MARINE TECHNOLOGY REPORTER

November/December 2015

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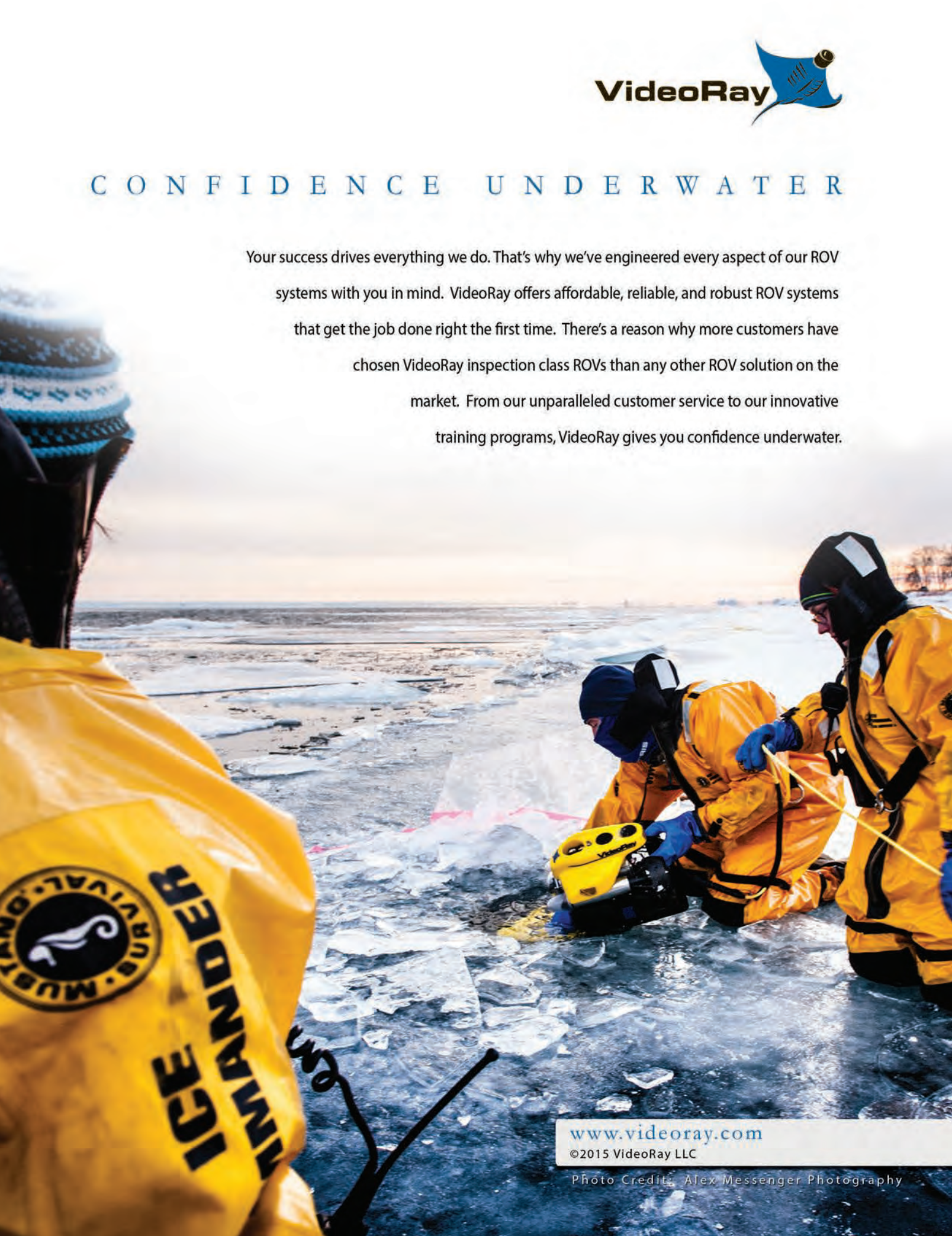

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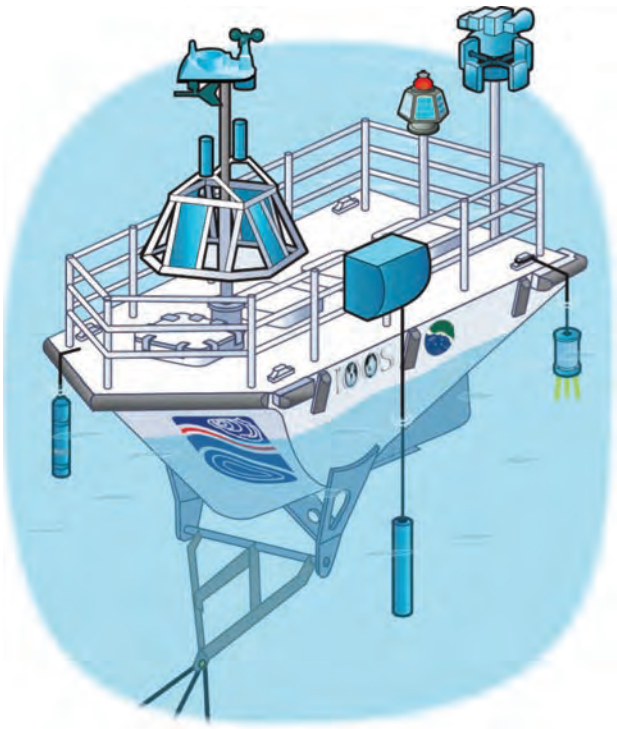
Teledyne Marine

On the Cover



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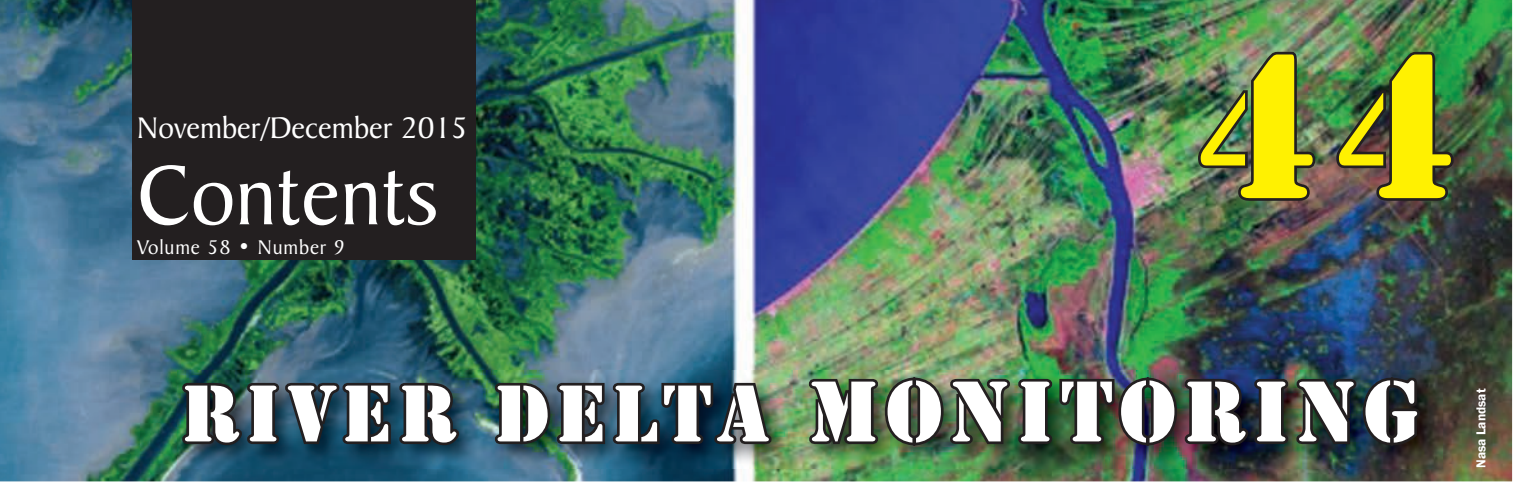

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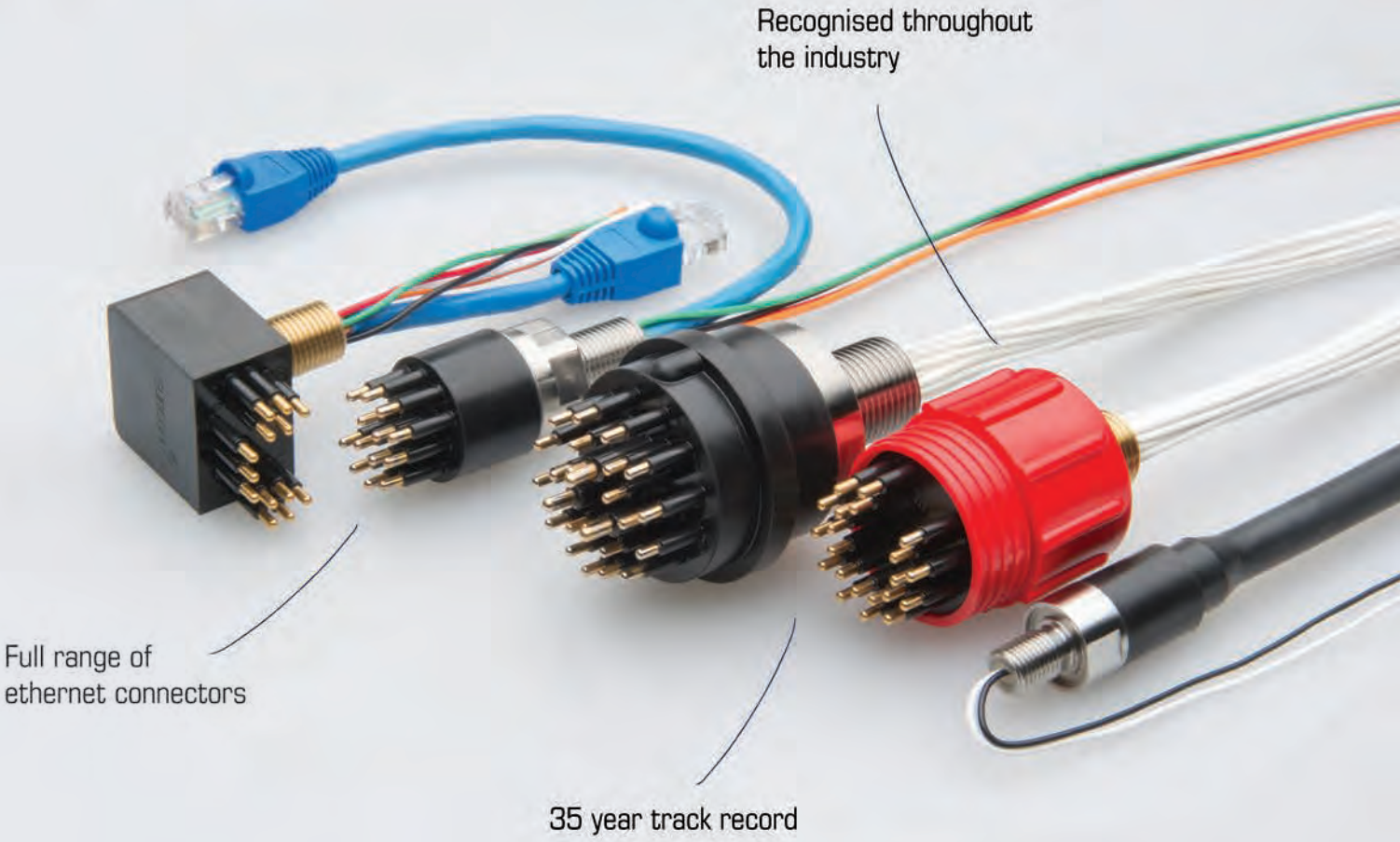

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Last month I was pleased to attend and participate in the 7th Annual BlueTech & Blue Economy Summit in San Diego, a high-level event hosted by the Maritime Alliance and attracting some of the most influential subsea professionals from corporations, government and the halls of academia. For the second year running I reprised my role as moderator on the "View from the Top" panel, a panel which featured leaders from six major subsea companies in a discussion on the burning topics of the day and the way forward in 2016 and far beyond. First and foremost, a note of thanks to Michael Jones and Greg Murphy, new Executive Director of The Maritime Alliance, for the inclusion of *Marine Technology Reporter* in this high-value event. I travel extensively throughout the year to events large and small, and I can say without hesitation that the formula created for this event in Southern California is a winner in terms of content, contacts and influence.

So what is the "View from the Top" you may wonder? Coming in the first edition of MTR in 2016 will be a full recounting of the panel, but until then the word of day is 'uncertainty.' Despite the fact that oil is (forgive the pun) in the tank with no perceptible light at the end of the tunnel, there remains an upbeat vibe. This premised on the fact that:

[A] Energy markets will eventually rebound, and that,
[B] While there is no substitute for a vibrant and healthy offshore business, there are plenty of opportunities available for efficient, cost effective technologies.

One such opportunity is featured on our cover, as **Eric Haun** recently visited with Ocean Power Technologies to discover how this company is seeking to crack the conundrum of providing reliable, persistent power to surface and subsea assets working at sea (see story page 14).

Another comes from perhaps the most unlikely place: Norway. Norway has been hit hard with the oil downturn, but **William Stoichevski**, our man in Oslo, found some optimism in the pipe lay, dredging and cable sectors (see story page 38).

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Earl Childress discusses

Teledyne Marine's 'One-Team' Mantra

By Eric Haun

Teledyne has spent much of the past 10 years consolidating the marine technology market, identifying and acquiring some of the sector's top brands along the way. Now as the group continues its growth and development facing a market more constrained by sustained low oil prices, Teledyne Marine aims to deliver more value – to do more with less – by taking a "one team approach."

"The idea of 'one team' is a journey from cooperation to collaboration," said Earl Childress, Executive Vice President – Teledyne Marine, Sales, Marketing and Business Development and Vice President / General Manager – Teledyne AG Geophysical.

In the past, customers seeking a variety of Teledyne products would often need to separately acquire those pieces from the company's different brands. But with the new one team approach, customers can now obtain the full capacity of Teledyne instrumentation, technology and software on one order with one point of contact.

Childress gave the example of a commercial ROV operator, who under many circumstances would typically require a customized solution including products from a dozen or more vendors. "Our message is you can do that under one purchase order, one warranty, one point of contact, yet we'll give you access to the technical people so that we can customize that solution to fit you're packaging and requirements, more specifically on a customer by customer basis," Childress said.

"And in an environment like we have today where everything is about how to lower costs, we think that's a value proposition that makes a lot of sense."

Reflecting this business model, the group's spirit of "collaboration" was on full display at the Teledyne Marine Technology Workshop (TMTW) in October. The newly expanded users workshop, which Childress called a "soft opening for the one team approach," was held in San Diego, and featured three days of industry discussion, learning and exploration addressing the user experience in regards to an extensive lineup of marine products, applications and technologies.

Photo: Teledyne Marine

From left: Earl Childress; Zdenka Willis, and Mike Read at the TMTW.

The TMTW, which builds upon Teledyne RDI's ADCPs in Action (AiA) Users Conferences and Teledyne Marine Acoustic Imaging's Underwater Technology Seminars (UTS), ultimately offers attendees a chance to experience the expanding and far-reaching components that make up Teledyne Marine, as customers and Teledyne staff members collectively address a diverse range of topics.

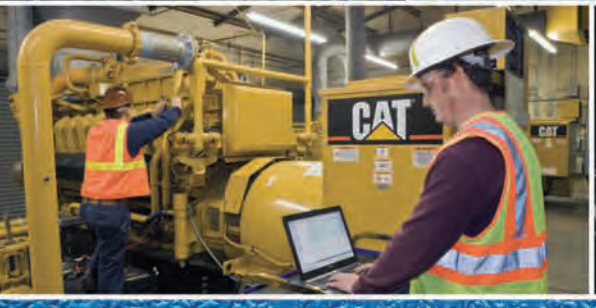
In all, the event gathered some 240 registrants and 120 Teledyne staff members, each calling upon a "sea of solutions" to play his or her part in the expansive ocean observation space.

Delivering the event's first keynote speech was Dr. Robert Mehrabian; Chairman, CEO and President of Teledyne Technologies; who discussed how Teledyne Marine's "one team" approach encompasses the group's effort to provide a broader "sea of solutions," from sensors to vehicles to analytical tools and technologies, as the group has spent some $2.1 billion on acquisitions over the last 10 years to incrementally expand its offering to customers and end users.

Throughout the TMTW, those same customers and end users were given a chance to discuss and learn from industry experts via training sessions, on-water demonstrations, networking opportunities and various speaker tracks, including offshore energy; oceanographic research and hydrography; civil engineering, river and stream monitoring; and security and defense.

From the surface to the seafloor, these subsectors make up a dynamic and absolutely vital industry, as pointed out by Zdenka Willis, Director of the U.S. Integrated Ocean Observing System (IOOS) Program, who in the event's second keynote discussed why ocean observation is important to everyone, every day.

FULL SPEED AHEAD



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Deepwater Downturn

A Bump in the Road or Long Term Slowing of Growth?

By Jim McCaul, IMA/World Energy Reports

IMA/World Energy Reports has just completed a comprehensive assessment of the five year outlook for the deepwater sector. The new report – the 19th annual floater market forecast prepared by IMA since 1996 – provides our forecast of orders for floating production systems between 2016 and 2020. Here's an overview of the findings and conclusions in the report.

Bottom Line

We see the downturn in market conditions and implosion of Petrobras as a bump in the road. While the outlook is clearly dimmer than last year, there is a large backlog of planned projects requiring floating production systems – and the long term fundamentals to support investment commitment in these projects remain very solid. But the next 12 to 24 months will test the resilience of field operators and contractors in the deepwater supply chain.

