MARINE TECHNOLOGY REPORTER

May 2018

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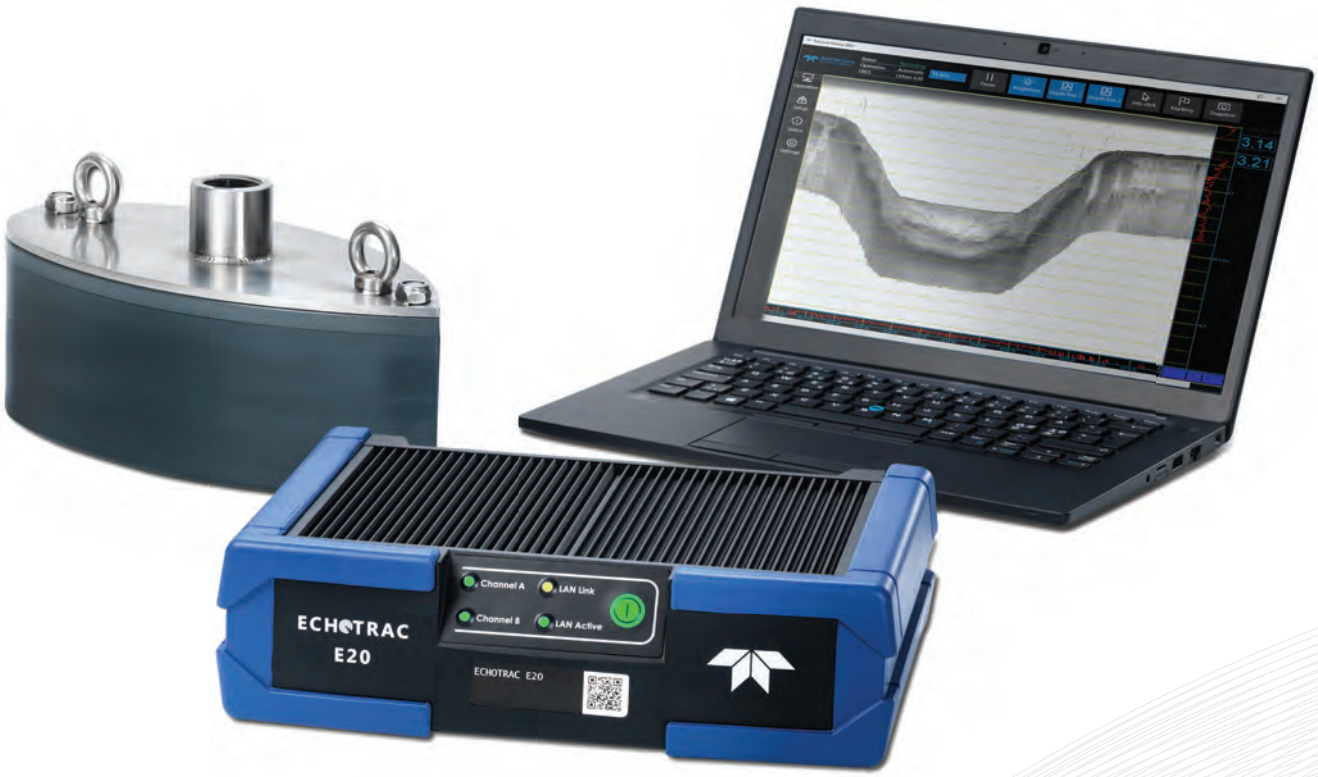

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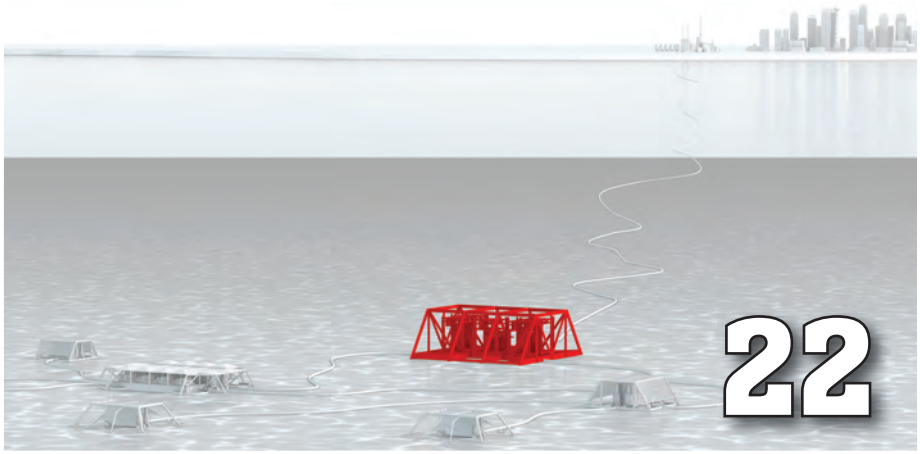

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Elaine Maslin

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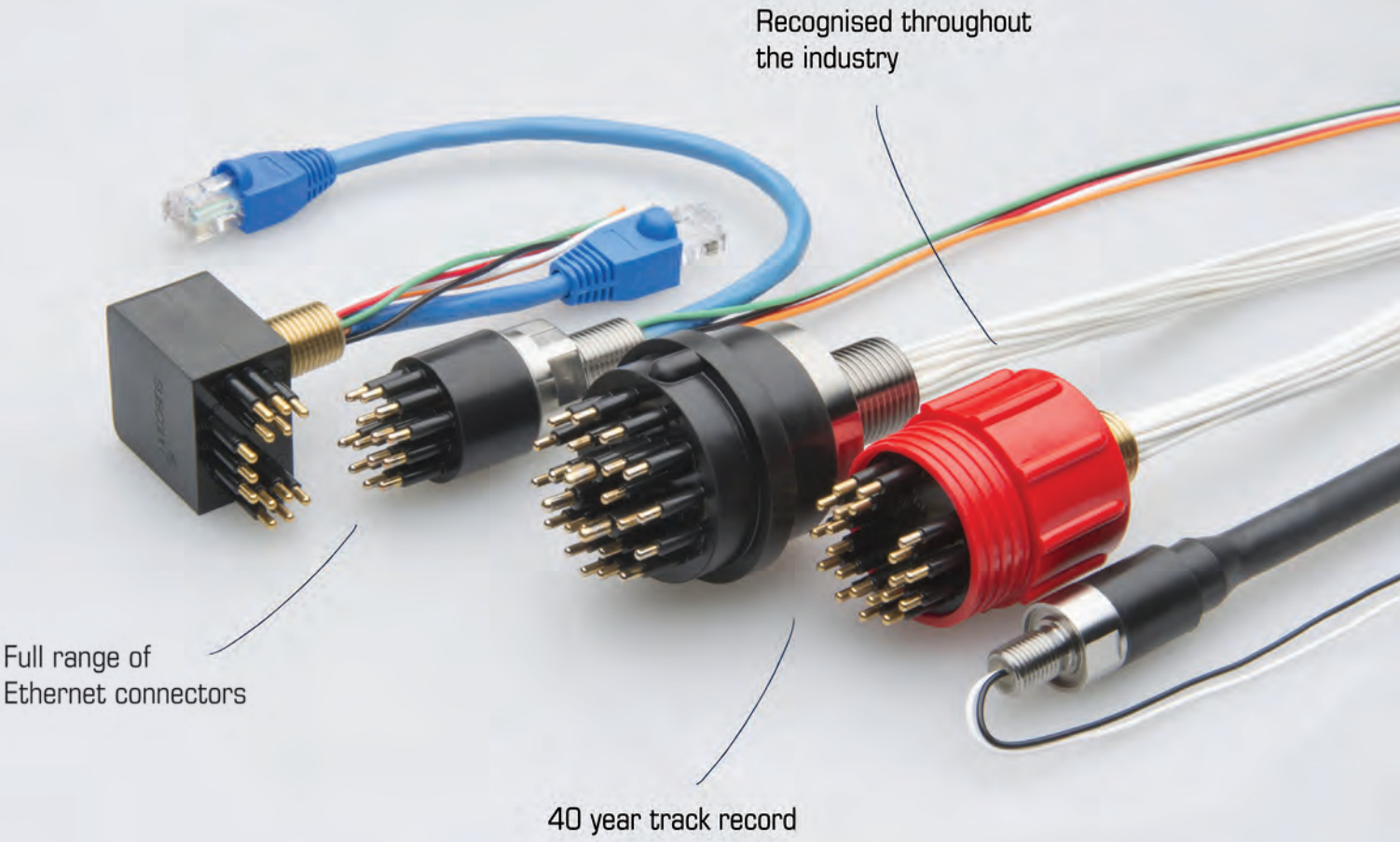

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Editorial

Gregory R. Trauthwein
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Fresh off a quick trip to Houston for the Offshore Technology Conference, I am happy to report that, while the offshore business is still *far* from buoyant, there are ample signs that business is picking up, with projects that were previously put in cold storage being dusted off and prepped for bidding and production.

This OTC capped off a torrid bit of travel all around the world this spring, starting with London and Oceanology International in March and ending with China and a Maritime Finance Forum just prior to OTC. While in Houston I was afforded the opportunity to interview **Yohei Sasakawa**, Chairman of the Nippon Foundation, a global grant fund that has interests in many global projects and issues, including the oceans. The contents of this interview will fuel a future edition, but the Nippon Foundation was in town to sign an MOU with Deepstar, as Japan is definitely in the market for subsea expertise and education of the coming generation, a strategic move to help it discover and recover some interesting natural resources found off of its shores (see page 10).

Per usual, this edition is packed with latest trends and developments on subsea technology, and our latest addition to a growing contributor staff is **Elaine Maslin**, known to many of you for her outstanding reporting on all matters energy, both traditional oil and gas as well as renewables.

Starting on page 22, *"Put a Socket in It"* discusses the energy revolution and recent efforts to power up the seafloor. This was a natural transition to her second feature in this edition, *"Taking Up Residency,"* which looks at the fast-moving evolution of robotic systems taking up permanent residence on the seafloor, starting on page 34.

MARINE TECHNOLOGY REPORTER
www.marinetechnologynews.com
Vol. 61 *No. 4*
ISSN 1559-7415
USPS# 023-276
118 East 25th Street,
New York, NY 10010
tel: (212) 477-6700
fax: (212) 254-6271

Marine Technology Reporter (ISSN 1559-7415) is published monthly except for February, August, and December by New Wave Media, 118 E. 25th St., New York, NY 10010-1062. Periodicals Postage Paid at New York, NY and additional mailing offices.

POSTMASTER: Send all UAA to CFS. NON-POSTAL AND MILITARY FACILITIES send address corrections to Marine Technology Reporter, 850 Montauk Hwy., #867, Bayport, NY 11705.

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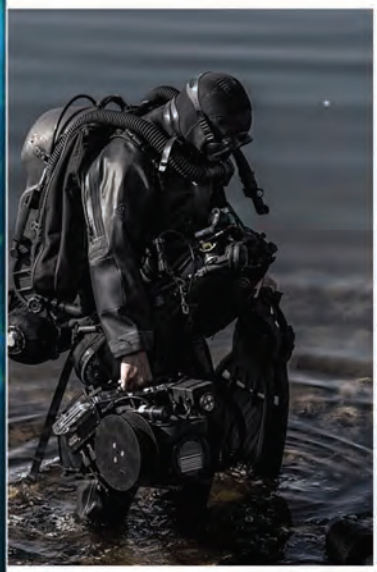

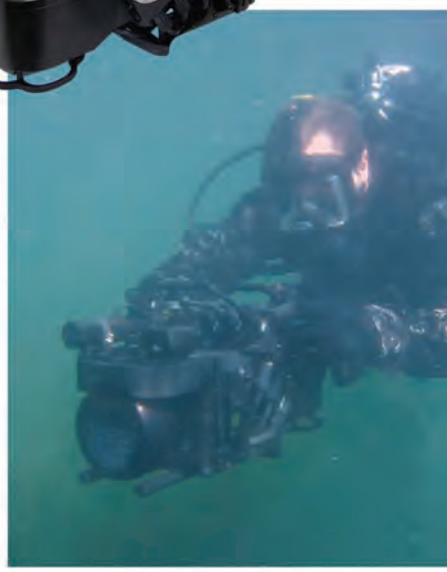

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Hughes

Andy Hughes joined the original Western parent of the Silicon Sensing Systems joint venture, BAE Systems, in 1984. (Silicon Sensing Systems is joint venture company. Today it is owned, 50% each, by UTC Aerospace Systems and Sumitomo Precision Products of Japan). Initially responsible for systems design on a variety of defense programs, he became increasingly focused on assisting customers with defining their requirements and therefore decided to join the company's Business Development team. He holds a Batchelor's degree in Electronic Engineering from Bristol University.

Lundquist

Edward Lundquist is a retired naval officer who writes on naval, maritime, defense and security issues. He is a regular contributor to Maritime Reporter and Marine Technology Reporter.

Maslin

Elaine Maslin is an offshore upstream and renewables focused journalist, based in Scotland, covering technologies, from well intervention and asset integrity to subsea robotics and wave energy.

Mulligan

Tom Mulligan is MTR's science and technology writer based in Ireland. Mulligan was born in London in 1958 and grew up in Manchester, England. He graduated Trinity College Dublin in 1979 with a BA Hons Degree in Natural Sciences (Chemistry). He obtained his Masters Degree in Industrial Chemistry from the University of Limerick in 1988.

Norton

Gregory Norton is a Commercial Director at Honeywell. In this role, Gregory is responsible for driving growth in industrial markets for Honeywell's Packaging and Composites business.

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Teledyne: Custom ROV for Saudi Aramaco

Teledyne Marine and Research Products Development Company (RPDC) have agreed to collaborate on global commercialization of new technologies developed within Saudi Arabia.

"We are pleased to have entered into this cooperation agreement with RPDC," said Mike Read, President of Teledyne Marine. "It formalizes our support of new technology and collaboration in the offshore oil industry with the belief that it will facilitate new and innovative solutions."

A first success under this agreement is the award of a development contract, which will integrate a unique sensor design developed by Saudi Aramco. Under a Memorandum of Understanding signed today at the Offshore Technology Conference in Houston, a special sensor will enable Teledyne's SeaBotix remotely operated underwater vehicle (ROV) to perform shallow water pipeline inspection and monitoring.

Teledyne SeaBotix' Shallow Water Inspection and Monitoring Robot (SWIM-R) is based on a modified vLBV300 ROV that is designed to perform underwater inspection tasks in shallow water environments up to 100 meters. The system consists of a specially modified vLBV300 with manipulating arm and dual measurement sensor (cathodic protection probe (CP) and thickness probe (UT)), an ultra-cavitation spot cleaner, automated navigation package and tracked crawler.

Photos: Greg Trauthwein

Signing left: Mike Read, President, Teledyne Marine; right: Abdulmohsen Almajnouni, CEO, RPD Innovations.

The integrated sensor can perform both ultrasonic thickness readings and cathodic protection voltage measurements at a single touchdown reducing inspection costs for shallow water pipelines, minimize inspection safety hazards and enable the inspection of hard-to-reach sections.

Shape-Shifting Underwater Robot

A Texas-based company started by team of former NASA roboticists unveiled a new multipurpose underwater robot unlike any other. Aquanaut is a new subsea vehicle that employs a patented shape-shifting transformation from an AUV to a ROV, removing the need for vessels and tethers.

According to Aquanaut's developer Houston Mechatronics, the vehicle enables both the efficient collection of data over long distances as well as manipulation of subsea objects – at a cost that's significantly lower than today's technology. "We firmly believe that this technology is a revolution in subsea robotics," said Houston Mechatronics CEO Matthew Ondler. "Aquanaut, and our tightly coupled over-the-horizon software Commander, enables Houston Mechatronics to deliver more feature rich, safer subsea services to commercial and defense customers that demand it."

Aquanaut is able to transform from an AUV to an ROV.

Photo: Houston Mechatronics

RIMCAW

Chain-Climbing Underwater Robot

A robot designed to hook onto, and scale up and down, large mooring chains, both at subsea level and in the air – with a nondestructive testing (NDT), ultrasonic imaging system on board that scans for critical defects – has recently undergone field trials. The new climbing robot, named RIMCAW (Robotic Inspection of Mooring Chains in Air and Water), is being delivered by collaborative partners Computerized Information Technology Ltd, Innovative Technology and Science Ltd, London South Bank University and TWI Ltd. for the inspection of large mooring chains.

TWI

RIMCAW robot being deployed for trial.

Nippon Foundation, Deepstar Sign MOU

Japan's Nippon Foundation and Deepstar signed a Memorandum of Understanding (MOU) recently which essentially will allow Japan to tap the expertise and resources of DeepStar to help Japan discover and recover newfound subsea resources, as well as educate future generations of Japanese.

The MOU was signed on May 1, 2018 at the Hotel ZaZa in Houston, and speaking at the event Nippon Foundation Chairman Yohei Sasakawa said "We need to acquire the resources to discover and reach (our) natural resources. There is no question that Houton is the hub of space exploration, but there are two other areas of clear leadership: baseball and the World Champion Houston Astros, and offshore energy."

