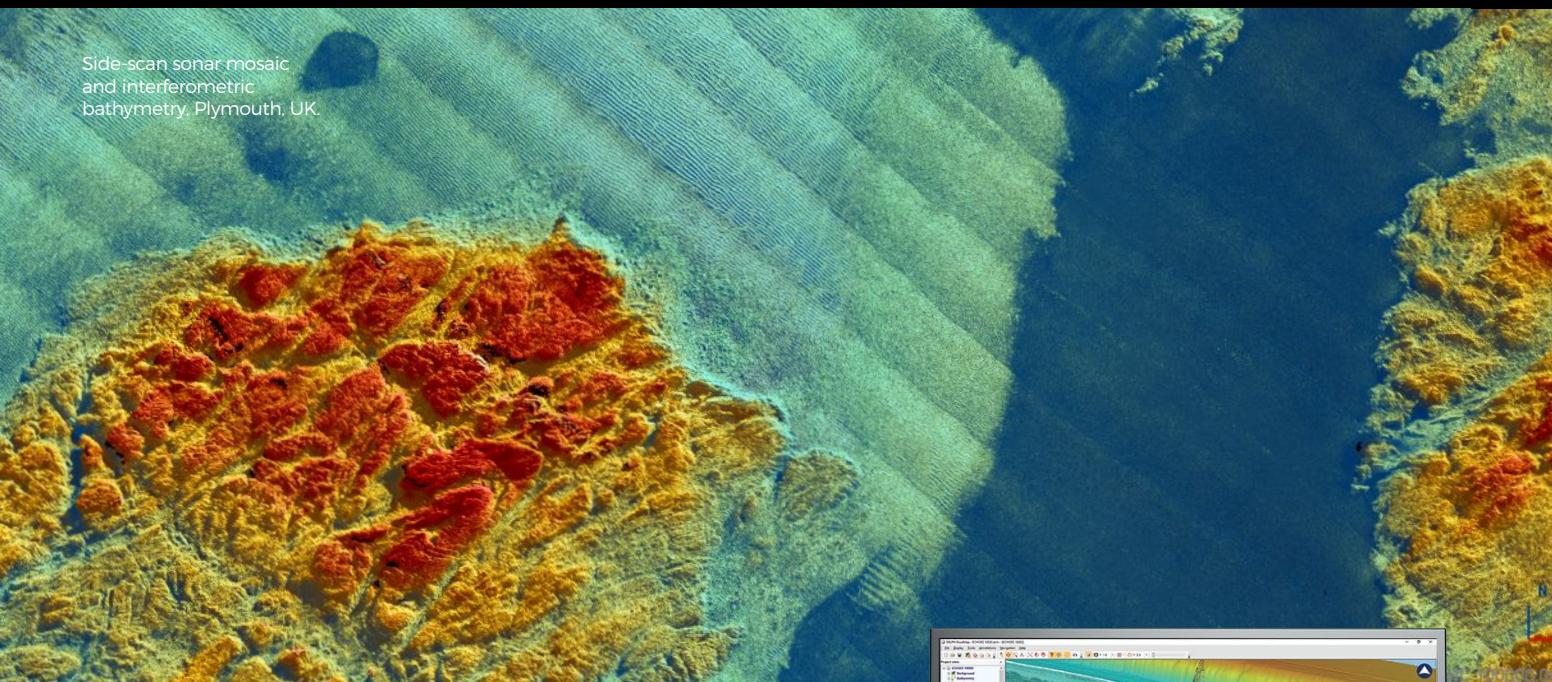
Ørsted is currently collaborating with Dominion Energy and is in the process of constructing the Coastal Virginia Offshore Wind project. Revolution Wind is a partnership between Ørsted and Eversource, New England's premier transmission builder, and is expected to be commissioned in 2023.



For more information visit:  
[WWW.WINDSERVEMARINE.COM](http://WWW.WINDSERVEMARINE.COM)

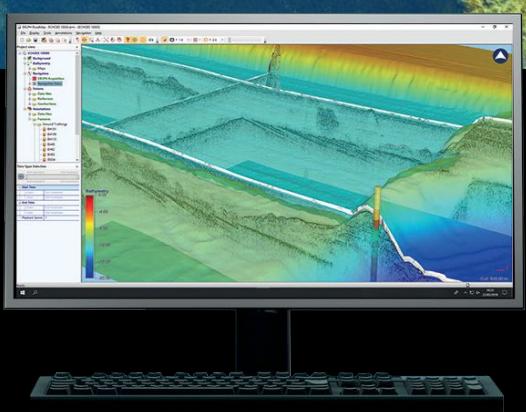
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## SHETLAND TIDAL ENERGY PROJECT COULD REDUCE OPERATIONAL COSTS BY 40 PERCENT



» Photo credit: Nova Innovation

The €20-million flagship EU tidal energy project, Enabling Future Arrays in Tidal (EnFAIT), has reduced the cost of tidal energy by 15 percent and grown its supply chain from four to 14 EU countries.

EnFAIT is an academic-industry collaboration between nine European partners focused on demonstrating the economic viability of tidal power. The project is also paving the way for a new industrial marine manufacturing sector with a supply chain based across Europe.

Consortium lead, Edinburgh-based Nova Innovation, reports that its Shetland tidal array—the world's first offshore tidal array—has reduced operational costs by 15 percent since the start of the project. By 2022, when the project closes, they forecast a cost reduction exceeding 40 percent, which could spark an explosion of interest in tidal power from global investors.

Further cost reductions will be driven by improvements in the design of Nova Innovation's underwater turbines,

learnings from the optimal arrangement of the turbines, and improved measurement and forecasting of tidal flows at prospective sites. Advances in forecasting, led by engineers from the Offshore Renewable Energy (ORE) Catapult, have contributed to the faster than expected cost reductions so far.

The array itself is now supplied with 100 percent EU-manufactured content, bringing the number of EU supplier countries up from four to 14. These suppliers are not limited to countries along the Atlantic shoreline (where Europe's tidal resource predominantly lies) but are drawn from across the European land mass.

The project is also bringing local economic benefits, with the array already powering homes and businesses across Shetland. There are more than 60 Scottish companies in the project supply chain, clearly demonstrating the economic case for local tidal energy production.

## NKT WINS HIGH-VOLTAGE CABLE PROJECT FOR 2 NORWEGIAN OFFSHORE PLATFORMS

Equinor has selected NKT as the turnkey supplier for the high-voltage cable project connecting the oil and gas platforms Gina Krog and Johan Sverdrup 2 in the North Sea. The order has a value of approx. EUR 29m in market prices (approx. EUR 25m in std. metal prices) and comprises supply and installation of 62 km of a 132 kV AC XLPE high-voltage power cable solution. Connecting the platforms allows Equinor to power Gina Krog from shore by leveraging the already planned power link connecting Johan Sverdrup 2 to the onshore power grid, currently under development by NKT.

"I am very pleased that we continue the close collaboration with Equinor to support their focus on reducing the environmental impact of the oil and gas production with power from shore cable connections. By connecting the two platforms we confirm our strong market position as a reliable turnkey provider of high-quality cable systems in the oil and gas segment supporting the growing industry focus on reducing its CO2 emissions. Here, we have a key differentiator in our ability to provide the most energy efficient offshore installation driven by the capabilities of our cable laying vessel NKT Victoria", says Andreas Berthou, NKT Executive Vice President and Head of HV Solutions.

NKT has extensive experience of providing power from shore solutions to the oil and gas industry and is currently executing on the power cable link connecting Johan Sverdrup 2 to shore.

Recently, the collaboration resulted in the successful completion of the power from shore connections for the platforms Johan Sverdrup 1 and Martin Linge. Combined, these connections will help save more than 800,000 tonnes CO2 annually when the platforms are fully in operation.

# PETROBRAS DISCUSSES PLANS FOR STEADY OFFSHORE PRODUCTION THROUGH 2019

During an earnings call from Petroleo Brasileiro SA Petrobras on 17 May 2019, Chief Exploration & Production Executive Officer, Carlos Alberto Pereira de Oliveira stated that in spite of lower production during the first quarter of FY2019, his company would meet its target oil production forecast for 2019 at 2.8 million barrels of oil equivalent per day, a figure he says the company met in May.

According to de Oliveira, lower production during the first quarter was mainly due to his company's divestment in the Roncador Field and the sale of 80% of their share in Petrobras America. He also mentioned delays on the commissioning of his company's new gas systems and maintenance stoppages, but assured listeners that Petrobras "can maintain our target oil production forecast, unchanged for the 2019."

He also noted that on May 2, Petrobras, "completed the ramp up of the P74 platform and this platform is now producing in its maximum capacity of 150,000 barrels of oil per day, with 4 wells on production."

He added, "We've an upward trend that the production is still -- production keeps growing."

Asked about whether experience gained on the P74 platform meant shorter ramp up times for new units, de Oliveira responded in the affirmative. He also said that "for the Campos Basin, not only we are working with Equinor in other companies in strategic partnerships in order to have more oil from those fields particularly in Roncador, but at the same time, we are working to have more oil from new wells that we are going to put in soon in the old platforms that we have there. At the same time, we are buying some territory areas, with a lot of sort of actions that we maintain a program Sustainability of the Campos Basin, our intention is to keep production in the next 2 years at the same level that we have today."

For future years, de Oliveira said that, "... we are keeping the same production levels that we announced when we made our business plan for the 2019 and 2023."

Concerning work in Sergipe deepwater plans, de Oliveira stated that "Because we are a deepwater company and we work on the pre-salt, we work on the Campos Basin . . . where we have almost 40% of our production. It's not pre-salt, but it's also very important for our production, and it's also important for the grooming of our production."

He also stated that they were buying some new areas to explore the Campos basin adding that, "... our perspective is to work in deepwaters, that's where we have the necessary capacity and the capabilities for salt. And also at the same time this is a new frontier area. We are going to do this. We have a partner there."

## MASSACHUSETTS UTILITIES ANNOUNCES SECOND 800MW OFFSHORE WIND SOLICITATION FOR 2019

One year after the successful 800MW solicitation won by Vineyard Wind, the State of Massachusetts administration and utilities are putting another 800MW offshore wind contract out to bid.

The state Department of Energy Resources (DOER) and electric distribution companies Eversource, National Grid and Utili have filed documents with Massachusetts regulators to initiate the second procurement, with the goal of executing a final contract by the end of 2019.

The timeframe for the next procurement, which is subject to Department of Public Utilities approval, calls for bids to be submitted in August, project selection in November and execution of a long-term contract by the end of 2019, enabling the venture that secures the contract to secure federal investment tax credits.

The link to the application is here:  
[https://macleanenergy.files.wordpress.com/2019/05/83c-ii-rfp\\_finalpackage.pdf](https://macleanenergy.files.wordpress.com/2019/05/83c-ii-rfp_finalpackage.pdf)

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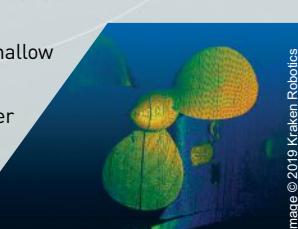


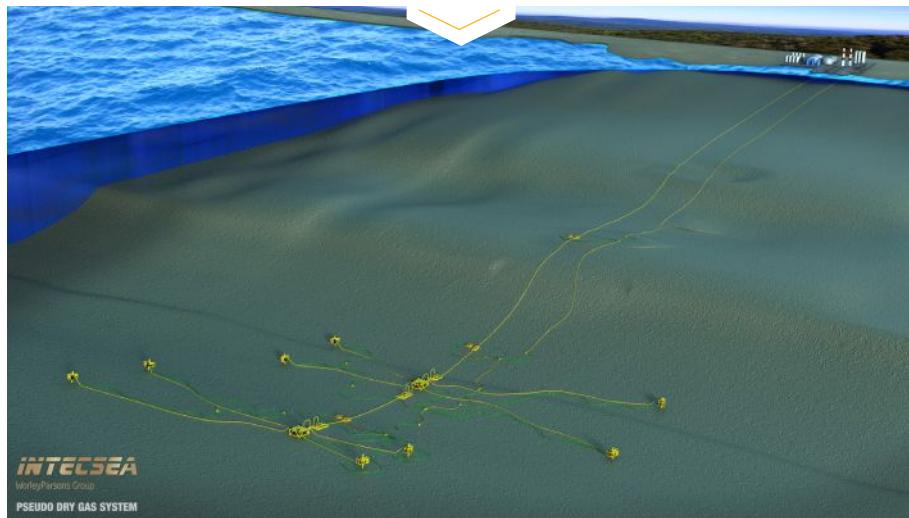
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# PSEUDO DRY GAS LIQUID REMOVAL TECHNOLOGY PROTOTYPED



Worley's INTECSEA consultancy has partnered with the Oil & Gas Technology Centre (OGTC) to fund prototype testing of its Pseudo Dry Gas (PDG) liquid removal system.

This innovative new technology has been developed to make long distance subsea tiebacks, which are not typically economic or technically feasible, commercially viable. By reducing back pressure in the pipeline, the technology eliminates the need for topsides and costly compression, reducing the associated high carbon emissions. This allows for much greater tie-back distances.

The prototype testing is based on a strong techno-economic concept study, also funded through the OGTC and was recently completed in March 2019. The study has already demonstrated the system's unparalleled recovery levels, providing an additional US\$10 billion in revenue over the alternatives – resulting in the strongest economic performance for a known stranded gas basin, North of the Shetland Islands. The study also demonstrated that upstream CO<sub>2</sub> emissions were reduced by 65-80%, significantly reducing the

environmental footprint.

An additional application for PDG that was studied as part of the original OGTC scope was gas disposal for small oil pool developments. This also provides a stand-alone economic case with significant follow through benefits for 'normally unmanned' facilities, due to the removal of high maintenance topside gas processing equipment.

The results of both these studies have driven the technology development forward with wider industry support, including a six-inch scaled prototype of the liquid removal unit, which will be tested over a six-month period at Cranfield University's flow loop facilities. It will simulate the expected flow conditions typically found within a gas / gas condensate subsea tie back system to demonstrate the liquid removal efficiencies and provide confidence in the macro flow assurance.

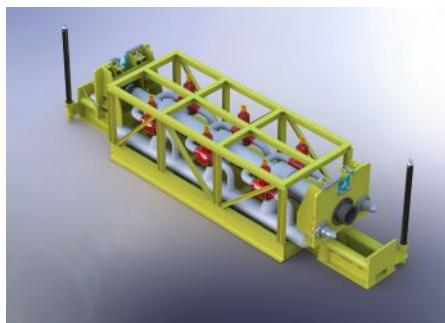
Lee Thomas, INTECSEA's Engineering Lead for PDG technology, anticipates that the prototype testing will raise the technology readiness level to the point where a pilot

project can be considered viable via a program of enhanced factory acceptance testing for an integrated unit.

Commenting on the project, he said, "The solution is elegantly simple; it uses multiple passive liquid removal units and a liquid disposal pipeline connected to proven standardized pumps. I am delighted that the OGTC's funding will allow us to move from computer-based simulations, through to physical testing, with a diverse range of Operators and Tier 1 contractors, demonstrating industry collaboration at its best."

Graeme Rogerson, Marginal Developments Project Manager for the OGTC, added, "There are over 360 marginal developments in the UK Continental Shelf, with approximately 3-50 million barrels of untapped oil and gas. Technology development is key to unlocking this potential and why we are excited to support Worley's INTECSEA in developing its Pseudo Dry Gas system, improving reserves recovery while reducing the industry's carbon footprint."

The search now begins for an operator willing to undertake a pilot project of an integrated unit. An ideal pilot would be maintaining gas production from an existing tieback post water breakthrough in a mono ethylene glycol (MEG) constrained environment. This would create a significant value impact, with a minimal downside.