The Current Situation

After four decades of rapid growth, the deepwater sector has suddenly stumbled. Very few orders were placed in 2015 for floating production systems. Only 2 FPSOs have been ordered since January of this year – compared to 12+ orders annually over the past decade. The downturn in orders reflects the general unravelling in industry conditions. Virtually every company in the supply chain feels threatened by business softness. Capital expenditures are being sliced and deepwater project starts deferred. Personnel reductions are being announced on a daily basis, rig contracts are being cancelled or renegotiated, assets are being written down.

What happened?

Behind the downturn is an imbalance in oil supply and demand brought on by the emergence of shale/tight oil and inability of major producers to coordinate a ramp-down of global output. A huge oversupply of oil is in the market. The result has been a plummeting of oil prices over the past year – reducing cash flow and prompting oil companies to severely cut back on capital expenditures to conserve cash.

Add to this the implosion within Petrobras. The major player in the deepwater sector has been largely taken off the field by a corruption scandal. More than a third of expected FPSO orders over the next five years were to be generated by Petrobras. But the company's financial problems have caused a massive cut back in planned project starts. In 2014 Petrobras was planning to acquire13 additional FPSOs for project starts between 2018/20. Now it is planning to acquire five FPSOs – and questions remain about the ability to finance even this reduced number of FPSOs.

Is a Rebound Likely?

Clearly there will be a rebound in the deepwater sector. It will be driven by increasing global oil demand and need to find new sources of oil to replace depleting sources. Global oil demand has been growing at an average rate of 1.4% annually over the past 20 years.With the exception of two years during the global financial meltdown, oil demand has increased year over year during this period.

Looking forward, industry analysts differ on the rate of future oil demand growth, but not on whether growth will continue. For example, the IEA sees world oil demand in 2040 growing to 104 mb/d, an increase of 10 mb/d over current consumption. The EIA predicts global oil/liquid fuel consumption will grow to 119 mb/d by 2040, a 30% increaseover the present. OPEC expects oil demand to grow to 111 mb/d in 2040, up 18% from global oil consumption in 2015.

Among the oil majors, ExxonMobil expects an average growth of 1.2% in oil demand through 2025, followed by a 0.5% growth between 2025 and 2040. BP calls for world oil demand to grow at an average rate of 0.8% annually through 2035. Ultimately new oil sources will be needed to accommodate this demand growth – as well as replace supply losses as depleting oil fields come off line. Deepwater is among those new sources.

What Will Drive the Rebound?

We are tracking more than 240 offshore oil and gas projects in the planning stage that likely require a floating production system for development. Some of these projects will require multiple systems. If all projects proceed to development, up to 275 new production floaters will be required over the next 10 to 15 years. A large backlog of eligible projects is significant – but only part of the picture in forecasting future pro-

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duction floater orders. Ultimately an investment decision is needed to transform these deepwater project opportunities into contracts for floating production facilities. In our forecast report we examine eleven underlying business drivers that will influence the timing and direction of future deepwater project investment decisions. Here's how we see these eleven drivers at the moment.

In the positive category are

- Oil and gas demand keeps growing.
- Supply disruption potential keeps focus on finding new sources of supply.
- Long term oil/gas prices will rise, driven by demand/supply fundamentals.

In the negative category are

- Near term oil & gas prices have fallen to levels that discourage investment.
- Major energy companies have been cutting back on capital expenditures.
- More supply has suddenly come into the oil and gas market.
- Shale/tight oil and gas projects are competing for investment funds.
- Local content constraints in the supply chain are creating delays and overruns.
- Petrobras, the major customer, is having serious financial problems.
- Cost of capital for deepwater projects will rise over the next several years.

In the unknown category are

- black swan events can (and have) disrupt the sector

Interaction of these drivers over the next few years will determine the number and timing of future production floater orders.

TheRebound Scenarios

Three plausible forecast scenarios are profiled in the report that capture a realistic range of underlying market conditions likely to prevail over the next five years.

- **Low scenario:**

Sluggish global economic growth, decelerating energy demand, strong competition from shale oil, oil prices in the $50 to $60

range through 2020, local content policies pressure deepwater cost growth, Petrobras problems continue into 2017/beyond

- **High Scenario:**

Strong economic growth, accelerating energy demand, oil prices in the $70 to $80 range through 2020, constraints limit shale development, easing local content policies reduce cost pressures in deepwater projects, Petrobras regains investment grade in H1 2016.

- **Most Likely Scenario:**

Modest but sustained economic rebound, 1.5% energy demand growth, oil prices in the $60 to $70 range through 2020, shale oil grows in North America – but not elsewhere, deepwater cost growth decelerates, Petrobras credit junk rated through 2017.

In all scenarios the expected long term price of oil – on which major investment decisions are based – falls within the EIA projected future crude price range of $70 to $170 per barrel in the late-2020s, $80 to $200+ in the late 2030s.

Forecast for Orders

In the most likely scenario, over the next five years we expect orders for 64 oil/gas production units (FPSOs, Semis, Spars and TLPs), 29 LNG processing units (FLNGs, FSRUs) and 25 storage/offloading units (FSOs). Capex associated with the building and conversion contracts will be in the vicinity of $106 billion.

A breakdown of the forecast by size unit, region, year order placed, new or modified hull, etc. is provided in the new report.

In the high scenario we anticipate a considerably stronger pace of orders. Here we expect orders for 77 oil/gas production floaters, 36 LNG processing units and 30 storage/offloading units. In the low scenario the number of orders is expected to be 45 oil/gas production floaters, 22 LNG processing units and 20 storage/offloading units.

The 2016/20 forecast is significantly lower than the five year forecast last year. There we projected orders for 98 oil/gas production units, 25 LNG processing units and 30 storage/offloading units.

Details for the production floater forecast are provided in our new 186 page report. Information about the report, including the table of contents and list of exhibits, is available at

https://www.worldenergyreports.com

Power in the Waves

For Multiple Offshore & Subsea Applications

By Eric Haun

Wave power is progressing as a viable source of renewable energy, and recently that progress has accelerated. One of the companies leading wave power's advancement is New Jersey based Ocean Power Technologies (OPT), considered a pioneer in the arena with more than 20 years' experience in generating electrical energy from waves. With its PowerBuoy system, the company has shifted its focus from larger scale power generation to a more targeted, and importantly, survivable and reliable product.

The wave power sector has encountered its share of challenges over the years. David Heinz, Chief Operating Officer at OPT, likened the current state of the wave power business to that of the wind power industry in its formative years: just as the first utility scale offshore wind farms "failed catastrophically," wave power too is encountering its own growing pains. "[Early offshore wind farms] failed because the industry was not ready for survivability first, then reliability second," Heinz said. "The wave energy industry is going through the same problems. . . Everyone is trying to build these very large devices at utility scale because that's where the influence and money."

With that in mind, and vying against more than 150 global competitors trying to secure niche capabilities to turn waves into electrical energy, OPT has implemented a step change. "What did wind do after its initial failures? It went to small, remote locations where a little bit of power made a big difference," Heinz said.

OPT, too, has "gone small." The company has been involved in numerous wave power projects since its formation the early 1990s, taking stabs at various forms of wave energy generation, but has more recently shifted focus to a solution that efficiently serves smaller scale non-grid connected applications

APB350 Being Transported To Launch Site.

Photo: OPT

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APB350 Being Towed to Deployment Site.

Story continues on page 18

Photo: OPT

APB350 Deployed off coast of NJ.

Photo: OPT

Photo: Eric Haun

"The wave energy industry is going through the same problems (as wind did) . . . Everyone is trying to build these very large devices at utility scale because that's where the influence and money."

David Heinz
OPT's COO

OPT testing equipment at its NJ HQ.

"All of these markets have a need for deployed, sustainable and persistent power sources in the ocean because they have a set of payload sensors that require power, communication capabilities, etc."

Dr. Mike Mekhiche
OPT's VP of Engineering

Photo: Eric Haun

offshore where its technologies have the potential to go a long way.

The PowerBuoy uses a float that moves up and down a spar in response to wave motion, while a heave plate maintains the spar in a relatively stationary position. The motion of the float drives a mechanical system contained in the spar that converts the linear motion of the float into a rotary one, driving electrical generators that produce electricity for the payload or for export to nearby marine applications. For persistence, the system generates power even in moderate wave environments, and its spar contains space for additional battery capacity if required to ensure power is provided to a given application even under extended periods of no waves.

Though OPT's scalable PowerBuoy could theoretically be connected to the grid should an application make sense from a cost perspective, its value proposition presently stands in providing power to key offshore markets: ocean observation, defense and security, oil and gas, and offshore wind. "All of these markets have a need for deployed, sustainable and persistent power sources in the ocean because they have a set of payload sensors that require power, communication capabilities, etc.," said Dr. Mike Mekhiche, OPT's Vice President of Engineering.

There are thousands of offshore devices – buoys, UUVs, etc. – currently collecting a wide range of data in the oceans around the world. These devices mostly run on solar or battery power, typically requiring a laundry list of services every 3-12 months. OPT's alternative, the APB350 PowerBuoy, is capable of supplying 350 watts of continuous power to these marine applications, bringing with it reduced operational costs via fewer trips for maintenance and service (the target service interval for OPT's PowerBuoy is three years).

The PowerBuoy can provide a platform for the integration of various onboard sensors that can collect and process data in real time send it to the customer, Dr. Mekhiche explained. In addition, power can be run to other offshore equipment via umbilicals, or the buoy can even serve as a docking station to recharge and collect data from UUVs, drastically increasing mission endurance.

For these applications, reliability is key. OPT is therefore focusing on making its wave power devices reliable, manufacturable, transportable and easy to deploy in the ocean, Dr. Mekhiche said. The company is also developing models with higher power capabilities.

In September, OPT deployed its APB350 A1 PowerBuoy 14 miles northeast of Atlantic City, N.J., where it is presently collecting and transmitting real-time performance and weather data to OPT's headquarters for analysis. According to OPT, the data is promising. "It's not of question how many years we are going to spend to get a commercial product," Dr. Mekhiche said. "A commercial product is imminent. It's here."

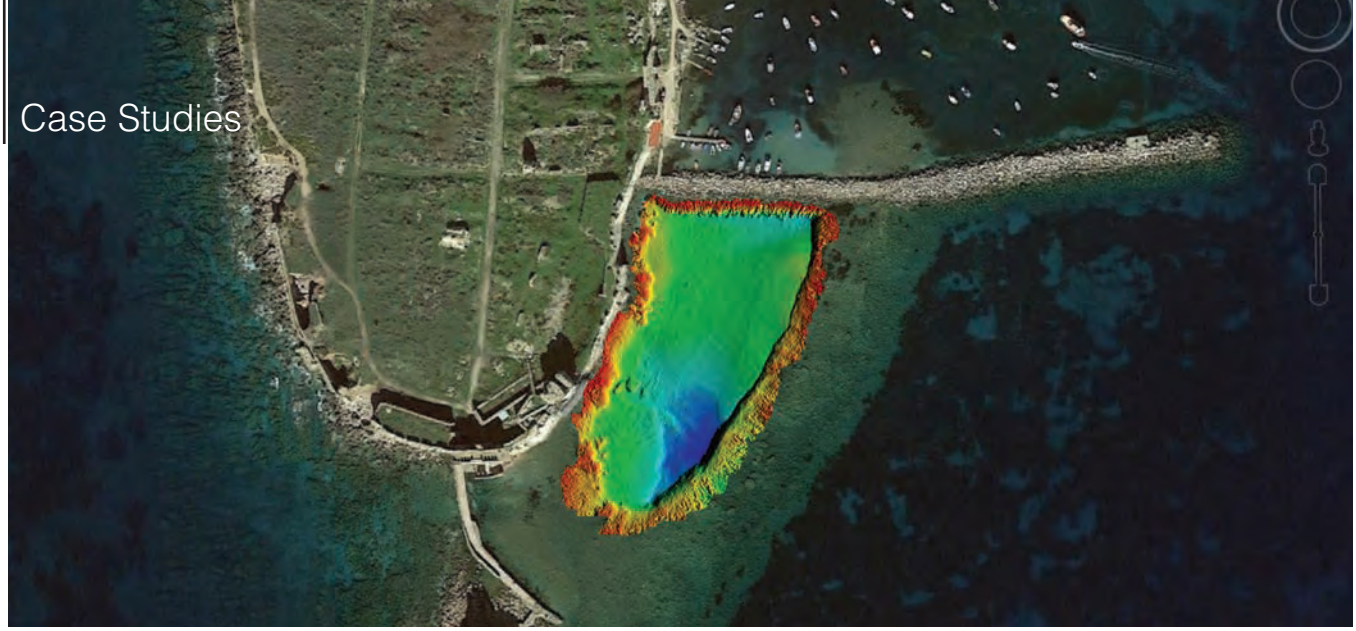


Image: Kongsberg Maritime

Greek Survey Uncovers Underwater Antiquities

A marine geophysical and hydrographic survey off Methoni, Greece uncovered a number of underwater antiquities, including historical shipwrecks, the town's ancient submerged pier and harbor, as well as ruins of the submerged prehistoric town – all mapped in 2D and 3D with the use of hydrographic and geophysical instrumentation. Led by a team of marine geophysicists from the Laboratory of Marine Geology and Physical Oceanography at the University of Patras, the survey was conducted under the auspices of the Greek Ephorate of Underwater Antiquities (Ministry of Culture and Sports) with support from Norwegian-based marine technology company Kongsberg Maritime.

The geoarchaeological survey, which was undertaken within the Evolved GE.N.ESIS (A marine GEophysical investigatioN for marine knowledge and the anthESIS of Methoni) project, aimed to highlight the Blue Growth potential in the Methoni

Kongberg OSV Simulator for Bibby Training

Bibby Ship Management India Pvt. Ltd. contracted for a Kongsberg Offshore Vessel Simulator (KOVS) including an upgrade of the customer's existing Kongsberg Dynamic Positioning (DP) simulator in Mumbai, representing the first KOVS in India. The Bibby Training Institute Mumbai has already helped to grow the number of certified Indian DP operators, from 60 when it opened in 2006 to more than 1000 today.

"This addition to the training center will open up new avenues for Indian seafarers who will have the opportunity to learn on high-end simulation technology," said Prakash Agarwal, Managing Director, Bibby Ship Management India Pvt. Ltd.

"Our new simulator will add a lot of value to what we have been doing so far and will help to meet the need for Indian crew certified in specialist operations."

The scope of supply for the delivery includes a Kongsberg Offshore Vessel Simulator with visual scene, featuring Anchor Handling vessel, Shuttle Tanker and Drilling Rig models, enabling advanced offshore operations exercises and courses covering: Manual Handling OSV, Anchor Handling, Offshore Loading, Position Reference, Drilling Rig Operation, Power Management, Ship Maneuvering, Advanced ECDIS, Bridge Team Management, Bridge Resource Management and Pilotage.

The existing Kongsberg DP simulator will also be upgraded to a DP 2 simulator fulfilling DNV/NI class A requirement as part of the project. The DP simulator will be integrated with the KOVS, providing the possibility to run DP2 courses with sea time reduction in addition to complete offshore vessel training.

Simon Barham, COO, Bibby Ship Management Group said: "This is an excellent opportunity to increase the number of courses which are being offered by Bibby Training Institute Mumbai. The new simulator will make it possible to provide modern training courses to the industry, which are the need of the hour."

"This contract is vindication of our commitment to the Indian market and reflects the relationship of trust and reliability that we have with our customers. We have recently moved into our own building and I believe that this gives customers more confidence that Kongsberg Maritime is a long-term partner in India," said Capt. Sanjiv Wagh, General Manager Sales, Kongsberg Maritime India Pvt. Ltd.

Kongsberg Maritime has also received an order from Bibby Ship Management's Bibby Ukraine Training Center to upgrade its existing Kongsberg DPS to the latest requirements for a NI (Nautical Institute) Class B DP Simulator.

A ship's wheel from a surveyed historic shipwreck off Methoni.

Greek Ministry of Culture and Sports

coast and to promote the protection of the local marine environment. The project outcomes are expected to highlight underwater resources that have the potential of being drivers for sustainable growth with special focus on the local underwater cultural heritage resources.

Regional physical processes, sensitive seabed habitats and development of the underwater environment through the millennia are also being studied. The identified synergies and conflicts between the underwater cultural heritage resources, local underwater environment, physical processes and human activities are expected to indicate the sustainable growth potential of the area, the environmental challenges and ultimately the necessity for implementation of an Integrated Maritime Policy.

The research team used the Kongsberg GeoSwath Plus Compact bathymetric sonar, the Kongsberg GeoChirp sub-bottom profiler, magnetometer and side scan sonar for the shallow water hydrographic and geoarchaeological investigation. Methoni's ancient submerged pier and harbor, a number of historical shipwrecks and artifacts, as well as ruins of the submerged prehistoric town were recorded in 2D and 3D.

The project is carried out with the support of CARIS and in the next phase CARIS HIPS and SIPS will be used for bathymetric and side scan data post-processing, analysis and 3D visualization of the recorded underwater antiquities and of features of potential archaeological interest.

The project objectives also include assessment of the extent of the submerged and semi-buried prehistoric settlement off Methoni, the investigation of evidence for its submersion, the description of physiography and geology of the Methoni bay, the contribution to the monitoring of the erosion pattern along the Methoni coast and the assessment of its impact on the underwater archaeological site evolution.

In its final phase the project will provide consultancy and demonstrate to stakeholders an advanced maritime spatial planning and sea use management platform.

Bibby Polaris on location at Premier Solan.

