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REPORTER

April 2016

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Offshore

Floating Production Systems
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View from the Top
**Casey Moore,
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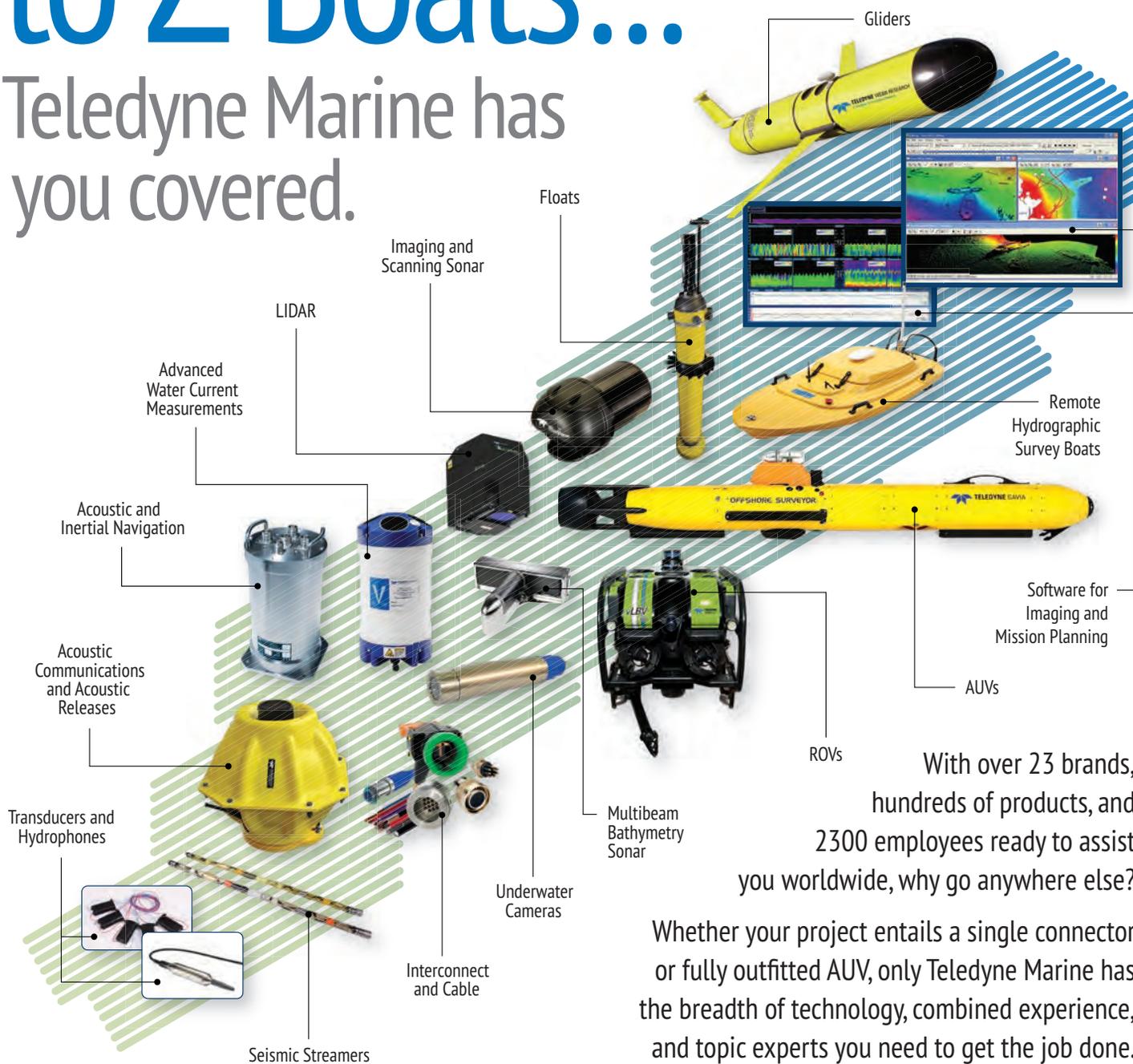


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(Photo Courtesy WITT Ltd.)

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By Greg Trauthwein



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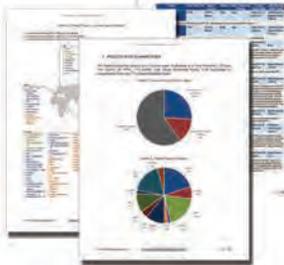
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Jim is the founder and manager of IMA, a consulting firm providing market analysis, competitive benchmarking and business planning support in the maritime and offshore sectors. Over the past 40 years IMA has performed more than 350 business consulting assignments for 170+ clients in 40+ countries. One of the firm's specialties is analyzing requirements for floating production systems. IMA has published more than 50 reports since 1996 analyzing this business sector and has been engaged by numerous clients to assist in analyzing specific market opportunities in the floating production sector. Please visit www.imastudies.com for more information about IMA. Jim is also the co-founder of IMA/World Energy Reports, a New York based business intelligence service for the floating production market.

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Alexander MacLeod

Alexander MacLeod is a degree qualified Chartered Engineer with over 20 years' experience of project planning for the oil and gas industry. *p. 50*



Ben Wilby

Ben is an Analyst for Douglas-Westwood; he primarily works on the updating of the Offshore Oil & Gas Database and has authored numerous reports.

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When I was finally able to lift my head from the March 2016 “OI” edition and look slightly ahead, I would be lying if I said that there was, at a glance, an uplifting feeling in sizing up our “Offshore Annual.” As readers of this magazine surely know, the current slog through historic prolonged depressed energy pricing is having a substantial material effect on the business of discovery and recovery of oil and gas offshore. That said, there is always a silver lining, and as we see it: Energy will rebound; how fast and how far is anyone’s best guess, but rest assured the need for oil and gas globally will be a viable business for generation; & the Subsea Industry, as a whole, will continue to grow in importance.

Two reports in this edition speak to the former, as starting on page 26 the latest analysis of the Floating Production Systems Market from Jim McCaul and IMA/World Energy Reports. This is a very specific but unique niche, and McCaul has covered it closely for more than 20 years. This excerpt of his latest report comes with full projections on what to expect in the coming five years.