[WWW.INTECSEA.COM](http://WWW.INTECSEA.COM)

## LATEST AUTOSUB LONG RANGE COMPLETES SEA TRIALS

The latest Autosub Long Range (ALR) vehicle being developed by the National Oceanography Centre (NOC) has successfully completed its first live trials in the waters of Portland Harbor in Dorset, England

The new autonomous underwater vehicle (AUV), ALR1500 – named for the 1500m depth it can achieve – passed its first major test in Portland Harbor in late March with flying colors, successfully demonstrating its integration with the unified Command and Control (C2) software platform that has been developed in parallel by the NOC in partnership with the Scottish Association for Marine Science, under the Oceanids program. These trials have shown that the vehicle's hardware and software systems are communicating effectively with each other, which provides a solid platform as ever more advanced features are added.

LR1500 is one of three vehicles that will further enhance the advanced marine observing capabilities available to the UK science community. Compared to the current 6000m depth-rated models, ALR1500 has been designed to have greater endurance and payload capacity, a knock-on benefit from the reduced requirement for the heavy and bulky pressure vessels that are needed for operating at extreme depths. Optimized for

surveying the continental shelf and upper slope, ALR1500 will have the potential for long endurance missions covering hundreds to thousands of kilometers over periods of several weeks to months. This opens up exciting new possibilities, such as a full trans-Arctic under-ice mission, that will also require innovative navigational solutions.

The harbor acceptance trial wasn't just of interest to engineers and scientists. The serious business of testing innovative ocean robots was irresistible for one keen observer – a bottlenose dolphin paid a visit and appeared curious about this new addition to the harbor's waters.

Further trials scheduled to take place in Loch Ness in the coming months will test the vehicle's enhanced functionality, including Terrain Aided Navigation and environmental profiling capabilities.

The ALR family of marine autonomous vehicles has become famous around the globe, not only for their ability to gather marine data from some of the most hostile locations on the planet (including deep ocean and under ice), but also as a result of the popularity of 'Boaty McBoatface,' the name given to a previous iteration of the small yellow robot submarine following a public vote in 2016.

[WWW.NOC.AC.UK](http://WWW.NOC.AC.UK)

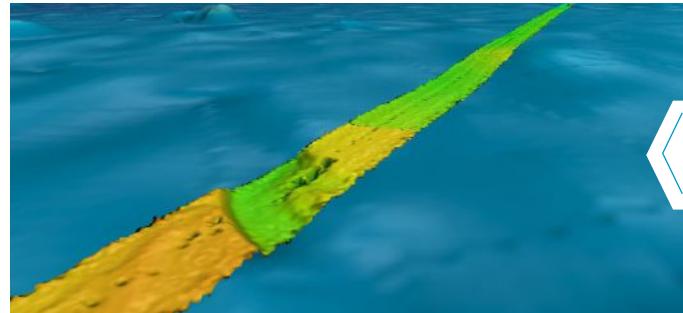
## FUGRO SUPPORTS SEABED 2030 WITH HIGH-RESOLUTION BATHYMETRY CONTRIBUTION

Fugro recently contributed more than 110,000 square km of high-resolution bathymetry data in the North Atlantic Ocean to help improve the quality and coverage of seabed mapping in the region. The dataset, which covers an area the size of Iceland, was delivered to two complementary programs: the Atlantic Ocean Research Alliance (AORA) and The Nippon Foundation-GEBCO Seabed 2030 Project (Seabed 2030).

AORA was formed under the 2013 Galway Statement on Atlantic Ocean Cooperation between the European Union, the United States of America, and Canada. With a goal of improving knowledge about the Atlantic Ocean to support a prosperous and sustainable blue economy, AORA has identified seabed mapping as a priority area of collaboration.

Seabed 2030 is a global initiative between Japan's Nippon Foundation and the General Bathymetric Chart of the Oceans (GEBCO) to produce a definitive, high-resolution bathymetric map of the entire world's ocean floor by 2030. Currently, less than 20 percent of the oceans are mapped to modern survey standards.

Fugro's approach to crowd sourced bathymetry was developed in 2017 and involves in-transit data collection from multibeam-equipped survey vessels. The company currently deploys the capability from seven ships and ultimately plans to expand the offering across its entire global survey fleet. The most



recent datasets were acquired from the Fugro Discovery while transiting between Scotland and the United States, and from the Fugro Searcher while travelling between Brazil and Canada. Fugro's overall data contributions in the North Atlantic now total approximately 278,000 square km, bringing its global contributions to approximately 450,000 square km. Contributions are expected to increase annually as additional vessels are added to the program.

In disseminating the crowd sourced bathymetry to AORA and the Nippon Foundation-GEBCO Seabed 2030 Project, Fugro coordinates with the International Hydrographic Office's Data Center for Digital Bathymetry within NOAA's National Center for Environmental Information (NCEI). Fugro maintains a long and successful working relationship with NOAA, and earlier this year teamed with NCEI to develop a workflow for integrating third party datasets into the Seabed 2030 project database.

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# FIRST 3D SEISMIC SURVEY OFFSHORE LABRADOR WILL PROVIDE PROSPECT DATA

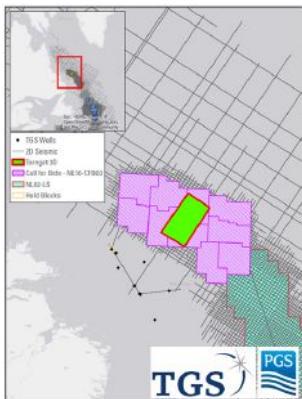
TGS and PGS have announced Torngat 3D offshore East Canada. Torngat 3D will cover approximately 3,287 km<sup>2</sup> and encompasses sections of the open acreage included in the Labrador South November 2021 bid round. PGS' Ramform Titan will perform the acquisition, utilizing Geostreamer® technology. The project is expected to commence in late July 2019.

The Torngat 3D survey sits within Labrador Sea's southern sedimentary basins where frontier exploration has already successfully identified hydrocarbons, such as in the nearby Hopedale and Snorri discoveries. Torngat 3D will be the first 3D seismic survey to be acquired offshore Labrador.

Following this ninth consecutive season of data acquisition in offshore East Canada, the jointly-owned library will have more than 189,000 km of 2D GeoStreamer data and approximately 52,000 km<sup>2</sup> of 3D GeoStreamer data. An expansive well log library is also available in the region, along with advanced multi-client interpretation products that will improve play, trend and prospect delineation.

"The successful joint venture between TGS and PGS has consistently provided the industry with the highest quality data in advance of scheduled licensing rounds. The Torngat 3D survey will be instrumental in assessing several amplitude variations (AVO) supported leads that were initially evaluated with our comprehensive 2D library in this region. Our combined seismic, well log and interpretation datasets provide the industry with invaluable subsurface insight. This is critical to help identify potential source rocks, structural and stratigraphic traps and reservoirs, allowing our clients to de-risk their exploration activities and prepare them for upcoming licensing rounds," said Kristian Johansen, CEO, TGS.

This project is supported by industry funding.



For more information visit:

[WWW.TGS.COM](http://WWW.TGS.COM)  
[WWW.PGS.COM](http://WWW.PGS.COM)



» Left to Right: Roger Wiik (Project Manager); Thomas Skattum (Business Development Manager); Andy Clark (Exploration Operations Manager LUNDIN); Carl Bentzroed (Business Line Manager Seabed Survey)

## iSURVEY WINS LUNDIN NORWAY CONTRACT

iSURVEY, a leading provider of survey and positioning services to the global oil and gas, offshore renewables and telecommunications markets, has signed one of its most significant contracts to date.

The work scope will see the Norwegian-headquartered surveying company undertake a campaign of drilling hazard surveys in the North Sea and in the Barents Sea, on behalf of Lundin Norway.

Work commences in June, with a seabed geological survey and continues with the series of drilling hazard surveys, which are planned to continue into the autumn.

The contract is a result of longstanding collaboration between the two companies, together with iSURVEY's expertise in applying new technology in combination with the charter of modern vessels with low energy consumption and NOx emissions.

Øivind Røegh, CEO of the iSURVEY Group said: "We are very proud to be awarded this contract. It is a clear demonstration of our commitment to make the iSURVEY group a provider of the full spectrum of offshore survey and positioning services."

For more information visit:  
[WWW.ISURVEY-GROUP.COM](http://WWW.ISURVEY-GROUP.COM)





## Valeport Marks 50th Anniversary with New Environmental Range of Optical Sensors

Valeport, British manufacturer of oceanographic and hydrographic instrumentation, has come a long way since its humble beginnings in Dartmouth, Devon, UK in 1969. Its first product, a Braystoke Flow Meter, was an impeller-type device used in the feasibility study for the Thames Barrier project in London. Today, the firm designs and manufactures for a worldwide customer base that includes the environmental, military, oil & gas, renewable, construction, dredging, civil engineering and scientific research sectors.

Now, as they celebrate five decades of excellence, Valeport has launched a new Environmental range of optical sensors, which are not just innovative and reliable—they are a key milestone in Valeport's anniversary year.

**Hyperion Turbidity** - is the industry's first standalone turbidity sensor with such a small footprint to combine Nephelometer and OBS readings in the same instrument. Created for inshore, coastal and oceanographic monitoring, this new sensor delivers a minimum detection level of just 0.03 NTU (nephelometer) and can measure turbidity up to 6,000 NTU (OBS). The titanium housing, data output up to 16Hz and low power requirements ensures this sensor can be placed in situ for extended periods with easy access to highly accurate data.



» Hyperion Turbidity

**SWiFTplus Fluorometer**, designed by Valeport's in-house specialists, is a unique new range of probes that combine the power of the SWiFT technology and a fluorometer for the high performance measurement of Chlorophyll a, Fluorescein, Rhodamine or Phycocyanin. Compact and robust, the suite of instruments are ideal for shallow water bathymetric and environmental survey, where observations can be monitored and recorded for surveys for up to 3 days continuous operation. These savvy sensors combine all that's needed to carry out survey grade Sound Velocity, Salinity, Density, CTD and optical profiles up to 200 meters, in a single instrument.



» SWiFTplus Fluorometer

Looking ahead, Valeport will continue to invest significantly in Research & Development to create innovative, high quality, high performance products to provide a diverse and reliable global offering. These growth plans, rooted in the company's basic principles - leading edge technology, lifetime product care approach and the ethos of a family business with a strong commitment to putting the customer first – will help Valeport remain one of the foremost global instrument manufacturers, leading the market for many years to come.

# AFRICAN LEADERS DISCUSS DEVELOPMENT OF DEEP SEABED MINERAL RESOURCES

High-level representatives from African States, international organizations and experts on law of the sea, policy, mining, environment protection and geology convened at a regional workshop from 16 to 18 May 2019, organized in Pretoria by the International Seabed Authority (ISA), in partnership with the Government of the Republic of South Africa and the Norwegian Agency for Development Cooperation (Norad).

It is the second workshop to be held to implement the Voluntary Commitment registered by ISA and the African Minerals Development Centre of the Africa Union at the 2017 UN Ocean Conference (#OceanAction16374), designed to foster international and regional cooperation to promote the sustainable development of Africa's Deep Seabed resources in support of Africa's Blue Economy (ADSR Project).

In recent years, the wealth of natural resources, including living and non-living marine resources that are to be found in the oceans and seas surrounding the African Continent, has



generated growing interest. In this context, the potential benefits that could be derived from the sustainable development of deep seabed resources located on the continental shelves and in the international seabed area could be a key driver for the development of Africa's Blue Economy. This strategic linkage is clearly established by the African Union in its 2050 Africa's Integrated Maritime Strategy and Agenda 2063.

Under the ADSR Project, five workshops will be held across the African continent between 2019-2020, one in each African sub-region.

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## CGG STARTS OCEAN BOTTOM NODE SURVEY IN MISSISSIPPI CANYON

CGG is commencing its first multi-client ocean bottom node (OBN) survey, taking their offshore data library to the next level of excellence. Located in the north-central region of the Gulf of Mexico, this dense OBN survey will provide well-sampled, full azimuthal coverage with long offsets, to deliver exceptional data for imaging the geologically complex structures in Mississippi Canyon.

Acquisition services are being provided by Seabed Geosolutions and the data will be processed by CGG Geoscience's Subsurface Imaging in Houston. Implementation of CGG's most advanced OBN processing techniques will provide a fine-tuned velocity model and improved definition of drilling targets. Preliminary products will be available in Q3 2019, and final products are expected in Q1, 2020.

Supported by industry prefunding, CGG's Mississippi Canyon Node survey paves the way for further CGG multi-client OBN surveys in the future.

Sophie Zurquiyah, CEO, CGG, said: "We are pleased to initiate our first multi-client OBN survey, in this strongly growing market, as clients take advantage of the enhanced geologic understandings that OBN data and advanced imaging can deliver."

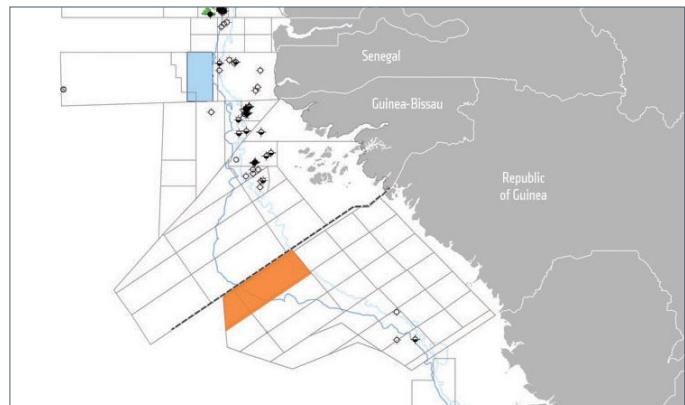
[WWW.CGG.COM](http://WWW.CGG.COM)

# PGS COMPLETES THE GUINEA MC3D SURVEY

PGS' latest MultiClient 3D GeoStreamer acquisition covering blocks A4 and A5 of the Republic of Guinea was completed on 8 May 2019. Fast-track processing is ongoing. The Guinea MC3D survey is PGS' first MultiClient project in collaboration with the Republic of Guinea and marks the start of a series of planned acquisitions. The Ramform Titan-Class seismic survey vessel commenced operations in mid-February and acquired 3D seismic data for 84 successive days.

The competent and well-managed PGS crews delivered excellent HSEQ performance, in line with our corporate commitment. The speed of operation, together with a highly effective seismic spread, reduced overall survey duration, maximizing efficiency and minimizing environmental impact. Online barnacle scraping lessened noise and improved data quality while reducing exposure to HSE risks. Evaluation of the acquired separated-wavefield data (P-UP) confirms the high standards achieved.

PGS brings GeoStreamer technology with a true broadband imaging solution to the Republic of Guinea. Broader bandwidth and rich low-frequency content provide clearer reservoir details in all play types, with reduced sidelobe artifacts.



The project includes the acquisition and processing of seismic, gravity and magnetic data over open acreages. Commercial, strategic and technical benefits are available now to early participants in the survey.

The fast-track product will be available within the next few weeks.

View the survey details in the data-library at [www.pgs.com/data-library/africa/africa2/north-west-africa/mc3d-republic-of-guinea/](http://www.pgs.com/data-library/africa/africa2/north-west-africa/mc3d-republic-of-guinea/).