Photo: Bibby

West Shetland Subsea Challenges

Some 20% of the remaining UK oil reserves are expected to be West of Shetland, a challenging environment on the surface and subsea. In February 2013, Bibby Offshore was awarded a contract by Premier Oil to provide subsea support during the installation phase of its Solan field development project, in Block 205/26a of the UK Continental Shelf, in 135m water depth.

The facility at the Solan field has been designed to produce a flow rate of 28,000 b/d, peaking at up to 35,000 b/d across a 20-year lifeline.

The production facility has been developed as a not permanently manned installation (NPMI), and will be operated remotely from an onshore control room in Aberdeen. The topsides facility supports produced fluid separation, gas treatment, all necessary utilities and power generation.

The field infrastructure also includes a 10,000-tonne subsea oil storage tank (SOST) capable of storing 300,000 boe. Produced oil is sent to the SOST before being exported, via a single anchor loading system (SAL), to shuttle tankers.

Bibby Offshore was brought in to perform installation of the subsea infrastructure and, recognizing the challenging environment, came up with a plan to minimize downtime caused by short weather windows.

Preparation

To mitigate the impact of this, Bibby Offshore completed detailed weather analysis prior to mobilization to allow a realistic expectation on the potential downtime that could be experienced. The project team also gathered regular forecasts from various sources to help build an accurate picture in the short term on how the weather would impact over a two to five day window.

Bibby Offshore was also able to take a flexible multi vessel approach to the project, making use of several of the vessels in its fleet. The Dive Support Vessel (DSV) Bibby Polaris was used extensively to complete much of the dive works. The DSV Bibby Sapphire and DSV Bibby Topaz and the Construction Support Vessel (CSV) Olympic Ares also made a significant contribution to the project. Further to this the company used short term chartered Remotely Operated Vehicle Support Vessel (ROVSV) and a third party DSV.

This multi vessel approach helped Bibby Offshore tailor the various vessel capabilities to the technical challenges presented by the development and the flexible timeline required to complete the task in line with the clients program. Crucially, it also helped to prevent any schedule slippages in order to maintain progress towards achieving first oil.

Subsea Considerations

The subsea aspect of the project was planned in two phases. Phase one saw the Olympic Ares carry out installation activities for the single anchor loading system (SAL), metrology, lay through spool removal, flexible and umbilical installation and wet storing of fabricated spools. Phase two consisted of the diving support operations to complete installation, tie in, stability/protection and recommissioning of the flexible, umbilicals, spools and storage tank.

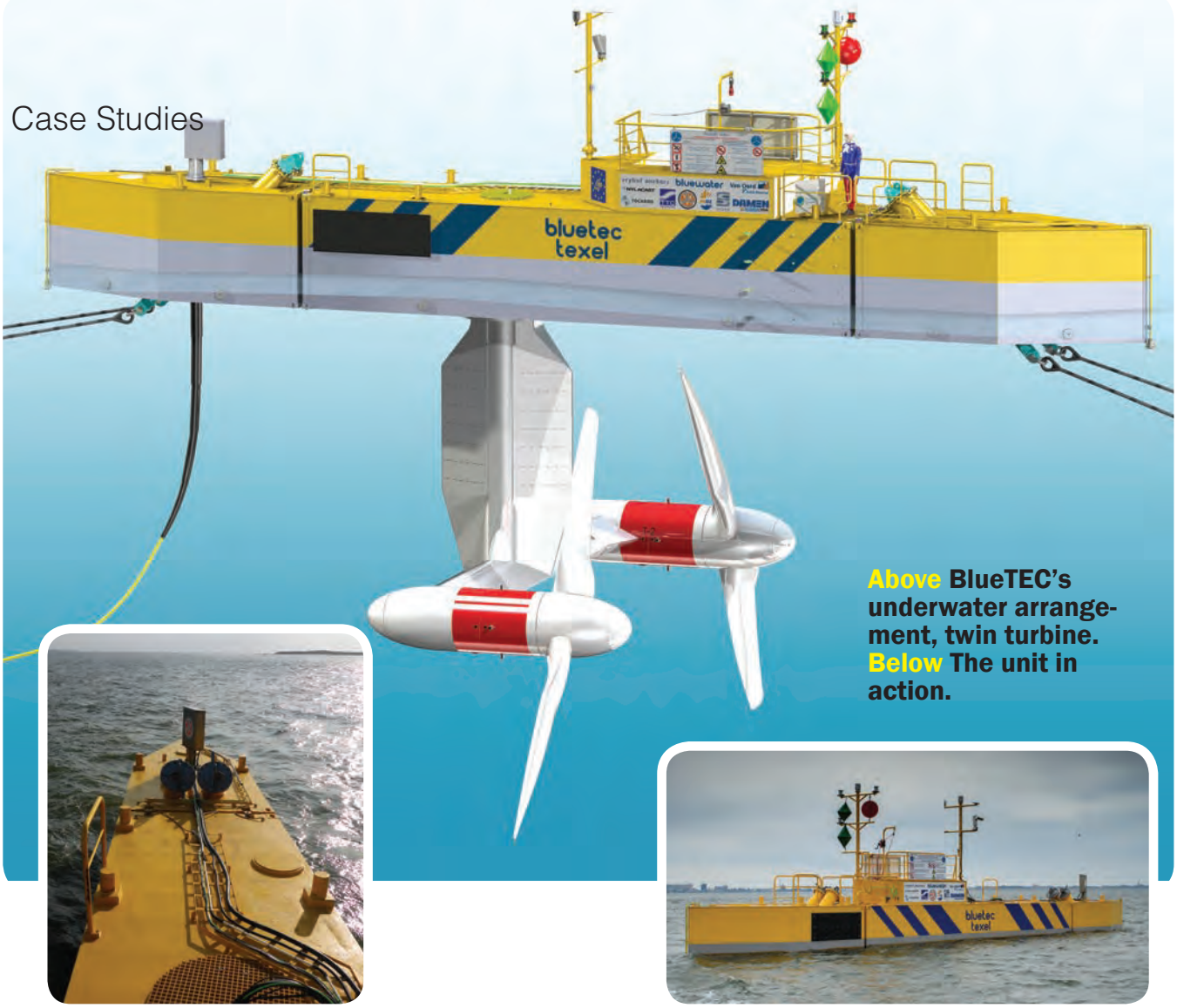
During the campaign, a 72-in. structure pile was installed which required a large 90-ton 'Fast Frame' to be deployed to the seabed. The loading hose itself presented a range of engineering considerations to the project team due to the inflexibility of the product and the fact it could not be pre-installed on a deployment reel onshore prior to installation on this occasion.

After completing the acoustic metrology, the Bibby Polaris was deployed to connect the pipeline to the SAL spool and the SAL to the offloading hose.

During the offshore operations, the project team configured an optimized deck layout on the Olympic Ares, thus creating the required working space. This was necessary due to a multi reel drive system taking up a significant amount of deck space and also the additional equipment required to install flexible and umbilical products before completing metrology between the newly installed platform and subsea oil storage tank. In subsequent campaigns, two DSVs and one ROVSV were mobilized to carry out spool installations, flexible and umbilical tie-ins, mattressing and general storage tank works.

Umbilical Loadout

Photo: Bibby



Above BlueTEC's underwater arrangement, twin turbine. **Below** The unit in action.

Image: Damen

Floating Tidal Energy Platform Up and Running

The first months of operating the BlueTEC tidal energy platform have been a success, according to the BlueTEC Texel Tidal partnership: with every tidal flow, the platform supplies electricity into the Dutch national grid. "Getting the platform from the drawing board to a grid-connected operating reality in just six months is amazing," said Allard van Hoeken, Head of New Energy at Bluewater Energy Services and recent recipient of the first Prince Friso Engineers Award. "The electricity production conforms to expectations, the mooring loads are lower than expected and the stability is better than expected. It is a great success."

Shortly after its launch this summer the platform's new moorings passed its first serious tests as two large storms passed over the area.

With the platform up and running smoothly, the project partners are now looking forward to the next step in its development. "We will install the next turbine – a Tocardo T2 – before the winter. This will double the platform's capacity," Van Hoeken said. "A few months after that we will install a second T2 turbine. With two turbines working simultaneously this will double the capacity once again to reach the 400-500 kW mark. This means a proven solution is available on the market. In the meantime we will proceed to even larger units of 2.5 MW each."

"These units can supply clean energy to islands and remote locations below the cost of diesel generators," Van Hoeken said. "In addition, what the industry may only be starting to realize, is that they also pave the way towards large, utility-scale tidal farms. Starting with 500 kW units means using existing technology and a small grid setup, hence keeping the required investment and associated risks to a minimum. In the following step, our 2.5 MW units will be used for full development."

Project partners includes Bluewater, Damen Shipyards Group, Niron Staal, Van Oord, Acta Marine, Vryhof Anchors, TKF, Tocardo, Schottel Hydro, NIOZ, Tidal Testing Centre, Nylacast and the Port of Den Helder. Further support came from the Netherlands Enterprise Agency and the Waddenfonds program, in addition to EU Life funding during the developmental phase.

MARIN Uses WFS Wireless Data Link in Sub Tests

MARIN's Seakeeping and Maneuvering basin in Wageningen, the Netherlands, is one of seven model testing facilities used for testing scale models of both surface and underwater vehicles. The basin measures 170m x 40m x 5m, with state-of-the-art wave makers and wave absorbers offering the capability to test a vehicle in uni- and multi-directional waves from various directions.

The purpose of tests in the basin is to quantify and demonstrate the behavior and performance of a vessel under particular conditions. Each vessel goes through an extensive series of tests and refinements to ensure that its physical characteristics are all optimized to produce the desired results.

MARIN approached WFS with a requirement for a wireless data link to allow communications to and from (moving) underwater vessels in its Seakeeping and Maneuvering basin. The wireless data link would be used to control the vehicle in the tank at up to seven meters range, and also to retrieve data from the onboard instrumentation to optimize behavior and performance.

The solution was delivered using a broadband data link from the seatooth family of subsea wireless instruments from WFS, enabling a high rate of data to be transmitted over a short range, underwater. seatooth can provide a reliable wireless communications link in the most challenging subsea environments:

- In shallow water or turbid water
- In the presence of bubbles or contaminants
- Near to large subsea structures
- Through ground, seabed, concrete and non-metallic structures

For testing of moving underwater vessels, a hard wired method of communication (and control) is not practical. Wires between a free sailing vessel and a monitoring system will also introduce extra drag which is both undesired in testing and will affect the accuracy of the test results. A wireless link like seatooth enables continuous monitoring for safety and efficiency and is preferable because it provides both continuous information and the opportunity to intervene on a real-time basis if required.

"Real-time wireless underwater communications is a key factor in efficient and accurate testing of model scale submarines," says Haite van der Schaaf, Project Manager, Measurement & Control Systems at MARIN. "We hope that in the future, we will be able to use seatooth wireless technology in numerous projects at MARIN's test facilities.

www.wfs-tech.com

Anemones blanketing jacket and anode SNS

The Importance of Marine Growth

Decommissioning within the offshore environment is rapidly becoming a focused activity for the oil and gas industry. Latest figures from Decom North Sea suggest that there are, approximately, 470 offshore installations in the UK sector due to come out of service by 2030 with an associated cost of $46.8 billion. With such a formidable undertaking ahead, oil and gas operators are developing their decommissioning plans. The effective management and mitigation of potential environmental impacts and risks is key to the success of this process. Integral to this are marine growth assessments which are increasingly being used to provide valuable information for decommissioning plans. ***Faron McLellan****, Environmental Consultant,* ***Dr. Dorota Bastrikin****, Senior Consultant, and* ***Dr. Joe Ferris****, Associate Director at BMT Cordah, a subsidiary of BMT Group, discuss the importance of these assessments drawing on a number of projects carried out both within the North Sea and overseas, and how they can assist the planning process, minimize the environmental impact and financial risks. An important environmental issue is the occurrence and spread of marine species on decommissioned structures outside their naturally occurring range with the risk of introducing an invasive species.*

Anemones

There are more than 1,500 registered offshore oil and gas installations in the North Sea, 470 of which are in United Kingdom (UK) waters with more than 10,000 km of pipelines and circa 5,000 wells. Many of these structures are over 40 years old and are now coming to the end of their design life. Over the next couple of decades a growing number of redundant oil and gas installations will be taken out of service and decommissioned. As well as the physical removal of the component parts, decommissioning of offshore subsea structures must include the management and mitigation of any potential environmental impacts and risks. This includes the consideration of organisms that colonize submerged oil and gas structures referred to as 'marine growth'. These colonies may form habitats from a range of species assemblages, the composition of which will differ depending on the structure's depth, geographical location and age. Marine growth introduces a wide range of issues in the context of decommissioning, including the added weight to a structure, colonization by protected species, the potential for transfer of invasive (non-native) species and management of marine growth waste. Existing literature indicates that the colonization of offshore structures can commence within weeks of submergence, continuing until the time of decommissioning. Throughout that period, marine growth can colonize and re-colonize, sometimes with species different to those originally found on the structure. In some cases, facilities may have been in place since the late 1970's, providing opportunities for colonization by a succession of marine species.

There are two protected species in the North Sea that must be recognized during the decommissioning process: Lophelia pertusa, a cold-water coral and Sabellaria spinulosa, a reef building polychaete worm. The Department of Energy and Climate Change (DECC) Guidance Notes on the Decommissioning of Offshore Oil and Gas Installations and Pipelines under the Petroleum Act 1998 provide guidance on these. If either of these species is likely to be present, it is prudent to confirm or disprove their presence prior to undertaking decommissioning operations. Both of these species are listed under the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES). This listing means that a CITES certificate is required if transporting Lophelia or Sabellaria between states.

Factors influencing the distribution and occurrence of marine growth colonization include water temperature, salinity, depth, distance from shore or from other fouled structures, exposure to wave action and predation. Geographical differences in these parameters exist as demonstrated in the variation in marine growth between the northern, central and southern North Sea. For example, Lophelia has not been recorded on southern North Sea structures and is typically only observed

Anemones out of water

in the northern and central North Sea in deep waters (>50 m) and colder conditions. Marine growth will develop at different rates, but it is not unusual for significant cover of marine growth to be established in as little as five years after installation. Lophelia has not historically been recorded within the first decade after installation. However, with an increasing number of platforms with Lophelia, these colonized platforms may provide a "stepping stone" effect and facilitating colonization within the first decade. In the SNS Sabellaria has been reported growing on the exposed surface of pipelines in areas designated as conservation sites. The decommissioning options for these pipelines may be affected by the occurrence of this species.

The differences in species composition and distribution between areas of the North Sea can be demonstrated through two marine growth assessments carried out by BMT Cordah.

(a) CNRI – Northern N. Sea Murchison Platform

The Murchison platform is a northern North Sea (NNS) structure in a water depth of circa 156 m where the additional weight of marine growth was approximately 2,394 tons. Of note here is that the deep-water zone was dominated by Lophelia and anemones which can add a significant mass to an offshore jacket. Marine growth accounted for an additional 12% of the total weight of the steel jacket and secondary steel jacket (caissons, risers, etc.). Of the total weight of marine growth 202 tons was from Lophelia (8.4%), which only made up 3% of the marine growth coverage on the structure.

(b) ConocoPhillips – Southern N. Sea Satellite Platforms

In contrast to Murchison, these platforms are situated in the shallower waters of the southern North Sea (SNS) in less than 34 m water depth. The added marine growth weight on the nine platforms averaged 39 tonnes, with a maximum of 72 tons and a minimum of 21 tons. Similar zonation patterns were observed in the shallow and mid-water zones across the platforms. No Lophelia were recorded on the SNS platforms since it is believed that they are situated in water too shallow for the coral to colonize and survive. The shallow-water zone of the SNS satellites showed more areas of bare member in contrast to Murchison which is most likely due to storm regime combined with the shallower water experienced in the SNS.

Considering the aforementioned factors, the importance of a marine growth assessment in the management of the decommissioning process to minimize potential environmental impacts and risks becomes more apparent. While not a statutory requirement within UKCS decommissioning environmental impact assessments (EIA), marine growth assessments offer a practical and cost-saving option for its effective management. Furthermore, a marine growth assessment contributes to both the environmental and socioeconomic aspects of the EIA. At a minimum, these assessments can be used to provide a quantification of the weight of fouling organisms and identification of species, including those subject to protection. The weight of the structures to be decommissioned is a fundamental consideration when planning lifting, transportation and disposal operations. Marine growth, by increasing the structural weight, can increase costs and the complexity of lifting operations.

Current approaches to the management of marine growth include:

- (i) offshore removal of marine growth by a Remotely Operated Vehicle (ROV) and/or divers in situ;
- (ii) onshore removal from cut jacket sections and subsequent landfilling; and
- (iii) land-spreading or composting of removed marine growth.

All of these options bring with them potential environmental impacts which need to be considered Potential seabed impact from marine growth removed in situ will also be influenced by the species composition. The suitability of landfill or composting sites will depend on species composition. The EU Landfill Directive (1999/31/EC) includes an obligation for member states to reduce the amount of biodegradable waste, which includes marine growth destined for landfill. The UK targets, based on the 1995 waste quantities, are a reduction of 75% by 2010, 50% by 2013 and 35% by 2020. Therefore disposal in landfill may become a last resort for this waste.

Offshore structures brought to shore with marine growth have often resulted in complaints from local communities regarding the odor. The major sources of smell following removal of structures laden with marine growth are the biologically-emitted odors from dying organisms, disturbed anoxic layers and removal of putrefying organisms, particularly originating from highly productive areas. The intensity of smell can become a considerable nuisance to local communities. The platform location and time of year for planned removal should be taken into consideration when developing the decommissioning program. Due to the seasonality of the productivity of fouling organisms, jackets and other subsea structures removed during the summer and autumn would be expected to emit a stronger odor for longer than those removed in spring from the same location.