The second report takes a different angle, specifically on the booming offshore decommissioning market through 2040 (starting on page 30). From Ben Wilby of Douglas-Westwood, this provides explicit detail on when and where this market will be hottest in the coming generation.

In analyzing trends in recovering energy offshore, it would be remiss to dismiss developments in the renewable sector. Despite low oil and gas prices, the renewable sector continues to draw investment and interest, as ever-tightening environmental regulation continue to buoy the prospects of Wind, Wave and Tidal power. This month we take an in-depth look at the \$2m Wave Energy Prize from the U.S. Department of Energy, with insights on the 11 finalist still alive, refining advance energy capture systems and vying for the top prize, to be awarded in November. This story starts on page 36.

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THE NEW SITE FOR NEWS

The screenshot shows the homepage of Marine Technology News. At the top, the site name 'MARINE TECHNOLOGY NEWS' is displayed in a blue header. Navigation tabs include 'News', 'Magazine', 'Directory', and 'Jobs'. A secondary navigation bar lists categories: 'Offshore Energy', 'Ocean Observation News', 'Subsea Defense', 'Vehicle News', 'New Product', and 'Events'. The date 'FRIDAY, FEBRUARY 21, 2014' is shown in the top right corner. The main content area features a large article titled 'Amphibious Ship America Runs Successful Trials' with a photo of the ship. Below it are several smaller news items: 'Sens. Menendez, Booker Urge Feds to Expedite Road Salt to NJ', 'Regs4ships Launch Australian Digital Product', 'Chautauqua Lake Airplane Crash Exercise Scheduled', 'EnSolve Launches Scrubber Water Treatment System', 'Jaya Delivers Vessel to Atlantic Towing', and 'RINA Acquires CSM Materials Technology Center'. On the right side, there are promotional banners for 'Maritime Global News' (with an App Store icon), 'Marine Technology Reporter' (described as the world's largest, audited, offshore energy, subsea defense and scientific communities), and 'MaritimeProfessional' (a networking group with 26,985 members). A 'Subscribe for Free' banner is also visible, along with a 'Download our FREE app' section featuring Google Play and App Store logos.

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REPORTER

Casey Moore

President, Sea-Bird Scientific



MTR caught up with Casey Moore, the ubiquitous president of Sea-Bird Scientific, at the 7th Annual Blue Tech & Blue Economy Summit in late 2015 in San Diego. His candor and insight during his “View from the Top” presentation makes him a natural selection for MTR’s April 2016 “View from the Top.”

By Greg Trauthwein



Sea-Bird Scientific

Here are Casey Moore’s thoughts on: The ability to look ahead and predict the course of the subsea market for the next 20 years.

“I find that I’m bad at predicting how long things are going to take when it comes to product innovation and new developments. To that point I’m going to be introducing some things today that is part of my vision cycle for 20 years from now that really was part of my five-year plan when I started my business in 1992!”

Challenges inherent in this business, balancing everyday work versus long-range predictions.

“I’m a nose to the grindstone kind of guy. There is a perspiration/innovation equation that’s going on with all that we’re doing here. In this business, the perspiration is a big part of it. We innovate new sensor technology, we get it out in to the field and we learn, and then it is a long road to getting it really right to provide the quality of data necessary for a lot of today’s scientific problems. The ocean is a big body of water

and when you're measuring a lot of small variance, you have a lot of challenges."

The size and scope of the company's task at hand.

When Moore looks at his companies business, he sees it in the following context:

- 1. **Ocean as a Climate Engine;**
- 2. **The Carbon Cycle** and the sequestration of carbon in the ocean (ie. Ocean Acidification);
- 3. **The Industrial Ocean**, meaning people using the ocean as a space to work, using the ocean as a resource, or using the ocean to extract resources (ie. transport, oil & gas, fisheries);
- 4. **The Ocean as a Habitat**, meaning the eco diversity and productivity of species living in the ocean, as well as human habitation in coastal community.

"These are all significant and distinct issues, but what really makes them compelling is when you realize that they are all inter-dependent, and they impact each other. Ultimately it comes down to 'how are we going to sustain this space over the next 50 years to maintain a viable human habitat.'"

"The ocean is a big body of water and when you're measuring a lot of small variance, you have a lot of challenges."



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Importance of issues surrounding the ocean.

“It is in my opinion that this is going to be the problem for the 21st century for ocean sciences. It is today, and it’s going to be there in 20 years; we’ll learn new ways to cope with it, but it’s not going away.”

The future funding of ocean science initiatives.

It is unrealistic to think that funding is going to ramp up wildly ... “we’re going to have to learn to work with limited resources. That means we have to get more efficient, and driving down acquisition cost is a big priority for our company. It’s not all about lower cost sensors; that’s important, that something that we can do, but the cost of getting good data out of the ocean is really driven by deployment and operations and maintenance and assimilation of the data. We’ve got to make it easier for people to do that.”

I think the second big thing for us is we’re in this era of bio-

geochemistry. (To be fair) I could have said that 15 years ago that we’re entering the era of biogeochemistry (and been correct then, too). In order to do this job well, to understand eco diversity and all of its impacts we’re going to have to move things along; we need to improve biological sensors, we need better in-water chemistry, we need new and improved multi-parametric techniques.

The need to develop the workforce of the future.

“One of the biggest gaps is the cross training of the workforce. We can get good engineers, we can get good scientists, we can get good commercial leaders, but what really will drive our business forward is getting scientists that understand the commercial business; getting engineers that understand science; commercial leaders that understand the science.”

When it gets too cut up and sequestered, you find yourself simply providing products to customers, and you lose contact with the fundamental problems.

Casey Moore, President, Sea-Bird Scientific, explaining the nature of his company:

Sea-Bird Scientific is approximately 200 employees across four locations in the U.S., Canada and Europe. It develops and manufactures sensors, systems, and platforms for in-water analytical measurement of natural waters. **“We build CTDs, we build sensors that go with CTDs, we build analytical instrumentation.”**

In 2013, Sea-Bird Scientific reorganized to provide more focused support for its expanding customer base. Today it provides products and services through two commercial businesses: The Ocean Research Business Unit and The Sea-Bird Coastal Business Unit.