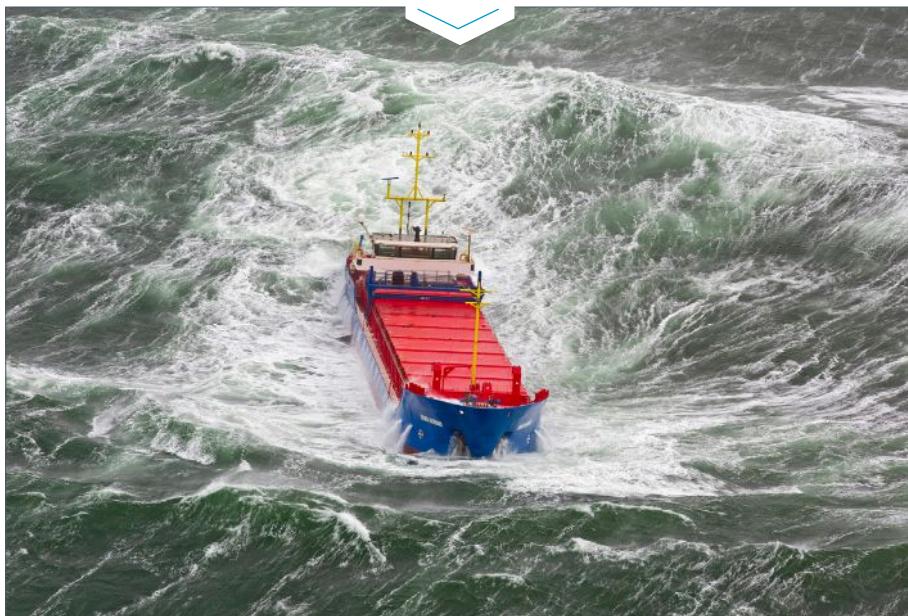
An advertisement for OKEANUS Science &amp; Technology. The central focus is a large blue hydraulic lifting arm system labeled 'KEANUS'. Surrounding it are four pieces of oceanographic equipment: a yellow surface buoy labeled 'SB-216S', a green and yellow Klein System 3500 multi-beam sonar, a white and yellow towfish, and a yellow and black multi-beam transducer. Below the equipment is the OKEANUS logo, which features a stylized blue fish icon and the text 'OKEANUS SCIENCE &amp; TECHNOLOGY'.

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## RADIO HOLLAND PROVIDES SERVICES TO EEMSWERKEN



» *The Eems Servant, a general cargo vessel.*

Dutch shipping company Eemswerken (Werkendam) has finalized service contracts with Radio Holland Netherlands for their entire fleet of cargo vessels. The service contracts include the SOLAS annual surveys, special regional service rates and on-demand services of the Navigation and Communication equipment on board, around the world.

Radio Holland has partnered with Eemswerken for many years, providing NavCom service support to their vessels. The contracts confirm the continuation and extension of this longstanding relationship. Radio Holland ensures the regulation related annual GMDSS, SSAS and BNWAS surveys, as well as the required SBM certificate. This is an important part of the service contracts for Eemswerken, to guarantee a flawless operation of the equipment on board, while complying with regulations.

Radio Holland will do a complete health check of the Nav/Com equipment on board, including detailed reporting on the actual status and performance of the NavCom equipment. In view of the global operations of Eemswerken, they were particularly interested in the worldwide service network of Radio Holland. Through the network, qualified & certified technicians can provide on-the-spot and quick support to their vessels along major shipping routes.

The contracts include a dedicated point of contact within the RH service coordination team, detailed annual management & operational reporting and proactive alerts on expiry dates of all GMDSS related equipment and certificates. Radio Holland will also be the preferred partner for spare parts, equipment, refits and newbuild projects.



[WWW.RADIOHOLLAND.COM](http://WWW.RADIOHOLLAND.COM)

# INMARSAT PARTNERS WITH AIRBUS TO TRANSFORM FLEET XPRESS NETWORK

Inmarsat has announced that Airbus Defence & Space (Airbus) has been selected as its satellite manufacturing partner as part of a development of its Global Xpress (GX) network that sustains Fleet Xpress maritime broadband connectivity. The partnership will provide a step-change in GX's capabilities, capacity and agility for the benefit of existing and future Inmarsat customers, partners and investors.

The new geostationary satellites will provide the platform for a transformational upgrade in Fleet Xpress, whose combination of Ka-band plus continuous L-band back-up connectivity is already installed on close to 7,000 ships worldwide helping enable digitalization at sea.

Inmarsat's GX network was first designed in 2010 and began global services in 2015. This created the world's first and only seamless global mobile broadband network. Inmarsat has since grown GX revenues strongly and established leading positions in the emerging global Maritime through Fleet Xpress, Aviation and Government mobile satellite broadband markets, with GX revenues

increasing by 85% to \$250.9m in 2018. GX is the most successful network for global mobility.

As part of this growth, Fleet Xpress was brought to market in March 2016, with a quartet of fifth generation GX satellites now providing its maritime broadband component via Ka-band, seamlessly backed up by continuous L-band connectivity using Inmarsat's I-4 satellites. Last year, market analyst Euroconsult indicated that Fleet Xpress is the fastest growing VSAT provider to the maritime industry.

The contract with Airbus is for the manufacture of three next-generation GX satellites (GX7, 8 & 9), with the first scheduled to launch in H1 2023.



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## MARLINK INTRODUCING SEALINK GLOBAL 4G

Marlink introduced an all-encompassing new hybrid communication service at Nor-Shipping 2019 held in early June 2019 in Oslo, Norway. Called Sealink Global 4G, as a turnkey solution it provides everything needed to leverage fast, low-latency mobile services when in network range while complementing VSAT connectivity when in regulated regions.

Devised as a single global capability with full predictability on performance and costs, Sealink Global 4G is a ready-to-go solution bringing a new dimension of low-latency and flexible connectivity to Marlink's global multi-band maritime network. The subscription is part of Marlink's suite of 4G Services that also allows ships to use alternative carriers such as Wi-Fi and mobile virtual networks.

The Sealink Global 4G service package is based on an onboard connectivity kit with options including Wi-Fi antenna, a Global 4G subscription and a subscription to Tampnet; the blistering fast, high-capacity offshore communication network for vessels operating in the North Sea or the Gulf of Mexico.

With intelligent routing, Sealink Global 4G automatically switches to the best available connectivity source, but also enables customers to apply their own preferences and connect to 4G when VSAT is also available. The solution deploys the latest-generation terrestrial internet service in coastal regions, enabling swifter and cost-effective connectivity in near-shore areas, and comes with the reassurance of round-the-clock support from Marlink's expert engineers, who can remotely access on board equipment even if VSAT is unavailable.

"Sealink Global 4G's low-latency, high throughput connectivity is a cost-effective back-up solution and complement to our global multi-band Sealink VSAT services," says Tore Morten Olsen, President Maritime, Marlink. "Crucially, it provides always-on connectivity even in areas where satellite communications are restricted."

[WWW.MARLINK.COM](http://WWW.MARLINK.COM)

## INTELLIAN INTRODUCES THE ALL NEW 1 METER GLOBAL XPRESS TERMINAL, GX100NX

Intellian, a global leader of mobile satellite communication antenna systems, unveiled an all new 1m Global Xpress terminal, GX100NX at the Intellian Asia-Pacific Partner Event held in May in Seoul, Korea.

The Intellian GX100NX offers high-speed data and global operation, and efficient RF design for unrivalled link performance on the Fleet Xpress service. It is also future-proof, with support for 2.5GHz Wideband Ka networks and optimized reflector and radome. GX100NX users can also unlock even higher levels of bandwidth with a 10W BUC option, which requires no additional components.

Based on Intellian's new NX technology platform, the GX100NX uses a single coaxial cable, which combines Tx, Rx, and DC power, to simplify installation. Its cutting-edge modular design results in lower cost of ownership throughout the entire lifecycle, while improving reliability and streamlining maintenance.

The GX100NX introduces a new 'All-in-One' GX Below Deck Terminal (BDT) which integrates an antenna control unit (ACU), a modem, a power supply, a 4-port switch and a mediator in a single unit to further reduce the time and cost of installation in Intellian's Fleet Xpress Rack.

Intellian also provides an upgraded antenna management and control platform. The new AptusNX software includes an installation wizard with a step-by-step commissioning guide for easier setup and enhanced diagnostic capabilities, which sends an alert to the operator when predictive maintenance is required.

The GX100NX will be commercially available at the end of June.



» The Intellian GX100NX

[WWW.INTELLIANTECH.COM](http://WWW.INTELLIANTECH.COM)

# nCENTRIC 5G READY IN BELGIAN NORTH SEA

On 15 May 2019, nCentric finalized the installation of the second 5G pLTE station in the North Sea, for which it obtained a license in 2015 in cooperation with sister company Citymesh.

Through its partnership with Nokia, providing state of the art equipment, nCentric states that all Belgian (and part of the Netherlands) offshore wind farms are covered with 5G pLTE, from Norther to Mermaid.

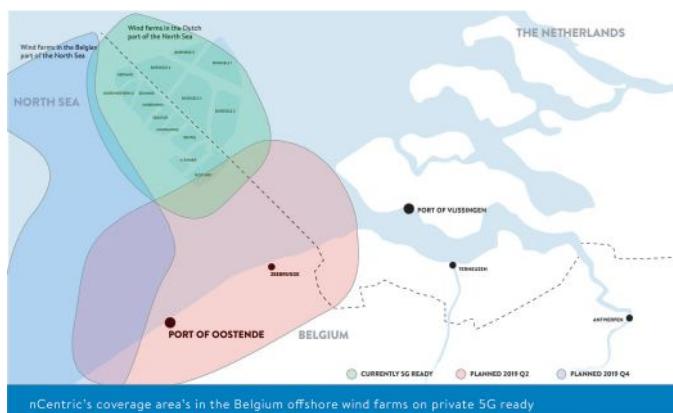
A coverage area of about 20km radius per unit and speeds onboard vessels up to 80Mbps are no longer exceptions. nCentric says that this is a new record when it comes to offshore wireless communications.

Several nCentric customers making use of this solution, MHI Vestas among others, confirmed this is the way forward for offshore operations where there is a need for high bandwidth, low latency internet connectivity.

"This customers' specific interest is big data as well as IOT-applications and today we can confirm what we already knew, the 5GpLTE system together with the own developed MESH network provides a stable, powerful high speed and redundant link to

shore," Marc Vereecken, Sales manager at nCentric Europe said.

After this successful installation, the next steps are 2 onshore units, first at the port of Zeebrugge, followed by the port of Ostend, providing internet access from the harbor towards the wind farms and decreasing communications costs (compared to 3G and VSAT).



[WWW.NCENTRIC..COM](http://WWW.NCENTRIC..COM)

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# RE2 ROBOTICS RECEIVES \$3 MILLION IN FUNDING TO DEVELOP DEXTEROUS UNDERWATER ROBOTIC HAND FOR U.S. NAVY



RE2 Robotics, a leading developer of humanlike robotic manipulator arms, has received \$3 million in funding from the Office of Naval Research to develop a dexterous, underwater robotic hand with tactile feedback. The program, called Strong Tactile mARitime hand for Feeling, Inspecting, Sensing and Handing (STARFISH), will create an advanced end-effector for mine countermeasures (MCM) and explosive ordnance disposal (EOD) missions for U.S. Naval expeditionary forces.

Using next-generation tactile sensing technology and a multi-finger, electromechanical design, STARFISH will allow operators to locate, identify and neutralize hidden and visible explosive threats on land and underwater. STARFISH-enabled manipulators will be deployed on both ground-base and

underwater robotic system to defeat explosive threats.

"The development of STARFISH takes underwater robotic technology to the next level by providing operators with the ability to 'feel' and sense the environment around them while remaining at a safe distance," said Jorgen Pedersen, president and CEO of RE2 Robotics. "The use of advanced tactile sensing and intelligent grasping will improve operational performance by removing operators from dangerous areas and allowing them to quickly and accurately respond to explosive threats."

RE2 will work with researchers at UCLA and the University of Washington to develop the hand, which will use state-of-the-art tactile skin and sensorized fingertips that are capable of sensing

normal and shear forces. Operators will command the hand using information provided by external sensing, such as cameras, sonar or LIDAR, which will then be processed with machine-learning algorithms to assist the operator in manipulating the object.

"Tactile sensing at the end effector can provide a wealth of information about the environment to a robotic system and its operator," said Dr. Andrew Mor, RE2 principal investigator. "Using a rich network of sensing, machine learning and assisted manipulation, STARFISH will be able to perceive and then share its interpretation of the environment with the operator, allowing Naval expeditionary forces to manipulate and control the robot at human speed."

For more information, visit [www.resquared.com](http://www.resquared.com).

# U.S. 2ND FLEET DECLares INITIAL OPERATIONAL CAPABILITY

U.S. 2nd Fleet declared the command has achieved initial operational capability (IOC) May 29, less than one year after being established by senior military leaders.

Vice Adm. Andrew "Woody" Lewis, commander, U.S. 2nd Fleet, made the announcement onboard Naval Station Norfolk, Virginia, the waterfront homeport of many 2nd Fleet maritime assets.

"The North Atlantic has some of the world's busiest shipping lanes, and with the opening of waterways in the Arctic, this traffic will only grow," Lewis said. "This is a fact acknowledged by both our allies and competitors, and as such, it is critically important U.S. 2nd Fleet reinvigorates the way our forces are employed in this influential theater."

In achieving IOC, the command has reached the capability to command and control forces assigned, as is expected of

a numbered fleet, utilizing the functions and processes of the Maritime Operations Center and Maritime Headquarters.

By focusing on the high-end training and employment of assigned assets, the new 2nd Fleet will be postured to support the employment of forces, whether that is on the Western side of the Atlantic, the Eastern side of the Atlantic, or up into the Arctic.

A few days after achieving IOC, the new Fleet will lead Exercise Baltic Operations (BALTOPS), marking the first time the Fleet will operate in the European theater, and leveraging increased lethality, interoperability and integrated warfighting capability with allies and partners in the region.

"BALTOPS 2019 is our collective opportunity to promote peace and security through cooperation, collaboration, interoperability,



» Vice Adm. Andrew Lewis, commander of U.S. 2nd Fleet, aboard the guided-missile cruiser USS Normandy (CG 60) in September 2018. Photo credit: Mass Communication Specialist 3rd Class Michael Chen, U.S. Navy.

and an unambiguous display of strength in the Baltic region," Lewis said. "As an alliance, increasing our capabilities across all-domains as well as building a command-wide network will give us the ability to deter aggression and project stability."

U.S. 2nd Fleet exercises operational and administrative authorities over assigned ships, aircraft and landing forces on the East Coast and the North Atlantic. Additionally, it plans and conducts maritime, joint and combined operations as well as trains and recommends certification of combat ready naval forces for maritime employment and operations around the globe.

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## PIRACY AMONG TOPICS AT CONFERENCE HOSTED BY GHANAIAN NAVY



A 2018 report by the International Maritime Bureau, issued about piracy and armed robbery against ships revealed that total of 201 incidents were reported in 2018. The report stated some other alarming figures, as the violence against crew from January till December 2018, varied between 141 incidents of crew taken hostage, 83 kidnapped, 9 threatened, 8 injured, and 2 killed.

Therefore, the Ghanaian Navy will host over 10 Chiefs of Navies from across Africa along with 250 international senior officials from Navies, Coast Guards and Marine Police at the International Maritime Defence Exhibition & Conference (IMDEC), taking place on 24-25 July 2019 in Accra, to discuss and address how to secure the increasingly volatile marine and coastal waters in Africa as well as stabilizing economic advancement and security on the crucial Gulf of Guinea. Ghana's Vice President Dr. Mahamudu Bawumia and The Chief of Naval Staff Rear Admiral Seth Amoama will inaugurate the event.

The latest Chiefs of Naval Staff to confirm their attendance as guests

and speakers at International Maritime Defence Exhibition & Conference (IMDEC) are Vice Admiral Ibok Ete Ibas, Chief of Naval Staff, Nigeria Navy, Rear Admiral Koi Alexis Maomou, Chief of Staff, Guinea Navy, Rear Admiral Momar Diagne, Chief of Naval Staff, Senegal Navy, Captain Kossi Mayo, Chief of Staff, Togo Navy.

Commenting on organizing IMDEC, Rear Admiral Seth Amoama, Chief of Naval Staff, Ghana Navy said, "At the conference we will explore modern technical innovations that will aid in curbing the illegal unregulated, unreported fishing dominating our maritime domain."