A marine growth assessment also provides information on the presence of potentially invasive alien (non-native) species (species from outside of their natural range) which can threaten the diversity or abundance of native species, the ecological stability of infested waters and/or commercial, agricultural or recreational activities. Invasive species can often out-compete indigenous species, detrimentally affecting local ecosystems. Mobile structures, such as Floating Production Storage and Offloading (FPSO) vessels, could act as sources for the introduction of invasive species when taken to different geographical regions for decommissioning or reuse. The European Union (EU) Marine Strategy Framework Directive (MSFD) that came into force on 15th July 2008 aims to protect the marine environment across Europe by achieving and maintaining Good Environmental Status (GES) by 2020. It lists prevention of the adverse alterations to the environment

by non-native species, as one of the vital elements of maintaining GES. In 2014, UK published Part Two of the Marine Strategy which focuses on a coordinated monitoring program for the ongoing assessment of GES and includes invasive species. A new EU Regulation No. 1143/2014 on Invasive Alien Species came into force on January 1, 2015 and foresees three types of interventions:

- (i) prevention;
- (ii) early detection and eradication; and
- (iii) management.

A marine growth assessment can satisfy requirements for detection and management.

With the transportation of offshore structures comes an increased potential risk to the marine environment of the introduction of invasive species. This is particularly important if the structure is to be transported out of the North Sea. This risk is determined by the:

- Presence and abundance of invasive alien (non-native) species and/or species that have the potential to become invasive;
- Period of air exposure of the marine growth during transport and resultant mortality of the species; and
- Capacity of alien organisms to colonise, survive and out-compete native species along the transport route and at the final destination.

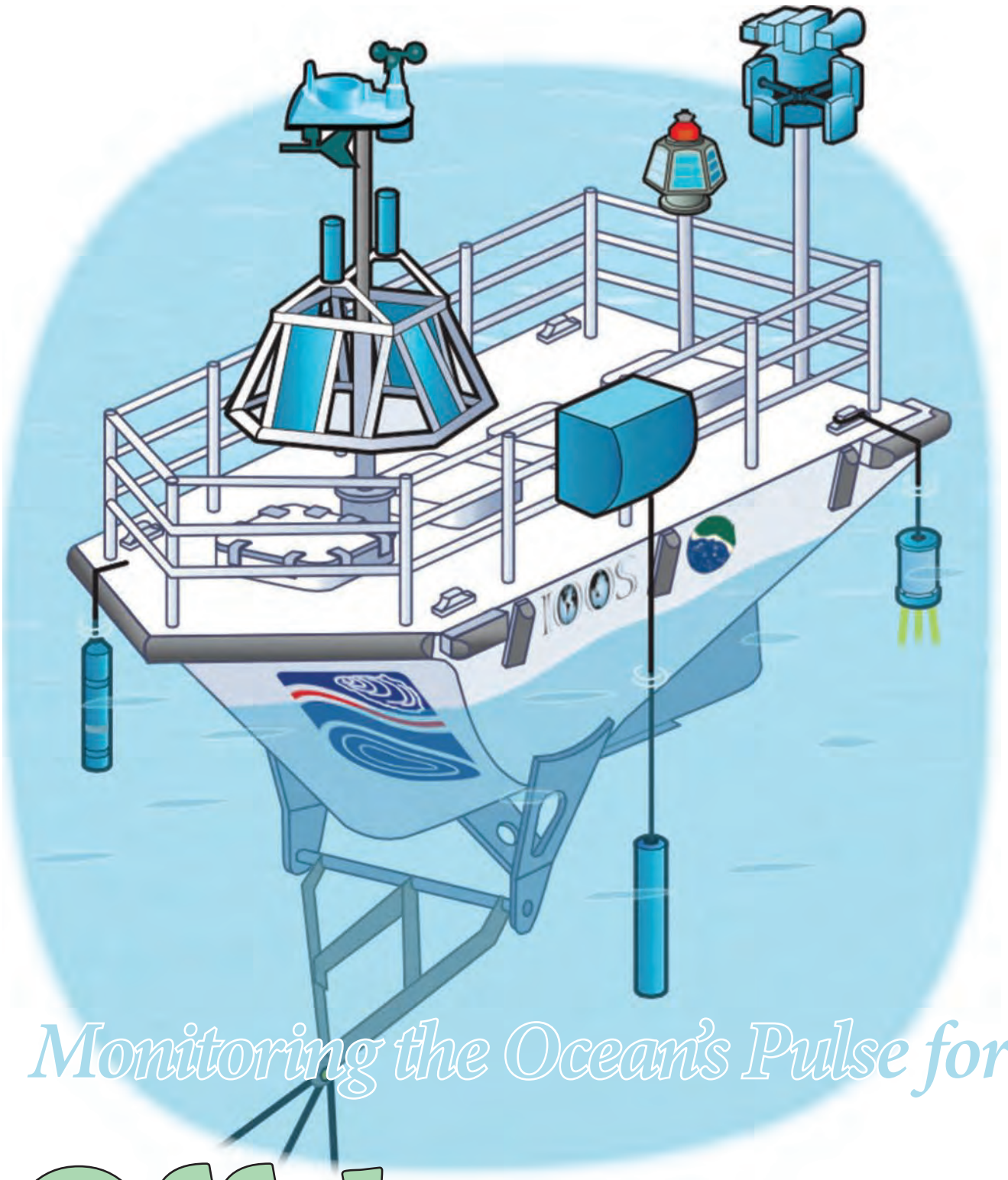
Case Study: **FPSO, Southwest Atlantic**

In 2014, BMT Cordah was commissioned to conduct a marine growth assessment for the decommissioning of an FPSO located in the southwest Atlantic. During the assessment, the presence on the hull of an invasive, non-native sun coral species, Tubastraea coccinea was reported. With a high tolerance range to environmental conditions and a prolific reproductive capacity, the sun coral readily out-competes native corals and other species. Tubastraea can also reproduce by fragmentation, making it a potentially dangerous species to carry through waters where it is not present should any part of the coral fall off in transit to the selected decommissioning site.

The major considerations when deciding the movement of the FPSO and geographical location of the decommissioning yard were:

- Identification of the suspected invasive coral;
- Consideration of remedial options for in situ removal;
- Assessment of existing international regulations and compliance with the transportation and deposition of non-indigenous species in international waters.

An assessment of the marine growth on offshore structures is an important component of decommissioning programs. The implications of additional weight and the occurrence of protected or invasive species are key drivers in lifting operations and final disposal. These must be considered to ensure the decommissioning process is completed safely, cost-effectively and within the frameworks of both best practice and relevant legislation.



Monitoring the Ocean's Pulse for

Offshore Aquaculture

By Kira Coley

In a time when aquaculture production has become the fastest-growing food-production sector in the world, marine monitoring technologies will be essential for reducing environmental impact. Aquaculture within the U.S. is set to increase by more than 50% over the next 5 years in a bid to reduce America's $11 billion seafood trade deficit. Combining new sustainable aquaculture methods, real-time scientific monitoring and a marine technology testing centre, the Catalina Sea Ranch goes beyond traditional approaches to a centuries old challenge. By using the latest innovative techniques for offshore monitoring and mussel production, this novel venture is paving the way for a sustainable and efficient future for the aquaculture industry.

The National Oceanic and Atmospheric Administration (NOAA) launched a "National Shellfish Initiative" in 2011 with an emphasis on growing sustainable shellfish aquaculture within United States waters. As a solution to the U.S. seafood trade deficit, NOAA recently announced its "Marine Aquaculture Strategic Plan FY 2016-2020" which aims to more than double marine aquaculture activity by 2020.

Globally, filter-feeding shellfish are important for ecologically sustainable aquaculture and are successfully farmed throughout the world. Although mussel cultivation does not require highly sophisticated techniques, consideration of environmental, ecological and seasonal factors are essential for the health of the stock. As the industry looms on the verge of an 'aquaculture boom', any negative ecological impacts must also be minimised from increased production.

The United States produced $1.2 billion of aquaculture seafood in 2012. NOAA's goal for a 50% increase amounts to over $600 million or $100 million a year. For this to be accomplished rapid permitting of aquaculture facilities would be needed, presenting an opportunity for innovative R&D programs and cost effective environmental monitoring packages. Advanced aquaculture husbandry technologies will also enable the production of higher crop yields, while innovative hatchery technologies can provide a competitive economic advantage for the early adopters.

Recognizing the potential of mussel cultivation, the Catalina Sea Ranch was proposed as the "First Open Ocean Shellfish Ranch in United States Federal Waters."

In July 2012, the Catalina Sea Ranch was awarded a permit from the U.S. Army Corps of Engineers to develop a

100-acre shellfish farm on the San Pedro Shelf—a large underwater plateau about 150 feet deep that drops off to 3,000 feet, creating natural upwelling that delivers an abundance of nutrient-rich phytoplankton from the deeper water.

While mussel farming has been practiced for centuries, the Catalina Sea Ranch is reshaping the traditional approach by advancing cultivation techniques and pushing the industry into a new age of innovative real-time monitoring technologies. By collaborating with institutes such as SCRIPPS, Woods Hole Oceanographic Institute (WHOI) and the University of Southern California (USC), research objectives have been designed to expand scientific understanding on topics from ecosystem dynamics to ocean acidification.

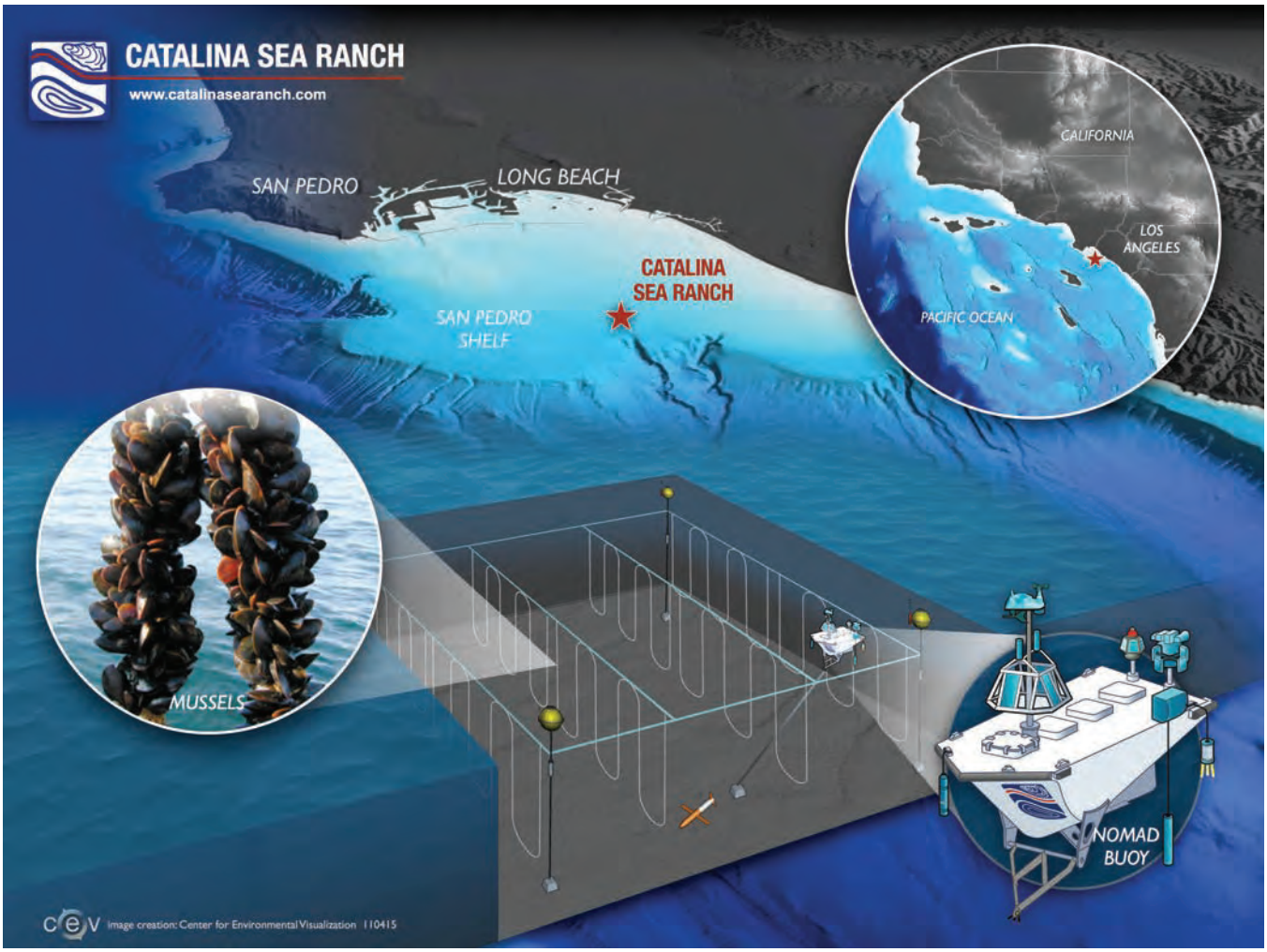
"It's a really exciting time in the area of offshore technology, as the cost of data storage and microprocessors is plummeting: this couldn't have been done two years ago," said Phil Cruver, Founder, President and CEO of Catalina Sea Ranch, LLC. "We can now collect real-time data remotely at a fraction of the cost, which really changes the capability of the assessment, evaluation and for 'taking the pulse of an area of the ocean'. This transparent data is then put onto the web so research scientists can conduct collaborative evaluations."

Taking the Ocean's Pulse

Traditionally it may take up to 6 months to assess negative impacts in the marine environment from aquaculture activities. Recent developments in marine monitoring technologies allows the Catalina Sea Ranch to identify any issues immediately and implement an adaptive management plan.

The ranch has three levels of real-time monitoring. The first monitors environmental data to comply with regulatory requirements such as biological impacts to water quality, seafloor composition, species quantity and other factors that could alter the environment in proximity to the shellfish facility. The second is husbandry data such as identifying thermoclines for the best depth to cultivate the shellfish and their carrying capacity to improve operations.

"Given the importance of phytoplankton in both sustaining the shellfish and the wider marine community, we want to know what is the carrying capacity of this ranch, i.e. would the mussels consume so much phytoplankton that it negatively effects other species access to this vital food source," said Cruver. "So we monitor this in both the vertical and horizontal plain using low cost sensors and send all that data into Verizon's cellular network. We can monitor massive amounts



of data in real-time with subject matter experts and make sure there is no problem. No one has ever done this before."

The final level of monitoring is security. Perimeter buoys can be located around the ranch with warning lanterns and a real-time radar is fitted to the NOMAD which serves as a corner marker buoy. In addition, the site is located within the scope of the Port of Long Beach, giving the United States Coast Guard access to the ranch quickly.

Double Act: A Test Center for Marine Technology

The advancement of novel technologies will be essential in the development of sustainable offshore aquaculture for both shellfish and seaweeds in the future. Both industries are recognised to have a major potential for achieving the 50% growth goal of NOAA's Marine Aquaculture Strategic Plan.

Catalina Sea Ranch was awarded a $481,550 grant contract by the South Coast Air Quality Management District to repower its Caption Jack Research Vessel with three new less polluting engines. The shuttle service brings scientists and ocean engineers to the RV where they can get access to a wet-laboratory. It is on this floating laboratory that the numerous participation PhDs, researchers and engineers seek to advance the science of marine aquaculture and real-time environmental assessments.

"With today's shellfish aquaculture there really is no sophisticated technology. What we are doing that is really advanced for exploiting this huge market what we called 'Ocean Internet of Things' (IoT). According to the McKinsey Global Institute, by 2025 the Internet of Things will be an $11 trillion market for connecting networks and sensors together," said Cruver. "We have a whole stack of technologies, most of which have been designed especially for the purpose of the ranch, others have not been used before in this way."

A wireless underwater acoustical network with sensors, transfers record

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breaking data of speeds up to 200 kbps between nodes in a mesh network 200 metres apart below the water.

The ranch uses a variety of remotely operated vehicles (ROVs) to help in underwater inspections throughout the site. A larger ROV inspects infrastructure integrity and collects scientific data, while a mini ROV is used for the inspection of the cultivation gear and anchors for maintenance, as well as mussel crops for growth and marine biofouling characteristics.

Above the water, Catalina Sea Ranch is developing its NOMAD buoy as a distinctive, one of its kind, IoT platform. The NOMAD is fitted with an array of sensors to collect bathymetric environmental data including temperature, salinity, pH, dissolved oxygen and phytoplankton density. The raw data is transmitted to computers on-board the buoy, allowing researchers and operation staff to quickly process and sort the data, before sending the valuable information back to Verizon's cellular tower.

Cruver and the team work closely with research institutions by providing platforms, such as the NOMAD, with the capability to transmit real-time automated data into the Internet cloud. By leveraging Verizon's network, the Catalina Sea Ranch intends to develop a proprietary automated offshore aquaculture monitoring system, for producing real-time data available for collaborative and transparent web-based scientific analysis.

"No one has ever used a cellular network to transmit that kind of signal from six-miles offshore. We started working with the CEO of Verizon as he is an advocate of sustainability, which resonates with our project." Explains Cruver, "Not only are today's sensors changing but the networks are changing. There is no one in the marine sector exploiting IoT technologies. We want to provide the platform for developing the latest innovative solutions for offshore monitoring and become leaders in 'Marine Big Data'."

Surging Subsea Segments

By William Stoichevski

"In pipe-lay, there's a steady growth. We see optimism," a Rolls-Royce executive tells a disbelieving clutch of journalists in Aalesund, Norway. Days earlier, the equipment maker and ship designer had announced hundreds of marine-division layoffs amid continued "tough times" offshore.