“When it comes down to it we are an Ocean Science business, and we build sensors for ocean scientists ... that’s at the core.”



Biogeochemistry Defined

Biogeochemistry is a relatively new scientific discipline that explores the physical, chemical, biological, and geological processes and reactions that govern the composition of and changes to the natural environment. In particular, biogeochemistry studies the cycles of crucial elements, such as carbon and nitrogen, and their interactions with other substances and organisms as they move through Earth's atmosphere, hydrosphere (water and ice), biosphere (life), and lithosphere (rock). The field focuses especially on the diverse and interlinked chemical cycles that are either driven by or have an impact on biological activity, in particular carbon, nitrogen, sulfur, and phosphorus. A prime example is carbon, the building block of life on Earth, and the planet-encompassing carbon cycle. Photosynthetic plants on land and sea take carbon dioxide (a form of inorganic carbon) from the atmosphere and convert it into the organic forms of carbon they need to live and grow. Animals that consume the plants incorporate the organic carbon into their own bodies.

Microbes eventually decompose dead plants and animals, and their carbon is recycled into soils and groundwater or swept into the oceans, where it becomes available to microbes and phytoplankton at the base of the marine food chain or it sinks and is buried in seafloor sediments. Over millions of years, carbon that is buried on land or at the bottom of the ocean becomes incorporated into rocks or hydrocarbons, where it might remain for tens to hundreds of millions of years. Ultimately, volcanoes return some of this carbon to the air as gas, where its heat-trapping properties affect Earth's climate, or else the rocks containing carbon are uplifted onto continents and gradually weathered, releasing their carbon back to the environment and making it available to organisms once again.

Why is it Important?

In a sense, chemicals are like currency, and biogeochemistry is the study of the nearly limitless "transactions" that drive the entire planetary system, including life on Earth. Understanding these fundamental processes provides crucial insights into how life formed, has evolved, is sustained, and is threatened on our planet, and how the various chemical cycles govern and regulate Earth's climate and environment.

Such knowledge enhances our ability to find ways to adapt to climate change and its impacts, enhance agriculture and food production, manage fisheries, mitigate pollution, develop alternative and renewable energy, prevent diseases and create new drugs, and spur innovations that can drive economic prosperity and improve our quality of life.

(Source: Woods Hole Oceanographic Institution)



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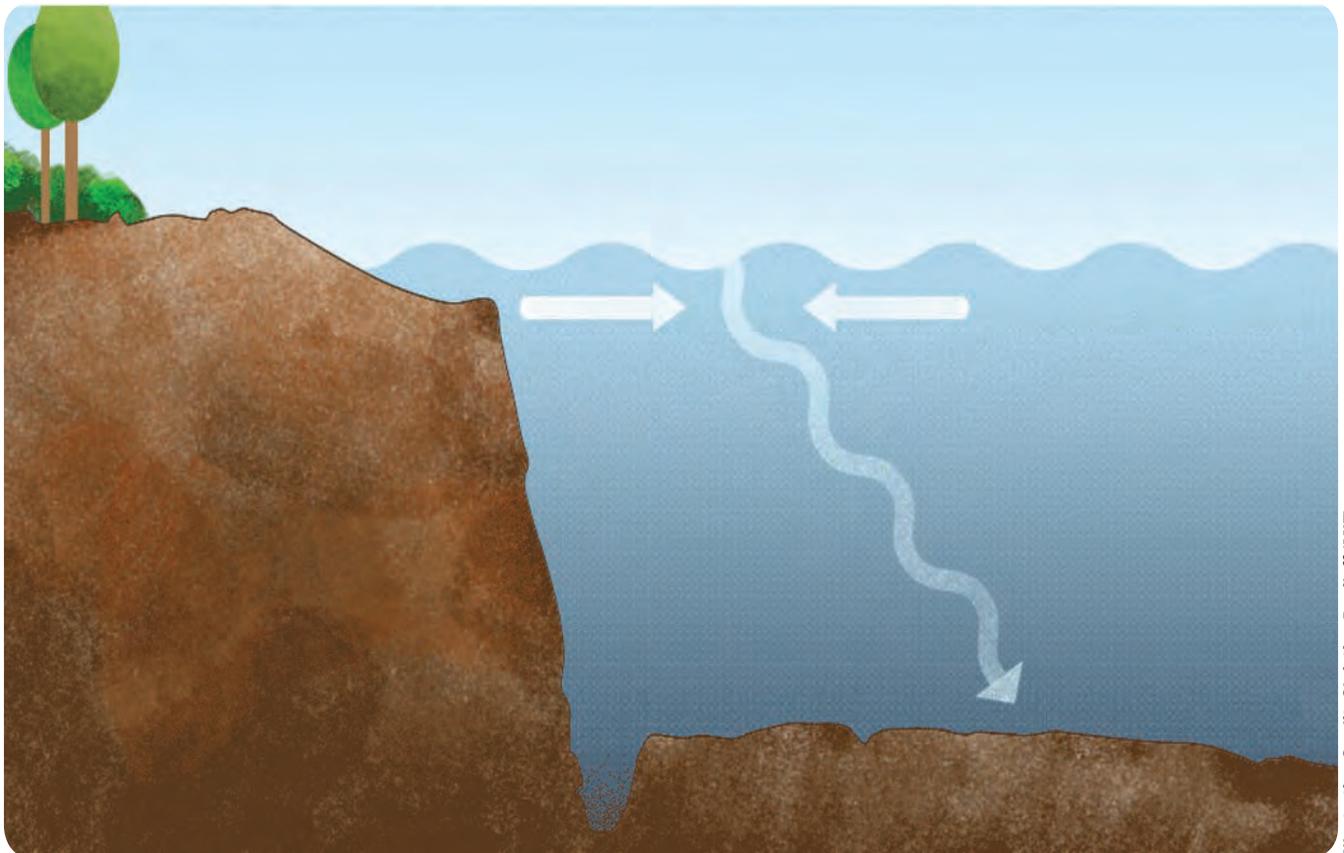
New Theory of Deep-Ocean Sound Waves may Aid Tsunami Detection

Surface waves can trigger powerful sound waves that race through the deep ocean, study suggests.