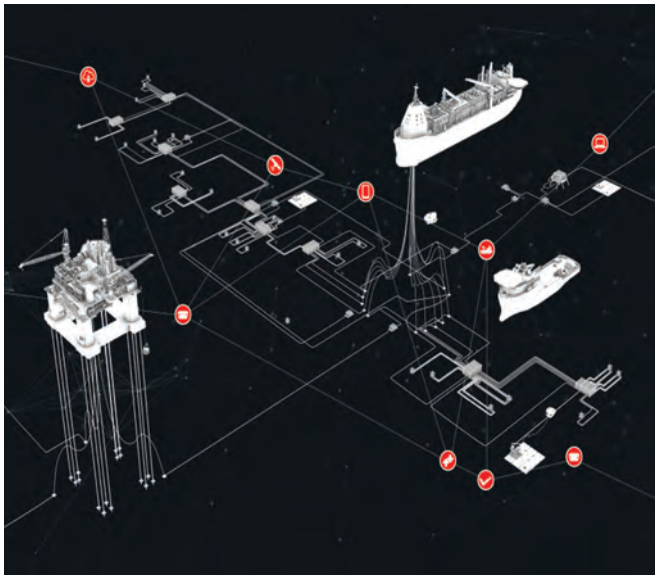
In an interview with *MTR* before the signing, Chairman Sasakawa said that there were two significant points in the signing of the MOU with Deepstar: one is "hands-on" and surrounding the discovery and recovery of natural resources off of Japan, "which as you know are scarce; but there have been recent discoveries of some rare metals" off the shores of Japan. "At the same time we do not have the means or the technology to extract those resouces. This capability is something that Japan will have to acquire as soon as possible to leverage those available resources."

While Japan is a technology leader in robotics and artificial intelligence, the same cannot be said for its offshore energy business. The plan is for the Deepstar relationship to facilitate intelligence transfer for Japan's next generation.

Japan's Nippon Foundation started May 1 at OTC in Houston by signing an MOU with Deepstar, and ended the day at Minute Maid Park to watch the Houston Astros play the New York Yankees. MTR sister-publication Maritime Reporter co-hosted a reception with JSMEA, and a highlight of the night was Nippon Foundation Chairman Yohei Sasakawa (photo 1 far left; photo 2 on Jumbotron; and in photo 3, second from left) **throwing out the first pitch.**

Photos: Greg Trauthwein & Rob Howard

Partners Set Out to Drive Subsea Digitalization



A five-year partnership agreement between Subsea 7 company i-Tech Services and Leidos will aim to develop and apply digital technologies to drive efficiency of operations and competitive advantage in the offshore oil and gas sector.

Through the partnership, the companies say they will be able to increase efficiencies in life of field capabilities by providing clients with greater insights into operations through the field lifecycle through digitalization.

The relationship will leverage Leidos's multi-sector experience in digitalization and enable i-Tech Services to significantly automate manual processes, reduce operating costs and utilize innovative technologies and capabilities to further differentiate i-Tech Services' offerings, the partners said.

Measuring Microplastics in the Oceans

Together with the Swedish Institute for the Marine Environment, Concordia Maritime initiated a preliminary study to determine the feasibility of gathering important information on the volume of micoplastics in the oceans. By installing a collection device on a tanker, water samples can be collected while it is under way for subsequent analysis by researchers. The aim is to draw conclusions as to the extent, distribution of microplastics and potential consequences for living organisms.

In addition to the Swedish Institute for the Marine Environment, the preliminary study, which is financed by Concordia Maritime, is being conducted in collaboration with the Department of Biological and Environmental Sciences at The University of Gothenburg and SMHI (Swedish Meteorological and Hydrological Institute).

Photos: Xocean

Xocean is a new name for our readers. Please provide an overview of the company, and the product you offer.
Based in Ireland, Xocean was founded in early 2017. Using unmanned surface vessels (USVs), Xocean offers turnkey data collection services to survey companies and government agencies. The Xocean platform operates 24/7, accelerating project delivery at a third of the cost of conventional methods. The team has extensive experience in technology development and operational delivery in the marine environment.

There are many vehicles in this market, and in fact a recent proliferation of surface vehicles. What makes your vessel stand out in an increasingly crowded field?
The XO-450 USV is designed specifically for the efficient and cost-effective collection of commercial ocean data, key features include:

- Operation: Full over the horizon using satellite broadband
- Range: 18 days / 1,512nm endurance
- Power: 1,050W continuous electrical load
- Payload: 100kg for sensors
- Transportation: Road trailer or 20-ft. shipping container

Applications include:

- Hydrographic survey
- Fish stock assessment
- Met ocean data collection
- Data harvesting

Xocean's business model is also unique by offering ocean data collection as a turnkey service. We manage everything from mobilization right up to the point we hand over the raw data to the survey organization or government agencies.

Where are you today in terms of ready for market. Do you have vehicles in the water? Are there any systems sold?
We launched the first unit in January 2018 and since then we have been completing extensive sea trials and system tests. Build of the second unit is currently under way and we plan to increase the fleet further by the end of the year.

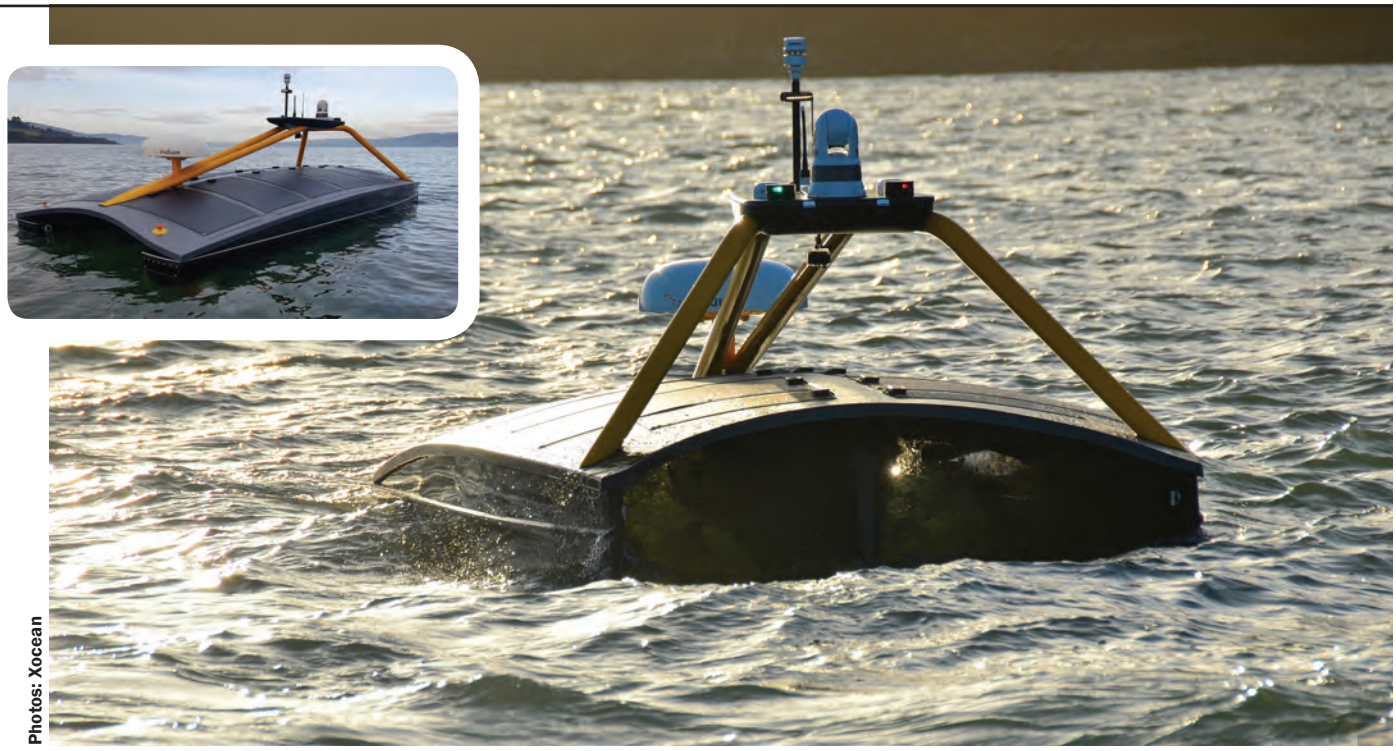
Are you looking to make Xocean a vehicle company, a data company, or both?
Xocean is an ocean data service provider. We offer turnkey data collection services to survey companies and government agencies. End to end, Xocean is responsible from mobilization right through to data delivery to the customer.

What are the company's prime objectives in the coming 12 to 24 months?
We are currently focused on delivering service in Europe and expanding into other markets such as Australia, U.S. and Canada from 2019. We are lining up several projects this year with partners including fish stock assessments, bathymetric surveys and data harvesting.

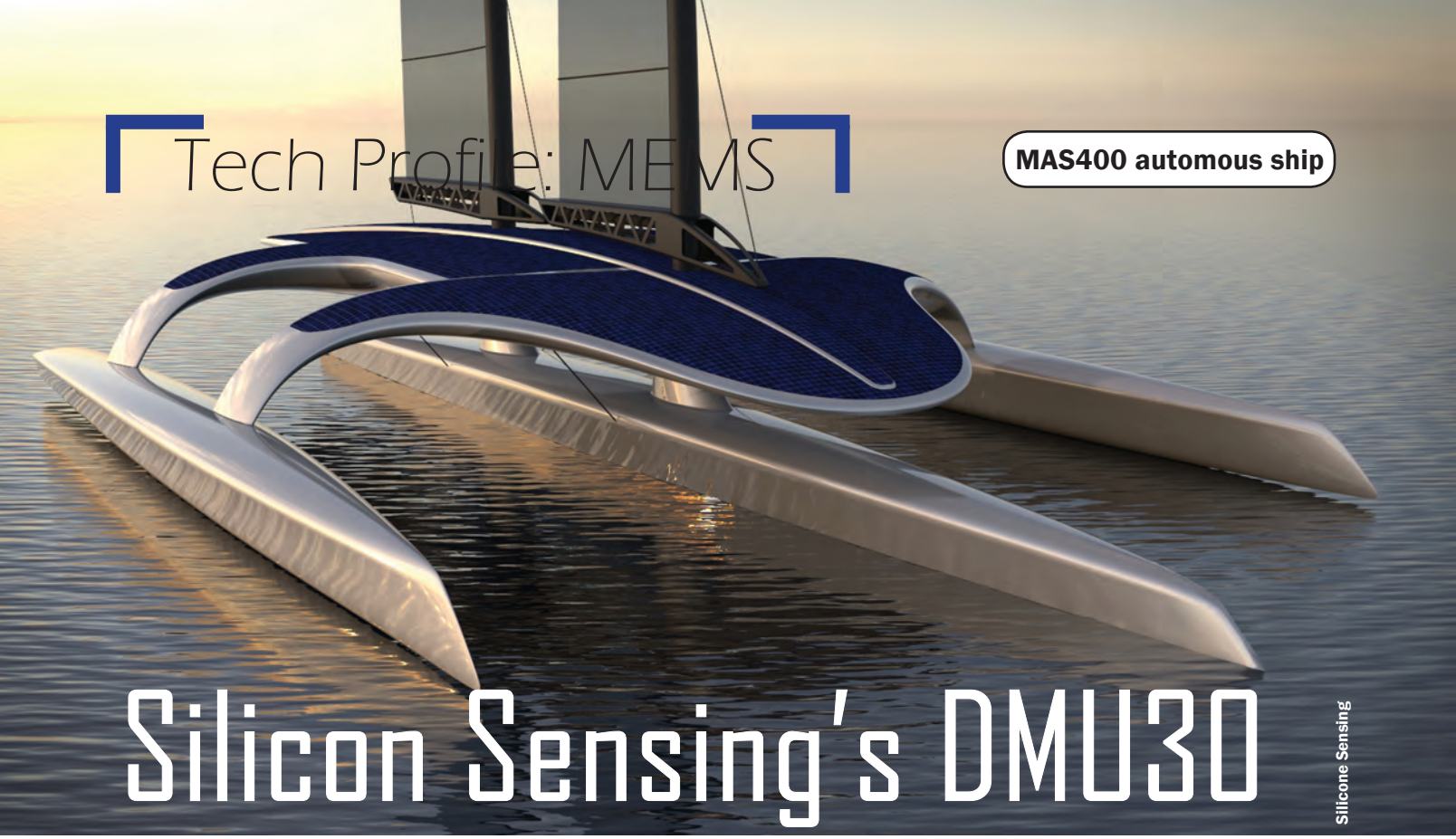
Meet James Ives

James Ives is an engineer and was previously the CEO of OpenHydro, a tidal energy business. At OpenHydro, James scaled the technology from a 35kW prototype to a 2MW industrial class turbine and built an international project portfolio spanning Canada, France, Japan and the UK with customers including EDF, Emera and Kyuden Mirai.

www.xocean.com



Photos: Xocean



Silicone Sensing

Silicon Sensing's DMU30

An innovative core for precise navigation and survey

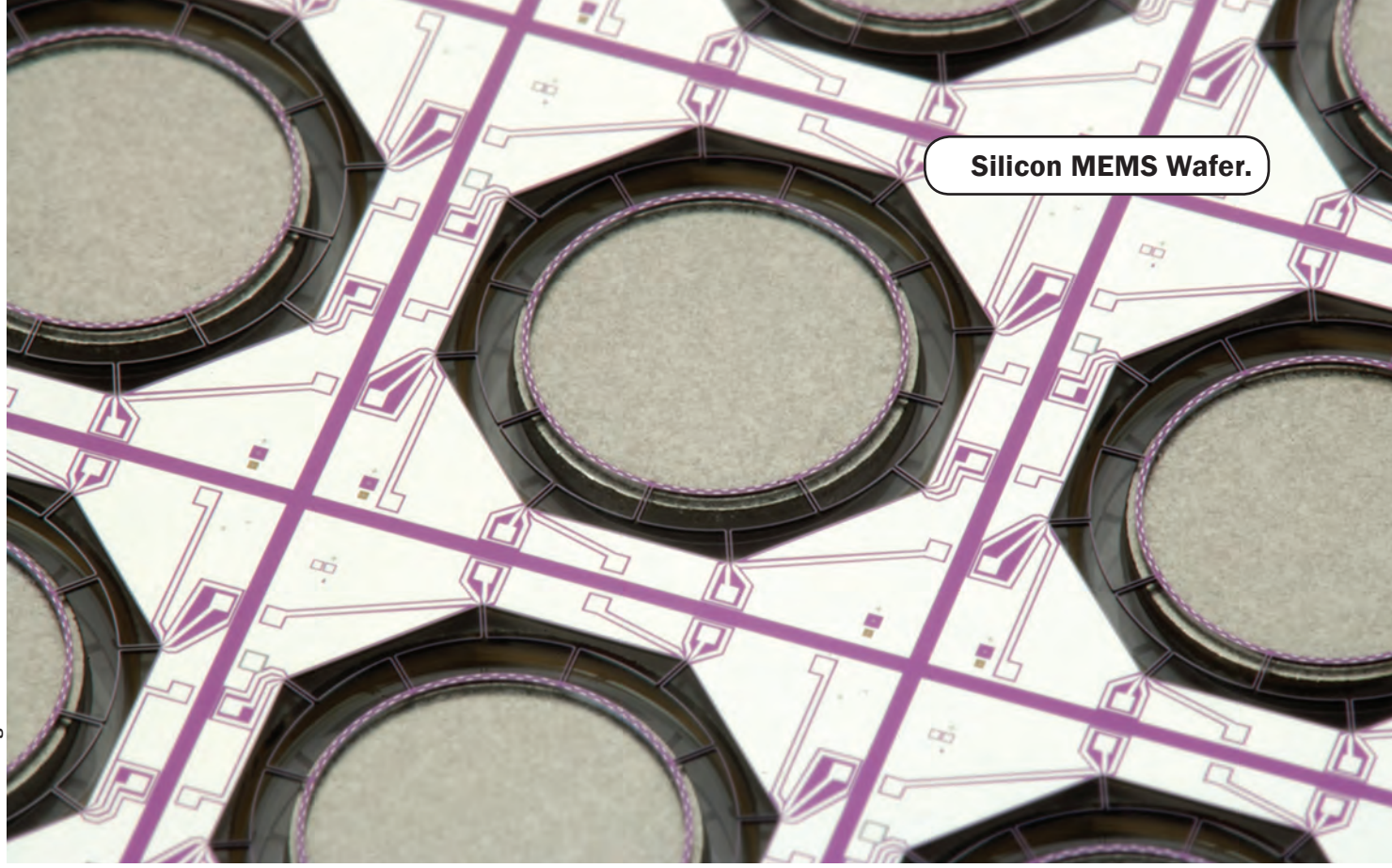
By Andy Hughes, Sales Manager, Silicon Sensing Systems Ltd.

As the autonomous marketplace develops (on land, in the air and at sea), more and more reliance is being placed on the delivery of accurate motion-sensing information to the navigation processing suite. And as these craft become smaller, making more demands on size and weight budgets, designers are looking increasingly towards MEMS (Micro Electro-Mechanical Systems)-based sensors.

DMU30 is a new, high performance inertial measurement unit (IMU) which pulls together the very best of motion sensing technology from Silicon Sensing Systems, a manufacturer of unique MEMS-based gyros and accelerometers. With performance matching that of Fibre-Optic Gyro (FOG)-based systems, this is a new and attractive choice for integrators concious of size, cost, weight and power of their delivered systems, without compromising navigation performance.