The results of Netherlands-based Boskalis, with its pipe-lay vessels, lends support to the Rolls-Royce business leader's optimistic comment. While dredging out a new Suez Canal might have helped produce a record profit of over 300 million euro, it was "high equipment utilization" offshore that produced what Boskalis CEO Peter Berdovski calls "a fantastic first-half, historically". For him, "there's a clear distinction" between short-term reluctance on the part of oil companies to invest and the long-term "prosperity" expected, soon, to drive energy demand.

Never too New

As 2015 winds down, Rolls-Royce's marine division can still cheer a new relationship with Wenchong Shipyard in China. The two are brought together by a DP deal for a 124-m Skipsteknisk-designed diving support vessel for Jumeirah Offshore of Singapore. The design is noteworthy, as it joins pipe-lay and cable-lay in the buoyant subsea segment "offshore support", where there's plenty of work for subsea support vessels (SSVs) or construction support vessels (CSVs).

The 60-ship Farstad Shipping, for one, has seen its SSVs completely outperform its anchor-handlers and platform supply vessels. A new three-year contract for the 9,500 DWT, Vard-built Far Sentinel is the second new-build CSV to win work for Farstad in 2015. Subtec S.A. de C.V. hired the Sentinel for construction and maintenance work in the Gulf of Mexico. Most maintenance and modifications (or M&M) work worldwide has been put off by oil majors, judging by the words of nearly every industry executive, so any M&M spending is rightly seen as "the start" (of recovery).

Farstad CEO Karl Johan Bakken — overseeing six new SSVs and one new-build — tells MTR, "The reality is, a combination of reliability during unforeseen events and quality vessels will keep (the Farstad fleet) working.

"The build-up in our subsea segment, which is small, has happened fairly recently," Bakken cautions. Nevertheless, he could book late-summer 2015 operating profits for Farstad's SSVs as up 220 percent year-on-year. The segmented profits for anchor handlers and supply vessels were down tenfold or slipped into loss.

Cable Guys

It's in cable-lay and related marine subsea services, where SSVs appear to be winning out. They're benefitting from a surge in Northwest European turbine and offshore-wind grid-

Instant success: the new-build Far 838 due for delivery in 2016.

Subsea surge: The newly employed Far Sentinel.

building; country-to-country cable-laying and a start to some of the largest oilfield projects ever seen in the North Sea rim at Johan Sverdrup (Norway), Culzean (U.K.) and Sword (Egypt). Fleets are growing, as Bakken says, and — as in the heyday of PSVs 10 years ago — the jobs keep coming. An ability to handle survey and seabed mapping work by autonomous underwater vehicles (AUVs) or remotely operated vehicles (ROVs) is key to winning work. It helps, as well, to have three types of trenching "robots" aboard, as with DeepOcean.

Though not yet fully fitted out, the DeepOcean cable-installation new-build Maersk Connector has newly helped the subsea contractor win a 136-kilometre trenching and route-engineering job at an Irish Sea wind farm as well as the installation, trenching and subsea "road work" for the bundled cable of a Britain-to-Belgium cable. The Irish Sea work will see DeepOcean asset, Havila Phoenix, launch an FMC Schilling Technology 200 horsepower WROV trencher.

Competitive Vision

In 2013 DeepOcean acquired half of ADUS to form ADUS DeepOcean Ltd., and the competitive move allows the Norway-based subsea player to present clients with "stunning subsea 3D visualizations" of subsea facilities, wind turbine pedestals or seabed terrain.

"It's going to get even more competitive," says Bakken. "(SSVs) will have the same challenges as the rest of (the offshore vessel market). We'll focus on reliability and safety, because it's going to get tough."

Petrobras *Stepping on the Brakes*

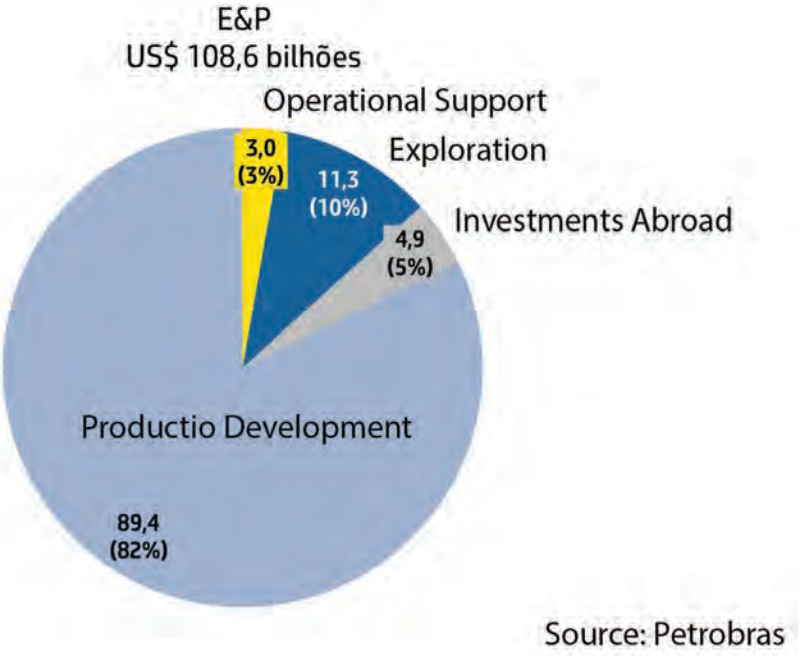
Credit: Claudio Paschoa

By Claudio Paschoa

Petrobras' Crisis

The Brazilian oil and gas industry finds itself in turmoil in part due to corruption probes involving senior directors of national operator Petrobras. The scandal has reached many areas of the super-major and federal prosecutors in charge of the investigations believe company losses can run into billions of dollars. Prosecutors allege that executives from Petrobras conspired with major Brazilian construction companies that had entered the O&G sector, to inflate the price of refineries, ships, advertising and other goods and services, along with forming a cartel to circumvent tenders. Prosecutors also allege contractors then paid a percentage of the overpriced contracts to executives, politicians and political parties. The federal judge responsible for the case has made it clear the bribes and kickbacks at Petrobras were systemic. "All large Petrobras contracts involved a percentage for company directors and politicians," said Judge Moro.

Petrobras' new CEO, Aldemir Bendine has pledged transparency in all of Petrobras' operations and to clear all corruption schemes involving the super-major. Bendine left the presidency of Brazil's national bank, Banco do Brasil (BB), a position he held for six years, to head Petrobras. At 51 years old he is a career BB employee and had never worked in the O&G sector before. He is highly regarded in the financial market and during his 6-year tenure at BB the value of the bank's assets rose from R$685.6 billion ($246b) to R$1.432 trillion ($512b). "The courts, market and the whole of Brazilian society know that Petrobras was the victim of a group of people who used their public positions or economic power to damage our company's property. However, we do not and will never passively accept victim status. It is the duty of everyone who is part of this company to strive to guarantee that these discoveries make Petrobras stronger, more solid and more transparent. Thanks to the efforts of the Public Prosecution Ministry and Federal Police, which have counted on our unconditional and unrestricted collaboration, we are swiftly recovering resources that belong to our shareholders and, therefore, all Brazilians. These resources will be used to enhance our governance.



Source: Petrobras

ernance. The second step is the launch of an additional series of measures to improve the company's internal controls, based on three pillars: replacement of individual decisions with collective decisions; monitoring and transparency; and enhancement of relations with our suppliers. Firstly, we are restricting our executives' individual decision-making capacity. As a result, the everyday work of managers, executive managers and board members will be overseen by a set of committees and support groups. This model is aimed at ensuring that no projects are approved unless they have undergone proper technical and financial evaluation, and abide by all the company's compliance rules. Secondly, we are ensuring that all internal mechanisms for receiving and investigating allegations are completely independent and protected against any kind of interference. We are expanding the presence of committees and external audits at the company, and increasing continuous cooperation with the regulatory and police authorities, to share sensitive information that is obtained in these investigations," said Bendine. It is clear that Petrobras' new president is aggressively trying to regain some of the company's credibility, however he faces a steep uphill battle and any new corruption disclosures will heavily tarnish Petrobras' already shaken reputation.

Supplier Policy

Petrobras has made its supplier management process stricter. Its suppliers must now provide detailed information about their structure, finances and mechanisms for compliance and combating fraud and corruption, among other items, which are evaluated through a process called "Integrity Due Diligence." The aim is to make the procurement of goods and services more secure and mitigate risks regarding fraud and corruption. The company has been implementing measures to ensure that only suppliers with proven compliance and integrity mechanisms remain in Petrobras' registry and can participate in competitive tenders. These measures were announced in July 31 during a ceremony to formally return funds to the company retrieved by the Federal Prosecution Ministry. Petrobras' review of its supplier's status began with local companies whose activities have been suspended by the courts due to evidence uncovered by the "Lava Jato" investigation. Petrobras is evaluating suppliers whose contracts are in the renewal process or

Aldemir Bendine

President, Petrobras

that are applying to join its supplier registry. Besides having to prove that the information they provide is correct, the companies that remain in Petrobras' supplier database will have to give Petrobras authorization to conduct audits of their integrity systems and mechanisms to combat fraud and corruption.

Pre-salt Potential

Between 2000 and 2010, Brazil's proven oil and natural gas reserves increased 68.5%, according to data from the National Petroleum, Natural Gas and Biofuels Agency (ANP), going from 9.854 billion boe to 16.609 billion boe. By 2014 proven oil and natural gas reserves in Brazil had reached 31.058 billion boe, of which 29.889 billion boe are located offshore, according to ANP, roughly a 53.48% increase from 2010. Between 2010 and 2014, 63% of the world's deepwater oil discoveries were made in Brazil. Brazilian pre-salt reservoirs were first discovered in 2006 and cover an area of 149,000 square kilometers, covering three major offshore basins. The Santos Basin, where the largest new discoveries occurred, is mostly located offshore the state of Rio de Janeiro, with a portion of the basin offshore the state of São Paulo.

The Campos Basin, which is still the largest producer in Brazil, is also located offshore the state of Rio de Janeiro, while the Espírito Santo Basin is located offshore the state of Espírito Santo.

A recent study by the National Oil and Gas Institute (INOG) of the Federal University of Rio de Janeiro (UERJ), states that the Brazilian pre-salt polygon contains undiscovered and recoverable reserves to the tune of 176 billion boe. This is equivalent to four times the pre-salt volume already discovered. This estimate by INOG is the only known large scale evaluation of the pre-salt polygon ever made and it is 54% bigger than INOG's 2010 estimate which varied between 114 and 288 billion boe. It is significant to note that researchers responsible for the study believe that 176 billion boe is a conservative estimate and there is a strong belief among some Brazilian geologists that the interval between the pre-salt polygon and the Brazilian Exclusive Economic Zone (EEZ) hold more promising deepwater pre-salt prospects.

Investment Plan 2015-2019

Petrobras' new management has already slashed its investment plan by 40%, from $221 billion down to $130 billion, yet the state of Brazil's economy, the devaluation of the Real (Brazil's local currency) and low oil prices may force the national operator to decrease its investment plan even more. Rumors have it that Petrobras may be forced to seek more funds through the financial market in the near future. The current investment plan was based on the dollar staying at R$3.10 and that the average price of the Brent would be $60 in 2015. At this point these numbers are unrealistic, with the dollar hovering between R$3.80 and R$4.00 and the Brent crude at $46.48 on September 15. Both variables directly affect Petrobras' results because low oil prices reduces revenues, while the high dollar increases the debt values, and over 80% of the national operator's debts are in foreign currencies. However, with the recent funding it has secured, the national operator does not need money immediately, but its position is still unsustainable

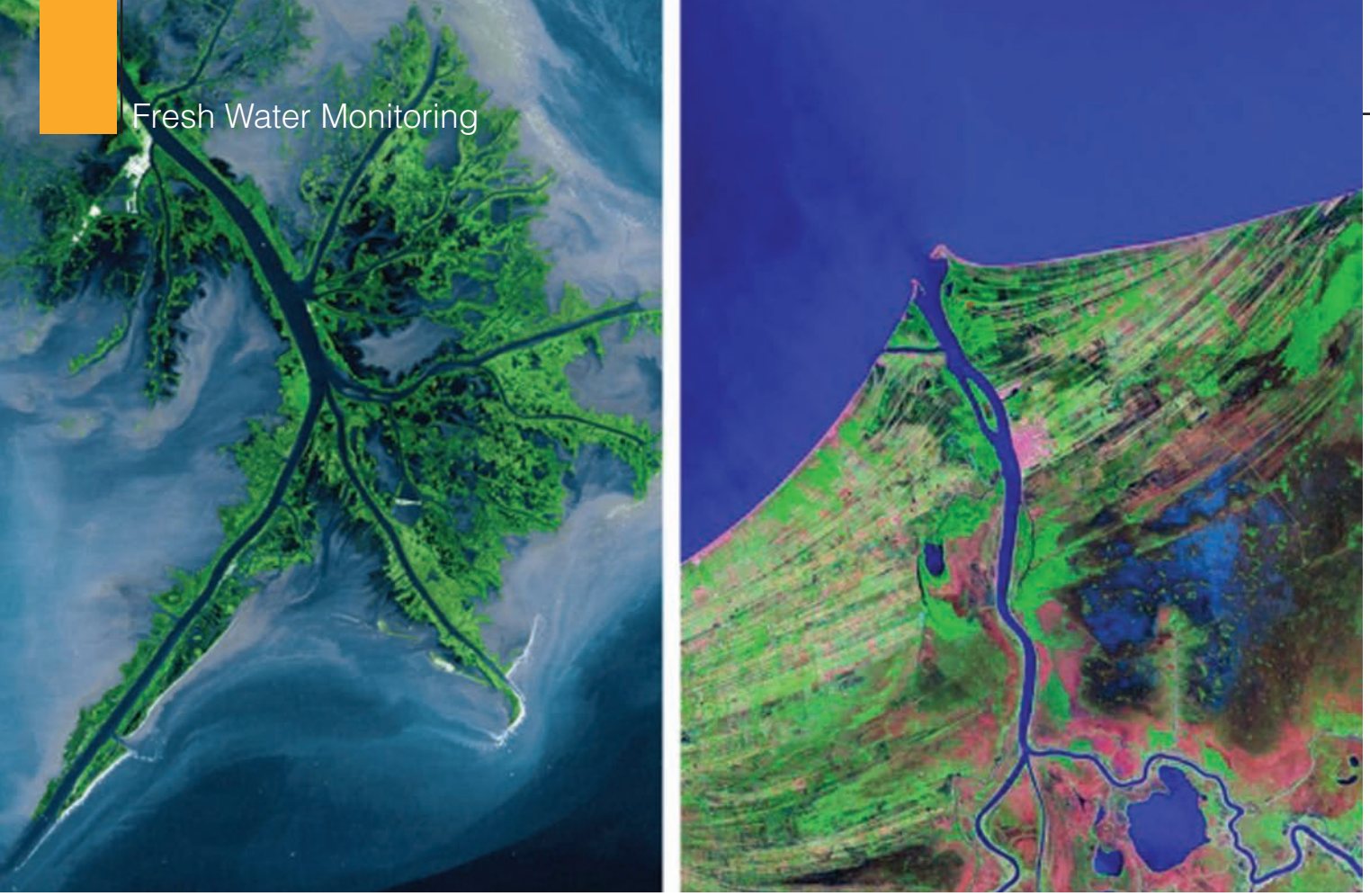
Aldemir Bendine, Petrobras' new CEO, has pledged transparency in all of Petrobras' operations and to clear all corruption schemes involving the super-major.

in the long rub. According to a recent report by Credit Suisse, the national operator earns around $17 billion per year, which is not enough to cover the $25 billion it needs for annual investments and still pay $7 billion in debt interest. At this point, Petrobras' board of directors is looking at which projects are still viable with the low dollar, implying that some more projects may be scrubbed and more lay-offs are expected along with renegotiations with suppliers, in order to decrease its yearly $12 billion operational costs.

Shipbuilding

According to Paulo Alonso, Presidential adviser at Petrobras, Brazilian shipyards need to increase their competitiveness in order to gain the preference of FPSO charterers. Alonso pointed out that the national operator has partners in the pre-salt E&P and there is a tendency to increase the number of chartered FPSOs. "Petrobras' preferred model from now on is chartering. Not because Petrobras prefers, but the decisions are made in conjunction with our partners. They want to charter because they don't have the CAPEX, only the OPEX," said Alonso.

Alonso went on to explain that even if the charterers have to pay fines for not reaching mandatory local content levels, there is a risk that they'll still order the FPSO abroad. "Brazilian shipyards will have to be very competitive, prepared from the point-of-view of productivity, engineering and keeping to deadlines, so that charterers will opt for Brazilian shipyards in detriment of foreign shipyards," said Alonso, highlighting that most of the world's FPSO charterers already have partner shipyards. He also emphasized that there is still time for local shipyards to prepare for the new orders. Petrobras has also reached an agreement with Sete Brasil to continue Sete's financial and operational restructuring, which has been negotiated since April 2015, following the suspension of project financing by national investment bank BNDES. Sete Brasil was created to build and operate drillships for the large deepwater pre-salt fields. BTG Pactual Bank is its largest shareholder with 30%, while Petrobras holds a 10% share, directly and indirectly. Banks such as Bradesco, Santander also have significant shares along with other banks and investment funds with minor shares.



(Image: NASA Landsat)

Predicting the Shape of River Deltas

Predicting the shape of river deltas around the world; new method may help engineers determine coastal impact of dams and levees.