By Jennifer Chu, MIT News Office

Acoustic-gravity waves are very long sound waves that cut through the deep ocean at the speed of sound. These lightning-quick currents can sweep up water, nutrients, salts, and any other particles in their wake, at any water depth. They are typically triggered by violent events in the ocean, including underwater earthquakes, explosions, landslides, and even meteorites, and they carry information about these events around the world in a matter of

Without compressibility and gravity, we cannot describe low-frequency sound waves correctly,” Usama Kadri says. “This is one of the reasons why researchers have mostly overlooked acoustic-gravity waves.”



(Illustration Credit: Christine Daniloff/MIT)

These waves, known as surface-gravity waves, do not travel nearly as fast, far, or deep as acoustic-gravity waves, yet under the right conditions, they can generate the powerful, fast-moving, and low-frequency sound waves.

minutes. Researchers at MIT have now identified a less dramatic though far more pervasive source of acoustic-gravity waves: surface ocean waves, such as those that can be seen from a beach or the deck of a boat. These waves, known as surface-gravity waves, do not travel nearly as fast, far, or deep as acoustic-gravity waves, yet under the right conditions, they can generate the powerful, fast-moving, and low-frequency sound waves. The researchers have developed a general theory that connects gravity waves and acoustic waves. They found that when two surface-gravity waves, heading toward each other, are oscillating at a similar but not identical frequency, their interaction can release up to 95 percent of their initial energy in the form of an acoustic wave, which in turn carries

this energy and travels much faster and deeper.

This interaction may occur anywhere in the ocean, in particular in regions where surface-gravity waves interact as they reflect from continental shelf breaks, where the deep-sea suddenly faces a much shallower shoreline. Usama Kadri, a visiting assistant professor and a research affiliate in MIT's Department of Mathematics, says the team's results establish a concrete and detailed relationship between surface-gravity waves and acoustic-gravity waves, which, until now, scientists had suspected did not exist. Understanding this relationship, he says, allows researchers to describe how energy is exchanged between gravity and acoustic waves. He says this energy could be vital for many marine life forms, and it could

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Kadri says the results may help scientists connect interactions between not only surface and deep ocean waters, but also with the atmospheric forces that affect surface waves.

play a role in water transport and the redistribution of carbon dioxide and heat to deeper waters, thereby sustaining a healthy marine environment.

Kadri and his colleague, Triantaphyllos Akylas, a professor of mechanical engineering at MIT, have published their results in the *Journal of Fluid Mechanics*.

Adjusting for the real world

For the most part, gravity waves and acoustic waves have been regarded as completely separate entities, one having no effect on the other. That's because their properties are so different, in both length and timescales. While gravity is the main force acting to restore and stabilize surface-gravity waves (hence the name), its effect on sound waves is negligible. On the other hand, the fact that water is slightly compressible is what allows pressure waves, such as sound, to travel through, though this property has almost no effect on surface waves.

Kadri says the typical water wave equations used to characterize ocean wave interactions do not apply to acoustic-gravity waves, as they do not factor in compressibility and gravity effects.

"Without compressibility and gravity, we cannot describe low-frequency sound waves correctly," Kadri said. "This is one of the reasons why researchers have mostly overlooked acoustic-gravity waves."

Kadri derived a wave equation that includes compressibility and gravity as well as higher-order nonlinear terms.

"In linear theory, two surface-gravity waves traveling toward each other do not feel each other; they get closer, pass each other, and then move away without exchanging any form of energy, as if they have never met," Kadri explains. "However, in reality the picture is more complicated, and nonlinear effects may come into play, resulting in energy exchange and even generation of new waves, sometimes. Here, at specific frequency ranges, gravity waves can actually produce an acoustic wave that has completely different properties — and that is amazing."

Rolling in the Deep

The newly derived wave equation allowed Kadri to study the behavior of both acoustic and gravity waves. He analyzed the theoretical interactions within a wave triad consisting of two surface-gravity waves and one acoustic-gravity wave. In 2013, he proved numerically that this configuration of waves should resonate, or exchange energy, meaning that as two of the three waves oscillate, they should drive the third wave to oscillate in

response. Now, using the modified wave equation, along with multiple scales analysis, he derived what are called "evolution equations" to describe how the amplitudes of all three waves change as they exchange energy.

Surprisingly, he calculated that if two surface waves flow toward each other at roughly the same frequency and amplitude, as they meet and roll through each other the majority of their energy — up to 95 percent — can be turned into a sound wave, or acoustic-gravity wave. This energy can fluctuate, depending on the initial amplitudes and frequencies of the surface-gravity waves. Even when the surface-gravity waves travel in the form of short bursts, they can still transfer over 20 percent of their energy to acoustic-gravity waves, an amount that cannot be neglected.

"This is incredible, just to think that these waves are so different," Kadri says. "Having them sharing energy is really exciting; this explains how some of the energy that comes from the atmosphere, from the sun and the wind, to the upper part of the ocean, can actually be driven to roll in the deep ocean through acoustic-gravity waves."

Kadri says the results may help scientists connect interactions between not only surface and deep ocean waters, but also with the atmospheric forces that affect surface waves.

Now Kadri is imparting this new understanding of wave interactions to a critical application: tsunami detection. He is working with the Woods Hole Oceanographic Institution to design a system to detect acoustic-gravity waves that precede a tsunami, traveling more than 10 times as fast as the more destructive wave.

"Severe sea states, such as tsunamis, rogue waves, storms, landslides, and even meteorite fall, can all generate acoustic-gravity waves," Kadri says. "We hope we can use these waves to set an early alarm for severe sea states in general and tsunamis in particular, and potentially save lives."