The latest report released by Ocean Beyond Piracy (OBP) showed that the economic cost of piracy to West Africa has been on the increase in the last three years, reaching over \$818.1 million in 2017, while about \$213.7 million was spent to contract maritime security personnel protecting vessels in the region. It revealed that regional spending on law enforcement and naval patrols increased by \$13.2 million in the year.

## BOLLINGER DELIVERS USCGC WILLIAM HART TO THE U.S. COAST GUARD

Bollinger Shipyards has delivered the USCGC WILLIAM HART, the 34th Fast Response Cutter (FRC) to the U.S. Coast Guard. The Coast Guard took delivery on the 23 May, 2019 in Key West, Florida.

The vessel's commissioning is scheduled for September 2019. FRCs already in commission have protected our country by seizing multiple tons of narcotics, interdicted thousands of illegal aliens and saved hundreds of lives. The FRC program is a model program for government acquisition and has surpassed all historical quality benchmarks for vessels of this type and complexity. The results are the delivery of truly extraordinary Coast Guard cutters that will serve our Nation for decades to come. We are extremely proud that the Fast Response Cutters built by Louisiana craftsmen here at Bollinger Shipyards are having such a major impact on our country's safety and security."

The 154-foot Sentinel-class Fast Response Cutter has a flank speed over 28 knots, state of the art command, control, communications and computer technology, and a stern launch system for the vessel's 26-foot cutter boat. The FRC has been described as an operational "game changer," by senior Coast Guard officials. Recently, the Coast Guard deployed the FRC 1124, OLIVER BERRY from Hawaii across the Pacific to the Republic of the Marshall Islands. The 4,400 nautical mile trip marked the furthest deployment of an FRC to date. This trip showcases the hugely expanded operational reach and capability that the FRC provides.



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# US SECRETARY OF THE NAVY VISITS FAIRBANKS MORSE'S BELOIT FACILITY



» Secretary of the Navy, Richard V. Spencer (right), meets some of the Fairbanks Morse workforce.

Fairbanks Morse, an EnPro Industries company (NYSE: NPO) and leading provider of solutions that are powering the world forward, announced today that the company has received a visit from Secretary of the Navy, Honorable Richard V. Spencer. The Secretary addressed Fairbanks Morse employees at its Beloit, Wisconsin facility and acknowledged the company's decades-long dedication to supporting the United States Navy with their critical power solutions.

During his address to the Fairbanks Morse team, the Secretary showed appreciation for the Fairbanks Morse workforce and the company's vital role as part of the US industrial base. "You are the bedrock of what national security is all about," commented Secretary Richard V. Spencer.

Secretary Spencer recently named the USS Beloit after the City of Beloit to honor the community and Fairbanks Morse contributions to national security. Secretary Spencer told employees at Fairbanks Morse, "You all have an invested right into the USS Beloit."

The USS Beloit will be named after the city for its contributions to the Navy and advancements in U.S. national security with the ongoing work at Fairbanks Morse, a company that's worked with the Navy since 1938.

"We are truly honored to have received a visit from Secretary Spencer. This gave us the opportunity to express gratitude for our decades-long partnership with the US Navy which we look forward to continuing for generations to come," said Deepak Navnith, president of Fairbanks Morse."

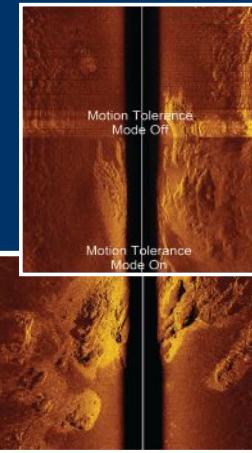
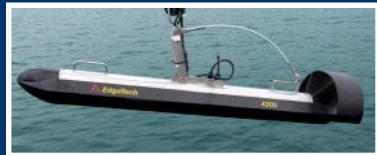
Secretary Spencer joined the United States Marine Corps where he served as an H-46 pilot until 1981 before departing active duty to enter the private finance sector. Secretary Spencer holds an impressive record during his time on Wall Street where his responsibilities centered on investment banking, strategic advisory services and capital market underwriting.



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# ISRAEL SHIPYARDS TO INTRODUCE COASTAL DEFENSE VESSELS AT SIDEF 2019



Israel Shipyards Ltd. and SK Group member – a leading shipbuilding and repair company for the naval and commercial marine markets – presented its advanced solutions for seaborne interdiction and prevention of terrorist and illegal activities for navies, law enforcement and HLS forces, at SIDEF 2019 in May.

Israel Shipyards introduced coastal defense vessels for short- and long-distance protection, developed to prevent illegal activity and maritime terrorism, provide coastal protection for Naval forces, and protect territorial waters and EEZs. The company presented a range of vessels and combat-proven solutions, including SHALDAG Fast Patrol Craft and OPVs with a high level of maneuverability and capabilities. Among the solutions installed on these vessels are cutting-edge weapon systems as well as command and control, electro-optics, and night vision systems.

## SHALDAG Fast Patrol Craft (FPC) Family

The company showcased one model of Fast Patrol Craft (FPC), the SHALDAG MK II. The FPCs are made of marine aluminum



and driven by water jets, with a speed of above 45 knots even in rough seas. It provides outstanding maneuverability and minimal draft, enabling operation in shallow waters. The SHALDAG MK II is designed for coastal protection as well as for rivers.

"We welcome cooperation between Israel shipyards and Naval forces worldwide and in Latin American in particular" says Mr. Eitan Zucker ISL's CEO: "The recent delivery of four SHALDAG - Fast Patrol Craft - to Argentina is a major milestone in our activities in the region, and we are looking forward to expand it furthermore"

## Offshore Patrol Vessel (OPV)

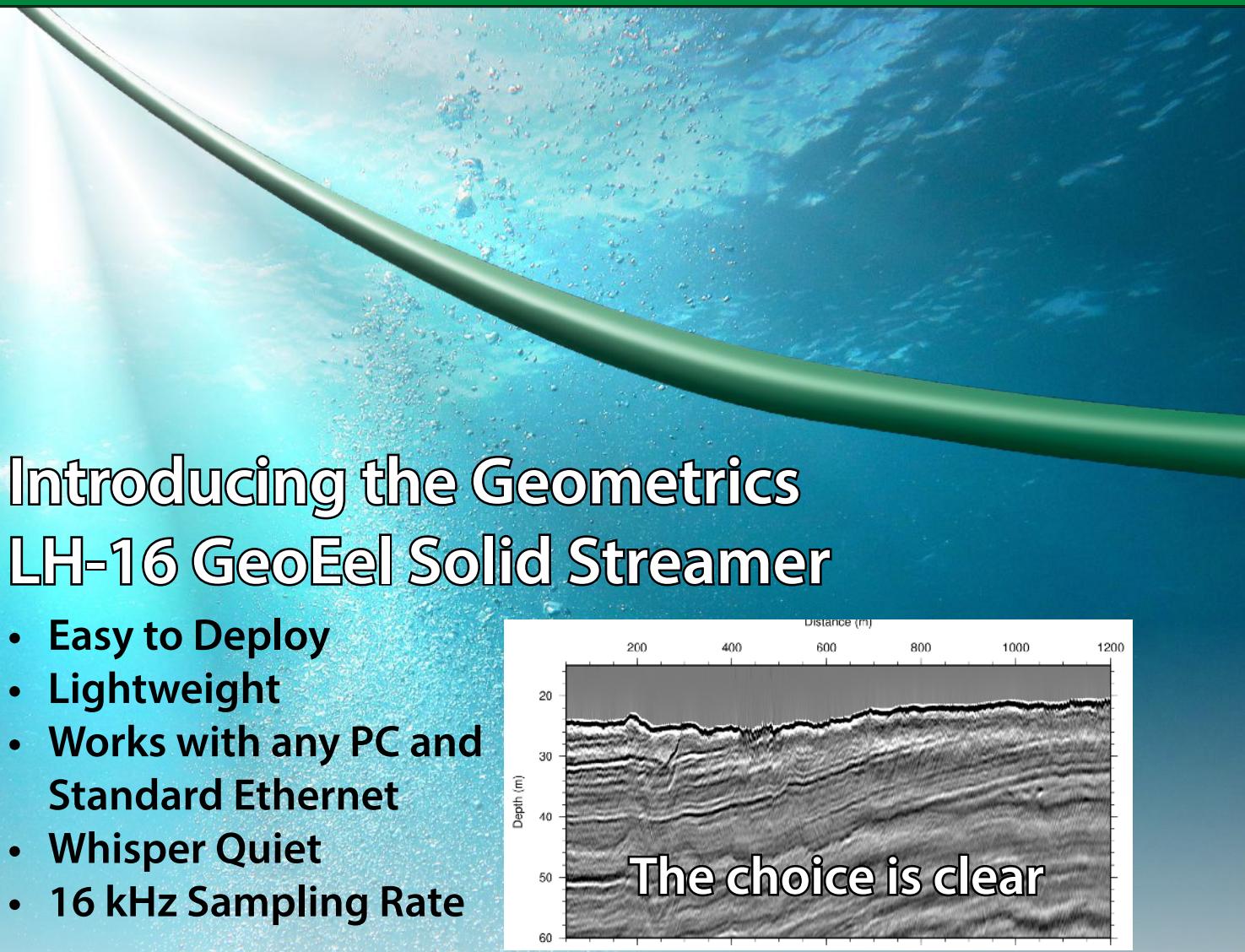
The company also showcased its OPV designed mainly for coastal protection, drilling rigs, and offshore facilities, they have variety of remotely controlled and stabilized armament systems. With a hull made of steel and a superstructure of aluminum, the vessel sails at high speeds (above 32 knots). Weapon control stations and navigation systems are installed on the command bridge, enabling the commanding officer to have centralized control from the bridge. A helipad is also optional.

The new version is available with a modern bridge structure design.



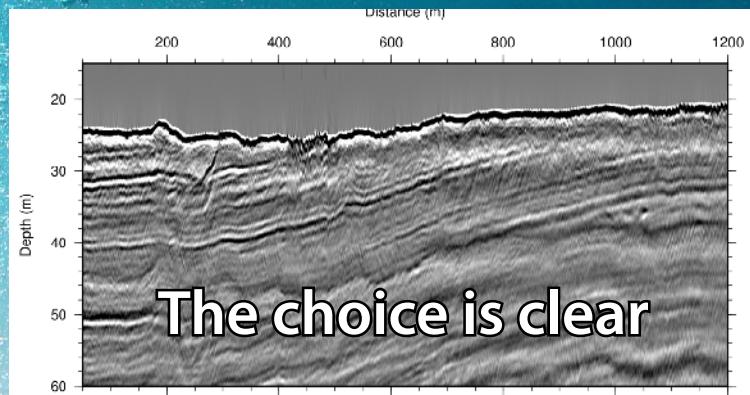
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# WAITING FOR EVENTS TO PROVIDE DIRECTION

BY G. ALLEN BROOKS | Author, *Musings From the Oil Patch* | [www.energymusings.com](http://www.energymusings.com)

## OIL MARKET:

Crude oil prices are range-bound. Yes, they bob up and down like a cork in the ocean, but all that movement does little but provide traders with minuscule profit-taking opportunities. In reality, oil prices are waiting for events to unfold that will provide clarity about future oil supply and demand. What are prices waiting for? Maybe it's learning whether we are in a global trade skirmish or a real trade war. There are unanswered questions about the future for the current oil production cut engineered by OPEC members and its friend Russia at the end of 2018 and scheduled to end in June. These are merely two of the many unanswered questions that will determine future oil prices. News or clues about any of the issues can cause oil prices to react. Without actual resolutions, however, price moves will likely be modest.

We are in the middle of the traditionally weak second quarter for oil. Refiners are shutting down operations, as maintenance and reconfiguration work begins in preparation for stepping up gasoline output for the summer driving season. That means refiners are not aggressively buying oil, since they need less at the moment. Offsetting the buying weakness is the response to the loss of substantial heavy oil volumes given the collapse of production in Venezuela. These volumes, necessary to efficiently operate refineries, caused refiners to bid aggressively for other heavy oil supplies from Saudi Arabia, Russia and Canada. The buying initially lifted global oil prices, but now it is helping support current prices.

The other one-time refinery event is the need to step up distillate output in order to have adequate supplies for the shipping industry next January to

meet the IMO 2020 low-sulfur fuel oil mandate. While the outlandish claims that the UN fuel standard would drive global oil prices to \$200 per barrel have been debunked, forecasts now suggest more modest price hikes of between \$2-5 per barrel, much of which may already be reflected in current oil prices.

The major uncertainties for oil prices are the duration and intensity of the growing U.S.-China trade war and its damage to economic growth, which has already shown signs of moderating. In fact, nearly every global financial organization – World Bank, International Monetary Fund, and OECD – has marked down its growth projections for 2019 issued earlier this year. This uncertainty, plus the question about the production output of troubled countries such as Venezuela and Libya, has people struggling to sense the direction of oil prices. There also remains uncertainty about how significant the impact of ending waivers from the financial sanctions leveled against the purchase of Iranian oil, awarded to a handful of countries by the United States, will be on global oil supplies this summer. These uncertainties are weighing on the discussions between OPEC members and Russia over extending their current combined 1.2 million barrels a day production cut put in place at the start of 2019, and which helped oil prices recover this year.

Also figuring into the OPEC+ negotiations is the issue of whether U.S. oil production will continue its rapid growth. The EIA recently upped its forecast for U.S. oil production this year and next, certainly muddling the global oil market outlook the OPEC+ group must fathom in order to set its future production quotas. At the present time, the likely scenario is for OPEC+ to ease back its cut – adding

anywhere from 300,000 to 800,000 barrels per day to global supply starting in the second half. With global oil inventories building in 2Q 2019, rather than falling as had been predicted, OPEC+ will probably wait until July for additional data before making its final decision. When OPEC+ speaks, the oil market may take its direction, but that may be more than a month away.

## NATURAL GAS MARKET:

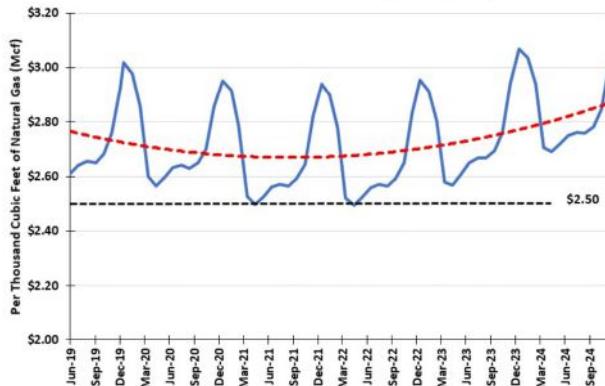
The natural gas market has been boring. That's because gas prices did not react to the large inventory draws early this year when Polar Vortex blasts depleted storage. As temperatures moderated heading into the spring, surging gas output, largely associated with growing crude oil production in the Permian Basin, has met all gas demands while also enabling large storage injections. As a result, gas storage has passed last year's low levels and is on track to rebuild inventory beyond the level at the end of last season. As this rebuilding is happening without significantly lifting gas prices, expectations are for little further upside for the balance of 2019. In fact, it is not until November 2019 that natural gas futures prices climb above \$2.70 per thousand cubic feet level.

In the accompanying chart, the trend in natural gas futures prices is downward for the next three years, before starting to climb. Note that it isn't until the winter of 2023-24 that gas prices exceed \$3/Mcf again, assuming they reach the January 2020 futures price of \$3.02/Mcf. The most interesting point about the near-term gas price outlook is that futures prices in March 2021 and March 2022 sit at \$2.50/Mcf, a threshold that prices briefly dipped below recently, but which had only been breached four times since the late 1990s.