The Mississippi River delta is a rich ecosystem of barrier islands, estuaries, and wetlands that's home to a diverse mix of wildlife — as well as more than 2 million people. Over the past few decades, the shape of the delta has changed significantly, as ocean waves have carved away at the coastline, submerging and shrinking habitats.

To keep flooding at bay, engineers have erected dams and levees along the river. However, it's unclear how such protective measures will affect the shape of the river delta, and its communities, over time.

Now researchers from MIT and the Woods Hole Oceanographic Institution (WHOI) have devised a way to predict a river delta's shape, given two competing factors: its river's force in depositing sediment into the ocean, and ocean waves' strength in pushing that sediment back along the coast. Depending on the balance of the two, the coastline of a river delta may take on a smooth "cuspate" shape, or a more pointed "crenulated" outline, resembling a bird's foot.

The new metric may help engineers determine how the shape of a delta, such as the Mississippi's, may shift in response to engineered structures such as dams and levees, and environmental changes, such as hurricane activity and sea-level rise.

Jaap Nienhuis, a graduate student in the MIT-WHOI Joint Program in Marine Geology and Geophysics, says the effects of climate change, and the human efforts to combat these effects, are already making an impact on river deltas around the world.

"Because there are so many people living on a river delta, you want to know what its morphology or shape will look like in the future," Nienhuis says. "For the Mississippi, the river supplies a lot of sediment. But because there are a lot of dams on the Mississippi nowadays, there is not as much sand coming down the river, so people are very worried about how this delta will evolve, especially with sea-level rise, over the coming centuries."

A variety of deltas: the Mississippi birdfoot delta (left) and Mexico's Grijalva cuspate delta (right).

Nienhuis, and Andrew Ashton and Liviu Glosan of WHOI, report their results in the journal Geology.

Shaping a Shoreline

Over hundreds of thousands of years, a river's sand and silt flow toward the coast, ultimately piling up at a river's mouth in the form of a low-lying delta. A delta's coastline can be relatively smooth, with most sand depositing from the main river, or it can fan out in the shape of a bird's foot, as the river bifurcates into tributaries and channels, each of which deposits sand in finger-like projections.

Scientists often characterize a delta as either river-dominated or wave-dominated.

In a wave-dominated delta, such as the Nile River delta in Egypt, incoming ocean waves are stronger than the river's flow. As a result, waves push outflowing sediment back along the coast, effectively smoothing the coastline. By contrast, a river-dominated delta, such as the Mississippi's, is shaped by a stronger river, which deposits sand faster than ocean waves can push back, creating a crenulated coastline.

While this relationship between rivers and ocean waves is generally understood, Nienhuis says there is no formal way to determine when a delta will tip toward a smooth or pointy shape. The researchers came up with a simple ratio to predict a delta's shape, based on a river's sediment flux, or the flow rate of sediment through a river, and the strength of ocean waves, determined by a wave's height, frequency, and angle of approach.

Based on the various factors that determine the overall ratio, the team determined the point at which a delta would no longer be a smooth outline, shaped by ocean waves, but instead, a pointy coastline, influenced more by the river.

"At some point there's so much sediment that you exceed the maximum of what waves can do," Nienhuis says, "and then you become a 'bird foot,' or river-dominated delta, because the river is so much stronger."

A Delta's Tipping Point

Nienhuis and his colleagues applied the new method to 25 river deltas on the north shore of the Indonesian island of Java, a region where sediments have deposited on a shallow continental shelf, creating a wide variety of delta shapes.

For each delta, the team used a global wave model developed by the National Oceanic and Atmospheric Administration to determine the height, frequency, and direction of each incoming wave. The researchers also used a model to determine the corresponding river's sediment flux.

Using data from both models, Nienhuis determined the ratio of river-to-ocean wave strength for each delta, and found that those deltas with a ratio greater than or equal to 1 were more likely to have multiple river channels, with deltas that project out from the shoreline. The main factor determining this transition turned out to be the angle at which ocean waves generally approach the coast: If the angle of approach is 45 degrees or greater, then ocean waves are no longer able to smooth out the amount of sediment coming from a river, tipping a delta's shape toward a river-dominated morphology.

Nienhuis says the group's method may help engineers predict the shape a delta may take if erected dams or levees change a river's sediment flow. Similarly, the method may estimate the evolution of deltas with climate change, as rising sea levels and increased hurricane activity will likely alter the behavior and magnitude of ocean waves.

This research was funded, in part, by the National Science Foundation.

(By Jennifer Chu; Source: MIT)

Bjorøy

Teledyn Tech Workshop

(Photo: Teledyne Marine)

EuroROV

(L to R): EuroROV co-founders, Sebastain Ruiz, Adrian Tramallino, Sebastian Ruggirello.

Sonardyne Appoints Bjorøy

Sonardyne International Ltd. appointed Robin Bjorøy as its new Managing Director. Bjorøy succeeds John Ramsden who leaves the position after six years in charge to return to Singapore following a transition period. Bjorøy joins Sonardyne with immediate effect and brings with him extensive operational and management experience gained over a 27 year international career with Geco-Prakla, WesternGeco and Schlumberger. Bjorøy has served in seismic field surveys, product development, survey design and management roles internationally including Middle East, Africa and Asia as well as in the UK. Bjorøy worked in Houston as the global QHSE manager for the Well Completions and Productivity segment.

Teledyne Marine: Joint Tech Workshop a Success

Teledyne Marine announced that the group has successfully hosted its first combined users' conference, the Teledyne Marine Technology Workshop (TMTW), October 4-7, 2015 in San Diego, Calif. More than 240 customers from around the globe attended the event, which detailed the utilization of Teledyne Marine products and technologies in challenging environments ranging from the shallowest streams to the deepest recesses of the ocean.

Nineteen of the 23 Teledyne Marine organizations took part in the workshop, which entailed four concurrent morning tracks detailing customer applications ranging from water resources, coastal engineering and oceanographic research to hydrography, defense and offshore energy. The event also included eight concurrent afternoon tracks dedicated to Teledyne Marine product and software training, case studies, and new product launches; as well as on water and dockside product demonstrations. Demonstrations ranged from the latest in ROV and diver technology to ADCPs, surface vehicles and imaging, including the newly released SeaBat T50-P multibeam echosounder from RESON, and the Active Flying Lead family (AFL) from ODI.

In addition to the Teledyne Marine companies, 19 other manufacturers and suppliers from across the industry participated in the inaugural event, sharing relevant products and services as official TMTW event exhibitors / sponsors.

The workshop was kicked off by two keynote speakers. **Dr. Robert Mehrabian, Chairman, President and CEO of Teledyne Technologies** provided insight into Teledyne Technologies strategy within the marine market space, and announced the restructure of the Teledyne Marine companies as a one stop solution provider (See related story p. 8). The second keynote speaker was **Zdenka Willis, director of NOAA's U.S. Integrated Ocean Observing System (IOOS) Program.** As Willis describes in her first-person account of TMTW 2015, her "message to the group was threefold: ocean observing matters to everybody, talk about the sector in terms of economic value, and encourage us to bring our voices together to be heard." Participating Teledyne Marine product brands included: Teledyne AGG, ATLAS Hydrographic, Benthos, BlueView, Bowtech, CDL, DGO, Gavia, Impulse, Odom Hydrographic, Oceanscience, ODI, PDM, RD Instruments, RESON, SeaBotix, Storm Cable, TSS and Webb Research

EuroROV Chooses Sub-Atlantic

EuroROV, the Spanish ROV training and engineering company, has taken delivery of a Forum Sub-Atlantic Mojave vehicle for its newly-launched ROV pilot training facility. The electric ROV was manufactured by Sub-Atlantic's

parent company Forum. “The Mojave is a perfectly balanced small vehicle which is well suited to the training requirements of the students,” said Sebastian Ruggirello, co-founder of the training school. “It is powerful and highly responsive, giving the students an excellent grounding in vehicle control. The subCAN control and diagnostics system is an industry standard and familiarity with its operation is of great benefit to the pilot trainees when securing employment.”

Ocean Energy Committee Members Selected

The Bureau of Ocean Energy Management (BOEM) announced that the National Academies of Sciences, Engineering, and Medicine have selected 14 experts to serve on the new standing committee on environmental science and assessment for offshore energy and mineral resources. The committee, which collectively gathers knowledge from academic, industry, government and nonprofit experience, aims to provide independent information on issues relevant to BOEM’s environmental studies and assessment activities and support discussions on relevant issues. Members of the committee are:

- Chair: Dr. Gary B. Griggs—University of California, Santa Cruz
- Dr. Peter J. Auster—University of Connecticut
- Deerin Babb-Brott—SeaPlan
- Dr. Keith R. Criddle—University of Alaska, Fairbanks
- Dr. Hajo Eicken—University of Alaska, Fairbanks
- Dr. Paul G. Falkowski—Rutgers University
- Dr. Mary (Missy) H. Feeley—ExxonMobil (Retired)
- Dr. Mardi C. Hastings—Georgia Institute of Technology (Retired)
- Dr. Bonnie J. McCay—Rutgers University
- Dr. Richard McLaughlin—Harte Research Institute for Gulf of Mexico Studies at Texas A&M University
- Dr. Jacqueline Michel—Research Planning, Inc.
- Dr. Timothy J. Ragen—Marine Mammal Commission (Retired)
- Dr. Mary Ruckelshaus—Stanford University
- Dr. William C. Webster—University of California, Berkeley (Retired)

EIVA Adds Brazilian Rep

The Brazilian company MACSEA is now part of EIVA’s international representative network of offshore specialists. MACSEA signed a contract with EIVA, thereby including both software and hardware solutions from the subsea engineering company in the MACSEA product portfolio. “We are seeing an increasing interest in our solutions at the moment in Brazil, as a result of a large number of ongoing and planned offshore activities. With this comes the need for strengthening our presence in the country through local representatives,” said EIVA Sales Director Jakob Møller Nielsen.

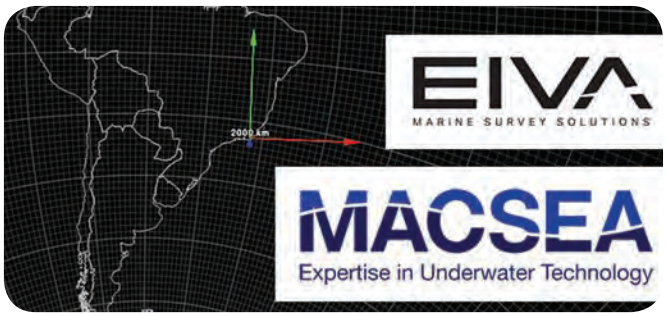


Image: EIVA

US Army to Receive 13 Units for Hydrographic Surveying

Seafloor Systems shipped 13 HydroLite-TM units to the U.S. Army Dive Team in Aberdeen, Md. The company introduced the Hydrolite-TM portable survey system in 2005, which incorporated a Trimble GeoXT handheld with a survey grade echosounder integrated to a small vessel mountable mounting bracket for the U.S. Army Tactical Dive Teams. For the past 10 years, the HydroLite-TM has servedhydrographic surveyors worldwide—surveying shallow waters such as ponds, rivers and lakes.

(Image: Seafloor Systems)

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Linden Photonics, Tethers Unlimited Team

Linden Photonics entered an exclusive partnership with Tethers Unlimited. Tethers, located in Bothell, Wash., was founded in 1994 and has developed technology to enable high-speed deployment of optical fibers and cable. Applications can be as varied as submarine launched buoys and torpedoes, to ROVs to terrestrial robots and even spacecraft. Optical tethers can range in length from <100m to >15km and can use bare fiber or ruggedized STFOCTM. Together the brands will offer a tether solution combining Linden's cable technology with Tether's spooling capabilities.

Aker Solutions, MAN D&T Form Subsea Compression Alliance

Aker Solutions and MAN Diesel & Turbo agreed to form an alliance to develop the next generation in subsea compression systems that can be used at even the smallest oil and gas fields to increase recovery and lower costs compared with conventional platform solutions.

The two companies will build on their experience and cooperation from the successful delivery of the world's first full-scale subsea gas compression system at the Åsgard field in Norway. A key objective of the partnership is to develop new, cost-effective technology for high-capacity subsea compression systems.

The compression systems will be based on proven technology and for use at small subsea fields as well as large deposits such as Åsgard.

Coastline Surveys Launches Offshore Division

Coastline Surveys launched Coastline Offshore Ltd., a new division of the company specifically developed to meet the growing demands for specialist offshore geotechnical and geophysical services beyond their established coastal markets. The new division will enable the company to employ their considerable expertise in emerging offshore renewables, at home and abroad, while also establishing it as a significant survey support subcontractor within the oil & gas industry. Coastline has recently focused sizeable investment within its geotechnical division, with the addition of a Datem 5000 CPT, which in conjunction with the expanding pool of vibrocorers, grabs and in house labs enables them to offer a complete package of geotechnical services.

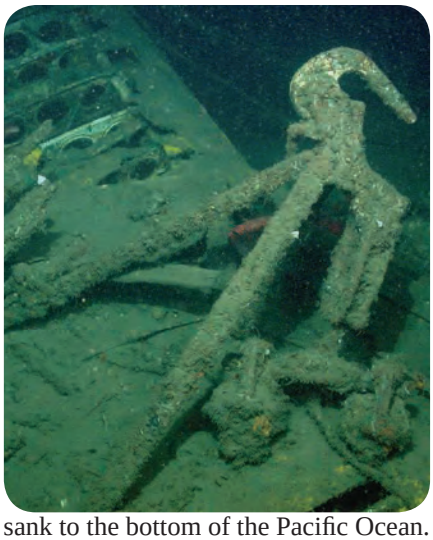
Bourbon Orders ROV LARS

Kongsberg Maritime subsidiary Kongsberg Evotec signed an agreement with Bourbon Offshore Norway for the delivery of the E-LARS launch and recovery system for remote operated vehicles (ROV). The system, to be delivered in December 2015, will be installed on an new VARD 2-12 ARCTIC design AHTS vessel, which is developed for worldwide operations, including arctic regions.

Ashtead Supports Exploration of US Airship Wreckage

Ashtead Technology has been supporting attempts to explore the wreckage of the USS Macon, the United States Navy's last flying airship.

Designed for long-range scouting, the airship crashed off the coast of California in 1935 when it was returning to the Moffett Federal Airfield following a successful exercise over the Channel Islands, Southern California. A storm caused extensive damage to the airship, control was lost and the USS Macon

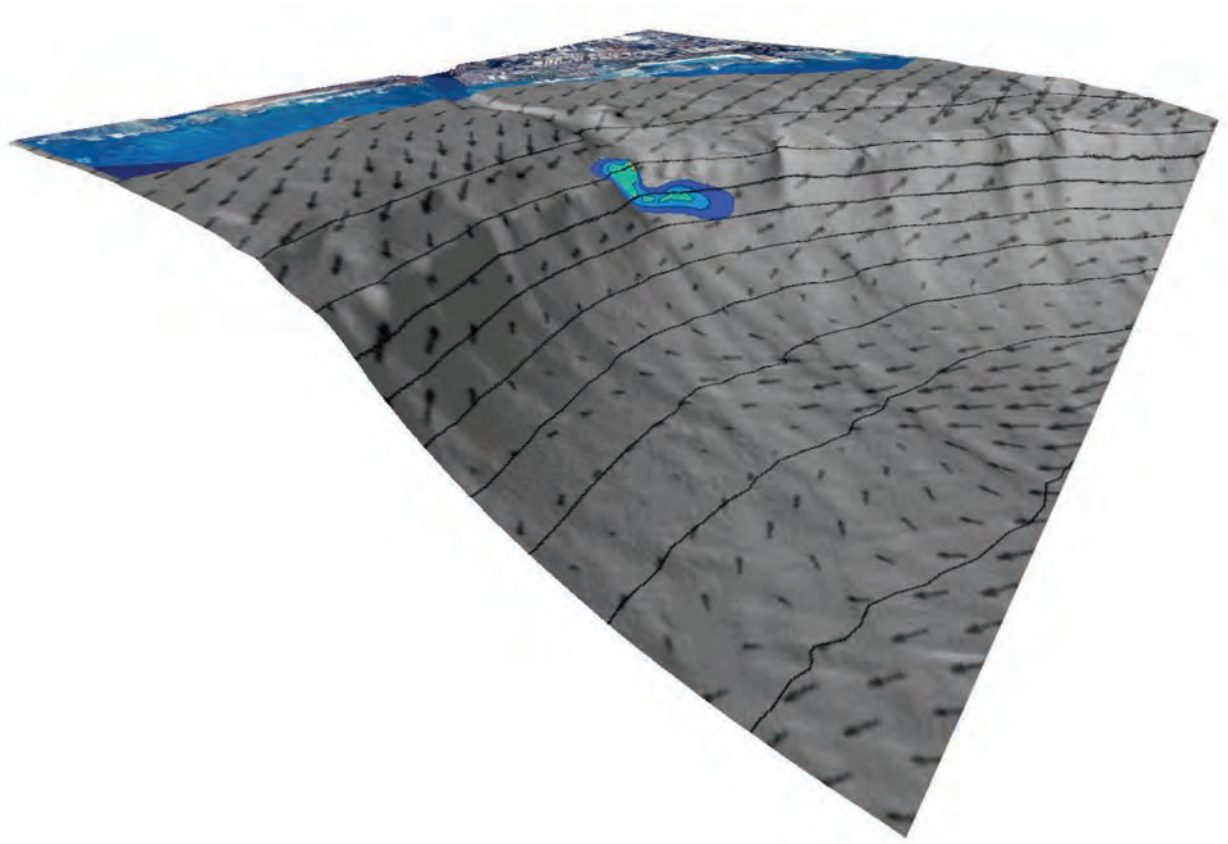


sank to the bottom of the Pacific Ocean.