*Additional background
ARCHIVE: Waves in the deep
[http://news.mit.edu/2015/
acoustic-gravity-waves-transport-tsunamis-0203](http://news.mit.edu/2015/acoustic-gravity-waves-transport-tsunamis-0203)*

EDITORIAL CALENDAR

Month/Edition	Features	Bonus Distribution
January/February Underwater Vehicle Annual: ROV, AUV & UUVs Ad Close: 01/21	Market: HD Cameras and Sonar for Vehicles Technical: Underwater Navigation Product: Scientific Deck Machinery Special Report: 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: Subsea Engineering: Complexity of Subsea Field Architecture Technical: Oceanology International 2016 Technology Spotlight Product: 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: Seismic Vessels: Streamers & Magnetometers Technical: Deepwater Positioning, Mooring & Anchoring Product: 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: Offshore Renewable Energy: Wind, Wave & Tide Technical: International Naval Technologies Product: 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: Comms, Telemetry & Data Processing Technical: GPS, Gyro Compasses & MEMS Motion Tracking Product: Interconnect: Underwater Cables & Connectors	
MTR Special Reports: Hydrographic July 2016 Bonus Electronic Edition Publication Date: July 15, 2016		
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MTR Special Reports: Unmanned Marine & Subsea Vehicles November 2016 Bonus Electronic Edition Publication Date: November 7, 2016		



LSU Site of Sixth National SeaPerch Challenge – Underwater Robotic Championships

SEAPERCH

2016 marks the sixth year of the National SeaPerch Challenge, an underwater robotics competition.

On Saturday, May 21, the Sixth National SeaPerch Challenge will be held on the campus of Louisiana State University (LSU) in Baton Rouge. More than 200 teams of middle and high school students from across the country, an impressive increase of almost 50 percent over last year, will have earned the right to compete against their peers on the national stage by winning at the regional level. Compare this phenomenal growth with the first National Seaperch Challenge, held six years ago in Philadelphia, where just 187 students in 38 teams participated.

Next month more than 1,500 students, teachers, coaches/chaperones, family, friends, volunteers, judges, invited guests, speakers, and committee members will gather for a weekend of learning, sharing and competition. On the line will be the title of National SeaPerch Champion, additional trophies for all three competition events and an expanded number of special awards.

Hosted by LSU's College of Human Sciences & Education, registered participants and spectators will be treated to the "college experience," enjoying the entire weekend's activities, including the Friday Night Social, Saturday's in-pool competition events and the new electronic poster competition. The Awards Ceremony, along with residence hall accommodations and meals through Sunday morning, will be featured for all participants on the university's picturesque campus.

What is SeaPerch?

SeaPerch is the innovative K-12 underwater robotics program, sponsored by the Office of Naval Research (ONR) and managed by the Association of Unmanned Vehicle Systems International Foundation (AUVSIF). It offers teachers and group leaders the opportunity to inspire their students to build their own Remotely Operated Vehicles (ROV's) following an academic curriculum consistent with national learning



(All Photos Courtesy Seaperch)



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standards supporting Science, Technology, Engineering and Mathematics (STEM) subjects with a marine engineering-based theme. The program promotes hands-on learning of engineering and scientific concepts, problem solving, teamwork and critical thinking, and introduces students to potential and rewarding career opportunities in naval architecture, marine, ocean and naval engineering. “With guidance afforded by AUVSIF and with ONR’s commitment to SeaPerch, we have grown exponentially, reaching over 300,000 students to date,” said Susan Nelson, Executive Director of SeaPerch. Over the years, more than 19,000 teachers and mentors have committed to supporting student learning through this stimulating and fun hands-on activity and to promoting student discovery and excitement about STEM subjects leading to a potential future career path. The program reaches a diverse population, so participants in the National Challenge frequently include students from inner cities to remote rural areas of the country to Native American reservations in Minnesota to the islands of Hawaii, all of whom have now been introduced to STEM through SeaPerch. This year, the organizers welcome teams from Australia, the Cayman Islands and Puerto Rico.

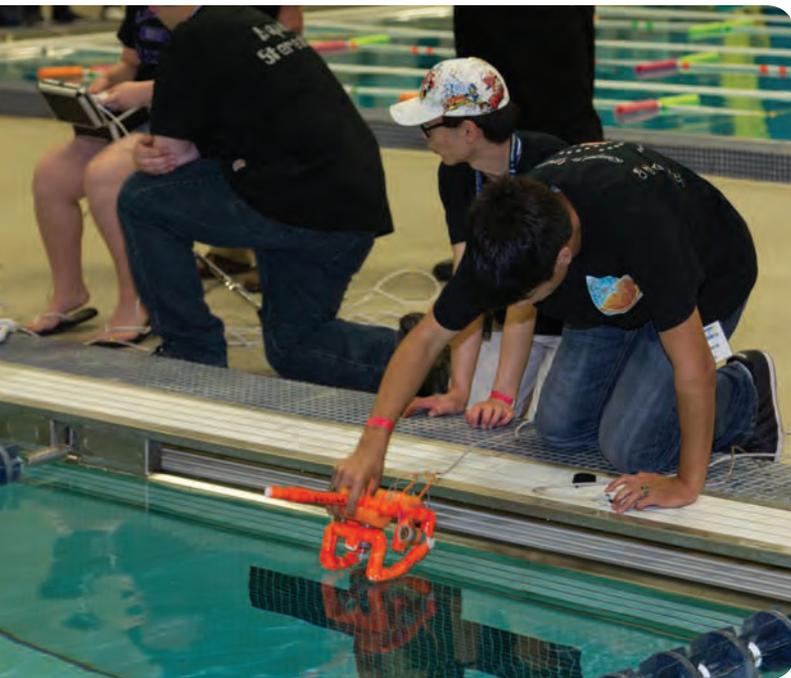
Beginning on Friday afternoon, May 20, arriving teams will first check into their assigned rooms in the LSU residence halls and get settled, then head over to registration in the LSU Carl Maddox Field House where they will check in and submit their ROVs for a compliance review. For those vehicles requiring adjustments and/or repairs, a triage station with spare parts and tools will be available. Following dinner at the Resident Dining Hall, teams will participate in the Friday Night Social where students from all over the country and beyond can meet, mingle and compare their design enhancements and innovations as well as their challenges along the way. All

participants will receive National SeaPerch Challenge T-shirts and giveaway bags with items contributed by the SeaPerch program and its corporate sponsors.