With natural gas production remaining strong, although not setting new monthly records, demand and exports will determine how much gas can be injected into storage. With multiple weeks of triple-digit storage injections, any concern gas traders had about a potential supply shortage this coming winter disappeared. The recent uptick in gas prices from \$2.50 to above \$2.60/Mcf reflected views that the lack of new gas production records coupled with greater liquefied natural gas shipments and increased pipeline exports to Mexico has slightly increased pressure on the market. Will it continue or wane as we await warmer weather? Recent snowstorms in Denver are highlighting a cooling trend that is emerging, confounding the energy outlook.

The greatest challenge for natural gas producers, and derivatively for gas prices, is the output from the Marcellus and Utica regions, our largest supply source. It is facing limited export opportunities to the Northeast and Canada, so more gas is going to the Cove Point LNG export terminal in Maryland, and more gas is heading westward and to the Southeast. This latter flow is meeting increased output from the Haynesville, which is squeezing gas prices in the Southeast. The Ohio and Pennsylvania gas flowing westward has run into greater volumes coming up from the Permian Basin, which is being forced to ship more gas west and north, until new LNG export and petrochemical facilities along the Gulf Coast open. This new gas flow pattern across the United States will create new price pressures, as regional supply/demand imbalances force prices to balance markets. All this turmoil works to keep gas prices range-bound for the foreseeable future.

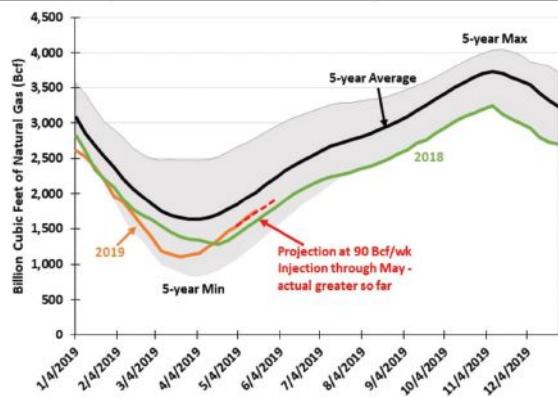
### Natural Gas Futures Price Curve - May 22, 2019



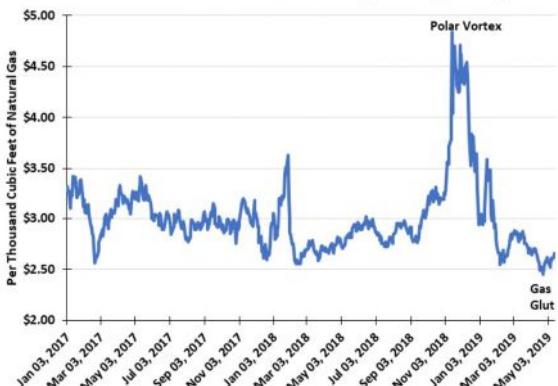
### Will 2H 2019 Experience Similar Price Drop As 2015?



### Why 2019 Natural Gas Prices May Remain Low



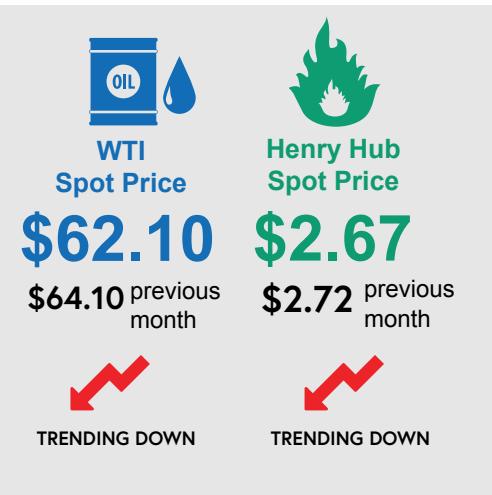
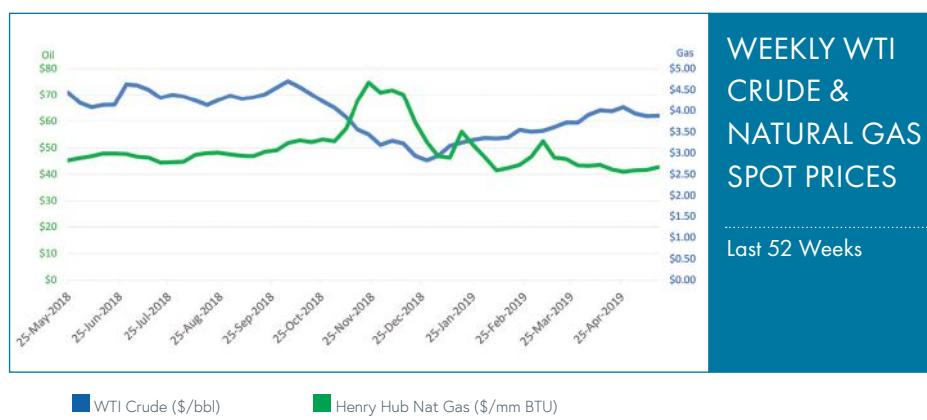
### 2019 Natural Gas Prices: From Promising To Disappointing



# CRUDE & NATURAL GAS Spot Prices

PRICES IN US DOLLARS AS OF MAY 12, 2019

Oil prices were largely stable through April and the beginning of May, with a slight price drop of only \$2.29 as of May 17; the most recent data available at press time. But reports later in the month of strong US stockpiles threaten further price decreases, according to the *Wall Street Journal* and other media sources.



## KEY EQUITY Indexes

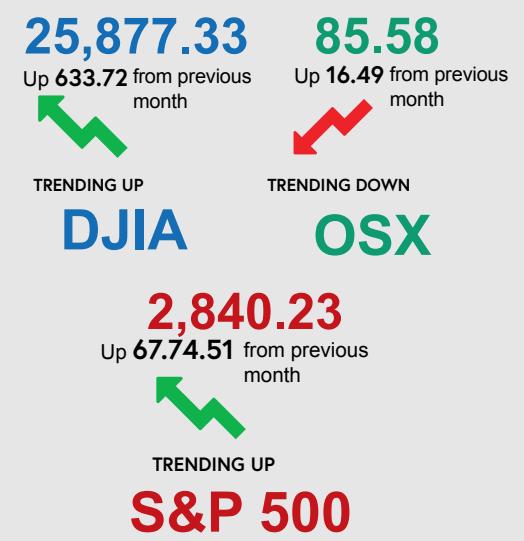
PRICES IN US DOLLARS AS OF MAY 22, 2019

**THE DOW JONES INDUSTRIAL AVERAGE AND S&P 500 have fallen significantly in the past month**

The Dow Jones and S&P 500 indexes have been up and down in the past month, riding the varying degrees of concern over the trade war between the US and China. The Dow dropped over 600 points and the S&P500 over 60 points during the month. The US-China trade issue is a major concern for traders, according to CNBC, and will be key to how the markets perform in the future.

After a solid rally in April, the Philadelphia Oil Service Sector Index (OSX) dropped significantly in the last month, closing at 85.58; down more than 15 points. The OSX had been steady at over 90 points for virtually all of 2019, as well as two weeks over 100 points in April. May saw an immediate drop, however, back below 90 points to levels comparable to those at the end of 2018.

### SELECTED EQUITY INDEXES



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## AMERICAS

### Brazil Offshore

Rio do Janeiro, Brazil » June 25-28  
[www.brasiloffshore.com](http://www.brasiloffshore.com)

### ESRI User Conference

San Diego, CA » July 8-12  
[www.esri.com/en-us/about/events/uc/overview](http://www.esri.com/en-us/about/events/uc/overview)

### PORTS'19

Pittsburgh, PA » September 15-18  
[www.portsconference.org](http://www.portsconference.org)

### OilComm

Houston, TX » October 2-3  
[www.2019.oilcomm.com](http://www.2019.oilcomm.com)

### Teledyne Marine Tech Workshop

San Diego, CA » October 6-9  
[www.teledynemarine.com/events/TMTW2019](http://www.teledynemarine.com/events/TMTW2019)

### LAGCOE

New Orleans, LA » October 9-11  
[www.lagcoe.com/home-expo](http://www.lagcoe.com/home-expo)

### AWEA Offshore WINDPOWER

Boston, MA » October 22-23  
[engage.awea.org/Events](http://engage.awea.org/Events)

### OCEANS'19

Seattle, WA » October 28-31  
[www.seattle19.oceansconference.org](http://www.seattle19.oceansconference.org)

### OTC Brazil

Rio de Janeiro, Brazil » October 29-31  
[www.otcbrasil.org](http://www.otcbrasil.org)

### GIPEX

Georgetown, Guyana » November 6-8  
[www.guyanaoilexpo.com](http://www.guyanaoilexpo.com)

### BlueTech Week

San Diego, CA » November 18-22  
[www.bluetechweek.org](http://www.bluetechweek.org)

## EUROPE

### European Wave and Tidal Energy Conference

Napoli, Italy » September 1-6  
[www.ewtec.org/conferences/ewtec-2019](http://www.ewtec.org/conferences/ewtec-2019)

### SPE Offshore Europe

Aberdeen, UK » September 3-6  
[www.offshore-europe.co.uk](http://www.offshore-europe.co.uk)

### Maritime Transport

Rome, Italy » September 10-12  
[www.wessex.ac.uk/conferences/2019/maritime-transport-2019](http://www.wessex.ac.uk/conferences/2019/maritime-transport-2019)

### DSEI

London, UK » September 10-13  
[www.dsei.co.uk](http://www.dsei.co.uk)

### Ocean Energy Europe

Dublin, Ireland » Sept. 30 - Oct. 1  
[www.oceanenergy-europe.eu/annual-event/oee2019](http://www.oceanenergy-europe.eu/annual-event/oee2019)

### Offshore Energy

Amsterdam, The Netherlands » October 8-9  
[www.offshore-energy.biz](http://www.offshore-energy.biz)

### WindEurope Offshore

Copenhagen, Denmark » November 26-28  
[www.windeurope.org/offshore2019](http://www.windeurope.org/offshore2019)

## OTHER REGIONS

### Africa Oil & Gas

Nairobi, Kenya » July 25-27  
[www.expogr.com/kenyaoil](http://www.expogr.com/kenyaoil)

### Marine & Offshore Expo

Batam, Indonesia » August 20-22  
[www.batam-marine.com](http://www.batam-marine.com)

### Submarine Networks World

Singapore » September 17-19  
[www.terrapinn.com/conference/submarine-networks-world/index.stm](http://www.terrapinn.com/conference/submarine-networks-world/index.stm)

### Telecoms World Middle East

Dubai » September 24-25  
[www.terrapinn.com/conference/telecoms-world-middle-east](http://www.terrapinn.com/conference/telecoms-world-middle-east)

### Bahrain Int'l Defense Conference

Manama, Bahrain » October 28-30  
[www.bahraindefence.com](http://www.bahraindefence.com)

### East Africa Oil & Gas

Dar-es-Salaam, Tanzania » November 7-9  
[www.expogr.com/tanzania/oilgas](http://www.expogr.com/tanzania/oilgas)

### ADIPEC

Abu Dhabi » November 11-14  
[www.adippec.com](http://www.adippec.com)

### Oceanology International China

Shanghai » November 13-15  
[www.oichina.com.cn/en/home](http://www.oichina.com.cn/en/home)

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<b>JANUARY</b>		
» Deepwater Inspection, Repair & Maintenance » ROV Tooling	Manipulator Arms & Tools; Pumps, Hoses and Hose Connectors; Cameras, Lights	Underwater Intervention » February 5-7 Subsea Expo » February 5-7 Oceanology Americas » February 25-27
<b>FEBRUARY</b>		
» Subsea Cables » Offshore Communication	Cable Installation Services and Equipment; Telecommunication Technologies	Int'l Wind Partnering Forum » April 9-10
<b>MARCH</b>		
» Mapping & Survey » Oceanology » MetOcean	Bathymetric Mapping/Charting; Data Acquisition & Processing	US Hydro » March 18-21 Ocean Business » April 9-11
<b>APRIL</b>		
» Offshore Technology » Maritime Security & Ocean Intelligence	Testing Facilities; Military Tech and Contractors	OTC » May 6-9 UDT » May 13-15 AUVSI XPONENTIAL » April 30 – May 2 □
<b>MAY</b>		
» Surface Vehicles » Tracking & Positioning	Transponders / AIS; S/P Power Systems; Dredging	H2O Conference » June 6-7
<b>JUNE</b>		
» Offshore Energy Exploration » Ocean Sound	Sonar Systems and Vessels; Imaging & GIS; Magnetometers	TBD
<b>JULY</b>		
» Unmanned Vehicles Buyers' Guide	ROV, AUV, USV, Glider, Towed Vehicles	TBD
<b>AUGUST</b>		
» Submersibles (AUV, ROV, UUV)	Cranes, Winches, LARS & Control Systems; Sensor, Profilers, Measurement; Thrusters; Umbilical, Tether, Cables, and Connectors	SPE Offshore Europe » September 3-6 Teledyne Marine Tech » October 6-9
<b>SEPTEMBER</b>		
» Renewables » Offshore Energy Installation & Maintenance	Acoustic Modems; Acoustic Releases, Transponders, Command & Control Systems; Technical Schools, Training Programs	Ocean Energy Europe » Sept. 30-Oct. 1 Offshore Energy » October 8-9
<b>OCTOBER</b>		
» Ocean Science & Technology	Energy Storage Devices; Inspection Drones; Current Meters	OCEANS'19 » October 28-31
<b>NOVEMBER</b>		
» Oil Spill Prevention & Response » Ocean Archaeology & Salvage » Executive Profile	Buoyancy Materials; Pressure/Watertight Housing; Well Control Equipment	TBD
<b>DECEMBER</b>		
» Upper Deck Equipment Guide	LARS, Winches, Cranes, A-frames, and Buoys	TBD



## DELIVERING 'INTELLIGENT EFFICIENCY' FOR OFFSHORE OPERATIONS

DOF vessels Skandi Vega and Skandi Iceman involved in a complex offshore operation (Photo courtesy of Equinor, by Espen Roennevik, Roar Lindefjeld)

Kongsberg Maritime has formed a partnership with DOF, SINTEF Ocean and NORCE, which aims to reduce fuel consumption and greenhouse gas emissions for complex offshore operations, while streamlining fleet-wide maintenance.

Enabled through sponsorship and support from Innovation Norway, the new partnership between four of Norway's

most established and advanced maritime organizations will develop a sophisticated new Decision Support System (DSS) for offshore vessel operations.

This new predictive, intelligent, and dynamic guidance tool will act as the foundation for DOF to simplify operational complexity with objective measurement, ultimately enabling optimal utilization and more sustainable fleet management.

Highlighting the potential of the partnership to catalyze a tangible transformation,



the multi-year project is backed with Innovation Norway's largest funded offshore vessel, environmental technology project in 2018. It will be a gamechanger in how marine operational decisions are supported by providing more accurate, timely, and easily consumable information

to decision makers; from the vessel's Chief Engineer to the Chief Operation Officer based shore-side.

[www.kongsberg.com/maritime](http://www.kongsberg.com/maritime)

## WORLD LARGEST SEMI-SUBMERSIBLE CRANE VESSEL COMPLETED

*Sleipnir, the world's largest and strongest semi-submersible crane vessel built by Sembcorp Marine.*



The world's largest semi-submersible crane vessel (SSCV) is set to blaze a trail when it enters into service in the coming months, armed with the strongest pair of revolving cranes for offshore oil, gas and renewable energy installation and decommissioning jobs.

Named after the Norse God Odin's eight-legged stallion and newly completed at Sembcorp Marine's Tuas Boulevard Yard for owner Heerema Marine Contractors, SSCV Sleipnir has a 220-metre by 102-metre reinforced deck area, making it the largest crane vessel to be built.

The vessel also has two 10,000-tonne revolving cranes which can lift loads of up to 20,000 tonnes in tandem. No other existing crane vessel has this capability. Sleipnir can accommodate 400 persons and will be deployed globally for installing and removing jackets, topsides, deep-water foundations, moorings and other offshore structures.