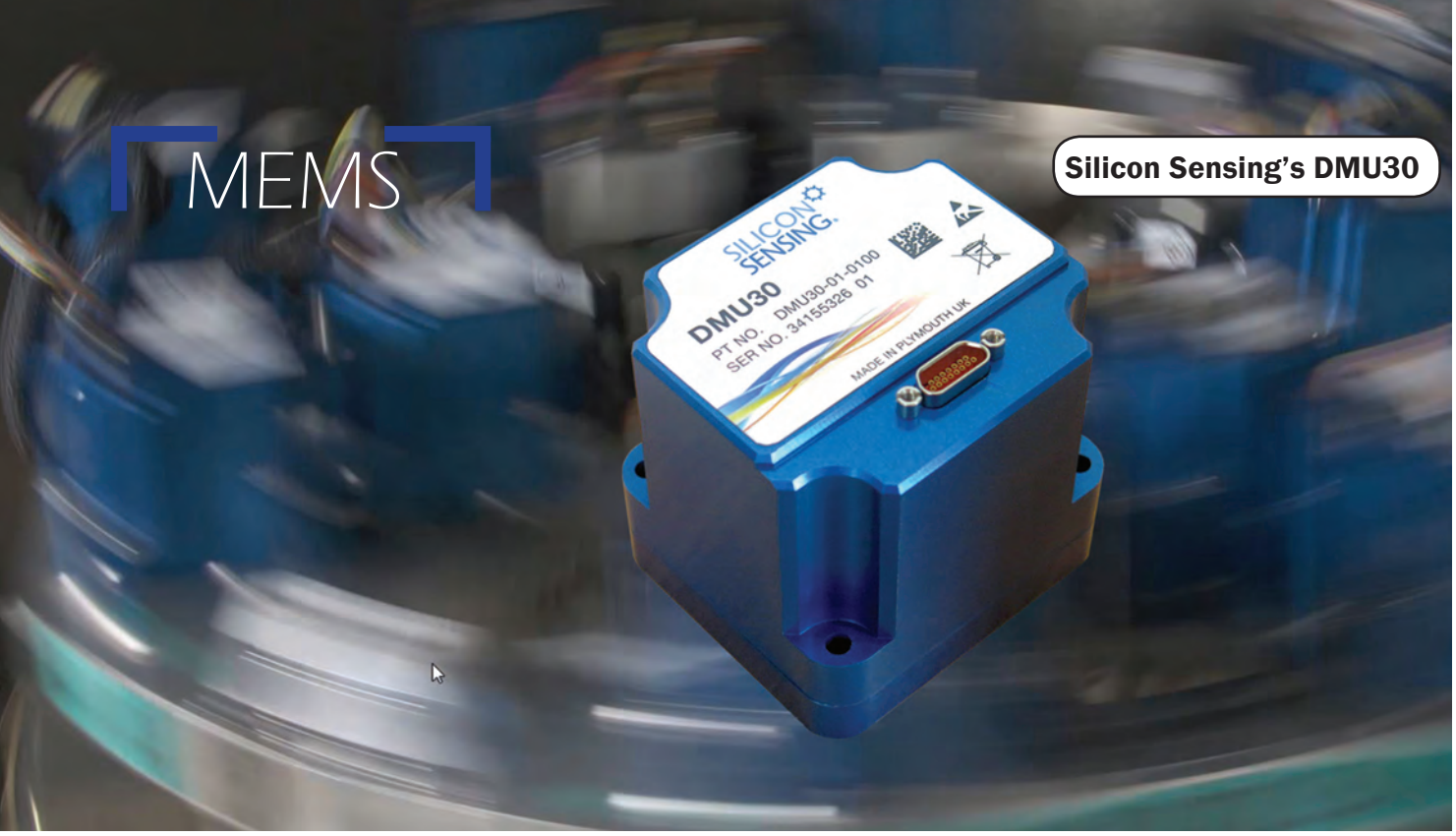
The particular MEMS technology used in Silicon Sensing System's products is based on resonating rings of silicon no bigger than a little fingernail (see image top of next page), delivered from its own foundry in Japan. This technology offers proven, real-world performance with particular immunity to shock and vibration. The latest products are the culmination of 20 years of design and manufacture, initially for the automotive industry and now focused towards tackling high-performance and severe environment requirements across a number of markets. It's worth noting that the sensors in DMU30 are returning to the automotive environment, currently clocking up thousands of miles of road testing in self-driving cars.

Uniquely, DMU30 employs six gyros and three 2-axis accelerometers in its design. Positioning the accelerometers in back-to-back configurations eliminates common-mode error



Silicone Sensing

Silicon MEMS Wafer.


MEMS
Silicon Sensing's DMU30
SILICON SENSING
DMU30
PT NO. DMU30-01-0100
SER NO. 34155326 01
MADE IN PLYMOUTH UK

sources. Three high-performance (low bias error, low rate) gyros are combined with three low-noise high-rate gyros – allowing the best of both worlds to be delivered through sophisticated blending algorithms. Every DMU30 unit is subjected to individual compensation for temperature and orthogonality through hours of spinning in gimballed, temperature-controlled chambers. This ensures each unit delivers maximised performance over the full temperature range of the IMU (-40 to +85°C).

The individual gyro sensors in DMU30, with bias instability of <0.1°/hr and angular random walk of <0.02°/√hr, are sufficiently sensitive to detect earth rotation. When built into a suitable indexing system, DMU30 thus becomes capable of determining the direction of North, even in a magnetically challenging environment.

System integrators for air, land and sea applications have favourably compared DMU30 with rival FOG solutions and have selected the Silicon Sensing Systems offering. In the air, DMU30 is directing LIDAR systems for aerial surveying, and on the ground it is supporting rail track mapping. At sea, the IMU will also perform a key role in the Mayflower Autonomous Ship programme (MAS400), pictured at the top of page 14.

MAS400 will be the first autonomous ship to navigate, unmanned, across the Atlantic and will form part of the Plymouth UK's Mayflower 400 celebrations – the 400th anniversary of the crossing of the pilgrim fathers in the original Mayflower from Plymouth UK to Plymouth MA. As well as sponsoring the program, Silicon Sensing will deliver DMU30 – which will provide highly accurate ship's attitude data to the autopilot that will navigate the ship throughout its voyage.

Feedback from various market sectors has been consistently favorable – with performance of deployed systems exceeding expectations. And, for Silicon Sensing Systems, it doesn't stop there: DMU30 is just the first of a suite of high-performance systems that will shape this marketplace for years to come. Integrated AHRS, INS and GNSS solutions, building on the DMU30 core, will appear over the next two years. Underpinning this, a well-defined technology roadmap will deliver better sensors and additional functionality to customers every year going forward.

Heneywell

Synthetic Rope

Advantages in Deep-Water Ops

By Gregory Norton, Commercial Director, Honeywell

The tides are changing. Exploration and production in deeper water is increasing, and equipment is advancing. New technologies need to offer greater support for changing marine activities, while also maintaining the consistent reliability that is crucial to operating in open waters.

Offshore oil and gas is a prime example of work that is moving into new depths. As these depths increase, performing subsea operations undoubtedly becomes more challenging. Applications such as pipe laying, the installation of subsea equipment, and anchor placement and retrieval all require sophisticated lowering and lifting equipment to fit the specific needs of the location and project. The winches typically used to support these types of applications are often large, cumbersome, and consume immense usable space. Winch systems, heave compensators, and tension members also add substantial weight to a platform – and when working offshore, space and weight are precious commodities.

Traditionally, wire rope has been used as the linear tension member for lowering and lifting operations. Wire rope has good bend-fatigue characteristics, is resistant to heat and, until the recent discussion surrounding steel prices, has been economical. The main drawbacks associated with the use of wire rope, however, are maintenance and weight.

Wire rope requires frequent lubrication to prevent corrosion and to maintain performance. This level of upkeep takes time and money, as well as increases risk when the wire rope is not given the proper attention. For a winch to support wire rope, a significant portion of the winch capacity must be used solely for handling the weight of the wire. Because of this, both the wire rope and the winches are oversized, yielding an inefficient use of power, deck space and ship-weight capacity.

As oil exploration moves into deeper water, the need for lightweight linear tension members is becoming more than just a preference. Some applications are beginning to require lighter weight alternatives – an advantage only provided by synthetic linear tension members. Depending on fiber type, synthetics measure to be at least five times lighter than wire

GettyImages-622200766

Image supplied by Honeywell

of an equal load rating. Moving away from wire rope to the adoption of synthetics can reduce the amount of horsepower required to drive single-drum winch drums, as well as reduce deck loads. In water, synthetics are either buoyant or close to neutral; this means they add little to no weight to the lift. Where synthetic ropes maintain system-lifting capacity regardless of the water depth, steel wire rope lifting capacity is contingent upon the weight of the wire. At a depth of 3,000 meters, the wire accounts for about half the load, leaving a limited useful payload when compared with the rope diameter.

In recent years, synthetic rope has replaced wire rope in a number of applications, including subsea cranes. In many cases, synthetic rope has been successfully utilized in both single-drum and traction winches; its construction provides a rope that can repeatedly be taken over sheaves with no tendency to twist. Applied examples are continuing to point to the assumption that synthetic rope will outlast and outperform wire rope for a myriad of needs, particularly among deep-water operations.

While rope life is impacted by many factors – like the base that is used, the rope construction and the conditions of use in each application – bending fatigue performance is particularly critical in offshore applications where heave compensation is employed. Cyclic bend over sheave (CBOS) tests provide a controlled method for evaluating durability in applications where ropes are cycled on and off sheaves and winch systems. Bending cycles-to-failure in CBOS test equipment provide a quantitative means of comparing fiber materials and rope constructions.

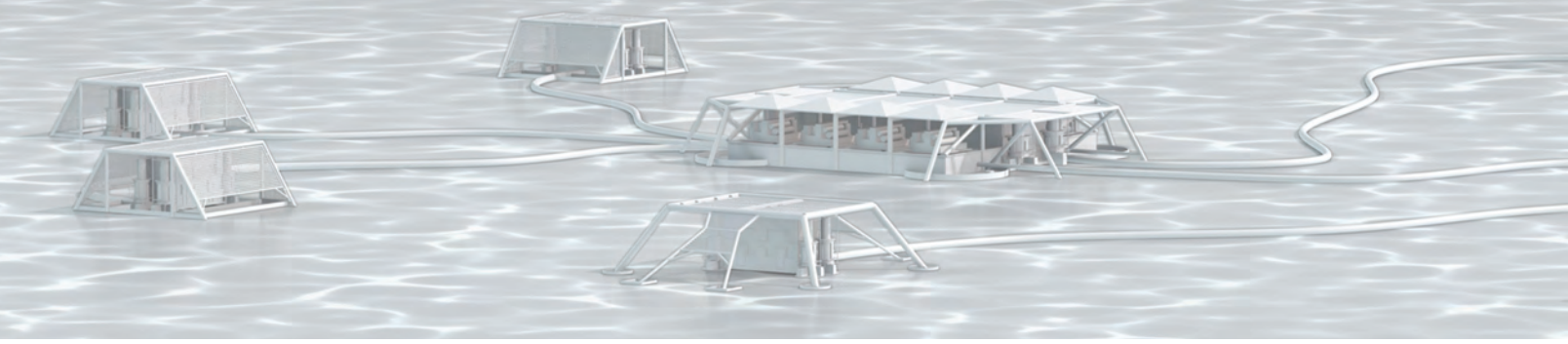
For example, in an isolated, internal application test that compared results using the same rope construction and test conditions, there was a 300% improvement in CBOS cycles-to-failure with Spectra synthetic rope observed in small braids – a performance that has also translated to larger scale ropes.

When viewed at the system level, synthetic ropes have demonstrated significant cost savings and improved efficiency over other lifting technologies – particularly for deep-water deployment and recovery winch systems. Continuing the use of these systems will increase savings opportunities and encourage widespread adoption of installment, thus creating a crucial competitive edge and expectation for operation. Synthetic rope clearly improves reliability and efficiency when designed as part of a lifting system, and it is key for the future of deep-sea exploration and operational advancement.

Powering the seafloor

Put a Socket In It

There's an energy revolution coming on the seabed. Elaine Maslin reports.

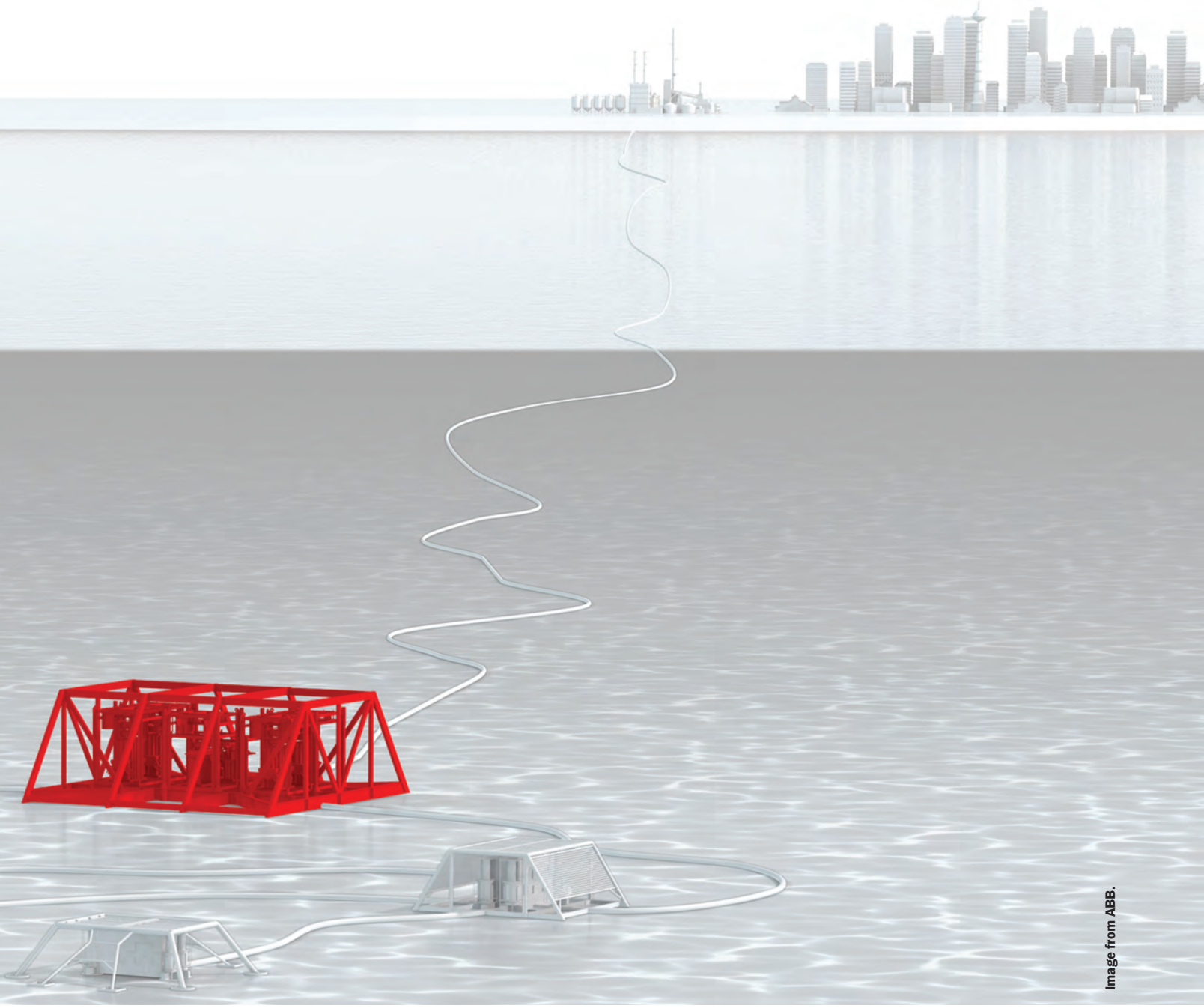


In efforts to boost subsea oil and gas production and reach fields further from shore, in deeper and even Arctic waters, a subsea power revolution is in progress. Several multinationals are developing systems to provide electric power across the seafloor – think subsea power sockets.

Giving access to subsea power this way would help oil and gas firms move processing equipment to the seafloor, instead of hosting it on platforms. On the seafloor, equipment, including pumps and compressors, would be more effective and efficient at boosting production rates. Reduced reliance on platforms would also help reduce oil firms' footprints, reducing pollution risk and CO2 emissions. All-electric systems would also provide more responsive control and advanced health monitoring of subsea equipment.

But, this new infrastructure could support more than pumps, compressors and actuators. It could also be used to support a growing fleet of unmanned underwater vehicles, as well as supporting other industries, from ocean science to deepsea mining.

"Once you have power down there, you can power ROVs (remotely operated vehicles), heating in pipelines (to prevent blockages), and a number of other applications, that are coming up," says Jan Bugge, Vice President of subsea technology at ABB and Project Director of a subsea power joint industry project (JIP) the firm has with Statoil. "There have been dis-



Subsea Power Substation: **ABB's subsea power substation concept visualized.**

cussions about connections to offshore wind, (deepsea) mining, aquaculture… Anything that has power to transmit (such as wind farms) and needs power can use this infrastructure to import and export power. We are just touching the surface."

THE CONCEPT

At the moment, subsea oil and gas systems are electro-hydraulic. Each power consumer is fed with power and communications via separate umbilicals from a topside variable speed drive (VSD). Such a system has limited flexibility, should an operator want to add in a new well or a subsea pump.

The subsea power grid concept, however, would involve a single power line to the seabed equipment (in up to 3,000m water depth at present), potentially from an onshore power source up to 600km away and with no offshore platform. Then, subsea installed switchgear and VSDs would control and distribute power to a range of users, from pumps and compressors to pipeline heating systems and ROVs or autonomous underwater vehicles (AUVs).