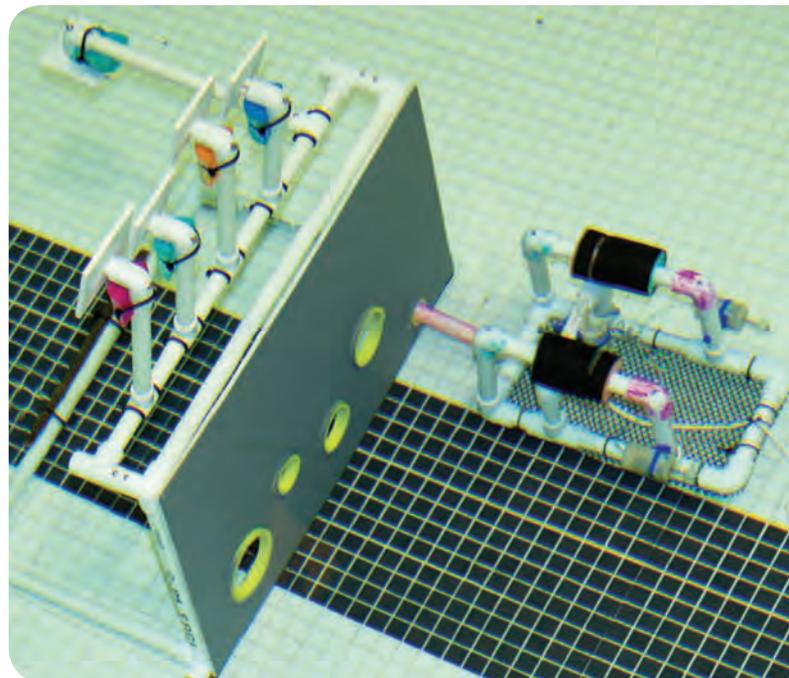
Competition day, Saturday, May 21, will take place at the LSU Natatorium. Teams may consist of a minimum of one student and one adult leader, and there is no restriction on the maximum number of students that can participate although teams averaged six members last year. Susan Nelson will preside over the opening ceremony in the LSU Field House featuring a number of notable speakers and last minute technical instructions for the teams, accompanied by photographers, videographers and local media. Again this year, there will be live streaming of the day’s activities for the benefit of classmates, friends and parents back home.

The in-pool technical competition consists of two events. The first will require students to steer their ROV through the Obstacle Course consisting of five, 18-inch diameter submerged hoops oriented in different planes. Every year, the second in-pool event changes, requiring the students to design their vehicles specifically to meet the designated mission. The second event for 2016, aptly named, “The Challenge,” will test the students’ ability to release three different sized balls from four dispensers on the pool bottom and transport them in a controlled manner either to a submerged container or to a floating pen on the surface as appropriate. Detailed specifications for both underwater events have been posted on the SeaPerch website, www.seaperch.org, for teams to construct their own events for practice prior to the national competition.

Again this year the third event will provide a chance for the competitors to share their learning, innovations and science understanding through poster displays and presentations. Introduced this year for the first time will be electronic poster



20 MTR



April 2016

judging in advance of the National SeaPerch Challenge. The top 30 teams will be offered an opportunity to present in-person to a panel of judges on competition day. Scores both for the posters and for the presentations will be added to each team's total points.

Approximately 150 judges and volunteers are also anticipated to attend during the day on Saturday in order to adequately oversee and judge the in-pool competitions, to judge the top posters that will have been selected for in-person presentations during the day and to ensure a rewarding and memorable day for all participants, attendees and guests.

On Saturday evening the Awards Ceremony will take place in the LSU Field House. Here, first-through-third place trophies in each event for middle school, high school and open classes, special awards and the naming of the 2016 National SeaPerch Champions will be made by Susan Nelson, ably assisted by the invited guests who will also be photographed with each winning team. Invited speakers, representing corporate sponsors, local and state congressional representatives, ONR, U.S. Navy, U.S. Coast Guard and other military branch personnel, will be able to take part in the day's activities. They have been encouraged to arrive early and observe the competitions, judge various events and speak first hand with the students before addressing them that evening about the importance of STEM to their future careers. All student team members will receive participation medals, and be photographed by team for the benefit of their families and schools. Additionally, Certificates of Participation will be available both for student participants and for teachers and advisors to download following the National Challenge. At the conclusion of the award presentations all registrants will enjoy an outdoor Awards Party and Barbeque.

Sunday, May 22, will be a free day for the teams to explore, on their own, the rich cultural history and outdoor activities in the greater Baton Rouge/New Orleans environs including museums, parks and historic sites.

The College of Human Sciences & Education (CHSE) is a nationally accredited division of Louisiana State University. Formed in 2012, CHSE brings together programs and capitalizes on individual strengths to create a dynamic college that addresses the socially significant issues we face as a state, nation and world. The college is comprised of the School of Education, the School of Human Resource Education and Workforce Development, the School of Kinesiology, the School of Library and Information Science, the School of Social Work and the University Laboratory School. These combined schools offer eight under-



(All Photos Courtesy Seaperch)

graduate degree programs and 18 graduate programs, enrolling more than 1,900 undergraduate and nearly 1,000 graduate students. The college is committed to achieving the highest standards in teaching research and service, and is continually working to improve its programs. Judges and volunteers are always welcome. Should you be interested in participating as a volunteer or judge on Saturday, May 21, please go to the SeaPerch website, www.seaperch.org, to sign up. Sponsorship opportunities are still available for individual, local and corporate funding, and can be viewed on the SeaPerch website. You may contact Susan Nelson at susan@seaperch.org about how to become a sponsor for this event.