With its single-lift capability catering to larger integrated structures than previously possible, Sleipnir will minimize offshore assembly work and raise operational efficiency to a new level, while not compromising the flexibility and robustness of traditional installation methodologies.

The vessel further stands out as the world's first crane vessel with dual-fuel engines running on Marine Gas Oil (MGO) and Liquefied Natural Gas (LNG). Coupled with an IMO- and US Coast Guard-approved ballast water management system, Sleipnir will operate sustainably across all environmental jurisdictions.

Heerema has already secured contracts to deploy the vessel in various offshore energy developments, including: Leviathan topsides installation in the Mediterranean Sea; Tyra jackets and topsides installation and removal in the Danish North Sea; Brae B jackets and topsides removal in the UK North Sea; as well as transportation and installation of the Hollandse Kust Zuid (HKZ) Alpha HVAC platform in the North Sea, off the Dutch coast.

In the offshore wind sector, Heerema sees a significant growth in the size of wind turbines and foundations, which requires specialized equipment for their installation. With its large cranes, Sleipnir can accommodate bigger offshore wind turbines.

[hmc.heerema.com](http://hmc.heerema.com)  
[www.sembmarine.com](http://www.sembmarine.com)

## A SMALL STEP TOWARDS ZERO EMISSION SHIPPING

A group of six leading Nordic industry companies has, in line with the UN sustainability goals, joined forces to solve a great societal challenge. The initiative is called Zero Emission Energy Distribution at Sea (ZEEDS).

Annually, shipping is responsible for nearly one billion tonnes of CO<sub>2</sub> gas emissions globally, and the consortium is trying to address this by developing a new infrastructure for green fuels for ships.

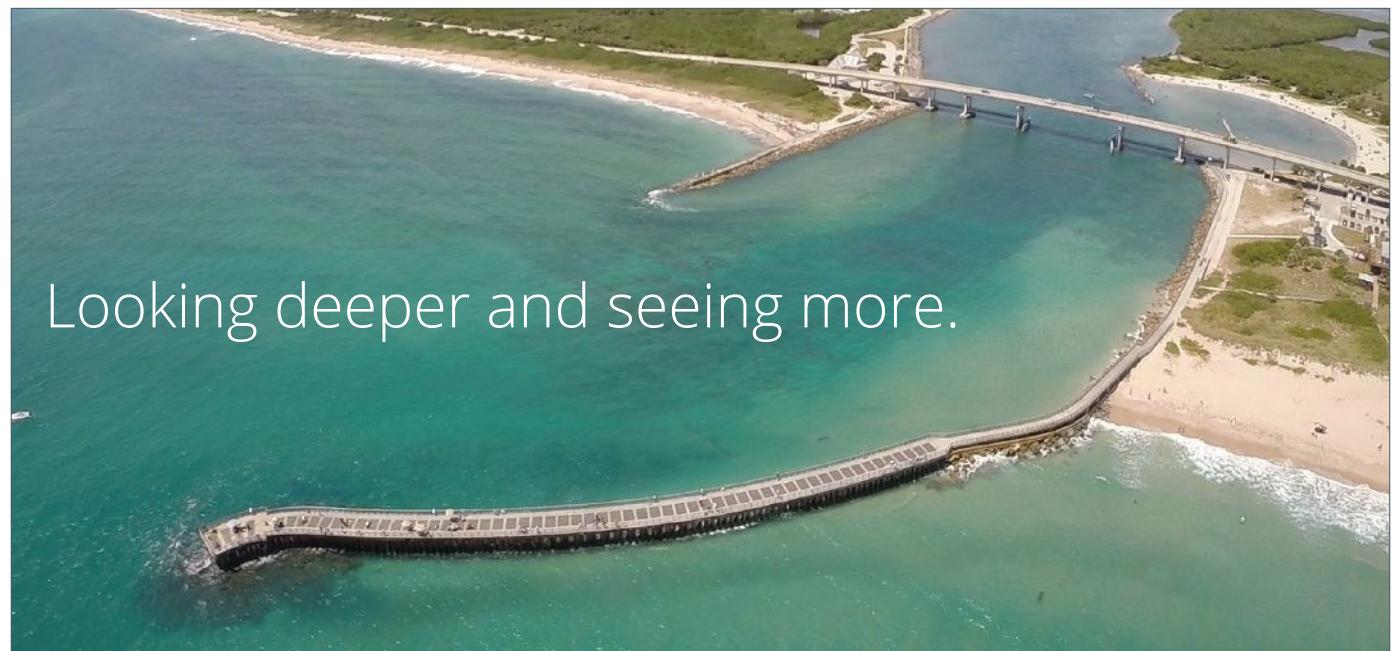
The collaboration is spearheaded by Wärtsilä, a leader in smart technologies for the marine and energy markets. It further consists of Aker Solutions, a global engineering company, Equinor, a multinational energy company, DFDS, an international shipping and logistics company, Grieg Star, an international ship owning and operating company and Kværner, a leading engineering, procurement and construction company.

Moving forward the focus will be on engaging the relevant authorities and potential new partners to ensure further development of the concept and the ideas.

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Morgan & Eklund, Inc. specializes in collecting data in the coastal zone providing bathymetric surveying services for project monitoring, beach restoration, dredging and offshore borrow area investigations.

For more information, visit [www.morganeklund.com](http://www.morganeklund.com) or call (772) 388-5364.

## IMO STRENGTHENS SHIPPING EMISSIONS REQUIREMENTS

The International Maritime Organization's (IMO) Marine Environment Protection Committee (MEPC) pushed forward with a number of measures aimed at supporting the achievement of the objectives set out in the initial IMO strategy on reduction of greenhouse gas (GHG) emissions from ships, in line with the Paris Agreement under UNFCCC and the United Nations 2030 Agenda for Sustainable Development.

The MEPC 74 session (13-17 May) approved amendments to strengthen existing mandatory requirements for new ships to be more energy efficient; initiated the Fourth IMO GHG Study; adopted a resolution encouraging cooperation with ports to reduce emission from shipping; approved a procedure for the impact assessment of new measures proposed; agreed to establish a multi-donor trust fund for GHG; and agreed

terms of reference for the sixth and seventh intersessional working groups to be held in November 2019 and in March 2020 respectively in order to expedite the work.

*Source: [www.imo.org](http://www.imo.org)*



## SEABED 2030 AND WORLD OCEAN COUNCIL IN NEW PARTNERSHIP

Dr. Graham Allen (left), Acting Director of Seabed 2030, and Paul Holthus, Founding President and CEO of the World Ocean Council, sign the Memorandum of Understanding in Copenhagen. Credit: The Nippon Foundation-GEBCO Seabed 2030 Project.

A new partnership for sustainable stewardship of the ocean has been agreed between The Nippon Foundation-GEBCO Seabed



2030 Project and the World Ocean Council (WOC), the global blue economy business organization, in an effort to further collaboration towards mapping the entirety of the world's ocean floor.

Under the Memorandum of Understanding (MOU), Seabed 2030 and the WOC will jointly engage with the ocean business community to promote the project's vision and the ways in which organizations in the maritime community can collect and contribute bathymetric data to Seabed 2030.

To mark the signing of the MOU it was announced that Seabed 2030 will be taking part in the World Ocean Council's 7th annual Sustainable Ocean Summit (SOS), Paris, 20-22 November 2019, and will collaborate with the WOC to conduct a workshop for industry on bathymetric data collection and sharing.

The Nippon Foundation-GEBCO Seabed 2030 Project, launched by Mr. Yohei Sasakawa of The Nippon Foundation at the UN Ocean Conference in 2017, is a collaborative project to map the entirety of the world's ocean floor by the year 2030, and to include all bathymetric data in the freely available GEBCO Ocean Map.

In pursuit of this goal, Seabed 2030 is building a global community of ocean mappers, hydrographers, scientists, industry, and the public to discover and publish all existing bathymetric data. Seabed 2030 also aims to inform and inspire new mapping expeditions to 'map the gaps' in our knowledge of the seafloor, and provide the world with the definitive map of ocean bathymetry.

<https://seabed2030.gebco.net>  
[www.ocean council.org](http://www.ocean council.org)

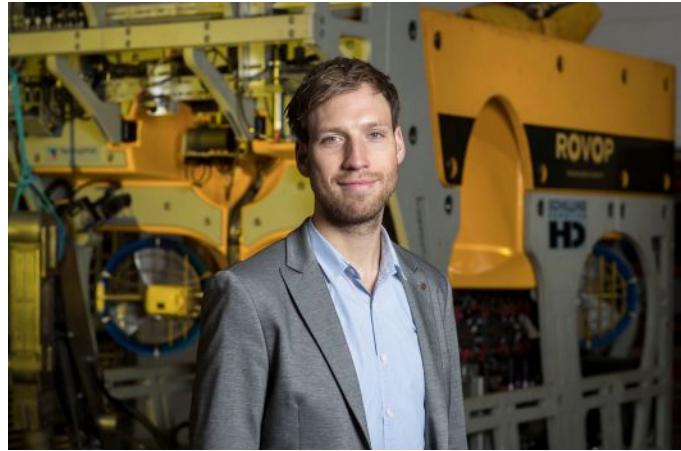
## ROVOP CELEBRATE EUROPEAN SUCCESS WITH A NEW OFFICE AND APPOINTMENT

ROVOP, the global subsea robotics specialist, has announced its expansion into mainland Europe with the appointment of Job Biersteker as Business Development Manager in its new facility located in Rotterdam.

Job has been active in the subsea industry for nearly a decade and has had various positions including ROV Technician, Project Engineer and Project Manager. The new Rotterdam office will provide support to mainland Europe based clients to further strengthen ROVOP's position in the market. This new appointment is in line with ROVOP's business and growth strategy of providing a focused ROV service to its customers in all markets and geographies.

With headquarters in Aberdeen and Houston, ROVOP's global scope encompasses the oil and gas, offshore wind, telecoms and power transmission industries.

For more information visit:  
[WWW.ROVOP.COM](http://WWW.ROVOP.COM)



» Job Biersteker, ROVOP's new Business Development Manager

## HYDROID ENGINEERING, OPERATIONS AND PROGRAM MANAGEMENT ORGANIZATIONS APPRAISED AT CMMI V2.0 Maturity Level 3

Hydroid, Inc., a subsidiary of Kongsberg Maritime and a leading manufacturer of marine robotic systems, today announced it was appraised at Maturity Level 3 of the CMMI Institute's Capability Maturity Model Integration (CMMI) ® V2.0. The appraisal was performed by JFR Consulting and included a comprehensive examination of Hydroid's business and development processes for its autonomous underwater vehicles (AUVs) and marine robotics products. Hydroid had been previously appraised in 2016 at Maturity Level 3 using the CMMI V1.3.

"Always looking to optimize our business performance, we are pleased to have received this appraisal result," said Duane Fotheringham, president of Hydroid. "Having been independently benchmarked by an authorized Lead Appraiser, it reaffirms our willingness to continually and consistently meet our performance

commitments with confidence. Additionally, unlike many organizations, Hydroid has taken it a step further and adopted the CMMI to improve processes across program management, operations and all engineering disciplines."

CMMI is a capability improvement framework that provides organizations with the essential elements of effective processes that ultimately improve company performance. The level 3 appraisal indicates that Hydroid is performing at a "defined" level. At this level, company processes are well characterized and understood, and are described in standards, procedures, tools and methods. It also means that Hydroid's set of end-to-end product development processes, which is the basis for maturity level 3, is established and improved over time.



For more information visit:  
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Teledyne RESON together with Teledyne BlueView and Teledyne Odom provides a range of high quality underwater acoustic hardware and software solutions for underwater imaging within Teledyne Marine. These solutions are delivered through recognized brands such as SeaBat, BlueView, Odom, HydroSweep and ParaSound Multibeam Echosounder and Teledyne PDS software suite.

Teledyne Marine is a group of leading-edge subsea technology companies that are part of Teledyne Technologies Incorporated. Through acquisitions and collaboration over the past ten years, Teledyne Marine has evolved into an industry powerhouse, bringing Imaging, Instruments, Interconnect, Seismic, and Vehicle technology together to provide total solutions to our customers.

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Website: www.nortekgroup.com



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

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Teledyne RD Instruments, Inc., located in Poway, CA USA, specializes in the design and manufacture of underwater acoustic Doppler products and oceanographic sensors for a wide array of commercial, academic, and defense applications.

Originally founded in 1982, RD Instruments developed the industry's first Acoustic Doppler Current Profiler (ADCP). Through the years, this innovation has spawned a full line of ADCPs for current profiling in environments ranging from the shallowest stream to the deepest ocean. Expanding on this technology, the company also offers their industry-leading Doppler Velocity Logs (DVLs) for precision underwater navigation onboard manned and unmanned submersibles.

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Cathx Ocean design and manufacture advanced subsea imaging and precision measurement systems for subsea operations.



Designed to meet stringent technical, operational and integration requirements associated with various subsea applications and vehicle types, Cathx Ocean's systems offer precision, reliability and peace of mind. Products include advanced still imaging, colour laser point cloud and video systems, designed to deliver precision subsea data in a way that allows automation for subsea vehicle operations.

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

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

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Since 1957, South Bay Cable Corp has designed and manufactured specialized electrical, electro-mechanical and electro-optical-mechanical cables for use in demanding marine environments. Cables are designed to meet customer requirements and include tether and umbilical cables for ROVs, tow cables, video inspection, faired cables and a host of other customer specific applications.

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 E-mail: sales@birnsaquamate.com  
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 Contact: Eli Bar-Hai



Birns Aquamate design and manufacture underwater electrical connectors, cable assemblies, and cable terminations. The company produces a wide range of standard industry products such as the 5500 Series, SC, MC, LP, FAWL/FAWM, NANO, TC, Rubber Molded, etc. Birns Aquamate is the only manufacturer to guarantee compatibility with other uw connectors. Birns Aquamate also specializes in fast turn-around for custom design of special connector solutions. All connectors are manufactured under DNV ISO 9001:2000 certification. Dealers in Canada, Brazil, UK, Belgium, Holland, Norway, Germany, South Africa, Holland, Italy, and China.

**SEACON**  
 1700 Gillespie Way  
 El Cajon, CA 92020 USA  
 Tel: +1 619 562 7071  
 Fax: +1 619 562 9706  
 E-mail: elcajonsales@te.com  
 Website: [www.seaconworldwide.com](http://www.seaconworldwide.com)



For the widest range of connectivity and sensor solutions designed for subsea applications, TE Connectivity (TE)'s portfolio includes over 2,500 underwater electrical and fiber optic connectors, and complete connectivity systems to give you a wide range of advanced connectivity options. The portfolio includes not only SEACON products, but DEUTSCH connectors, Rochester engineered cables, and TE sensors – giving you one-stop access to rugged, reliable solutions.

**TELEDYNE MARINE**  
 1026 N. Williamson Blvd.  
 Daytona Beach, FL 32114  
 Tel: 386-236-0880  
 E-mail: TeledyneMIS@teledyne.com  
 Website: [www.teledynemarine.com](http://www.teledynemarine.com)



Teledyne Marine Interconnect Solutions integrates the resources of ODI, DGO, Impulse, and Cable Solutions into a single organization that supplies innovative, high-performance solutions for harsh environment interconnect. Solutions for these harsh environments include wet-mate, splash-mate and dry-mate connectors, pressure boundary penetrators, cable assemblies, cable terminations, and custom-engineered encapsulation and molding. TMIS contains a broad portfolio of field-proven, time-tested electrical, optical, and hybrid interconnect capabilities optimized for applications where performance and reliability are imperative. Products are available as stand-alone items, or as complex solutions that integrate technologies into advanced, value-added systems.