The incident led to the death of two crew members and ended the Navy's quest to use airships as long-range scouts for the fleet.

The recent expedition was led by archaeologists from the National Oceanic and Atmospheric Administration (NOAA), the Naval History and Heritage Command's Underwater Archaeology Branch, and Ocean Exploration Trust to piece together a clearer map of the wreck site and to study how the remains of the airship were being consumed by the sea.

Ashtead provided subsea inspection equipment to study the wreckage and carry out an in-depth corrosion analysis on the aircraft to monitor deterioration.



Environmental Coastal & Ocean Modeling Tool

Makai is expanding its environmental and coastal modeling services for clients who discharge into, or withdraw from, the world's oceans, lakes, and reservoirs. Makai recently completed a three-year effort to adapt the EPA-approved Environmental Fluid Dynamics Code (EFDC) into a robust and flexible dispersion and water quality modeling tool. The new Makai EFDC modeling system (M-EFDC) is designed to simulate and predict the dispersion of large industrial water flows. Combined with Makai's experienced team, the new M-EFDC enables cost-effective modeling solutions ranging from initial project planning to more rigorous regulatory submittals and watershed management efforts.

The adapted M-EFDC model is a hydrodynamic and water quality model used to simulate aquatic systems in up to three dimensions and time. The modeling results are used in the design, planning, and permitting process for the intake or discharge of a variety of facilities, including desalination, seawater cooling systems including once through cooling systems, LNG processing plants, petroleum refineries, traditional thermoelectric power plants, pulp and paper mills, chemical manufacturing plants, food processing plants, and metal manufacturing plants. The M-EFDC suite can model flows across a wide range of sizes and time-scales. This enables developers to understand the physical, chemical, and biological impacts and decide between design variations in the water system. For example, M-EFDC can help with the site selection for the water intake or discharge pipes, model thermal and chemical plume dispersion, and enable regional nutrient and biological

studies.

Under DARPA and Department of Energy funding, the M-EFDC model was originally developed to predict the physical, chemical, and biological impacts around offshore Ocean Thermal Energy Conversion (OTEC) plants in Hawaii. The model was adapted to dynamically couple a turbulent plume model with a regional ocean circulation model and predict both near-field mixing and far-field dispersion of discharge flows; a critical enhancement for accurately resolving larger scale discharge flows. The model integrated regional circulation from tides and atmospheric conditions, nutrient cycles, and phytoplankton population dynamics. Results were shown to reproduce the historical 20 year observational dataset collected by the Hawaii Ocean Time Series.

Makai most recently developed a front-end initialization tool for the M-EFDC model to satisfy a broader range of needs more efficiently. The front-end tool automates nesting of the M-EFDC grids within third party regional ocean or coastal models (e.g. ROMS or HYCOM), import of local tidal conditions from the TPXO global database, or inclusion of user defined time series based on site measurements or known flow conditions. More generally, the model can be forced with regional flows, tidal flows, atmospheric forcing, and river or terrestrial sources, enabling the simulation of flows that vary with space and time across complex seafloor terrain. In addition, the tool enables quick and automated setup of simpler hydrodynamic studies for project planning.

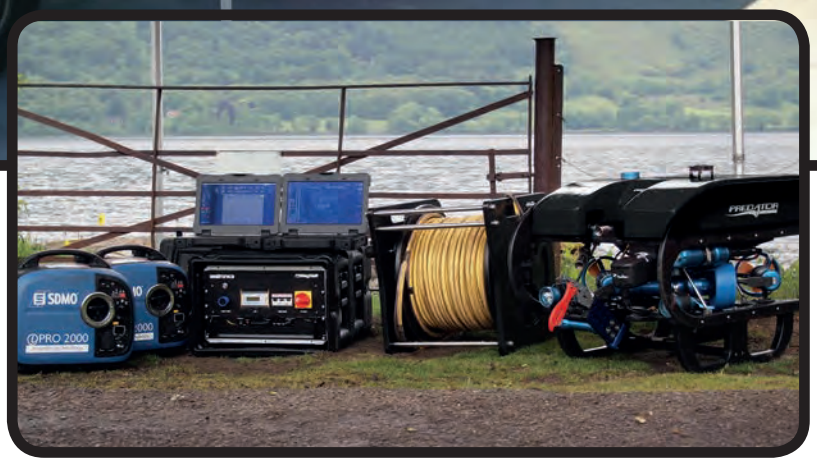
M-EFDC's discharge model with terrain-following grids has been enhanced to model large and dense (e.g. brine) coastal discharges such as for seawater air conditioning (SWAC), desalination, LNG cooling, and once-through cooling of power plants. For these large flow systems, the tool's use of coupled near-field and far-field models provides several advantages. For example, the tool seamlessly handles space and time scales that range from meters to kilometers and from days to years. Plant developers and operators can use the tool to clearly visualize and present results to regulatory authorities and other stakeholders. The high-fidelity and dynamic model can predict a wide range of possible plume conditions, allowing the user to estimate the statistical likelihood of plume sizes and properties that are typically required by the Department of Health and EPA for permitting.

Benefits of the

Makai EFDC Model

The ultimate benefit of the Makai EFDC model is that it greatly reduces the uncertainty in the early design and permitting process. Advantages of the M-EFDC model include:

- Ease of Use: a front-end initialization tool provides efficient and flexible model setup.
- Clear Results: accurate modeling and visualization of plumes provides stakeholders with a clear understanding of impacts.
- Versatility: useful for anything from simple studies to detailed regional and biological models.
- Proven Technology: the M-EFDC model is derived from one of the most widely used and technically defensible hydrodynamic models in the world over the last 20+ years and is EPA-approved.



World First

Seatronics Activates P.A.N. Disrupter Subsea with Predator ROV Elite System

Seatronics reports that it has triggered a Percussion Actuated Non-electric (P.A.N.) disrupter, subsea, with its Predator Remotely Operated Vehicle (ROV), while maintaining station keeping during a live fire mission.

The Predator ROV – manufactured and developed by Seatronics – is designed to function in all market sectors, offering a compact and portable structure for ease of deployment and operation.

The Predator ROV Elite System was devised as a Bomb Squad Capable Improvised Explosive Device (IED) ROV designed to perform demonstrations in conjunction with Great Eastern Group (GEG) for the U.S. Maritime Bomb Squads. A demonstration of the unit was conducted in April 2015 in response to requirements outlined by the nation's bomb squad community and the Port of Los Angeles/Long Beach Port Dive Operations Group (PDOG).

"Feedback received from the demonstration proved to be positive, categorizing the Predator ROV Elite System as a capable ROV with great potential for underwater counter IED projects," said Euan Mackay, VP – Sales, Seatronics Inc.

"The attendees recognized the system's power, effective station keeping ability and low cost-basis as key beneficial features. The Predator's ability to hold station was made possible with the use of the SeeByte CoPilot software, which was developed in conjunction with Seatronics and refined to address the specific needs of the FBI and PDOG teams. The trials and client comments enabled the Seatronics and GEG team to identify areas for ROV enhancement to capitalise on the functionality for counter IED missions, including lowering the overall system weight, improving mobility as well as

Initial demonstrations resulted in an invitation for Seatronics to demonstrate the Predator ROV Elite System at the Underwater Post Blast Investigators Course in Bluffton, South Carolina, hosted by the FBI Counter-Improvised Explosive Device Unit (C-IEDU), along with the South Carolina Law Enforcement Division's (SLED) Bomb Squad.

successfully integrating the P.A.N. disruptor function onto the unit."

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"The Predator ROV Elite System performed flawlessly, aiding the dive teams in finding post IED explosions debris in near black-water conditions," said Derek Donaldson, VP of global operations, Seatronics. "The capability demonstration culminated with the Predator successfully live-firing a P.A.N. disruptor subsea, while maintaining full control using the vehicle's SeeByte CoPilot system. The Predator is the first ROV in its class to achieve this prestigious accolade."

"The Predator ROV Elite System's cameras positively identified a suspected IED and the P.A.N. was fired from the ROV's Operator's Control Unit," said Robert Von Loewenfeldt, senior special agent, South Carolina Law Enforcement. "The firing of the P.A.N. had little effect on the Predator's ability to maintain station keeping, making it easy for the operator to see the effect the P.A.N. round had on the target. Unlike most ROVs, the Predator ROV Elite System offers a truly remote solution to the underwater IED problem."

To see the Predator ROV Elite System in action, visit:
www.youtube.com/watch?v=d_KXCvMYy7g&feature=youtu.be

MacArtney LUXUS Dual 360º P/T

LUXUS Dual 360º P/T is a heavy-duty pan-and-tilt unit suitable for a wide range of actuation tasks and intended for many applications in subsea tooling. It is a powerful addition to MacArtney's LUXUS range of underwater cameras, lights, and media controllers. The LUXUS brand of MacArtney instrumentation represents cameras, lights, controllers, and accessories – together with the latest novelty now being launched: a slip-ring based pan-and-tilt unit. The LUXUS series serves the purpose of combining operational and service flexibility, excellent performance and reliability in the most severe subsea environments. The sturdy and modern design of the different LUXUS units and their versatile first-rate specifications make them ideal for a multitude of demanding underwater tasks and uses. Being rugged and durable enough for virtually any environment, LUXUS Dual 360º P/T is ideal for heavy-duty operations involving various tools and instruments like work class ROVs, rock dump ROVs, trenchers and ploughs as well as for surveillance operations. Being based on standard housings, the LUXUS series allows for swapping e.g. lights and cameras in the field in a fast and convenient manner.

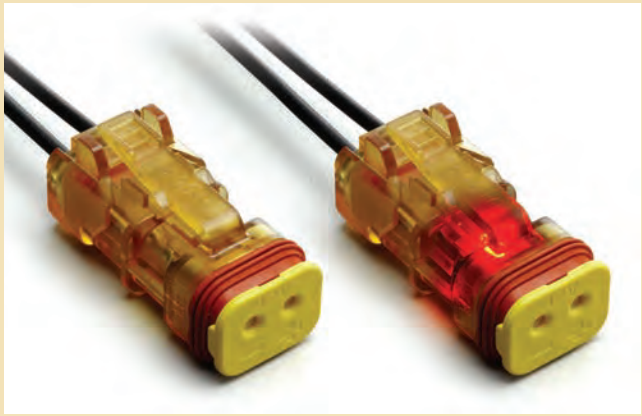
The unique properties of the LUXUS Dual 360º P/T feature qualities like a high torque of 100 Nm and a payload of 100 kg. Besides, this LUXUS product is the first pan-and-tilt unit to be featuring unlimited movements of both 360º pan and 360º tilt. This is made possible by means of the mounted slip rings enabling full-scale activation and thus facilitating operation at all angles. The LUXUS Dual 360º P/T can be controlled via the LUXUS P&T Controller or directly by means of the software that comes with the unit, installed on a PC.

www.macartney.com

ROS L-300 LED Light

The new ROS L300 AC Flood or Spotlight features a new, full-range dimming technology as well as brilliant illumination. The L300 offers 7500 lumens illumination and features full-range, flicker-free dimming control, from zero to max. The compact 42 LED light array design is also new and offers brilliant spot or flood illumination and long operating life underwater. The L300 is depth rated to 6000m. Connection options include side or rear mounting with multiple connectors available.

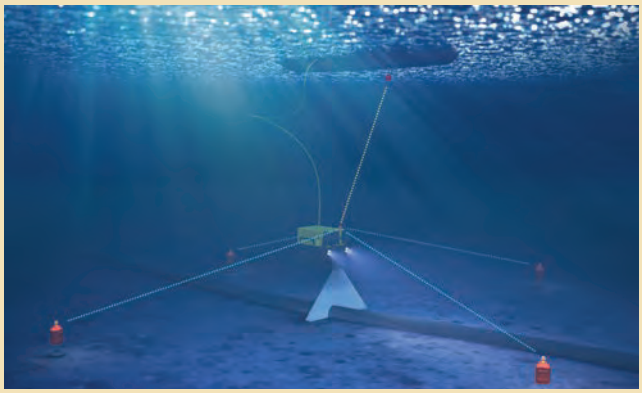
www.rosys.com



Transparent Connector with LED

TE Connectivity (TE) Industrial & Commercial Transportation, a leader in harsh environment connectivity, released the new DEUTSCH DT Detector connector. The Detector connector provides a visual confirmation of power by producing a distinct glow, which helps with troubleshooting, especially in areas with difficult connector visibility and accessibility. The new 2 way plug features a transparent housing and a wedgelock with an integrated 12 or 24 volt LED. The Detector connector is environmentally sealed and designed to withstand the demands of the construction, agricultural, trucking, marine, and mining industries.

www.te.com/DTDetector



3G HIPAP System from Kongsberg

HiPAP 502 a High Precision Acoustic Positioning Systems from Kongsberg Maritime. The new HiPAP 502 specifications deliver 100% better angle accuracy, with improved range capability to 5000m. Angle accuracy is essential in SSBL (or USBL) positioning; the HiPAP 502 has an accuracy of 0.06 degrees vs the 0.12 degrees of the HiPAP 501.

The third generation HiPAP features a smaller and lighter transceiver unit, which is housed in a stainless steel cabinet and is less temperature sensitive so there is no requirement for extra cooling in warm environments. It also uses new Low Power Transceiver (LPT) boards with better filtering and signal processing providing an extra 5-6 dB more sensitivity.

www.km.kongsberg.com

LinkQuest Enters Multibeam Market

LinkQuest added a state-of-the-art multibeam echosounder product into its product family of acoustic instruments. The EchoSweep 300 multibeam Echosounder is a high-resolution, highly robust and cost-effective swath bathymetric system for mapping of sea floor, inland waterways and reservoirs. The EchoSweep 300 system is capable of reaching up to 280 m in range with 140 beams. It operates at 260 KHz and has a swath coverage of 140 degrees. The EchoSweep 300 multibeam echosounder maps the sea floor accurately by a sweep of very narrow acoustic beams.

www.link-quest.com

New Multibeam Echosounder from Teledyne RESON

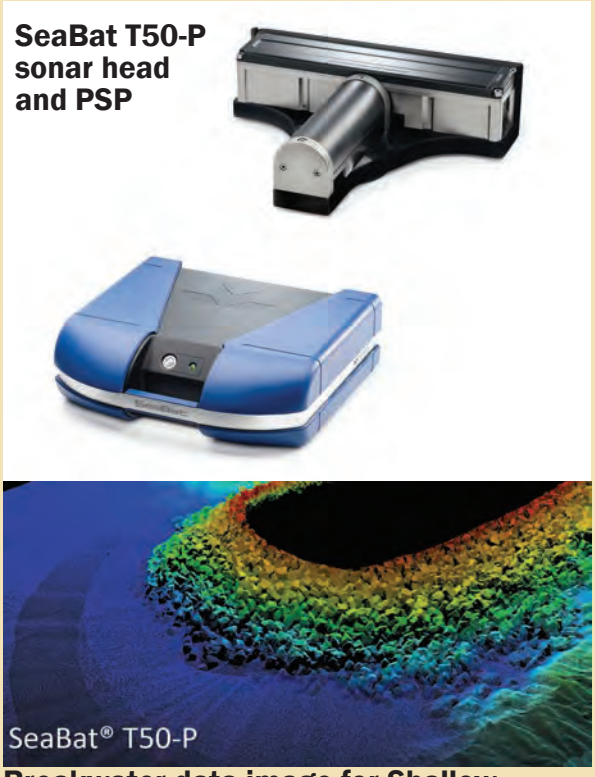
Teledyne RESON introduces the SeaBat T50-P for faster operational surveys, deliverables and reduced processing time. Teledyne RESON, a provider of hydrographic sonar solutions, announced the launch of the ultra-high resolution, portable multibeam echosounder, the SeaBat T50-P at the recent Teledyne Marine Technology Workshop in San Diego.

The SeaBat T50-P is a new addition to the SeaBat T-series, introduced in the beginning of 2013 as a completely new product generation, built from the ground up.

Combined with the Portable Sonar Processor, the SeaBat T50-P is designed to deliver clean survey data and faster operational surveys and reduced processing time, the manufacturer said. The SeaBat T50-P is fully frequency agile from 190 to 420 kHz allowing for improved swath performance and reduced survey time under difficult conditions.

It is designed for fast mobilization on smaller vessels and is optimized for shallow water survey companies, port and harbor authorities, dredging companies and other users looking for an ultra-high resolution system. The Portable Sonar Processor and sonar head form a compact system, securing minimal interfacing and low space requirements.

www.teledynemarine.com



Breakwater data image for Shallow Survey 2015, Plymouth UK.

(Images: Teledyne RESON)

New Recreation Submersible Dives Deep

Triton 6600/2 designed to transport two people down to 6,600 ft.

Triton Submarines LLC, a builder of personal submarines designed for yacht deployment, has launched a new submersible designed to dive to ocean depths of 6,600 ft., transporting passengers deeper than other models in its range. Announcing the new submersible was Triton Submarines CEO L. Bruce Jones, who unveiled plans for the new Triton 6600/2 at a press conference held at the Fort Lauderdale International Boat Show in November.

"We are excited about this new deep-diving acrylic-hulled sub that will dive twice as deep as our 3300 series submersibles," Jones said. "Like other Tritons, the transparent pressure hull provides remarkable viewing and the capability of diving over a mile deep adds tremendous versatility."

The Triton 6600/2, which is now available for order, features capability to transport two people in air-conditioned comfort to 6,600 ft. below the ocean's surface. Although similar in appearance to Triton's 3300 series submersibles, 6600/2 includes a number of upgrades, including hulls that allow passengers to board after the vessel has been deployed into the water.