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Offshore Innovation in Motion

By Kira Coley

Last year, a record \$376 billion was invested in the UK's renewable energy sector. With the UK Government's 2020 renewable energy target approaching, the race is well underway to shape the future of the industry through innovative solutions which offer long-term promise in both power efficiency and affordability. Described by some as the most exciting new development in renewable energy since the invention of the solar panel, the Marine

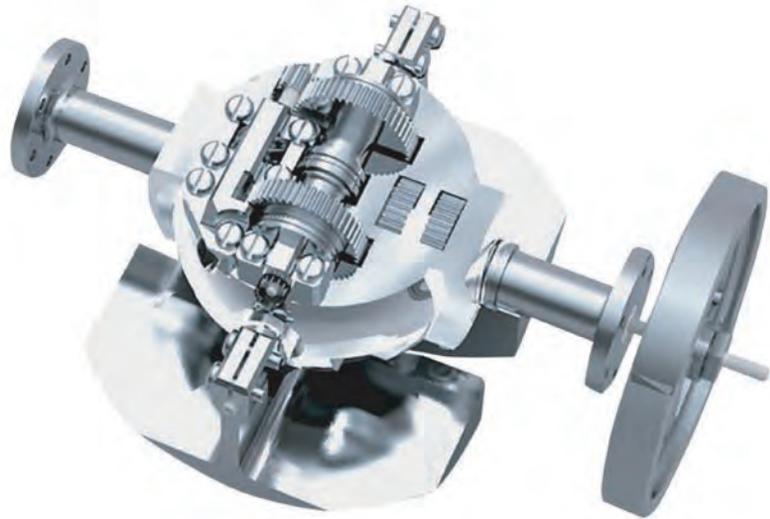
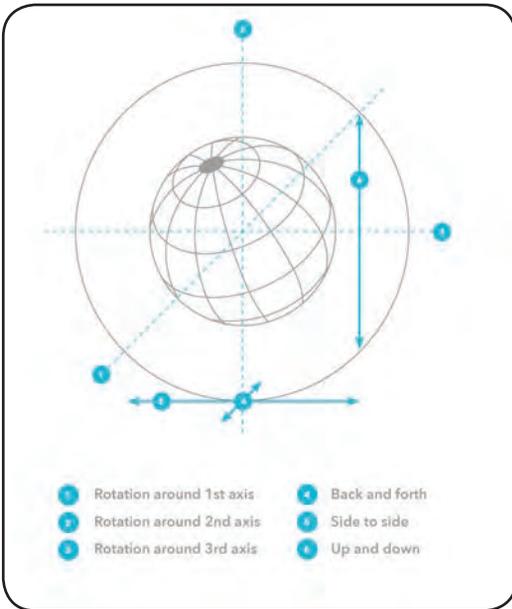
WITT (Whatever Input to Torsion Transfer) is a unique technology with the power to harness energy from motion. WITT Ltd., a new one-to-watch company based in Plymouth, UK, are making waves in the offshore energy sector with the invention of this novel transmission system which has the ability to convert six degrees of water movement into a new source of clean power.

As an island nation surrounded by abundant sources of clean



(Photo Courtesy WITT Ltd.)

The couple in the middle are Martin and Mairi Wickett. The gentleman on the left side was Mike Reynolds, Ports Director for A&P shipping who was also part of our presentation endorsing the WITT by A&P shipping, Mike has since left A&P and is now WITT Project Manager. The gentleman on the right is Jason Ball of Moffat & Nichol, sponsors of Ocean Exchange 'Leap to Zero' General Dynamics Gulfstream event in Savannah, Georgia.



(Photo Courtesy WITT Ltd.)

energy, the UK has long been global leaders in offshore renewable sector. The falling costs of technology continues to boost investment as organizations work to streamline project development, reduce costs and improve the overall efficiency of renewable systems.

It is an especially exciting time for Wave and Tidal energy as each year sees an increasing presence of innovative technology being tested within UK waters. WITT Ltd. is one such technology manufacturer, hoping to see its first product – the Marine WITT – come into production through collaborating

-Jack Fisher,
Founder

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(Photo Courtesy WITT Ltd.)

Witt in Plymouth University wave tank

with world leading organizations.

Contained within a sealed unit, the Marine WITT uses a 3D pendulum which drives the transmission system. This converts all motion, in any combination of the six degrees of freedom, into a single unidirectional rotation of a flywheel, to produce electricity. The Marine WITT is the first energy harvesting system that can capture this full spectrum, offering 100% more energy compared to any other device.

Martin Wickett, Chief Technology Officer and inventor of the system, built the first unit in his workshop almost a decade ago. Since then WITT has received multiple awards including the General Dynamics Gulfstream 'Best Global Technology' at Ocean Exchange 2013 in Savannah, Georgia; 'Pitch@Palace' in October 2015 and \$57,000 in the Shell Springboard event in 2015. Through R&D support from companies such as Ricardo and Schaeffler, the Marine WITT has caught the attention of those in the yachting community as a potential solution for achieving zero-emission vehicles.

By working with a precision engineering manufacturer, Gibbs Gears, together with Schaeffler, the first robust unit is in development after completing various design iterations with input from experts such as Drive Systems Design.

"Working with Schaeffler and Gibbs Gears has sped up the development process significantly. We will have robust units to test in wave tanks at Plymouth in July. We have identified the best manufacturing process which will allow us to minimize costs whilst retaining a superior build quality," said Peter Beech, WITT Ltd.

The power outputs generated from the wave tank testing will be used to evaluate the potential of WITT units to generate offshore grid level electrical power by connecting devices together. They also anticipate being able to meet these power requirements at a far more competitive cost compared to any other solution.

Last year, WITT won the Innovate UK Award for a feasibil-



(Photo Courtesy WITT Ltd.)

A prototype generating electricity.

ity study for a wave energy project. Now, working as part of a consortium, the project looks to ascertain a harmonized cost of energy for a range of device sizes in order to identify priority applications. The consortium is made up of Gibbs Gears, Schaeffler, DNV GL, Mojo Maritime, Offshore Renewable Energy Catapult (OREC) and three universities; Bristol, Plymouth and Southampton.

The power output will be dependent on several factors – namely the amount of motional energy available as well as the design of the containment and mooring configuration in marine applications. University of Glasgow's School of Mechanical Engineering has produced energy graphs demonstrating the potential of different sized units suited to a wide range of applications.

"We are extremely excited about the potential for this product for several reasons," said Beech. "Firstly, is its scalability, from a small unit for personal use to grid scale power generation - the bigger the unit the more potential there is to harvest larger amounts of power. Collaborating with companies, who have the technical knowledge and the resources, is vital to bringing a new product to a renewable energy market that has stalled somewhat in technological development."