The concept is being driven out of Norway, largely by Norway's Statoil, along with other oil majors via JIPs. "The direct benefits (of subsea electrification) are reducing topside foot print and cost, through removal of the hydraulic system, having a smaller, less complex umbilical, smaller and lighter subsea modules, improved health, safety and environment, and simplified testing through removal of pressurised equipment,"

says Vidar Strand, senior sales operations manager, technology and solutions center for oil and gas at BHGE. Strand, speaking at the Subsea Valley conference in Oslo in March, cites a 10-20% typical lifecycle cost saving, from going all electric, with 25% in some cases.

WHO IS DOING WHAT

Moving power electronics subsea is no easy task. Nevertheless, companies including ABB, Siemens and Baker Hughes, a GE Company (BHGE), are working on solutions, by either marinizing already proven components (VSDs, switchgear, transformers, etc.) in one atmosphere containers, or creating and qualifying new components, which can operate in oil-filled pressurized environments.

BHGE has a qualified a one-atmosphere system, which was designed to transmit power 120km from shore to Shell's Ormen Lange field, where it would power subsea compression (a project which was shelved).

ABB is working on a system able to work to transport up to 100MW of power up to 600km and down to 3,000m water depth. It has built and wet-tested a subsea VSD and is preparing for a second, shallow water test, along with a switch gear this year. The complete system is due to be complete in mid-2019. ABB is putting the components in oil-filled containers and using natural convection for cooling.

Siemens, was planning a full system test in 2017. Siemens is

Image from ABB

ABB Subsea: The subsea power grid could help operators monitor more closely the health of their subsea equipment.

mostly putting its components in oil-filled containers too. Siemens Subsea is working on a subsea power grid JIP with Statoil, alongside Chevron, ExxonMobil, Petrobras and, since last year, ENI.

Siemens is also advocating an in-field low voltage distribution system called DigiGrid, which incorporates fiber optic communications.

ALL-ELECTRIC

In tandem with the development of the subsea power grid, moves toward all-electric equipment are being made. All-electric actuators have been in use for 15 years and were the primary form of valve actuation on Statoil's Åsgard subsea compression project – an industry first for subsea processing, launched in 2015, offshore Norway.

Some 8.5 million hours experience has been built up with electric actuators since the first were installed on Statfjord in 2001/2, with 99.3% availability, Eldar Lundanes, Global Sys-

tem Manager, TechnipFMC, told Subsea Valley.

In 2016, Total installed the first fully all-electric subsea Xmas tree (a set of valves on the wellhead), in the North Sea, offshore the Netherlands. One stumbling block to this achievement had been the availability of an electric downhole safety valve (eDHSV), which was achieved, but is only currently proven in a 5in version, which limits applications.

All-electric systems also pave the way for drones. "Using all-electric you have so many more options. You can have drones there all the time, you can plug in to power and communicate with them," says Helge Sverre, business development at Norwegian subsea inductive connector firm Blue Logic. "You could have 24/7 surveillance, cost could be reduced, it would be safer, with smaller footprint, no vessels, lower CO2 emissions…" This could be of particular benefit in sensitive areas like the Lofoten Islands or the arctic.

Indeed, subsea vehicle manufacturers and operators have been developing electric ROVs, AUVs and hybrids for a number of years, with a view to enabling subsea resident vehicles which could plug in to these subsea power sockets to extract data, perform operations and charge their batteries.

Advances made in inductive connectors, for two-way power and communication transfer, by companies like Blue Logic, and through water optical communication, by the likes of Sonardyne, are helping enable subsea positioning and docking, charging, control and through water communication for these vehicles.

ABB's subsea substation system design has had an ROV "socket". With scale, these systems could even help level out energy demand, as is being done in cities where car batteries are drawn down at peak demand, when the cars are not being used, suggests Bugge, treating them like mobile power banks.

Where there's not a large amount of power to draw on, subsea batteries could be trickle charged and then used as and when required, suggests Strand. Standardization of interfaces, not least for docking, for power and communications, is seen by many as important to realizing this vision.

A stickier problem is industry agreement on the failsafe mechanism for safety critical systems. Spring fail safes are currently used, but in an all-electric system, you would move to battery powered failsafe systems. "It is one of the most interesting discussions we have ongoing in the industry – spring or battery?" says Strand. The benefit of an electric fail safe is that you are able to test it without shutting in production. "With the spring, it is not easy to just release it a little bit. With an electric failsafe, you can have full control of torque and speed," says Strand.

Current industry requirements, under API 170 ("the Xmas tree bible," says Lundanes) is very much written for electro-hydraulic systems, however. "There's a bureaucracy to overcome. But we will overcome it."

The downturn in the oil and gas industry has helped. There's more open minds and acceptance to new technology," says Lundanes. "Even if the API is not moving fast, operators' specifications are being opened up to allow new technology, such as all electric. Lundanes cites 25-50% cost reduction by eliminating some of the steel or thermoplastic tubes in the umbilical, and more, if the umbilical can be eliminated completely by also moving chemical storage and injection subsea, and even having local power generation for power needs (ENI

Subsea Lab: ABB is testing power electrics to destruction at its Subsea Lab in Oslo.

Image from ABB

is working with a wave energy buoy firm on such a concept) and using wireless communication.

DATA

There's also another benefit to going all-electric: greater process control and condition monitoring capabilities, and the potential to leverage big data. "Electric systems are inherently more instrumented than hydraulic systems, so you have better knowledge and predictability, and availability and you can further reduce system cost," says Lundanes.

Electric actuation, for example, "improves process control and actuation positioning," says Strand. "Compared with electro-hydraulic systems, there's a huge difference in the amount of data we can leverage." For example, voltage, current and battery data can be measured to know if it will fire the actuator when needed. "You know more about the position of the valve, you can measure the speed of the actuator, and have a torque profile," from which you can infer wear. Vibration data could even help infer information about what is flowing through a valve, he adds.

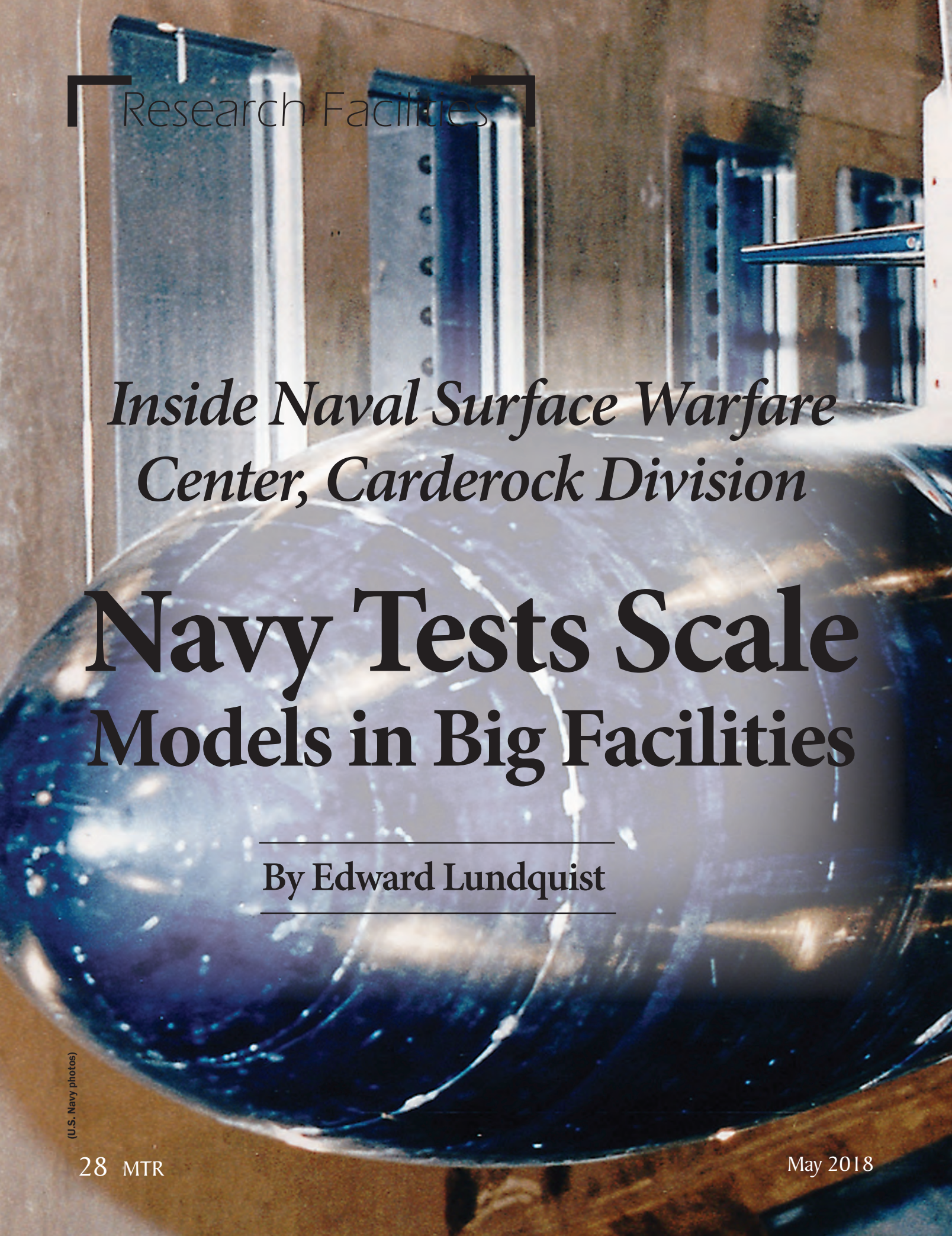
Electric DHSVs (which can be installed faster than their hydraulic counterparts, says Strand) could also support all-electric completions inside the wells, which would then mean more intelligent completions – which again means more information about and greater control of the wells is available. Indeed, BHGE is working on a battery powered DHSV, which is expected to be ready in 2020.

Combining electrification with ethernet and fiber optic communications then enables that data to be readily available, real-time, so that data analytics can be applied for production optimization, condition monitoring and predictive maintenance.

The shape of the communications and computing architecture – i.e. centralized or decentralized (using edge computing) – is still a debate. But, the bottom line is that there's more information and more control and to this framework subsea through water communications can be added, so that vehicles can talk to the infrastructure and each other, without having to physically connect.

This all enables a more flexible system. "Moving to all-electric is like starting with a clean sheet of paper," says Strand. "Today, electric solutions that have been developed for electro-hydraulic solutions were developed within the boundaries of these systems. With all-electric we can go beyond that."

The industry has been here before, in the 1990s, when electric solutions were first considered. "Now the market is ready and the applications are ready," says Bugge. Reliability of this equipment will be key, but it's coming. "It's early days, but I think this energy revolution at the seabed is coming and it won't be just for oil and gas."

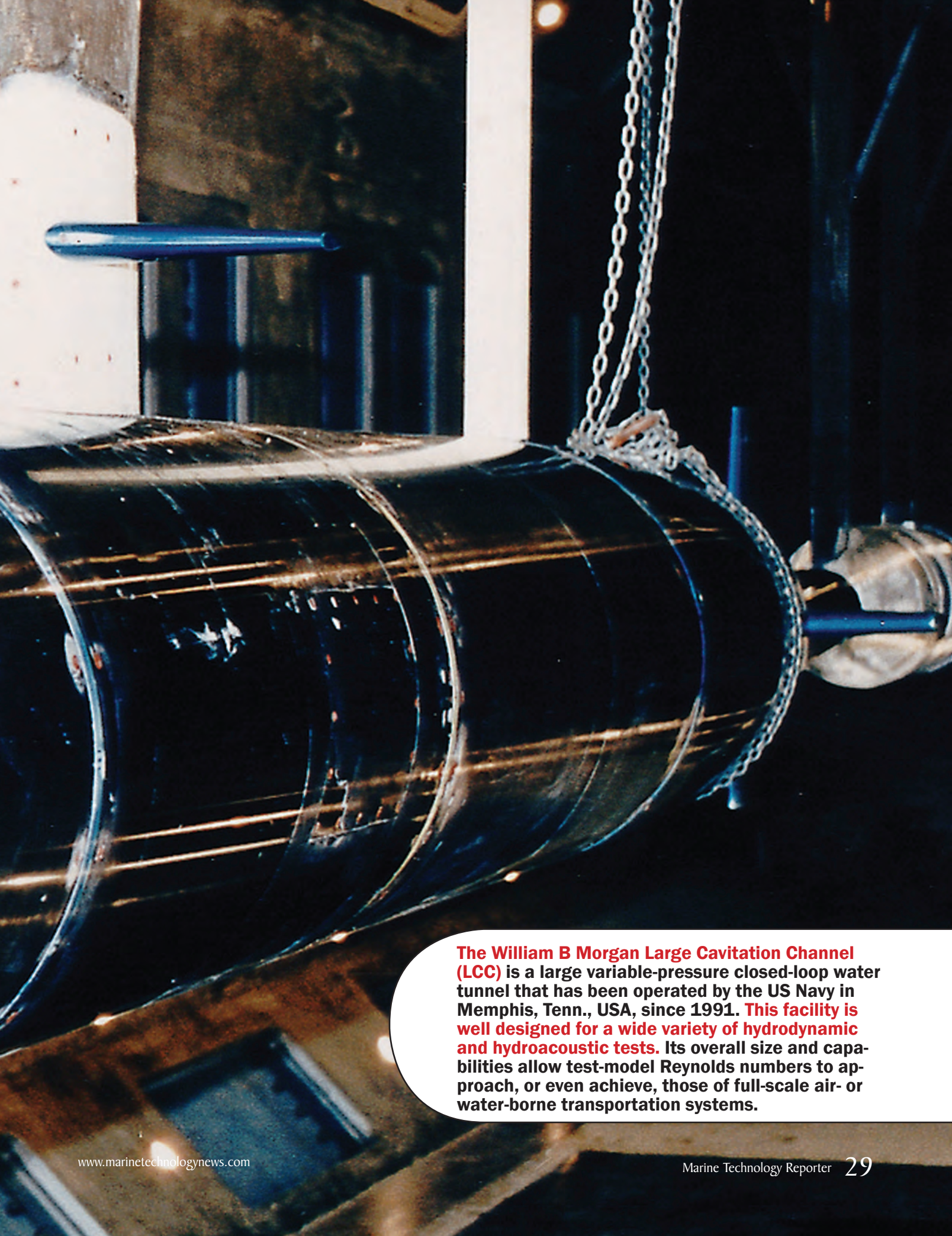


Inside Naval Surface Warfare Center, Carderock Division

Navy Tests Scale Models in Big Facilities

By Edward Lundquist

(U.S. Navy photos)



The William B Morgan Large Cavitation Channel (LCC) is a large variable-pressure closed-loop water tunnel that has been operated by the US Navy in Memphis, Tenn., USA, since 1991. This facility is well designed for a wide variety of hydrodynamic and hydroacoustic tests. Its overall size and capabilities allow test-model Reynolds numbers to approach, or even achieve, those of full-scale air- or water-borne transportation systems.

U.S. Navy Photo by Petty Officer 2nd Class Heath Zeigler/Released

Aqua Harmonic's wave powered single point generator is demonstrated during an innovation showcase in the Maneuvering and Seakeeping Basin in Carderock, Md.

Jessica McElman, an electrical engineer at Naval Surface Warfare Center, Carderock Division, adjusts a magnetic field sensor in the model track located in the Magnetic Fields Laboratory in West Bethesda, Md.

The Naval Surface Warfare Center, Carderock Division in West Bethesda, Md., is one of the world's leading centers for surface and underwater hydrodynamic expertise, research and design, to include world-class facilities for experimentation, testing, evaluation and validation.

"We build scale models of ship designs and can test these hull forms in our facilities to measure hydrodynamic load on the structure or evaluate seakeeping abilities," said Mike Brown, head of Carderock's Naval Architecture and Engineering Department. "This helps us to characterize and predict the performance of our platforms."

Carderock's campus along the Potomac River houses the tow tank to test surface ship, submarine and unmanned vehicle models, as well as the 240 x 360 foot wave making maneuvering and seakeeping (MASK) basin, which can generate any kind of wave and wave pattern that occurs anywhere in the world, as well as waves that don't occur naturally, in a controllable and repeatable environment.

Detailed radio-controlled self-propelled scale models of submarines can be used to precisely measure control forces on appendages and different rudder angles. "We're able to characterize ship performance finely enough to write fly-by-wire algorithms on a full scale submarine," said Brown.

The center's rotating arm basin pivots around a center for propulsor evaluations in turns and captive model stability and control experiments. The center also has access to a reservoir in Maryland where scaled models of both ships and submarines are tested.

But some of Carderock's most impressive capabilities reside far away, at facilities from the Alaska to the Bahamas, and from Tennessee to Idaho.

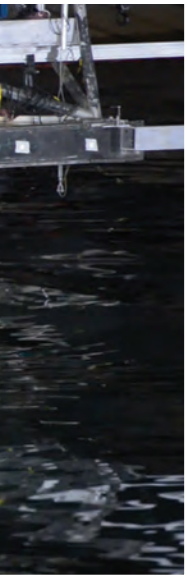
Carderock's Combat Craft division in Little Creek, Va., manages a number of small craft projects to include design, construction, acquisition and sustainment.