#### DESIGN & ENGINEERING

**HYDRO LEDUC NA, INC.**  
 19416 Park Row, Ste. 170  
 Houston, TX 77084  
 Tel: 281-679-9654  
 E-mail: bogden@hydroleduc.com  
 Website: [www.hydroleduc.com](http://www.hydroleduc.com)



Hydro Leduc is a specialist in the design and manufacture of hydraulic piston pumps, hydraulic motors, hydro pneumatic accumulators, and customized hydraulic components satisfying customer needs with reliable products from a reliable source. As the leader in micro hydraulics, it is feasible to obtain several tons of force from a minimal power source within a restricted space envelope. The techniques of micro hydraulics allow simple solutions to problems that are often beyond the limits of traditional mechanical options. Hydro Leduc's expertise is at your service in varied applications such as oil service tools, oceanographic instrumentation, aeronautics, and any extreme working condition of temperature, pressure, medium, and environment.

#### DIGITAL VIDEO RECORDING SYSTEMS

**DIGITAL EDGE SUBSEA, LTD**  
 Doubletree Court, Cavendish St.  
 Ulverston, Cumbria  
 LA127AD  
 E-mail: john@digitaledgesubsea.com  
 Website: [www.digitaledgesubsea.com](http://www.digitaledgesubsea.com)  
 Contact: John Benson



The EdgeDVR is currently used worldwide by most of the major ROV and Diving contractors. With our present Version 4 software, we have 6 models. The EdgeDVR has become an essential part of any ROV and Diving system offshore, easy to use and reliable. The system is capable of recording simultaneous High Definition and Standard Definition video, together with auto creation of Dive, Video, Photo and Anomaly logs. Multi channel digital overlay is also available for all recorded channels, logos and real-time survey data can be displayed. With around 500 systems now offshore, we have a proven record of reliability.

Our version 5 software is currently in development and full details will be released soon....

## EQUIPMENT RENTAL

## OKEANUS SCIENCE &amp; TECHNOLOGY, LLC

2261 Denley Road  
Houma, LA 70363  
Tel: 985-346-4666  
Fax: 985-346-8444  
E-mail: Bleblanc@okeanus.com  
Website: www.okeanus.com  
Contact: Benton LeBlanc



Okeanus is the premier rental provider for oceanographic and marine scientific research equipment utilized in nearshore and offshore projects around the world. Focused on providing industry-leading customer service, Okeanus offers advanced, high-quality technology coupled with knowledgeable and experienced staff that can deliver dedicated support regardless of a project's location.



## FIBER OPTIC PRODUCTS / SERVICES

## OCEAN SPECIALISTS, INC.

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Stuart, FL 34997  
Tel: +1 772 219 3000  
Fax: +1 772 219 3010  
Email: contact@oceanspecialists.com  
Website: www.oceanspecialists.com



Ocean Specialists, Inc. (OSI) is a system development and advisory firm for undersea cable projects and technology with global capabilities. OSI works with clients during all project phases of subsea network development, from planning and design to procurement and implementation. Our customers, primarily representing Oil and Gas, Telecommunications and Ocean Observing, recognize the value of fiber optic networks to their field and services solutions, and look to OSI to deliver the skills and experience that developing these networks require.

## GYRO COMPASSES

## KONGSBERG SEATEX AS

Pirserteret  
N-7462 Trondheim, Norway  
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Fax: +47 73 51 50 20  
E-mail: km.seatex.sales@kongsberg.com  
Website: www.km.kongsberg.com/seatex  
Contact: Finn Otto Sanne at finn.otto.sanne@kongsberg.com



KONGSBERG

Kongsberg Seatex is a leading international marine electronics manufacturer specializing in the development and production of precision positioning and motion sensing systems. Our commitment is to provide quality products and solutions for safe navigation and operations at sea in the commercial offshore, maritime, hydrographics and defence industries.

## LIQUID STORAGE

## AERO TEC LABORATORIES, INC. (ATL)

45 Spear Road Industrial Park,  
Ramsey, NJ 07446 USA  
Tel: +1 201 825 1400  
Fax: +1 201 825 1962  
E-mail: atl@atlinc.com  
Website: www.atlinc.com  
Contact: David Dack



ATL specializes in the design/manufacture of custom bladder-type fluid containment systems, including tanks, inflatables, pillows and bellows for surface and subsea. ATL's flexible fluid containers boast unparalleled chemical tolerance, abrasion resistance, and remarkable durability - used with methanol, diesel fuel, gases, ethylene glycol, hydraulic fluids and chemical cleaning cocktails. Expedited deliveries are also available.

## MARINE ENVIRONMENTAL CONSULTING SERVICES

## CSA OCEAN SCIENCES INC.

8502 SW Kansas Avenue  
Stuart, FL 34997  
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Fax: +1 772 219 3010  
E-mail: gstevens@conshelf.com  
Website: www.csaocean.com  
Contact: Gordon Stevens



CSA Ocean Sciences Inc. (CSA) is a marine environmental consulting firm specializing in multidisciplinary projects concerning potential environmental impacts of activities throughout the world. With extensive experience in environmental sciences and technical field operations, CSA is staffed and equipped to offer a complete range of services for projects in offshore, nearshore, estuarine, wetland, and freshwater environments.

## MARINE VENTURES INTERNATIONAL, INC. (MVI)

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Tel: +1 772 419 9627  
Fax: +1 772 419 9628  
E-mail: kcomer@marineventures.com  
Website: www.marineventures.com  
Contact: Kevin Comer



Marine Ventures International, Inc. (MVI) provides high quality, marine environmental and technical experts to conduct coastal and offshore field operations worldwide. We leverage our wealth of talent and resources to bring you a customized team of independent contractors, subject matter experts and specialized equipment to get the job done. Our professionals work in a variety of sectors from submarine cable projects and engineering services to protected species observation and environmental consulting.

## MOTION SENSING EQUIPMENT

## KONGSBERG SEATEX AS

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Fax: +47 73 51 50 20  
E-mail: km.seatex.sales@kongsberg.com  
Website: www.km.kongsberg.com/seatex  
Contact: Finn Otto Sanne at finn.otto.sanne@kongsberg.com



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## NAVIGATION &amp; POSITIONING SYSTEMS

## ADVANCED NAVIGATION

Level 8, 37 Pitt Street, Sydney 2000  
New South Wales, Australia  
Tel: +61 2 9099 3800  
E-mail: sales@advancednavigation.com.au  
Website: go.advancednavigation.com/ONT



Advanced Navigation is a privately owned Australian company that specialises in the development and manufacturing of navigation technologies and robotics. The company has a focus on generating products of the highest quality standard, both in terms of hardware and software. Advanced Navigation has specialised expertise across a broad range of fields including sensors, GNSS, inertial navigation, RF technologies, acoustics, robotics, AI and algorithms. Advanced Navigation is an ISO 9001 certified company and maintains a strict quality control system across the two research facilities and three manufacturing facilities that they operate in Australia. Advanced Navigation is a carbon neutral company, offsetting all emissions due to energy use through the planting of trees.

## EVOLOGICS GMBH

Ackerstrasse 76  
13355 Berlin, Germany  
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Fax: +49 (0) 30 4679 862-01  
E-mail: sales@evologics.de  
Website: www.evologics.de



EvoLogics provides the world's most advanced spread-spectrum underwater communication systems (S2C) with multi-channel data management, networking capability, built-in tracking and positioning functions with USBL Data loggers, acoustic wake-up module and releasers optionally included. Deployments in offshore platforms (FPSO, ABS), environmental monitoring, defense systems, ROV and AUV operations and more. Applications include simple positioning and sensor information to transmission of underwater photos.

## KONGSBERG SEATEX AS

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Fax: +47 73 51 50 20  
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Kongsberg Seatex is a leading international marine electronics manufacturer specializing in the development and production of precision positioning and motion sensing systems. Our commitment is to provide quality products and solutions for safe navigation and operations at sea in the commercial offshore, maritime, hydrographics and defence industries.

**RJE INTERNATIONAL, INC.**  
15375 Barranca Parkway, Ste I-112  
Irvine, CA 92617  
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Website: [www.rjeint.com](http://www.rjeint.com)  
Contact: Bruce O'Bannon



RJE International offers product design, development, evaluation and marketing for military divers, offshore and marine scientific communities, search and rescue teams, and more. RJE has become the industry leader in diver navigation and acoustic relocation. Our team has an extensive background in developing, manufacturing, and supplying underwater acoustic marking and relocation systems, diver navigation platforms, and other subsea equipment.

#### NETWORK & DATA COMS

##### KONGSBERG SEATEX AS

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Website: [www.km.kongsberg.com/seatex](http://www.km.kongsberg.com/seatex)  
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**KONGSBERG**

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#### OCEANOGRAPHIC INSTRUMENTS/SERVICES

##### ASL ENVIRONMENTAL SCIENCES, INC.

Victoria, BC, Canada  
Tel: +1-250-656-0177  
E-mail: [asl@aslenv.com](mailto:asl@aslenv.com)  
[www.aslenv.com](http://www.aslenv.com)



- **Metcean Equipment Leasing:** Acoustic Doppler Current Profiler ADCPs (including StreamPro & RiverRay), Ice Profilers, AZFP, acoustic releases, wave/tide gauges, pingers, satellite beacons, CTD+DO+Tu profilers, DO & turbidity loggers, weather station, cages, flotation, bottom frames.
- **Oceanographic Products:** Acoustic Zooplankton Fish Profiler (AZFP), Ice Profiling Sonar (IPS5) & shallow water Ice Profiler (SWIP), Imagenex scanning sonar logger (IRIS), instrument cages, bottom frames. Custom acoustic products and system integration.
- **Consulting:** Field work, data collection, analyses, numerical modelling, acoustics, remote sensing, oceanographic mooring design and system integration.
- **Manufacturer's Representative:** Teledyne RD Instruments, Deep Water Buoyancy, WERA Northern Radar.

**RBR**  
95 Hines Road  
Ottawa, ON K2K 2M5  
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[Website: https://rbr-global.com/](https://rbr-global.com/)

RBR creates instruments to measure the blue planet. From the ocean abyss to the polar ice caps, our sensors track water parameters – temperature, depth, salinity, dissolved gases, pH, and many others. With design and manufacturing centrally located in Ottawa, Canada, our team works in a fast-paced, dynamic atmosphere to serve customers all over the globe.

##### ROMOR OCEAN SOLUTIONS

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Website: [www.romor.ca](http://www.romor.ca)  
Contact: Darrin Verge, President & CEO



ROMOR Ocean Solutions provides instrumentation solutions for the geophysical, oceanographic, defense, security, oil & gas, and renewable energy industries. By partnering with world renowned manufacturers, ROMOR is able to offer technical knowledge, value added services, logistics expertise, and the most reliable instrumentation on the market.

##### SEA-BIRD SCIENTIFIC

13431 NE 20th St.  
Bellevue, WA 98005  
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Fax: +1 425 643 9954  
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Website: [www.sea-birdscientific.com](http://www.sea-birdscientific.com)  
Contact: Calvin Lwin, Sales



Sea-Bird Scientific provides best-of-class sensors and systems for oceanographic research and environmental water quality monitoring of physical and biogeochemical properties. Sea-Bird Scientific is the leader in accurate, stable ocean instruments for measuring conductivity (salinity), temperature, pressure, oxygen, pH, chlorophyll, CDOM, turbidity, beam attenuation, irradiance, radiance, PAR, nitrate, and phosphate. Our CTD profilers, water samplers, moored CT recorders, wave/tide recorders, DO sensors, and optical sensors are used by research institutes, ocean observing programs, government agencies, and navies globally.

##### STAR-ODDI

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Gardabaer, Iceland  
Tel: +354 533 6060  
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Website: [www.star-oddi.com](http://www.star-oddi.com)  
Contact: Baldur Sigurgeirsson



A manufacturer of miniature data loggers with sensors as temperature, depth/pressure, salinity, tilt/acceleration, compass direction/magnetometer, light levels, acoustic receiving/transmitting. The loggers are used for various researches, including oceanography, fishing gear studies, equipment behavioral monitoring and fish tagging.

## SONAR SYSTEMS

**ECHOLOGGER**

303 Venture Center,  
76 Hanggongdaehak-Ro, Deokyang-Gu,  
Goyang-Si, Gyeonggi-Do, 10540, Korea  
Tel: +82-2-3158-3178  
Email: info@echologger.com  
Website: www.echologger.com  
Contact: Doowon Choi



Echologger represents the best quality sonar products in the market. We are a leading developer/manufacturer of high-end ultracompact echosounders and high resolution scanning sonar that are equipped with state-of-the-art features and essential functionalities to match customers' needs in affordable price.

Founded in 2009 and a company located in South Korea, and with a brand name Echologger, EoFE Ultrasonics Ltd. is a knowledge-based company that continuously designs, develops and manufactures high technology sonar devices and solutions to meet the changing needs of the customers. Having been in the industry for years, the company understands how the industry operates and what works best for the benefit of our valued customers.

**EDGETECH**

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E-mail: info@edgetech.com  
Website: www.edgetech.com  
Contact: Amy LaRose



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

**KLEIN MARINE SYSTEMS, INC.**

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Salem, NH 03079  
Tel: +1 603 893 6131  
International: 603 893 6131  
E-mail: sales@kleinmarinesystems.com  
Website: www.kleinmarinesystems.com



Celebrating over 50 years in the marine technology industry, Klein Marine Systems continues to be a world leading sensor technology manufacturer of high-resolution side scan sonar equipment and radar-based security and surveillance systems. Klein Marine Systems has developed a worldwide reputation of excellence in the industry by providing quality products and excellent customer service. Klein sonar systems are deployed by government agencies, navies, port authorities, surveyors, oil companies and universities worldwide. Visit our web site at [www.KleinMarineSystems.com](http://www.KleinMarineSystems.com) and discover how Klein is Making the Oceans Transparent!

**MARINE SONIC TECHNOLOGY**

120 Newsome Dr. Suite H, PO Box 1309  
Yorktown VA 23692-1309  
Toll Free: +1 800 447 4804  
E-mail: Regan.Lipinski@na-atlas.com  
Website: [www.marinesonic.com](http://www.marinesonic.com)



MARINE SONIC TECHNOLOGY  
A brand of ATLAS NORTH AMERICA

Marine Sonic Technology builds high quality, high resolution side scan sonar systems. Located in Yorktown, Virginia, Marine Sonic has been in business for more than 25 years. Our towed systems are rugged, easy to deploy and simple to operate. We also offer highly efficient AUV/ROV embedded systems, which occupy minimal space and low power consumption.

## SOUND VELOCITY PROBES/CTDS

**SAIV A/S**

Nygardsviken 1, 5165  
Laksevag, Norway  
Tel: +47 56 11 30 66,  
Fax: +47 56 11 30 69  
E-mail: info@saivas.com  
Website: [www.saivas.no](http://www.saivas.no)  
Contact: Gunnar Sagstad



Environmental Sensors & Systems

- STD/CTD, Sound Velocity probes/recorder with optional multi-parameter facilities; Turbidity, Fluorescence, Oxygen etc. The new CTD/STD model SD208 with wireless communication and high accuracy: 0.002 mS/cm, 0.002 °C.
- Precision pressure / depth (0.01% accuracy) and temperature sensors/recorders. Applications: hydrographic profilings, installation on ROVs and towed systems, etc. Robust and compact designs are combined with accuracy and "plug and play" compatibility. Output format for sonar equipment, e.g. EM1002, EM3000, SSP, HiPAP and Reson 8125.

## SUBSEA FABRICATION

**NEW INDUSTRIES**

6032 Railroad Avenue  
Morgan City, LA 70380  
Tel: +1 985 385 6789  
E-mail: bill.new@newindustries.com  
Website: [www.newindustries.com](http://www.newindustries.com)  
Contact: Bill New



New Industries provides quality fabrication services to the offshore oil & gas and marine industries focusing on large diameter pressure vessels, suction piles, DNV buildings and deepwater subsea production equipment such as jumpers, PLETs, PLEMs and manifolds.