Additionally, the Triton 6600/2's passenger compartment remains at surface pressure irrespective of diving depth and is engineered utilizing a new technique developed by the manufacturer's acrylic manufacturing partners. Furthermore, the Triton 6600/2's maximum dive duration is 10 hours, though its life support system will operate for up to 96 hours.

"It should take about an hour for the sub to get down to its maximum depth, but once there, the pilot and passenger will have plenty of time to investigate a wreck or some other artifact on the bottom, and shoot video if desired," said Triton Submarines Project Manager Ron Stamm. "Six 20,000-lumens lights will be standard, but owners will be able to add more if needed to support their video operations."

www.tritonsubs.com

Dimensions	
Length:	13 ft
Width:	10.8 ft
Height:	6.9 ft
Weight:	14,300 lbs
Pressure hull ID:	56.7 in
Hatch ID:	20.1 in
General	
Certification 1:	DNV/GL
Certification 2:	Cayman Islands Registry
Payload:	550 lbs
Depth Rating:	6,600 ft
Speed: 3 kn	
Crew:	Pilot + 1 pax
Variable ballast:	220 lbs
Main ballast:	2,755 lbs

(Image: Triton Submarines LLC)

EDITORIAL CALENDAR

Month/Edition	Features		Bonus Distribution
January/February **Underwater Vehicle Annual: ROV, AUV & UUVs** Ad Close: 01/21	Market: Technical: Product: Special Report:	HD Cameras and Sonar for Vehicles Underwater Navigation Scientific Deck Machinery US Navy	
MTR Special Reports: Oceanographic February 2016 Bonus Electronic Edition Publication Date: February 27, 2016			
March **Oceanographic Instrumentation: Measurement, Process & Analysis** Ad Close: 02/22	Market: Technical: Product:	Subsea Engineering: Complexity of Subsea Field Architecture Oceanology International 2016 Technology Spotlight Sonar Systems & Seafloor Mapping	**Oceanology International** March 15-17, London **Subsea Tieback** March 22-24, San Antonio
April **Offshore Energy Annual** Ad Close: 03/21	Market: Technical: Product:	Seismic Vessels: Streamers & Magnetometers Deepwater Positioning, Mooring & Anchoring Subsea Vehicles and Systems for Pipeline Survey & Inspection	**AUVSI** May 2-5, Arlington **OTC** May 2-5, Houston
May **Underwater Defense** Ad Close: 04/21	Market: Technical: Product:	Offshore Renewable Energy: Wind, Wave & Tide International Naval Technologies Subsea Housings	**Sea-Air-Space** May 16-18, National Harbor **Mast Europe** May 24-26, Amsterdam **UDT** June 1-3, Oslo
June **Hydrographic Survey** Ad Close: 05/20	Market: Technical: Product:	Comms, Telemetry & Data Processing GPS, Gyro Compasses & MEMS Motion Tracking Interconnect: Underwater Cables & Connectors	
MTR Special Reports: Hydrographic July 2016 Bonus Electronic Edition Publication Date: July 15, 2016			
July/ August **MTR 100** Ad Close: 07/22	The 11th Annual Listing of 100 Leading Subsea Companies Market:	The Norwegian Subsea Market	**Offshore North Sea** August 29-September 1 Oslo
September **Ocean Observation: Gliders, Buoys & Sub-Surface Networks** Ad Close: 08/22	Market: Technical: Product:	Research Vessels Seafloor Engineering & Remote Operations Geospatial Software Systems for Hydrography	**Oceans 2016** September 18-22, Monterrey
October **AUV Operations** Ad Close: 09/21	Market: Technical: Product:	Harsh Environment Systems for Arctic Ops ROV Technology: Workclass to Micro Systems Underwater Tools & Manipulators	**Arctic Technology Conference** October 24-26, St. John's
November/ December **Subsea Engineering & Construction** Ad Close: 11/23	Market: Technical: Product:	Fresh Water Monitoring & Sensors Offshore Inspection, Maintenance & Repair (IMR) Underwater Imaging: Lights, Cameras & Sonars	**Underwater Intervention 2017**
MTR Special Reports: Unmanned Marine & Subsea Vehicles November 2016 Bonus Electronic Edition Publication Date: November 7, 2016			

maxon's MT-30 thruster

Photo: maxon motor

New Compact Underwater DC Drives

Modern technology must be equipped to withstand extremely harsh conditions found deep in the ocean, including high pressure and high oxidation levels. Drive systems developer maxon motor has worked closely with research institutes and universities to provide solutions that meet the many demanding challenges for electrical and mechanical components required for underwater systems.

Electrical actuated underwater vehicles like remote operated vehicles (ROVs) and autonomous unmanned vehicles (AUVs) require drives which are lightweight, efficient and compact. Maxon said its program of aquatic solutions offer these features and much more. The thrusters and actuators are oil filled and range in size from 16- to 42-mm diameter. The core element is a motor-gear combination based on a brushless DC-motor and a planetary gearhead. These underwater drives are designed with a high quality polymer housing to ensure protection against the harsh underwater elements.

maxon's MT-30 thruster is pressure tolerant up to 6,000 m with oil compensation. The propeller is modified for low noise operation. Other features include: output power of 180W, voltage of 48 and weighs slightly under 2 lbs.

www.maxonmotorusa.com

Thunderstorm Detector for the Offshore Sector

Thunderstorms often play a significant part in disrupting offshore operations, especially when conducting personnel transportation by helicopter. And it is not just the threat of lightning, but also the dangerous wind-shear and icing events which can take place in a cumulonimbus cloud that can present added danger offshore.

Helping to ensure the safety of operating personnel and minimize downtime, a new thunderstorm detector from Biral aims to provide early warning of nearby thunderstorms. The company's new BTD-300 uses a quasi-electrostatic operating principle which gives early warnings of overhead lightning risk and detects strikes as far as 83 kilometers away. According to Biral, its experience from the aviation and industrial sectors where the dangers of lightning activity have been understood for many years, has allowed the company to develop its new BTD-300 Thunderstorm Detector for the oil, gas and wind energy sectors.

An additional advantage of the BTD-300 thunderstorm detector is the operational time gained after the lightning has stopped. Usually technical crew wait about one hour after the last lightning strike has been reported by remote, third party lightning location networks. With live on-site monitoring using the Biral BTD-300, an immediate restart of activities can be made once it is safe to do so.

As well as lightning detection, the BTD-300 has the ability to detect the presence of electrically charged precipitation and strong electric field. Both of these features indicate the presence of a cumulonimbus cloud overhead, providing early warning of potential nearby lightning activity.

The Biral BTD-300 is virtually immune to all forms of manmade radio frequency interference so minimizing false alarms. With the ability to detect over twice as many flashes as conventional lightning detectors, the high sensitivity combined with low false alarm rates make it suited for thunderstorm detection.

www.biral.com

File photo: Jan Berghuis

FOG Technology for High Latitude Navigation

Fiber optic gyroscope (FOG) technology occupies a unique place in the navigation history, according to navigation, positioning and imaging solutions provider iXBlue, who says FOG continues to break performance boundaries. FOG and inertial navigation systems (INS) technologies perform even in extreme applications such as mission critical space operation, nuclear submarine stealth operation and high latitude (North) navigation. Navigation in the northern latitudes is especially difficult mainly because of the alignment. The physical effect that is measured for the alignment is the projection of the earth's rotation rate on the horizontal plan. The higher the latitudes, the more difficult it gets to accurately project where North is. iXBlue systems, however, are suited for use in many arctic missions, under the Canadian's ice and in the Norwegian seas, the manufacturer says. Recently, the Norwegian Polar Institute conducting a routine mission to recover scientific instruments, offered iXBlue live Arctic testing of its products. "When we plan a sailing route, especially when we are close to land, it is very important for us to know the exact heading," said Lance's captain.

At North latitude, more than the stability, the problem is to determine the correct heading without bias. Thanks to its high precision, iXBlue Phins consistently delivered performance similar to the ones at lower latitudes. Furthermore, iXBlue gyroscopes, compensated for thermal behavior, maintained performance even mounted on the exterior of the vessel.

iXBlue FOG has also been put to harsh real-world subsea test where GPS aiding is not available. The high latitude test was conducted onboard the International Submarine Engineering Arctic Explorer class AUV. This equipment was selected to support the "Cornerstone" project performed in conjunction with NRCAN/DRDC. The goal was to develop the equipment and methodology necessary to collect high-resolution, hydrographic-quality, bathymetric data of the Arctic seabed in harsh weather conditions. UNCLOS Article 76 survey missions were conducted with an AUV under the ice and a full acoustic positioning solution including iXBlue PHINS to track it.

www.ixblue.com

(Photo: iXBlue)

Lance is equipped with iXBlue INS

Palfinger Enters AHC Subsea Crane Market

Palfinger Marine won a contract with Norside for delivery of a 100 tons active heave compensated (AHC) crane to be installed on the vessel Vestland Cygnus, a VS485 MKIII vessel designed by Wärtsila Ship Design.

The vessel was delivered from Fjellstrand to Norside earlier this year but will now undergo a conversion program at Fjellstrand yard in Norway. After the rebuild, the vessel will be upgraded with an accommodation unit to raise the total capacity to 134 persons, a motion compensated gangway and a 100 tons AHC knuckle boom crane. Palfinger's range of AHC cranes is developed in close co-operation between Palfinger Dreggen and Norwegian Deck Machinery (NDM). NDM was earlier this year acquired by Palfinger and its technology for AHC winches has been fully utilized in order to develop the range of AHC cranes. Palfinger Dreggen is a well-known supplier of offshore cranes and NDM is well known for its winches for offshore vessels.

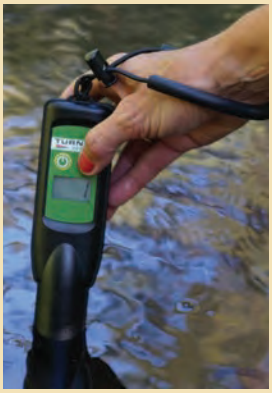
The crane to be installed onboard Vestland Cygnus is a knuckle boom crane with 100 tons single fall capacity, 100 tons @ 12m and 20 tons @ 37m. The main winch will be delivered with 1000m of wire but is designed and prepared for a capacity up to 3000m of wire. In addition to the main winch, the crane is also equipped with an AHC auxiliary winch, 10 tons @ 40m, with 500m wire. Main benefits for the crane is the high AHC performance and user friendly interface for operation. The crane has been designed with full focus on safety for cargo, equipment, personnel and environment and has systems for both storing and recovery of energy. In addition, the crane fulfills all requirements from DNV 2.22 for a vessel with "crane" notation. The crane will be built and tested at the Palfinger facility in Gdynia, Poland, and is scheduled for delivery September 2016.

"The main reason we selected the crane from Palfinger Marine was the low weight combined with a low center of gravity which made it possible to use a bigger crane than originally planned on the vessel," said Hans Martin Gravdal, owner of the vessel and owner of Norside. "The flexibility on the technical solutions combined with the commercial terms, and the fact that it is a local company based in Bergen were all part of the reason why we finally ended up signing with Palfinger Dreggen."

www.palfinger.com/marine

Turner Designs' FluoroSense

Turner Designs offers phycocyanin (PC) as an optical configuration of its FluoroSense handheld fluorometer to assist with identification of PC containing algae typically associated with Harmful Algal Blooms (HABs). Obtaining both PC and chlorophyll estimates helps in determining whether additional testing is required to check toxicity levels in a body of water. FluoroSense's simple two-button keypad enables users to quickly power on the instrument and take a reading to estimate chlorophyll or PC in almost any aquatic habitat. There is no warm-up time required; chlorophyll or PC µg/L estimates are displayed in seconds. The FluoroSense boasts an extremely lightweight, small, waterproof design, while offering a high degree of durability. With a very low power draw, the FluoroSense can take more than 10,000 measurements on a single pair of AA batteries. Factory calibrated, the only maintenance required is simply rinsing after use. The PC FluoroSense can estimate phycocyanin concentrations spanning the linear range from 0-199µg/L and resolve down to 1µg/L of PC. Together with the chlorophyll FluoroSense, this is the ideal tool for quickly assessing pigment levels of algal blooms.



Turner Design

www.turnerdesigns.com

CARIS Onboard 1.0

CARIS released of the near real-time data processing and mapping application, CARIS Onboard, which the company claims will revolutionize the way in which bathymetry and imagery data is processed. CARIS Onboard automatically converts data as it becomes available and applies a range of pre-determined corrections, the data can then be used to generate a terrain model or mosaic. This allows for early visualization of seafloor characteristics, putting a greater emphasis on quality control and supporting an environment of improved decision making and greater efficiency. CARIS Onboard has been designed to work with survey launches, autonomous underwater vehicles and unmanned surface vehicles.

CARIS Onboard is a force multiplier allowing multiple datasets to be processed quickly and consistently. With the ever expanding volume of data being collected at higher resolutions, CARIS Onboard fits seamlessly into the Ping-to-Chart suite of software and reduces your product creation timeline.

www.caris.com

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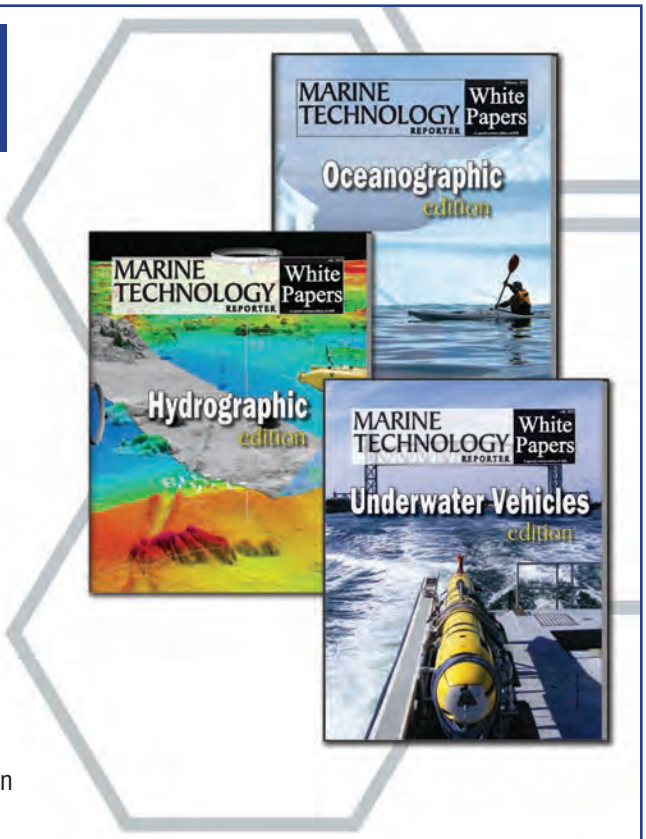

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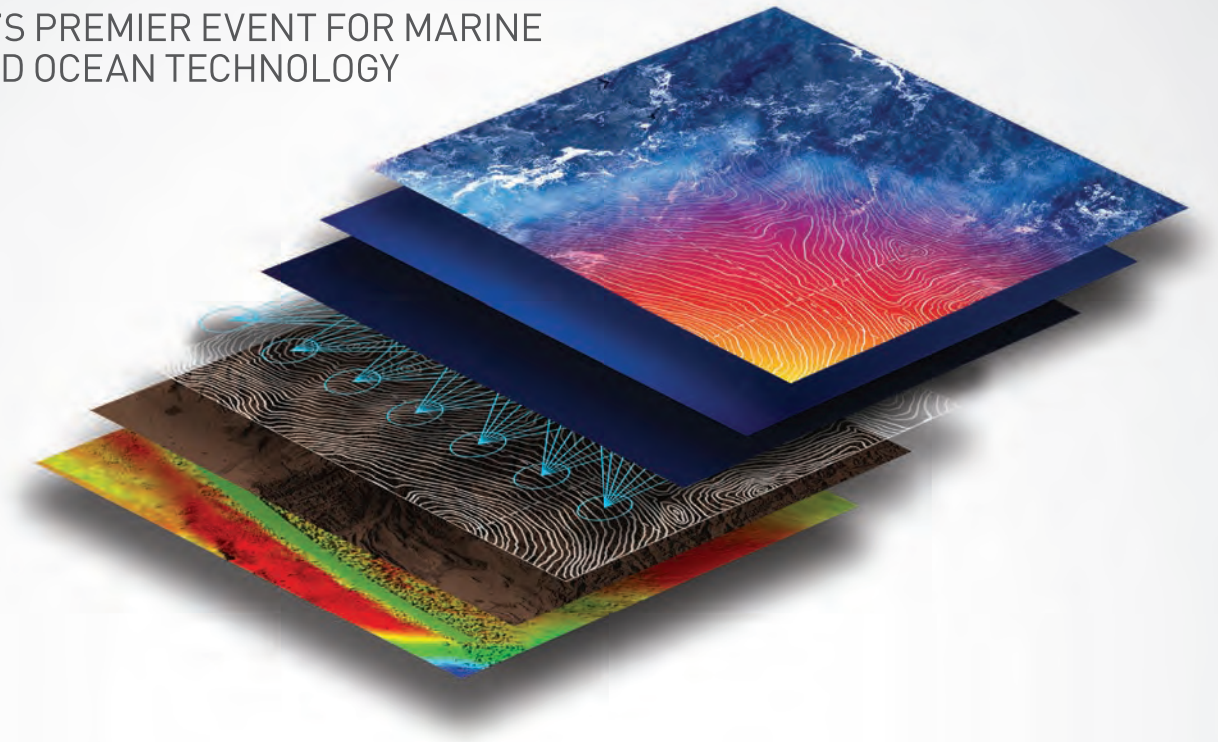

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