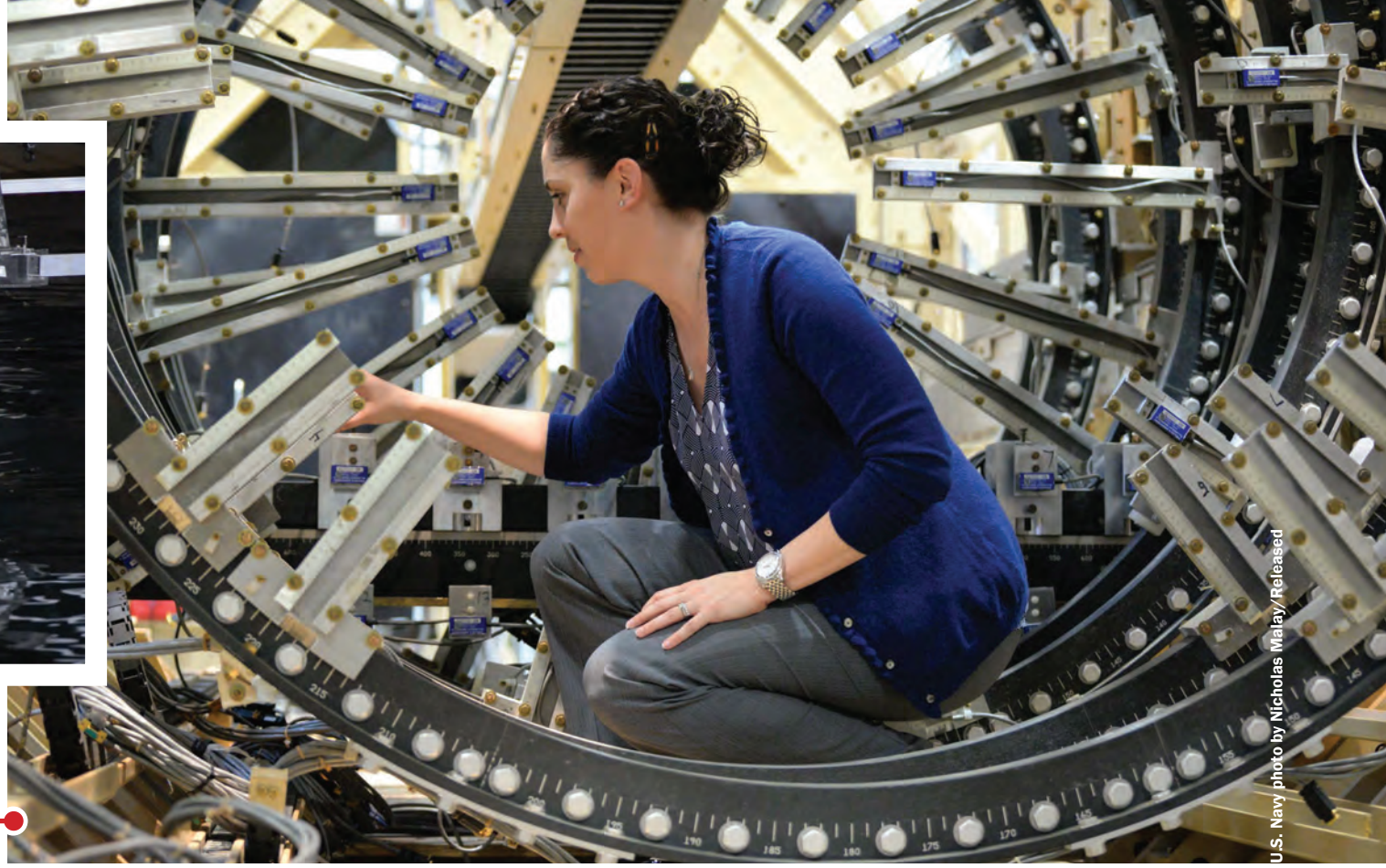
The South Tongue of the Ocean Acoustic Measurement Facility (STAFAC) in the Bahamas and the Southeast Alaska Acoustic Measurement Facility (SEAFAC) near Ketchikan, Alaska, feature underwater arrays to perform high fidelity passive acoustic signature measurements.

Carderock's Acoustic Research Detachment (ARD) is located far from the ocean in Idaho. Thanks to deep and quiet Lake Pend Oreille, the Navy has a superb controlled environment for acoustic testing using large scale model submarines. The ARD maintains self-propelled large scale vehicles (LSV), such as the 90-foot long Kokanee (LSV-1), a scale model of a Seawolf-class submarine, and the 110-ft. Cutthroat (LSV-2) model of a Virginia-class boat, for the evaluation of design changes and new technologies to ensure the boats are as quiet as possible.

The William B. Morgan Large Cavitation Channel (LCC) is located on the banks of the Mississippi River in Memphis, Tenn. The LCC is like a wind tunnel, but filled with a 1.5 million gallons of fresh water. Just as a wind tunnel helps understand aerodynamic properties of various shapes, the LCC can test shapes like scale models of surface ships, submarines or even full-size torpedoes and underwater vehicles, collecting enormous amounts of data to measure extremely small perturbations in hydrodynamic performance.

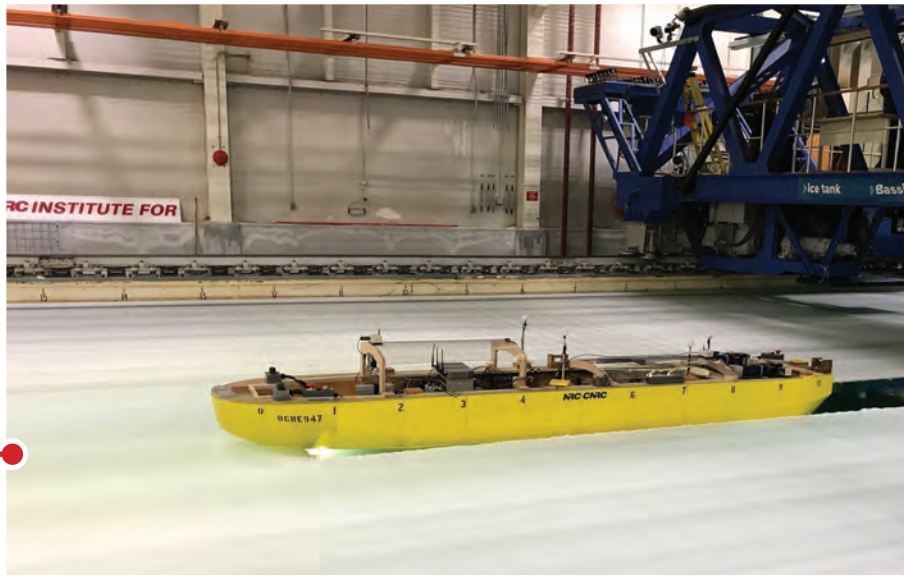
"In the LCC, the model is held in place in the test section and we control the flow of the water around it," said Dave Fos-





U.S. Navy photo by Nicholas Malay/Released

U.S. Navy photo by Steven Ouimette/Released



A model icebreaker demonstrates its maneuverability during a test at the National Research Council of Canada's facility in St. Johns, Newfoundland. The test showcased the progress made on the testing and evaluation of design models for the U.S. Coast Guard's icebreaker acquisition program, which is being supported by an international, multiagency team including engineers from Naval Surface Warfare Center, Carderock Division.

A ship hull model attached to a high-speed sled moves through waves at the David Taylor Model Basin at Naval Surface Warfare Center, Carderock, during ONR-sponsored research.

ter, LCC Operations Manager. The flow is created by a 14,000 hp electric motor. "By varying the RPM of the large motor driving the 18 foot diameter LCC propeller, the velocity of the flow of the water through the test section can be controlled precisely to match the test parameters," said Foster.

The test objects are suspended in a 10 x 10 by 43 ft. long chamber. The chamber can be drained and opened to gain access to the test object, which can be changed to test difference shapes and configurations. "We can create different control surfaces through 3D printing," said Brown.

Right now the LCC is being used to characterize the performance of the propulsor for the Columbia-class ballistic missile submarine, the replacement for the Ohio-class submarines. "We built a scale model of the entire submarine and propulsor to measure everything from unsteady forces to powering to cavitation. It's the most sophisticated model Carderock has ever built," Brown said. "We can vary the test conditions and measure very small perturbations in performance."

And unlike the ocean, a big advantage of the LCC is that the team can change the LCC flow and pressure and vary model parameters such as control surface and model angles. "We can maintain test conditions for hours under precise conditions allowing the collection of large amounts of data in the course of a day," said Foster.

"We recently conducted testing of full scale minehunting towed system. The LCC was the only facility where we could obtain actual data without taking it to the ocean" Brown said.

"And unlike the ocean, the LCC test section has windows allowing the test object to be observed and recorded during the runs," Foster added.

The tests can be run in many iterations to validate and improve the computer modeling capability at Carderock.

A significant amount of testing is conducted before coming to the LCC. "We can do our computer modeling of the computational fluid dynamics, then build a physical model to test in our tow tank. Then we can test that model, or a larger one, in the LCC. Eventually, our signatures department can conduct acoustic testing at the ARD in Idaho.

Using data obtained from testing models in the Carderock facilities, the computer models are improved to provide better predictions and then these computer models can used to run millions of variations to fully characterize the properties and behavior of different designs.

The Navy has also utilized the U.S. Army Corps of Engineers Engineer Research & Development Center Cold Regions Research & Engineering Lab (CRREL) laboratory in Hanover, N.H., which has world-class facilities to conduct testing and research in extremely cold environments, such as submarine operations in Arctic waters.

Academic institutions and commercial companies also use Carderock's facilities to support testing involving complex computational fluid dynamics, flow patterns and cavitation.

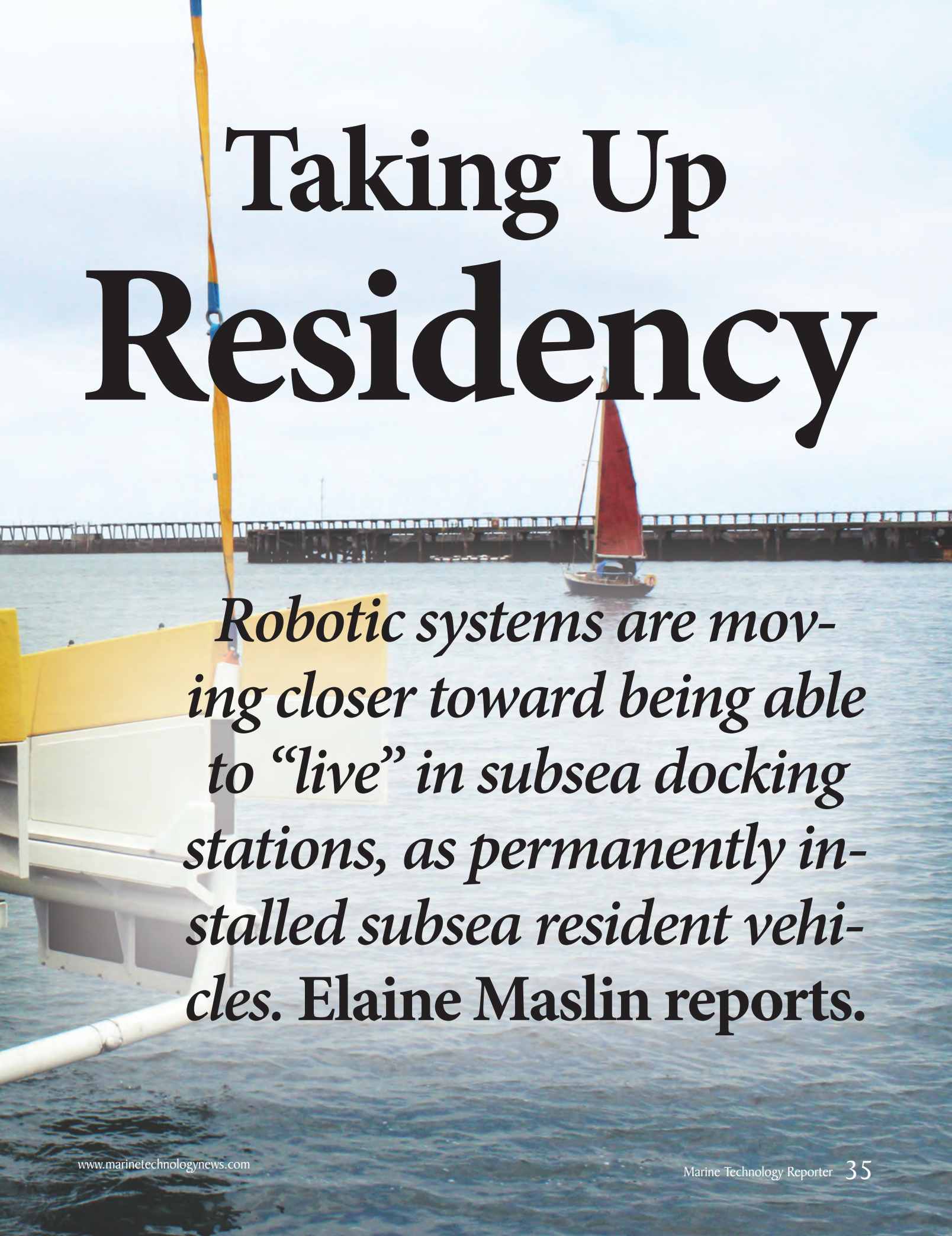
"We work together through CRADAs, which are mutual agreements that benefit all parties," Brown said.

Cooperative Research and Development Agreements (CRADAs) are legal agreements between a government research and development laboratory and a non-Navy partner to cooperatively conduct research and development in a given technical area and share in the technical results derived from the joint effort.

U.S. Navy photo by John F. Williams/Released

Modus Seabed Intervention's
resident vehicle for offshore wind docking station.

Image: Osbit.



Taking Up Residency

Robotic systems are moving closer toward being able to "live" in subsea docking stations, as permanently installed subsea resident vehicles. **Elaine Maslin reports.**

Image: Saab

For the 40 years that the oil and gas industry has been working subsea, there's been a gradual evolution in the technology it uses. Remotely operated vehicles (ROVs), built to perform underwater tasks in place of divers, have evolved from fairly crude machines to today's highly capable and complex vehicles, with many now electrically powered.

Autonomous underwater vehicles (AUVs), which operate without a tether (umbilical) are now supplementing ROV operations, by providing an alternative for survey operations including pipeline. But there's now also another new entrant to the subsea underwater market: resident vehicles, from resident ROVs to hybrid vehicles.

Why?

One of the main drivers is cost reduction. ROV support vessels cost a lot. Remove the need for the vessel and a significant percentage of the cost of the operations is removed, Statoil's Tom Glancy, Advisor Pipeline Mapping & Geographical Information, told an International Association of Oil and Gas Producers event in Stavanger last year.

Having a vehicle living subsea, in "garages" or docking stations, could also reduce wait-on-weather time, operations costs in harsh conditions, and health, safety and environmental issues. It could also mean the ability to collect more data and mean faster response time. Another driver is the move by oil firms into ever deeper waters.

What's Been Done

It's not a new concept. French subsea robotics firm Cybernetix, now part of TechnipFMC, developed the Swimmer concept – a shuttle to deliver a work class ROV to a docking station subsea – and then the ALIVE (autonomous light intervention vehicle) concept (an intervention-AUV, or I-AUV) in the late 1990s early 2000s.

Subsea 7 has long been developing its autonomous inspection vehicle (AIV) resident concept and in recent years has been testing the vehicle offshore, including docking ability. BG Group, now part of Shell, developed the FlatFish AUV, with the help of German research institute DFKI and Brazilian research organisations. It is an inspection and survey vehicle which was aimed at being able to be launched from a floating production platform or docked subsea. (read more in November/December 2016 *MTR*). In March, Saipem and Shell agreed to work together to commercialise the FlatFish.

There is now increasing interest from other operatots. Since

Saab Seaeye's
Sabertooth hybrid ROV/AUV.

2016, Norwegian oil and gas operator Statoil has been investing in programs to trial subsea resident vehicles, initially using existing electric ROVs. The operator is taking the idea so seriously that it's coined (and trademarked) a new phrase, the underwater intervention drone (UID).

Saab Seaeye

A vehicle already operating in the market is Saab Seaeye's Sabertooth. The Sabertooth, which demonstrated docking capability in 2013, is a hybrid hovering ROV/AUV. The Sabertooth can work as an AUV, ROV and hybrid, has payload adaptability – which could soon also include a work class electric manipulator - and can work in 3000m water depth (with a target for 4500m). It can be operated via a thin fiber optic tether real-time communication/control at excursion ranges of up to 12km and can operate much further in AUV mode, without the fiber cable.

For autonomous operations, Sabertooth is fitted with sensor reactive control and enhanced navigation capabilities, says Peter Erkers, sales director, underwater systems, during the Subsea Valley conference in Oslo in March. These capabilities, including autonomous docking, got Sabertooth on Italian oil firm Eni's Clean Sea project, a subsea monitoring system covering oil spill detection, preplanned surveys along flowlines and pipelines, and inspection of subsea production systems (SPS).

A Sabertooth is also being used in resident system project for offshore wind farms, being developed by U.K.-based Modus Seabed Intervention, with engineering firm Osbit and the Offshore Renewable Energy Catapult. This year, Modus will be trialing an AUV docking station with a Sabertooth, for recharging and communications, in an indoor tank before going offshore to an Innogy-owned wind farm, Gwynt y Mor.

In AUV mode, the Sabertooth has already done multibeam echosound pipeline tracking, magnetometer/gradiometer pipeline tracking and bottom sediment sampling. An electrical torque tool and an Orion a sensor for detecting buried pipeline or cable tracking have also been developed.