## SUBSEA TECHNOLOGY

**KONGSBERG MARITIME AS – SUBSEA DIVISION  
(DIVISION OF KONGSBERG GROUP)**

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NO-3183 Horten  
Norway  
Tel: +47 33 03 41 00  
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KONGSBERG

Kongsberg Maritime is a marine technology company providing innovative solutions for all marine industry sectors including merchant, offshore, subsea, naval and fisheries. The company delivers systems that cover diverse maritime applications. Within subsea, Kongsberg Maritime's sonars, Sub-bottom profilers, multibeam and single beam echo sounders, cameras, positioning and underwater communication & monitoring systems, instruments, software and Marine Robotics are used in survey and inspection operations worldwide. Working closely with customers to develop technology that pushes the limits in subsea applications, Kongsberg Maritime is also dedicated to developing innovative environmental monitoring solutions such as the K-Lander system in addition to cutting-edge Marine Robotic platforms such as the futuristic Eelume vehicle.

## UNMANNED MARITIME VEHICLES

**GENERAL DYNAMICS MISSION SYSTEMS'  
BLUEFIN ROBOTICS PRODUCTS**

553 South Street  
Quincy, MA 02169  
Tel: +1 617 715 7000  
E-mail: adam.mara@gd-ms.com  
Website: [gdmissionsystems.com/underwater-vehicles/bluefin-robotics](http://gdmissionsystems.com/underwater-vehicles/bluefin-robotics)  
Contact: Adam Mara



Mission Systems

General Dynamics Mission Systems' Bluefin Robotics products provide undersea capabilities for defense, scientific and maritime customers worldwide. Bluefin Robotics products offer a range of systems and configurations that can operate in the open ocean and in constrained waterways. Our core autonomous product line includes Bluefin SandShark, Bluefin-9, Bluefin-12, and Bluefin-21, Hovering Autonomous Underwater Vehicle (H AUV), and Subsea Power technologies.

The Bluefin Robotics AUV family shares a free-flooded, modular, and open architecture backbone that has enabled the integration of 70+ sensors. We have developed and delivered AUVs worldwide to research institutes and industry and have provided AUVs to the United States' and International Navies.

**INTERNATIONAL SUBMARINE  
ENGINEERING LTD. (ISE)**

1734 Broadway Street,  
Port Coquitlam, BC, V3C 2M8  
Tel: 1-604-942-5223  
E-mail: info@ise.bc.ca  
Website: <https://ise.bc.ca/>

International Submarine Engineering Ltd. (ISE) is a world leader in the design and integration of autonomous and remotely operated robotic vehicles and terrestrial robotics. Over our 40+ years in business, we have accumulated a great deal of expertise in the design, manufacture, and maintenance of:

- Autonomous Underwater Vehicles (AUVs)
- Remotely Operated Vehicles (ROVs) for subsea operation
- Human Occupied (HO) submersibles
- Customized systems for the offshore oil industry
- Customized systems for the Military-Naval sector
- Hydraulic, pneumatic, and electric robotic manipulators
- Teleoperated and autonomous robotic systems
- Robotic systems for nuclear Industry applications
- Communications and real-time control system

**L3 OCEANSERVER, INC.**

275 Martine Street  
Fall River, MA 02723 USA  
Tel: +1 508 678 0550  
Fax: +1 508 678 0552  
E-mail: [sales@ocean-server.com](mailto:sales@ocean-server.com)  
Website: [www.iver-auv.com](http://www.iver-auv.com)  
Contact: Jim Kirk

L3 OceanServer, Inc. is one of the leading manufacturers of unmanned underwater vehicles (UUVs) with over 300 units delivered to customers around the world.

The Iver UUV is an affordable, simple to operate commercial system for military, survey, water quality, and research applications.

**OUTLAND TECHNOLOGY**

38190 Commercial Ct.  
Slidell, LA 70458 USA  
Tel: 985-847-1104  
Fax: 985-847-1106  
E-mail: [jeff@outlandtech.com](mailto:jeff@outlandtech.com)  
Website: [www.outlandtech.com](http://www.outlandtech.com)  
Contact: Jeff Mayfield

Offering the most rugged equipment and unsurpassed customer service, Outland Technology has been the world's leading manufacturer of underwater video, lighting and ROV equipment for over 30 years. We recognize that no two jobs are the same and specialize in products that are customizable for your specific applications.

**TELEDYNE OCEANSCIENCE**

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Poway, CA 92064  
Tel: +1 858-842-2600  
E-mail: [oceanscience.sales@teledyne.com](mailto:oceanscience.sales@teledyne.com)  
Website: [www.teledynemarine.com/oceanscience](http://www.teledynemarine.com/oceanscience)  
Contact: Jamie Carrig



Teledyne Oceanscience manufactures unmanned deployment platforms for echosounders and environmental monitoring instrumentation. Our major products are remotely-controlled Q-Boats and tethered instrumentation deployment Riverboats for echosounders and ADCPs, remotely-controlled Z-Boats for hydrographic surveys in shallow or hard to access areas, the Underway CTD that provide affordable and compact profiling from a moving vessel, and the popular Sea Spider and Barnacle seafloor platforms.

**TELEDYNE SEABOTIX**

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Fax: +1 619 450 4001  
E-mail: [inquiries@teledyne.com](mailto:inquiries@teledyne.com)  
Website: [www.teledynemarine.com](http://www.teledynemarine.com)  
Contact: Jamie Carrig



Teledyne SeaBotix is a world leading manufacturer of capable underwater MiniROVs that perform a multitude of tasks including maritime security, search and recovery, hull and pipeline inspection, hazardous environment intervention, aquaculture, sensor deployment and oceanographic research. The Little Benthic Vehicle systems have become the benchmark in compact ROVs around the world and ROV equipment for over 30 years. We recognize that no two jobs are the same and specialize in products that are customizable for your specific applications.

**VIDEORAY**

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Fax: +1 610 458 3010  
E-mail: [sales@videoray.com](mailto:sales@videoray.com)  
Website: [www.videoray.com](http://www.videoray.com)  
Contact: Chris Gibson



With more than 3,700 ROVs in service around the world, VideoRay is the global leader in Observation ROV technology. VideoRay's underwater robot systems are extremely versatile, portable, affordable, and reliable solution for underwater operations including surveys, offshore inspections, search & recovery, homeland & port security, science & research, aquaculture, and many other underwater applications. The latest Mission Specialist systems provide solutions for particularly difficult underwater challenges. VideoRay is available on the General Services Administration (GSA) Schedule.

**WINCHES, HANDLING, & CONTROL SYSTEMS****MARKEY MACHINERY COMPANY**

7266 8th Ave. South  
Seattle, WA 98108 USA  
Tel: +1 800 637 3430  
Fax: +1 206 623 9839  
E-mail: [info@markeymachinery.com](mailto:info@markeymachinery.com)  
Website: [www.markeymachinery.com](http://www.markeymachinery.com)



Preferred by the U.S. fleet, Markey's advanced oceanographic winch systems provide ultimate dependability, reliability and precise performance when and where you want it. Operating within critical windows of opportunity you can count on our custom winches, capstans, windlasses and auxiliary machinery for the successful execution and completion of your research.

**OKEANUS SCIENCE & TECHNOLOGY LLC**

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Tel: +1 (425) 869-1834  
Fax: +1 (425) 869-5554  
E-mail: [info@oceanus.com](mailto:info@oceanus.com)  
Website: [www.oceanus.com](http://www.oceanus.com)  
Contact: Ted Brockett



SOSI and DT model winches, handling systems, and engineered solutions are available exclusively from Okeanus Science & Technology. Proven, reliable, and cost-effective standard and custom designed winches range from small all-electric instrumentation winches to high horsepower all-electric or hydraulic umbilical and multi-purpose oceanographic systems. Our winches can be packaged or supplied with skids, A-Frames, over-boarding sheaves, docking assemblies, HPU's, and other auxiliary equipment. Okeanus has offices in Houston, TX, Redmond, WA, and Houma, LA.

Airmar / MSI Transducers .....	68	Oceaneering International .....	09
<a href="http://www.msitransducers.com">www.msitransducers.com</a>		<a href="http://www.oceaneering.com">www.oceaneering.com</a>	
CSA Ocean Sciences, Inc. ....	05	OCEANS Conference 2019 .....	51
<a href="http://www.csaocean.com">www.csaocean.com</a>		<a href="http://www.seattle19.oceansconference.org">www.seattle19.oceansconference.org</a>	
ECA Robotics.....	31	Ocean Specialists, Inc. ....	41
<a href="http://www.ecagroup.com">www.ecagroup.com</a>		<a href="http://www.oceanspecialists.com">www.oceanspecialists.com</a>	
EdgeTech.....	21, 45	Okeanus Science & Technology .....	37
<a href="http://www.edgetech.com">www.edgetech.com</a>		<a href="http://www.okeanus.com">www.okeanus.com</a>	
Evologics GmbH .....	67	Shark Marine Technologies, Inc. ....	39
<a href="http://www.evologics.de">www.evologics.de</a>		<a href="http://www.sharkmarine.com">www.sharkmarine.com</a>	
Geometrics .....	47	SPE Offshore Europe .....	58
<a href="http://www.geometrics.com">www.geometrics.com</a>		<a href="http://www.offshore-europe.co.uk">www.offshore-europe.co.uk</a>	
Hydroid .....	04	Sonardyne International .....	43
<a href="http://www.hydroid.com">www.hydroid.com</a>		<a href="http://www.sonardyne.com">www.sonardyne.com</a>	
iXBlue .....	29	SubCtech GmbH .....	36
<a href="http://www.ixblue.com">www.ixblue.com</a>		<a href="http://www.subCtech.com">www.subCtech.com</a>	
J.W. Fishers Manufacturing, Inc. ....	17	Teledyne Marine .....	07
<a href="http://www.jwfishers.com">www.jwfishers.com</a>		<a href="http://www.teledynemarine.com">www.teledynemarine.com</a>	
MacArtney A/S .....	03	VideoRay .....	02
<a href="http://www.macartney.com">www.macartney.com</a>		<a href="http://www.videoray.com">www.videoray.com</a>	
Morgan & Eklund .....	55		
<a href="http://www.morganeklund.com">www.morganeklund.com</a>			



# SMART SUBSEA SOLUTIONS

## S2C TECHNOLOGY: COMMUNICATION AND TRACKING COMBINED

- time, space and cost-saving solutions
- low power consumption for autonomous operations
- advanced data delivery algorithms, addressing and networking, remotely configurable settings
- extendable platform with multiple configuration options: power-saving Wake Up module, acoustic releaser, additional sensors, custom solutions, OEM versions available

### USBL POSITIONING SYSTEMS

**simultaneous** positioning and communication - no need to switch between positioning mode and modem mode

- flexible SiNAPS positioning software
- reliable data transmissions
- range: up to 8000 m
- accuracy: up to 0.04 degrees

### UNDERWATER ACOUSTIC MODEMS

reliable data transmissions even in adverse conditions, customizable R-series modems, light and compact M-series "mini" modems, the S2CM-HS high-speed modem, special editions for developers, S2C communication and positioning emulator - remote access or standalone device

- range: up to 8000 m
- depth: up to 6000 m
- data rate: up to 62.5 kbps

### LBL POSITIONING SYSTEMS

highly accurate, precise and stable performance, simultaneous positioning and data transmissions

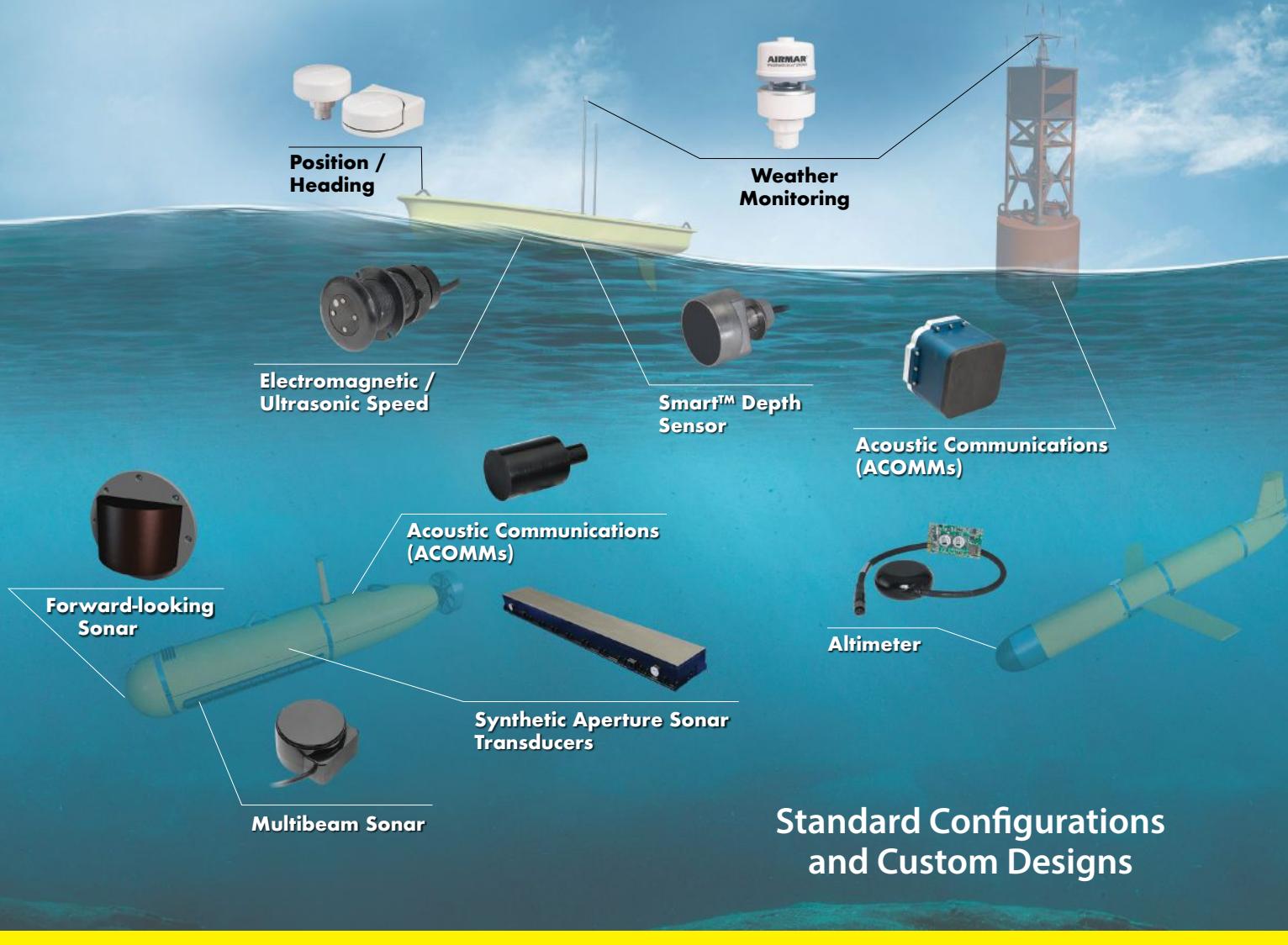
- flexible SiNAPS positioning software
- reliable data transmissions
- range: up to 8000 m
- accuracy: better than 0.01 m

**NEW!**  
**ULTRA-COMPACT**  
**"TINY" MODEMS**



S2C M (left) and the new S2C T "tiny" modem - 20% smaller and lighter

# Acoustic Transducers and Arrays



From prototype to production AIRMAR and MSI push the boundaries of sonar technology. Whether you need a simple single element sensor or a large multi-element array, we have the solution. We specialize in partnerships providing strong engineering support, innovative technology, advanced manufacturing capabilities and exceptional customer service.



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