Saab Seaeye also has plans for autonomous contactless cathodic protection measurements, using field gradient sensor technology. It's also working on autonomous structure inspection and riser/umbilical/mooring chain inspection operations, with trials in all these areas planned for this year.

In addition, Saab Seaeye is working

Image: Elaine Maslin

on feature-based identification for navigation, enhanced station keeping, remote control from an unmanned surface vessel (ASV) and also to demonstrate and commercialize 3D terrain navigation and 3D object recognition. To this will be added 3D mapping and 3D vision capability, to enhance tracking/navigation capability, position estimation, stereo vision and the ability to compute distances to objects, says Erkers.

For long-term resident capability, Saab Seaeye is planning to add recharging and data upload/download capabilities and then carry out long-term testing and a reliability enhancement program.

Saab Seaeye is also developing its own electrical manipulator, equivalent in size and power to an industry standard work class ROV manipulator, such as the Schilling T4. Prototype joint testing was carried out late last year and it is due to be launched to the market in Q4 2018. Saab is also looking at other electric tooling.

"Sabertooth is not a work class ROV," Erkers says. "It's an AUV that has capabilities other AUVs do not have. It is not easy to develop this type of system. In 2015, Saab Seaeye demonstrated that it had everything needed to have autonomous behaviour – auto-docking, station keeping, 3D terrain navigation. Eni Cleansea is 10 years ahead of Statoil."

Freedom

One of the latest concepts to emerge on the market is Oceaneering's Freedom. Oceaneering says that the 3.3m-long vehicle will be able to perform inspection, advanced survey, and light intervention work, under a modular design.

This will mean it can be configured for the mission it's required for.

"Freedom will be autonomous or with real-time control operation," says Arve Iversen, ROV Operations Manager, Oceaneering, during Subsea Valley. "It will be free swimming or tethered, long-range and with the possibly of being resident for long periods of time."

Freedom will have a common center section, housing system components that will support four different vehicle configurations: inspection and light intervention; towed, long range survey and long-range inspection. The different configurations are created by switching out the vehicles nose and aft sections. The vehicle will also have access to a suite of intervention tooling, stored subsea.

As a resident vehicle, Freedom will operate out of one or more docking stations, which provide power for recharging, tooling, and data upload and download. This will be in a frame, sitting on a subsea base (suction anchor), which contains a

Saipem's Hydrone platform, on show at MCE Deepwater Development.

launch and recovery and docking basket. The basket would be used to recover the vehicle for any maintenance, etc.

The docking station will also house system components like navigation aids, battery packs and control infrastructure, and a homing beacon for the vehicle to home in on, says Iversen. Iversen says the vehicle would be able to go on 50km excursion, untethered. Oceaneering is aiming for offshore prototype trials Q2 next year.

"We are looking at solutions where if you don't have sufficient power if link to existing fields we don't have any power or communication network as it is you need to find other solutions," he adds. "We are looking at using communication buoys, wave buoys to charge the power. For new fields, it is important to design these (technologies in) from the beginning. You need to trickle charge batteries in the docking station."

Image: Elaine Maslin

Stinger's drone docking station, on display at Subsea Valley in Norway.

Hydrone

Saipem also has a resident vehicle concept, which is part of a fleet of vehicles, labelled the Hydrone platform. The SonSub Hydrone platform was designed to perform life of field subsea services and includes the Hydrone R, a resident vehicle, Hydrone W (a work class semi-resident ROV) and Hydrone S (an advanced survey and inspection unit). They would use a subsea docking stations, called ByBase (for permanent deployment) and HyBuoy (a power and communication buoy for temporary/permanent deployment), as well as from a vessel when required. The Hydrone R is described as being able to work as an ROV, tetherless ROV and AUV and able to work down to 3,000m water depth, according to a presentation by Stefano Meggio at MCE Deepwater Development in Milan. It would be able to move between different subsea garages, which would also house various tooling skids, as well as recharging facilities, and would be open to third party component integration, Giovanni Massari, a Saipem project manager, told last year's Underwater Technology Conference in Bergen. The Hydrone R unit would be controlled from a floating production vessel or from shore. It would also have a "menu" of automated missions, which could be selected remotely by operators onshore and implemented autonomously by the Hydrone-R.

The Hydrone-S is an "advanced resident AUV," says Meggio, with an interchangeable tooling skid, operable down to 3,000m water depth, with 8-12 hour endurance, and 50km excursion ability.

Saipem has already been testing remote operations ability with its Innovator ROV, deployed off the Castorone pipelay vessel with control from onshore in Aberdeen via satellite. Meggio says the FlatFIsh concept will share the technologies developed by Saipem for the Hydrone platform.

Flexibility

Statoil's hope is that while there may be different vehicle solutions, that they will "plug" in to the same socket, much like we plug different devices in to the same sockets in our homes. To this end, Statoil has a roadmap to see a field-proven vehicle agnostic docking station on a subsea production system in 2020-23, ready to pilot a UID that can swim autonomously between stations and perform survey and IMR tasks.

In fact, Norwegian company Stinger is developing a UID docking station able to support any resident vehicle. Bjarte Langeland, CEO at Singer, says the company is designing two systems: a UID docking station and its "little sister," a plug socket, which can support multiple power and communications needs but with a smaller footprint.

The 9m-long UID docking station would be modular and could be a standalone station or retrofit inside a production

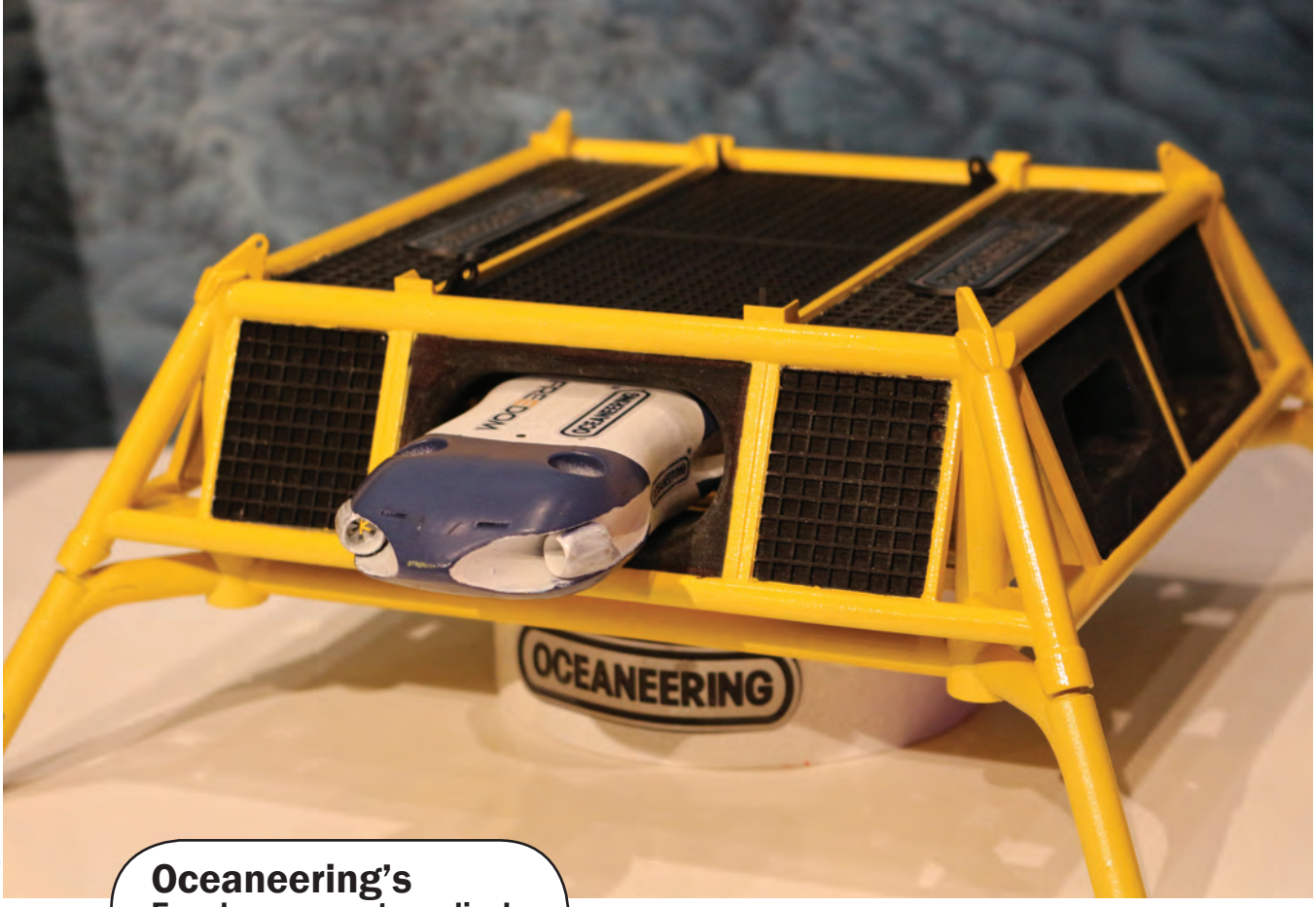


Image: Elaine Maslin

Oceaneering's Freedom concept, on display at Subsea Valley in Norway.

template, says Langeland. It would include a vehicle "landing plate" and a tool induction plate, for various interchangeable tools and sensors for resident vehicles to use. Statoil is planning a number of test installations with this system offshore at the Åsgard field and at inshore locations, as part of qualification work. These would have "Lego-like" inductive power supply and wireless communication connection points for vehicles to plug into, which will also mean operations rooms onshore will see live what tools are in place and how well charged they are, etc. The docking station would also have batteries, a bidirectional smart charger.

Is it Commercial?

Glancy says the UID concept could be more attractive if it could be a shared service, for example, operated on a joint venture or leased to other operators, as well as for civilian, surveillance, security or other mapping applications. Further into the future, unmanned surface vessels could assist unmanned subsea operations.

Glancy says there are still various challenges, however, including the readiness of subsea infrastructure for resident vehicles, regulation relating to unmanned vehicles, and scepticism and resistance to change. But, with a string of roadmaps in place, from vendors to operators and service providers, resident subsea vehicles are just a matter of time.

Interview: Antony Croston Trelleborg Offshore

By Eric Haun

Antony Croston is Business Group Director at Trelleborg's offshore operation in Houston, responsible for the externally-facing functions of the business covering engineering, business development and project management.

MTR caught up with Croston recently to discuss some of Trelleborg's latest developments in buoyancy, FEA and engineering analysis, and fire suppression solutions.

What is dynamically adjustable buoyancy, and how does this technology benefit its users?

Dynamically adjustable buoyancy is a patented technology whereby the amount of uplift acting within a structure can be increased or decreased during service. Its primary application is within the 'subsea shuttle', a developmental concept that is intended to provide a cost-effective way of subsea structure installation or chemical injection. For the installation version of this concept, payloads are 'shuttled' from the surface to the seabed via a submersible barge, controlled via wire rope deployed to two service vessels. Once in position, the buoyancy can be removed from the barge through pumping as it is no longer needed, and can be used elsewhere on other barge systems. Furthermore, if recovery of the payload is required at some point in the future, the dynamically adjustable buoyancy can be pumped back into the subsea shuttle to allow accurate trimming of weight, enabling precise control of its recover to the surface with wire rope payout length. We believe that this technology offers a credible alternative to traditional heave-compensated crane installation from a vessel, especially as the buoyancy is reusable and strongly customizable.

Please describe Trelleborg's new multi-functional buoyancy solution, Helically Grooved Buoyancy. How did this product come to be, and what are its chief advantages?

In addition to providing critical uplift to drilling risers, the

Subsea View of Inverted Helical Grooves on Drill Riser Buoyancy.

Image: Trelleborg

Next-gen Firestop

Image: Trelleborg

incorporation of the patented helically grooved technology dramatically improves operational drilling windows. The design achieves this through a combination of reduced drag and the effective suppression of Vortex-Induced Vibration: a common problem with drilling risers in high currents. The helical grooves actually channel water around the riser and convert it into a rotational flow, which 'pins' the riser in place to lower drag forces. The product is a result of a joint development exercise between Trelleborg Offshore and Diamond Offshore Drilling, and it has been thoroughly qualified in simulations and hydrodynamic testing, as well as through successful deployment on a number of drilling rigs in the Gulf of Mexico. With the combination of VIV mitigation and low drag, performance has been shown to rival fairings, yet this integral solution comes without the operational drawbacks of increased riser running time. The net result is the ability of drilling rigs to operate in higher currents, with greater time available for disconnect operations in the event of bad weather.

How does engineering analysis at the start of a project lead to more technically sound designs? Will you please provide a few examples?

Generally, every project starts with engineering analysis at pre-FEED and FEED stages. Here, ancillary equipment provided by Trelleborg's offshore operation is typically designed based on experience, or with rough parameters suitable for a system-level design. By incorporating engineering analysis into Trelleborg's product engineering teams, products can be designed with the system in mind. More importantly, the overall impact of a design on the rest of the system can be assessed to provide the best optimization within the broadest parameters. For example, changes to the position, spacing or even shape of distributed buoyancy modules can be made to provide the absolute highest fatigue life of a riser, as opposed to the traditional approach with equal spacing and standardized sizes. It enables us to 'speak the language' of the overall system and ensure that we are communicating the potential options that can be considered at pre-FEED and FEED stage. Furthermore, engineering analysis allows us to convey the true impact of design improvements to contractors and operators. In the example of our helically grooved buoyancy, it gives us the ability to convert the tested values of drag and VIV suppression into tangible terms such as the increase operational uptime or reduction in fuel usage. This is essential for us to be able to effectively communicate the benefits of the technology.

What is Trelleborg doing to help minimize fire escalation on oil and gas rigs?

We are currently doing several things to help minimize fire escalation on oil and gas rigs including developing our next-generation Firestop material at our in-house laboratory in Norway. Based on proven technology, the material is lighter and thinner than our first-generation material. Both versions are used to protect personnel and equipment by providing time to evacuate people, close down critical equipment and for responders to gain control of a fire. The newly formulated compound allows for manufacturing processes such as extrusion and press molding that could not be done previously, enabling us to better support our customer's project needs and reduce both costs and lead time.

When you look at today's offshore oil and gas market, where do you see Trelleborg's best opportunities for growth?

Our best opportunities for growth have been when we've aligned ourselves with our customers' needs, and we see this only getting more important moving forward. All companies today are looking for ways to reestablish competitive advantage through efficiency, technology, responsiveness or any combination of the three. By meeting regularly with our clients and understanding their objectives, we are gearing our own focus to supporting them in achieving their goals as much as possible. Without doubt, solutions that improve the efficiency of operations without compromising safety are proving to be the most attractive opportunities at the moment.

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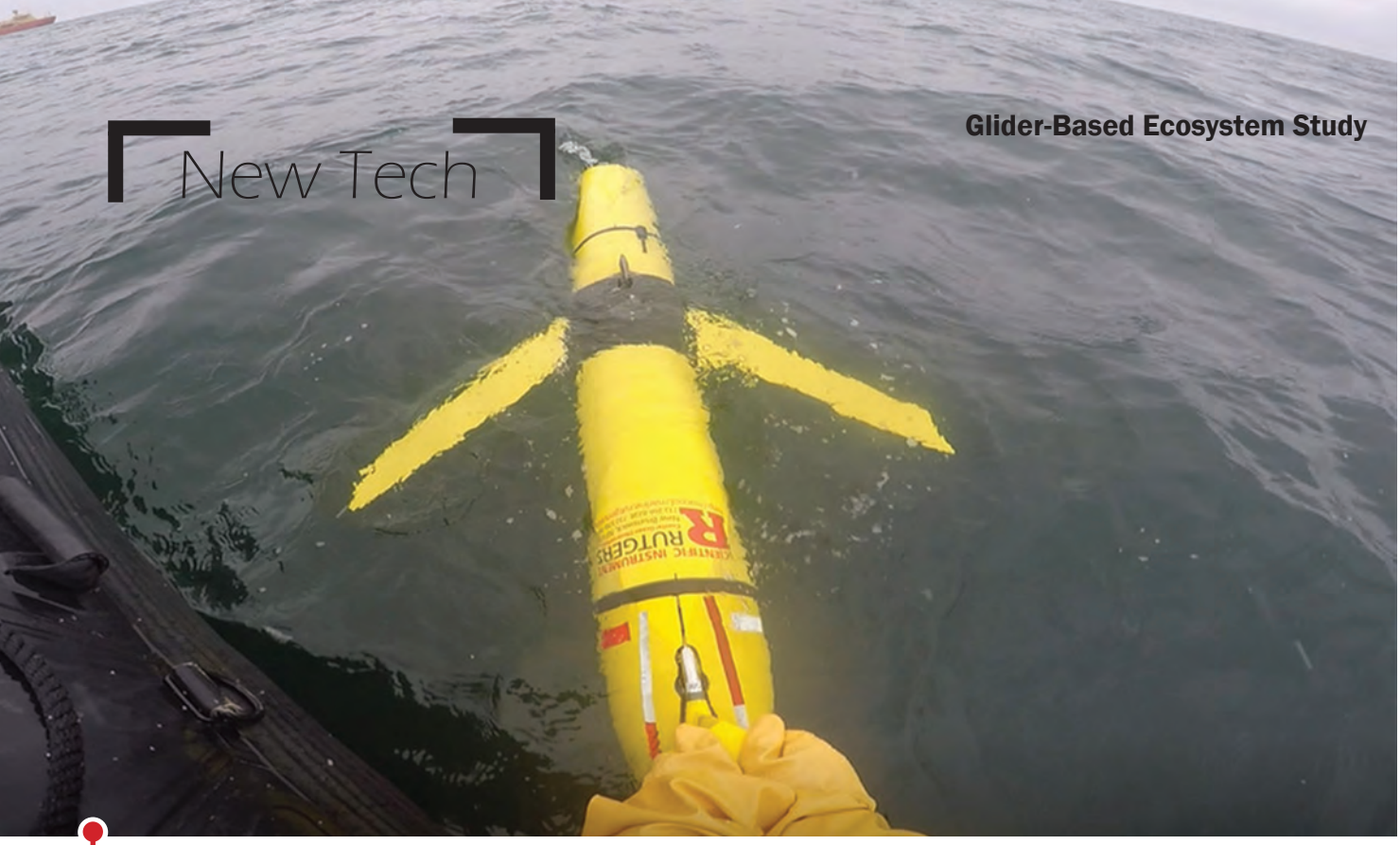


Photo: Corie Charpentier, post-doc research associate at Rutgers University

Glider-Based Ecosystem Study

On January 9, 2018, a post-doctoral researcher and undergraduate student of Dr. Grace Saba (Assistant Professor, Rutgers University, Center for Ocean Observing Leadership) deployed a Teledyne Webb Slocum Glider with an integrated ASL Environmental Sciences Inc. Acoustic Zooplankton Fish Profiler (AZFP) 38, 125 and 200 kHz instrument in the Terra Nova Bay (Ross Sea, Antarctica). The deployment lasted 3 weeks and the glider was recovered on January 31, 2018.

The purpose of this deployment was to obtain mesoscale and sub-mesoscale measurements of hydrographic processes and simultaneous biological distributions and abundance. From the resulting data, the researchers will examine the interactions between multiple trophic levels (phytoplankton, zooplankton and fish) and their relationships to the physical hydrographic driving forces such as sea ice and currents.

A key component to this investigation is the AZFP's ability to differentiate key species within this important Antarctic food web. Species of specific interest include various copepods, crystal krill (Euphausia crystallorophias), and Antarctic silverfish (Pleuragramma antarcticum). The glider was also instrumented with a CTD, a WET Labs BB2FL ECO puck to measure phytoplankton biomass and an Aandera Optode dissolved oxygen sensor.

To validate glider acoustic-based species, size and abundance data, a coordinated ship-based acoustic and net sampling program was conducted in close proximity to the autonomous glider. Open accessible, automated hydrographic data produced during this project is available through RUCOOL (Rutgers University Center for Ocean Observing Leadership) and THREDDS (Thematic Real-time Environmental Data Distribution Services).

Aquabotix SwarmDiver Micro USV / UUV

UUV Aquabotix Ltd. released SwarmDiver, a micro unmanned surface vehicle (USV) and unmanned underwater vehicle (UUV) that operates in a swarm. Multiple SwarmDiver can function simultaneously as a single coordinated entity, be controlled via one operator on the surface, and perform dives on command to collect valuable intelligence.

"This vehicle is a game-changer for both the industry and Aquabotix," said Whitney Million, Aquabotix's CEO. "Until today, there were simply no micro hybrid USV/UUV vehicles and no swarming unmanned vehicles with diving capabilities, commercially available in the industry. Aquabotix has changed that."

Maritime swarming is rapidly becoming an area of focus for naval forces globally. SwarmDiver advances amphibious warfare tactics as it is engineered to handle dynamic operational situations, including Intelligence, Surveillance, and Reconnaissance (ISR) missions and sophisticated, coordinated assaults through tracking, trailing and overwhelming targets.

SwarmDiver Particulars

- Miniaturized – weighing 1.7kg at a length of 75cm
- Vertical dive capability
- Ability to operate as both a UUV and a USV
- 50m dive-depth
- Easy to deploy and Recover
- Wireless data feedback upon surfacing
- High accuracy temperature & pressure sensor
- Additional sensor payloads available
- Multi-constellation GPS for +/-1m location accuracy
- Deployable in groups for synoptic data gathering
- Sustained surf zone operation

Self-Compensating Magnetometer

Ocean Floor Geophysics (OFG) reportedly offers the only Self-Compensating Magnetometer (SCM) system that can operate with the sensor mounted inside an AUV to acquire high resolution, high quality magnetic data that is automatically compensated and corrected to remove the effects of the vehicle on the magnetic data in real-time. To produce useful data from a magnetometer mounted /inside /the body of an AUV, it is necessary to compensate not only for the attitude of the AUV in the earth's field, but also for secondary effects related to the strength of the electric currents flowing in the vehicle propulsion and vehicle control circuits. Alternatively magnetometers can be mounted away from the AUV with specialized mounting apparatuses (e.g. a towed body or pole mounts), but at the cost of increased complication to launch and recovery operations and risk to vehicle safety. OFG has solved this problem by developing the patented OFG SCM, a system containing sensors, procedures and software that correct and compensate for the internal magnetic field caused by the heading, attitude, and electric current effects of the AUV.

New Simulator for Sustainable Fisheries

Kongsberg Digital signed a contract with Lofoten Vocational School for development and delivery of a complete K-Sim Fishery Simulator with fish finding and fish catching applications. The simulator will be based on Kongsberg K-Sim simulation technology and market-leading Kongsberg Maritime (SIMRAD) professional fishery equipment, including echo sounders, sonars and trawl monitoring systems.

Lofoten Vocational School will be the first to bring this new approach to training to the fishing industry, which is especially important for this geographical area of Norway, where fishery is an important livelihood. The simulator will play a vital part in ensuring a safe and sustainable industry.

The school will upgrade its existing Kongsberg Polaris ship-handling simulator to the latest K-Sim Navigation technology platform, which integrated with the new fishery module will fulfill the STCW-F requirements. Lofoten Vocational School will move to a new location in Leknes in Lofoten and the opening of the new facility is planned in 2019.

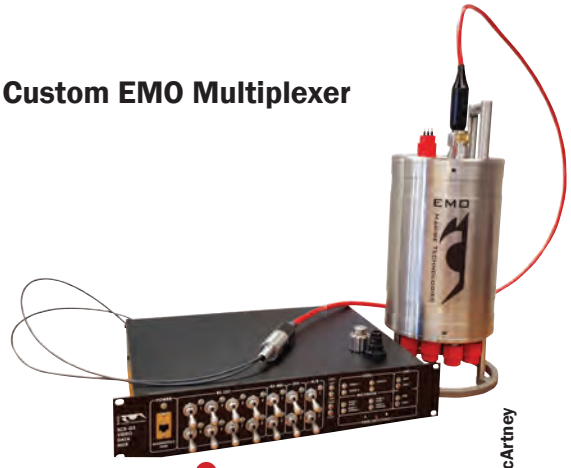
K-Sim Fishery is designed as a fishing vessel bridge (different vessel model and sizes are available) with all necessary bridge and navigation equipment for fish catching, including winch for handling fishing equipment such as purse seine, trawl and long line.


Kongsberg Digital

Dual GyroUSBLs for Lorelay Stinger

Sonardyne

Custom EMO Multiplexer



MacArtney

Dual GyroUSBLs for Lorelay Stinger

Offshore pipeline installation and subsea construction company Allseas has ordered Sonardyne International's GyroUSBL acoustic positioning technology for two systems for its 236-m long lay vessel Lorelay. Used in conjunction with a Ranger 2 USBL (Ultra-Short BaseLine) topside which also formed part of the order, the GyroUSBL transceivers will be installed on the end of the Lorelay's stinger to acoustically track a remotely operated vehicle (ROV) deployed to ensure a pipe is accurately touching down in the permitted corridor.

USBL transceivers are routinely deployed through the hull or over-the-side of a vessel, enabling targets to be tracked below, to the side and far behind. However, on a large DP pipelay vessel such as the Lorelay, a transceiver cannot reliably 'see' through the thruster wash created at the rear so touchdown monitoring operations are often conducted by an ROV operating from a survey vessel (equipped with its own USBL system) following on behind. With a stinger-mounted GyroUSBL, there is a proven alternative.

The unit combines a 6G HPT transceiver (either 5,000 or 7,000 model) and Lodestar Attitude and Heading Reference System in the same assembly and is supplied pre-calibrated to eliminate the mechanical alignment errors seen in conventional USBL setups. These features allow an acoustic transceiver to be sited well away from noise interference, even on a dynamic structure such as a stinger, and deliver outstanding positioning performance. It also means that a pipelay vessel is able to employ its own ROV to carry out touchdown monitoring, allowing the accompanying survey vessel to get on with another task, or eliminating the need for it altogether.

Custom EMO Multiplexer

Upgrading the subsea survey and camera interfaces of an ROV represents the primary purpose of the MUX having been deployed in Singapore. The requirements for reliable transmission of large amounts of data and video from ROVs, ROTVs, ocean observatories and instrumentation packages are constantly being sharpened. Gathering high-quality data from the deep sea is an immense undertaking, which calls for ensuring that multiple sensor and equipment types work in perfect unison and that all data are efficiently transmitted to the surface for analysis. A custom version of MacArtney's EMO DOMINO-7 fiber optic multiplexer system (MUX) was built for installation on an ROV in Singapore with the aim of upgrading the subsea survey and camera interfaces of the ROV. The DOMINO-7 MUX is a compact fiber optic system with a wide range of MUX channel and power supply configurations. Offering 3 videos with 10 bit data channels, the DOMINO design also offers 2 x industry standard multibeam ports, consisting of gigabit Ethernet (GBE) communications, coupled with 48 VDC supply voltage.

Applied Acoustics Launches New Products

Applied Acoustics launched new products from both its acoustic positioning and its geophysical product lines. The flagship USBL system, the Easytrak Nexus 2, is now available with a choice of transceiver; the directional 2780 version that can achieve very long ranges (up to 3km) with a high degree of accuracy (0.1% slant range), and the omni-directional 2686 version ideal for use in extremely shallow water (<2 meters). The operating console is the same in either case enabling the

New Acoustic Release Mooring Connectors

InterMoor recently introduced the Inter-M Release mooring connector. Acoustic release mooring connectors allow a rig's mooring legs to be released remotely and immediately, in case of emergencies, severe weather events, or simply to save time and money during rig moves.

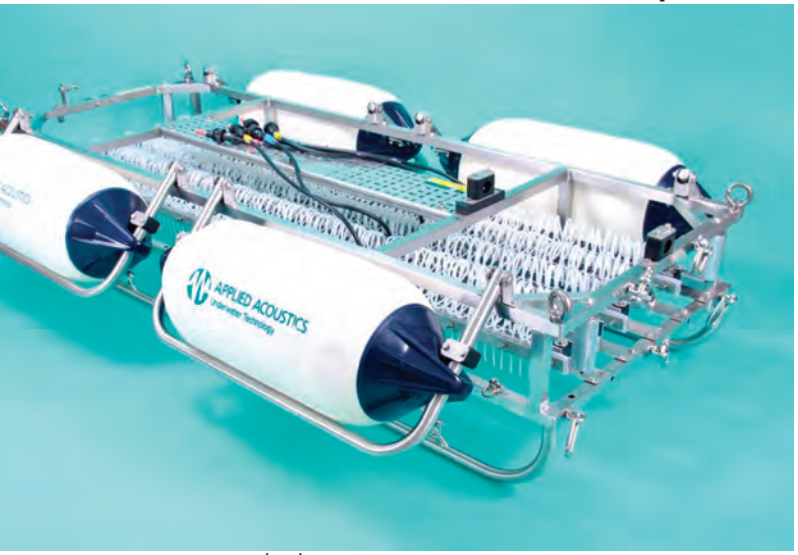
The new connector is touted by the manufacturer for being smaller and lighter, while still able to disconnect at full capacity.The device was designed using the platform of sister company SRP's Rocksteady mooring connector and its secondary actuated release system, with a control system developed in conjunction with Teledyne Marine. The control system uses military-grade, high-fidelity Teledyne Benthos acoustic modems, and implements domain key authorization, unique addressing, network relay and frequency hopping techniques, ensuring the mooring connectors are never affected by obstructions or conflicting noise. The domain key and unique addresses eliminate the possibility of an inadvertent release and allows for the connector to be actuated individually, in clusters, or even sequenced in any order.

These new electronic features have been implemented without sacrificing battery life, which has been improved from 18 months in old acoustic release connectors to five years in the Inter-M Release.

transceivers to be inter-changeable. In addition, the 1100 series of transponders now all feature data telemetry functions which can be used when used with the Nexus 2 USBL. The transponders themselves can be used without telemetry with all Applied Acoustic USBL systems, as well as those from other manufacturers, thereby maintaining their overall flexibility.

To meet the challenges faced by surveyors involved in shallow water, ultra-high definition geophysical surveys Applied Acoustics has re-designed to Dura-Spark range. The sparker sound sources now feature faster rep rates, tunable electrode banks and adjustable source heights, all resulting in clearer high-resolution data, ideal for use in offshore wind farm surveys.

The Dura-Spark UHD



Applied Acoustics

Intermoor

New Tech

Acoustic Zooplankton Fish Profiler

The National Research Institute of Fisheries Engineering of the Japan Fisheries Research and Education Agency has deployed an ASL Environmental Sciences Inc. multifrequency Acoustic Zooplankton Fish Profiler (AZFP 125, 200, 455 and 769 kHz) in Yamada Bay, 450 km north of Tokyo since 2013. As the AZFP is battery powered and enclosed in a pressure case, periodic recovery was necessary to access the data. To help the scheduling of the release of hatchery reared juvenile salmon and increase their survival in the sea, upgrades were purchased by FRA scientists in 2016 which included a solar-powered datalogger with a cellular modem for the AZFP and a Conductivity Temperature (CT) sensor. The datalogger acquires raw data from the AZFP and then averages the data into 1 m bins over a ping interval of 30 pings. These data are then retrieved on demand via a cellular modem and downloaded to the NRIFE's offices. The raft-mounted system includes a solar panel, a charge controller, rechargeable batteries, a datalogger with AZFP data software, serial connections to the CT sensor and AZFP and a cellular modem all in two weather-proof enclosures.

Fish Profiler

ASL

Sound Metrics Expands ARIS Line

Sound Metrics launched its latest addition to the ARIS (Adaptive Resolution Imaging Sonar) product line.

The new model, known as the ARIS Voyager 3000, is depth rated to 4,000m and is currently available with 3.0 MHz and 1.8 MHz operating frequencies.

Sound Metrics said the ARIS Voyager 3000 offers a sleek titanium design and delivers on what many customers have been asking for: the same high-resolution sonar imagery of an ARIS, but in a deep rated system.

The ARIS Line

Sound Metrics

OSIL Marine Snow Catchers for NASA Project

Ocean Scientific International Ltd. (OSIL) have equipped the NASA EXPORTS Field Campaign with three Marine Snow Catchers and will contribute to the upcoming PACE (Plankton, Aerosol, Cloud, ocean Ecosystem) Mission that aims to provide insight into Earth's ocean and atmosphere using remote sensing.

Marine Snow Catchers are large volume water samplers with separable top and bottom sections that allow researchers to collect and characterize suspended and sinking particles in the water column. This provides a greater understanding of the export processes of the oceanic organic carbon cycle (removing carbon from the upper ocean), and can help to predict how these processes may change in the future. The design of the OSIL Marine Snow Catchers has been subtly altered, guided by user feedback, with the intention of making them easier to operate in extreme conditions.

OSIL Snow Catchers

OSIL

University of Washington

RV Thomas G. Thompson

Research vessel (R/V) Thomas G. Thompson (AGOR-23) completed an 18-month upgrade to improve operating systems, bolster its research capabilities and extend its working life. The Navy-owned vessel has been operated and maintained University of Washington since 1991, under a charter lease agreement with the Office of Naval Research (ONR)-which manages the ship on behalf of the service.

The $52 million refit, which was sponsored by ONR, the University of Washington and the National Science Foundation, extended the Thompson's life by another 15-20 years. By comparison, it would cost around $200 million to build a new research vessel.

"The refit of the R/V Thompson provides a continued global capability of support to Navy and national oceanographic research objectives," said Dr. Tom Drake, head of ONR's Ocean Battlespace Sensing Department. "It also enables additional years of service, hundreds of thousands of ocean miles sailed, research opportunities for thousands of scientists, and the training of the next generation of seagoing scientists and technicians."

Vigor Shipyard in Seattle conducted the refit, and the 274-ft. Thompson was refurbished from stem to stern, throughout all five of its decks. It received new cleaner and more efficient diesel engines, the latest navigation and ship-positioning systems, as well as sophisticated sonar, allowing it to map the ocean floor in sharper detail and even differentiate between species of fish and other marine life.

The Thompson's laboratories were updated to include advanced IT infrastructure to better support scientific data collection and analysis at sea, while also enabling improved real-time communications with shore. Several critical sensor systems also were replaced, providing upgraded scientific capabilities and increased reliability.

"Besides extending the vessel's useful life at an attractive cost, this mid-life refit updates the propulsion systems with the newest in marine technology," said Tim Schnoor, the program officer overseeing ONR's research vessel program. "This means better diesel-electric generation and distribution systems, stronger compliance with environmental requirements, and reduced obsolescence of various systems and components."

Since finishing the refit earlier this year, the revamped Thompson has sailed to New Zealand and Taiwan-and will travel to India, Sri Lanka, the Philippines, South Africa and Australia in coming months. Research projects include using special floats to measure the ocean's temperature and salinity, mapping underwater mountains, and studying the heat flow generated by an aquatic volcano and hot springs.

"The R/V Thompson has performed very well since its refit, and the crew has provided positive feedback," said Douglas Russell, the University of Washington's manager of marine operations. "They especially appreciate things like the improved air conditioning and heating systems, water-making and sewage plants, and the new drainage system-things you don't think about until you're out at sea and really need them to work well."

Bibby Wavemaster Keel Laid

Bibby Marine Services' second service operations vessel (SOV) is underway at Damen Shipyards Galati in Romania less than a year after Bibby took delivery of sister ship Bibby Wavemaster 1.

Bibby ordered the new SOV in early 2018 after lining up a charter for the vessel in December 2017. The new vessel, scheduled to be delivered in 2019, will go to work under contract for Siemens Gamesa Renewable Energy and EnBW for maintenance operations on two windfarms in German waters: Hohe See and Albatros, both owned by EnBW and Enbridge.

The vessel's final name will be announced after a competition within Siemens Gamesa and EnBW, however it will continue to be part of the Bibby WaveMaster series.

The SOV 9020 is a new class of purpose-built SOV with Walk-to-Work (W2W) capability developed by Damen in consultation with the offshore renewables industry. The design is an entirely new concept from the ground up, combining DP-2 capability, a new motion-compensated gangway, innovative hull design, a revolutionary internal layout, and a comprehensive range of additional innovations designed to increase efficiencies and reduce costs.

"We have believed in the SOV 9020 from the beginning," said Bibby Marine Services managing director, Stephen Bolton. "Siemens Gamesa and EnBW were looking for higher access to the wind turbines and this is what the SOV 9020 is built to do, with the Wavemaster 1 providing the evidence."

The Wavemaster 1 has recently completed her first charter servicing wind farms off the east coast of England, having seen all her options to extend taken up by the client. As of April 5, she is now working with Total E&P Netherlands servicing its gas platforms in the southern North Sea.

Image: Damen

Keel-laying ceremony for second Bibby Wavemaster.

Image: Damen

HMS Magpie

Photos: Royal Navy

The U.K. Royal Navy's new hydrographic survey vessel encountered a bout of rough weather during sea trials in the Irish Sea.

Launched less than a month ago, HMS Magpie is the newest addition to the Navy's hydrographic squadron, replacing veteran survey launch Gleaner decommissioned earlier this year after 35 years' under the White Ensign. The new 18-m catamaran is being delivered by Atlas Elektronik UK through a subcontract with Cork shipbuilder Safehaven, based on the firm's Wildcat 60 craft.

The vessel is due to be formally handed over to the Royal Navy next month and be ceremonially commissioned into the fleet early in the summer. She will then join the rest of the hydrographic squadron at HM Naval Base Devonport. "Magpie will help lead the way in modernizing the Royal Navy's survey and underwater surveillance capabilities," said Lieutenant Commander William Alexander, Magpie's new commanding officer and Gleaner's last. "Her primary role will be in maintaining the integrity of coastal waters, ensuring safety of navigation and resilience of key national infrastructure in U.K. ports. And with an enduring presence around the U.K., she will also contribute to national security at sea."

Magpie – named after the Duke of Edinburgh's only command – is larger than Gleaner, can stay at sea much longer (12 crew for up to seven days), and is much more resilient in rough seas. The Royal Navy said it expects Magpie to be able to maintain 20 knots in a Sea State Four with waves up to 2.5m high.

People & Companies

Holmes

Swathe Services

Lynch

Sonardyne

Dillon

Kraken

Holmes Joins Swathe Services

Ex-naval captain and marine consultant Jon Holmes has joined Swathe Services as business development manager, a new role to maintain and increase product sales and services as well as manage long-term strategic growth. Holmes was made ship's captain of six naval vessels during his full career as a hydrographic surveyor. After his time with the Navy, he worked at the University of Plymouth's Hydrographic Academy and then as a marine consultant.

Sonardyne Hires Lynch

Sonardyne International Ltd. UK, appointed Derek Lynch as its new Global Business Manager for Marine Vessel Systems. Lynch brings with him more than 25 years of experience working within the offshore energy, maritime and naval sectors. A former serviceman in the RAF and licensed avionics engineer, Lynch has held senior management positions with several technology companies involved in positioning, navigation and vessel control systems.

Kraken Appoints Dillon

Kraken Robotics Inc. said that Dr. Jeremy Dillon has joined Kraken's wholly owned subsidiary, Kraken Robotic Systems Inc., as Chief Scientist. Dr. Dillon has 20 years of experience in research and development with a background in signal processing and mathematics. Dr. Dillon completed his PhD in Physics and Physical Oceanography at Memorial University of Newfoundland. He also holds a MSc in Mathematics from Carleton University, a MSc in Aeronautics from Caltech, and a BEng in Aerospace Engineering from Carleton University.

Kreuz Makes Appointments

Kreuz Subsea strengthened its senior management team with two key appointments at its Singapore headquarters to support its global expansion plans. Pradeep Verma has joined the company as chief commercial officer while Marek Kaminski is welcomed as director of marine assets. The duo brings more than 50 years of combined oil and gas experience to Kreuz Subsea. Verma joins the business from Larsen & Toubro Ltd.; Kaminski has joined the firm from Subsea 7.

Rhode Island Backs Electric Boat Expansion

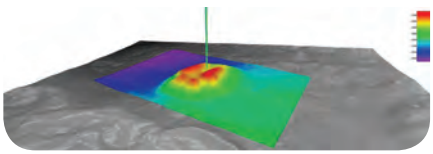
The state of Rhode Island will provide $20 million in incentives to General Dynamics Electric Boat to help the submarine builder expand its facilities. The investment will allow Electric Boat to accelerate the hiring of 1,300 new employees over the next decade as the builder is slated to produce 29 Virginia Class Submarines and 12 Columbia Class submarines for the U.S. Navy. Over the next 10 years, General Dynamics Electric Boat will invest more than $800 million to double its footprint in Quonset Point, adding roughly 1.3 million square feet of manufacturing space, about half of which will be new construction. The company will also expand its facility at the Quonset Business Park.

Hunting for Hydrocarbon Seeps

Working for multi-client geoscience data company TGS, Fugro continues the hunt for hydrocarbon seeps, this time offshore Brazil. Two modern, purpose-built vessels – Fugro Brasilis and Fugro Searcher – have been deployed to acquire high-resolution multibeam echosounder and sub-bottom profiler data in the Campos and Santos Basins.

The survey is designed to mirror TGS's 2016-2017 Gigante and Otos projects in the Gulf of Mexico in which Fugro provided similar services. Covering an area of approximately 200,000 square kilometers, Fugro will use these data to identify and recommend the most prospective locations to target for geochemical sampling.

Fugro has reported increased confidence in identifying seabed expressions of hydrocarbon seeps and this has led



Fugro

Verma

Kreuz Subsea

Kaminski

Kreuz Subsea

Electric Boat Expands

Rhode Island Commerce Corporation

to continued vigorous demand for its combined multibeam mapping and surface geochemistry sampling services. "Integrating our high-resolution modern multibeam systems with our expert interpreters enhances the services we provide for our clients," said Jim Gharib, Fugro's Global Product Manager for Seep Hunting and Geochemical Campaigns.

Shell Awards Deepwater Contract in GOM

In another sign that activity in the moribund offshore sector is starting to loosen, Jumbo said that it has won the installation contract for the Shell deep-water Vito development in the US Gulf of Mexico. The Vito development is located in the Mississippi Canyon, approximately 150 miles south of New Orleans in water depth of more than 4,000 feet.

Jumbo's installation contract involves the initial pre-lay of the mooring system as well as the subsequent tow and hook-up of the FPS. Roddy Lafontaine, VP Offshore for Jumbo says:

"The Jumbo Offshore team is very grateful to Shell for this opportunity. It is the first time Jumbo and Shell will work directly together in U.S. deep-water Gulf of Mexico and we are committed to the successful completion of this project. Our engineers are already working on the detailed plans so as always we can perform a reliable, smart and efficient execution."

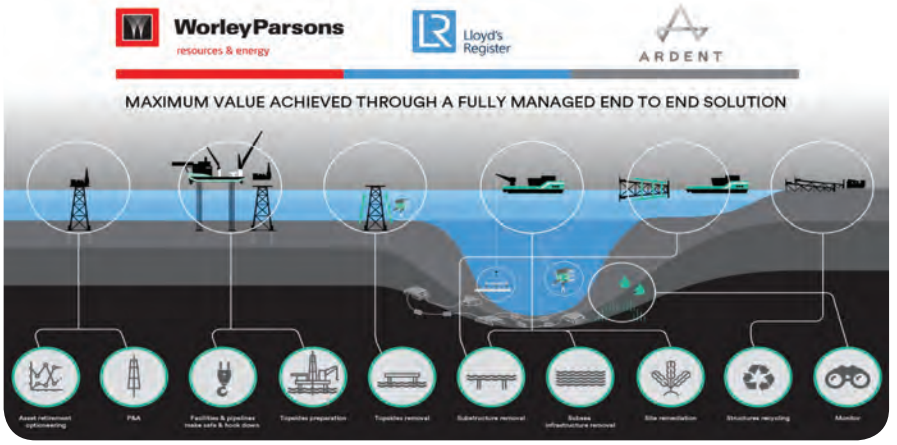
Forum ROV to Support Renewables Research

Forum Energy Technologies, Inc. delivered a Remotely Operated Vehicle (ROV) to the University of Limerick (UL) to support its research into subsea inspection and intervention campaigns on renewable energy sector infrastruc-

New Consortium for Offshore Decommissioning

A new global oil and gas decommissioning consortium launched recently, looking to bring a collaborative supply chain approach, offering an end-to-end solution to reduce the decommissioning burden, risk and cost for operators. The consortium includes Lloyd's Register, WorleyParsons and Ardent. **Global spending on oil and gas decommissioning is expected to be $13 billion per year by 2040.**

Jumbo



Ardent

MacArtney Underwater Technology Turns 40

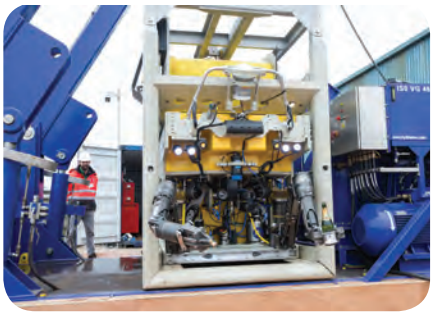
After the humble beginning on May 1, 1978, where the late founders Martin 'Mac' MacArtney and his wife Winnie worked out of their home, MacArtney Underwater Technology has turned into a market leader within the underwater technology industry. At the beginning MacArtney was solely a distributor of cables and connectors for offshore use but gradually focus was directed towards engineering and research and development of own products. Today, the MacArtney Group is accessible around the world and around the clock with 20 Group operations supplemented by a distributor network of 25 companies spread across the globe.

Since its foundation in 1978, the MacArtney Group has been supplying underwater technology solutions to operators and developers within several industries. The cornerstones of the MacArtney fields of operation are oil and gas, ocean science, defense, marine renewable energy, civil engineering and fishery. Possessing vast engineering competences, the company manufactures high-quality products, fully integrated systems and innovative custom solutions, from design to installation, supported by training, after-sales service and local workshops. Its competences range from mechanical, electrical and software engineering to specialized fiber optic and molding expertise as well as project management.

Less than one year ago, the executive board of MacArtney changed top management. The position as CEO was assumed by Claus Omann, who took over from Niels Erik Hedeager, long-serving CEO who is now Chairman of the Board of Director of MacArtney. In preparation for the long-term existence of the MacArtney Group, dispositions have now been made for sustainable empowerment of the company. Thus, strengthening its competitive performance is important, as is expansion and investment in developing new markets.

Entering a new era, the two owners – the two MacArtney sons, Glenn and Marco MacArtney – look forward to many years of growth for MacArtney Under-water Technology and to being part of this new epoch headed by Claus Omann as CEO and Niels Erik Hedeager as Chairman of the Board of Directors.

Photo: MacArtney



Forum

ture. The Comanche 2,000m observation class ROV was selected due to its high thrust-to-drag ratio enabling it to operate in strong currents, typical conditions for the offshore renewables industry. The ROV is equipped to a high specification with precision positioning and navigation systems, camera and lighting systems and sonars. The systems will be used as a test bed for research to develop capabilities for inspection, maintenance and repair work on Marine Renewable Energy (MRE) infrastructure in the challenging strong wave and current conditions at MRE test-sites and offshore MRE sites in Ireland and further afield.

Riptide, Draper Deliver Open Architecture Autonomy

Riptide Autonomous Solutions and Draper agreed to implement Maritime Open Architecture Autonomy (MOAA) on all Riptide Unmanned Undersea Vehicles (UUVs) delivered to the U.S. Government. Draper developed MOAA for the U.S. Government as an extensible open architecture framework for autonomous mission controllers for autonomous undersea vehicles (AUVs). MOAA capabilities have been demonstrated at-sea on multiple AUV classes with capabilities applicable to various undersea mission areas. Draper has requested and received approval from the Naval Undersea Warfare Center Division Newport (NUWC-NPT) to provide MOAA as an option on all Riptide UUVs sold to the U.S. Government or Government purposed vehicles.

Polarcus Scores Two Seismic Survey Projects

Polarcus

Polarcus announced it has secured two offshore seismic survey survey projects. The company has entered into a contract for a two-month broadband 3D marine seismic acquisition project in Australia that will commence immediately. Polarcus also received a letter of award for an XArray 3D marine seismic acquisition project in Asia Pacific. The two-month project is slated to begin immediately after the Australian project.

Fugro to Train Saudi Students

Fugro's new partnership with KAUST (King Abdullah University of Science and Technology) was marked recently with the inauguration of the KAUST - Fugro Center of Excellence for Marine Technology. The new center will provide training in ROV operations and hydrographic survey within the Kingdom as part of the Saudization program.

KAUST's facilities and location, on the shore of the Red Sea, are ideal for addressing the challenges associated with mapping the Red Sea, large tracts of which remain unexplored due to extreme depths, temperature and salinity.

It will also establish an ROV Training Academy (ROVTA) at the KAUST Coastal and Marine Resources Core Lab. At this academy, the only such facility in the Kingdom, Fugro will train Saudi students to become ROV pilots and engineers for work in both industry and marine research. Support from Fugro's ROVTA in Abu Dhabi will bring the highest standard of training and technology to the region to sustain new developments in the Red Sea and surrounding areas.

Fugro

Teledyne Bringing Its Tech Workshop to Europe


Teledyne Marine

Building upon Teledyne Marine's Teledyne Marine Technology Workshop (TMTW) event hosted biennially in the U.S., the company has decided to host this event in Cannes, France on October 9-11, 2018 to address the needs of customers in Europe and the surrounding area. As with the U.S. based TMTW, this event will allow speakers, influencers and attendees from around the globe to explore, learn and share their experiences on a broad range of marine and inland technologies. This three-day workshop will once again include customer presentations, product/software training, networking opportunities and on-water demonstrations provided by Teledyne Marine's top-tier manufacturers.

A cornerstone of this users' conference is presentations given by customers sharing their field and laboratory experience utilizing Teledyne products. The three-day workshop will include three concurrent morning tracks dedicated to the following broad topic areas: Offshore Energy; Oceanographic Research; Hydrography; Defense/Security; Aquaculture/Fisheries; and Civil Engineering/River Monitoring.

Teledyne is asking customers to submit an abstract sharing their experience using Teledyne products in any of these applications. Abstracts can be submitted for speaking slots or poster paper presentations. All accepted speakers will receive free admission to the event.Abstracts are due May 15, 2018.

Full details and an online abstract submission form can be found on the Teledyne Marine website at:

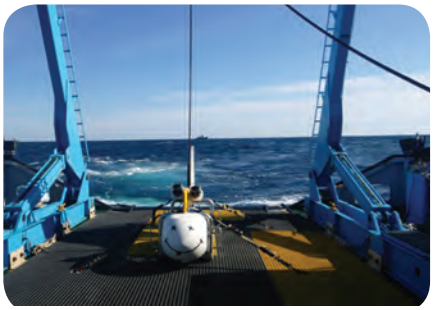
www.teledynemarine.com/events/TMTW2018

UKHO Buys NORBIT iWBMS Multibeam Survey Capability

NORBIT has been appointed by the UK Hydrographic Office (UKHO) as the single framework supplier until August 2020 for survey equipment and associated engineering support to enable British Overseas Territories and other Commonwealth Small Island Developing States (SIDS) develop their own hydrographic survey capability to meet IHO standards.

Gas Hydrate CSEM Mapping Campaign Completed in Japan

Ocean Floor Geophysics Inc. (OFG), in cooperation with Fukada Salvage and Marine Works Co. Ltd. (Fukada), has completed a third high resolution Controlled Source Electromagnetic (CSEM) survey of near surface gas hydrates using the Scripps Institution of Oceanography (Scripps) Vulcan system for the National Institute of Advanced Industrial Science and Technology (AIST) in Japanese waters. Following the CSEM surveys and 3D inversion models completed in 2014 and 2015, the 2017 survey comprised more than 413 line kilometers of high resolution data collected in depths up to 1,640 m from the Fukada vessel Shin Nichi Maru. A 3D inversion of the EM data for the entire 2017 survey area has also been completed and delivered to the client.


OFG

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