The WITT collects energy from any naturally occurring movement whether in the air, on the ocean surface, subsea and on land. This offers power in a much more diverse range of areas including very harsh environments with less environmental and aesthetic impact. At present, a WITT 200 watt is being developed to provide a power solution in a range of applications such as desalination and emergency power.

The system harvests power from surge & pitch, sway & roll, with no shock load, producing twice the capacity for wave power conversion than other devices on the market. WITT are working with the consortium in the wave energy project to design, build and test a sealed Marine WITT for wave tank testing, with the aim of bringing it into manufacture for sale to

Martin and Mairi Wickett receiving the Ocean Exchange Award.

customers from mid-2017.

“There have been many challenges, acceptance being one of the early ones,” said Beech. “Few people initially believed that one man had solved a problem that large companies had spent millions of pounds on trying to overcome. Once the worldwide patents had been approved, early trials proved the concept worked and different markets were identified. Then it was a case of finding the right companies to work with to bring a final prototype for testing prior to manufacture.”

The WITT has potential in many onshore and offshore markets and will be open to discussions with companies seeking to license the technology. A smaller WITT in the near future will also be developed to provide 10 to 15 watts of power for autonomous vessels, buoys and marine safety equipment. While at present the company does not envisage a market on gliders or Remotely Operated Vehicles (ROVs), WITT Ltd. also want to provide autonomous power for sensors and telemetry solutions, as well as beacons for safety at sea.



(Photo Courtesy WITT Ltd.)

“There are many lifesaving and ocean survival applications where energy power is needed and we are delighted to have the RNLI and global survival company, Survitec, wanting to deploy our WITTs at sea,” said Beech. “Back onshore, WITT is in discussions with Ricardo regarding a small unit for harvesting energy from walking. We will also develop a smaller, personal consumer, WITT units, which will allow mobile phones, torch or radio batteries and similar to be charged while on the move.”

WITT will continue to showcase products at worldwide exhibitions and conferences whilst looking for new and exciting uses for the novel system.

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Floating Production Systems

Which Way is Up? The Six Things You need to Know Now

Jim McCaul – IMA/World Energy Reports

No question that the market for new floating production systems has taken a battering. The past 12 to 18 months have been a difficult period for everyone in the business sector. Absence of new contracts has forced fabricators and equipment suppliers to make huge cutbacks in personnel and spending. But deepwater production will rebound – oil demand keeps growing -- and though the signs are mixed we see indications of the rebound starting.

1. Production Floater Inventory and Current Orders

First some numbers about the state of the business. 261 oil/gas floating production units are currently installed on offshore fields. FPSOs represent 64% of the installations, production semis 15%, tension leg platforms 10%, production spars 8% and production barges 2%. 19 LNG regasification units and 92 FSOs are also in service. No FLNGs are yet in operation - but this is about to change when PFLNG Satu is delivered in April.

Another 25 oil/gas production units are off field and available for redeployment, FPSOs account for 76% of the available units, production semis the remaining 24%. More than

half of these production units are likely to be scrapped due to age and/or market conditions.

The growth in the number of production floaters in service or available is shown in the accompanying chart.

An additional 55 production floaters and 7 storage/offloading units are currently on order. Of these, 53% are FPSOs, 13% are another type of oil/gas production unit and 35% are LNG liquefaction or regasification units.

2. Oil Prices Hit Bottom in January and Appear to be Recovering

The continuing imbalance of oil demand and supply has weighed on oil pricing and has caused many oil companies to cut back on capital spending plans. Brent crude in March 2014 was trading around \$105 per barrel. By March 2015 the price had fallen to around \$55 per barrel – and in late March 2016 Brent was trading around \$40 per barrel. The nadir was on 20 January 2016 when spot Brent closed at \$26 – a level far below the breakeven on many oil fields.

As a result of the oil price collapse, daily announcements of lower capital spending have been common over the past six to 12 months – from majors like ExxonMobil to smaller up-



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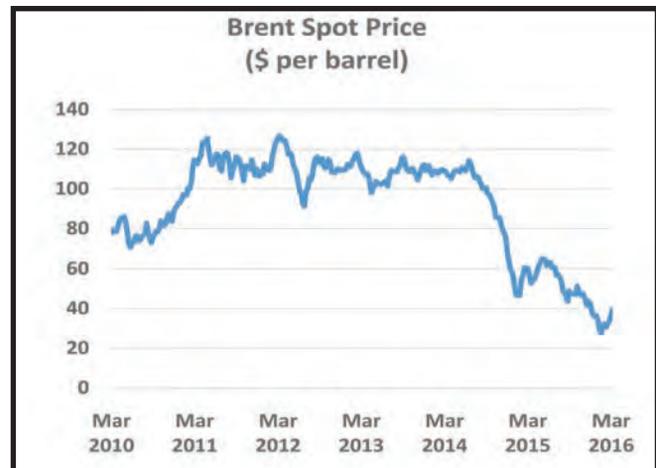
Bonga FPSO

(Photo: Shell)

stream players like Premier, Cobalt, others. ExxonMobil, for example, in March said it will budget \$23.2 billion in capital spending in 2016 – down 25% from the \$31.1 billion spending in 2015 and 45% lower than the peak spending of \$42.5 billion in 2013.

Over the past two months the picture has brightened a bit and some analysts (including this author) see a rebound beginning. By March 21, Brent had recovered to \$41 -- and the futures market is pricing Brent at \$44 at end 2016, \$49 at end 2018 and \$52 at end 2020. While higher than current spot, these futures prices are still far below the \$100+ price of Brent just two years ago. But the trajectory in oil prices has been upward since hitting bottom in January and the futures market has the upward trend continuing.

While no one can predict the price of oil, we see the worse being over – and recovery underway. The world producers are talking about a production freeze, drilling of new shale wells in the US has stalled and – most important – global demand for oil keeps growing. Sooner or later supply and demand will come back into balance. While many things can disrupt and delay this rebalancing (e.g., downturn in the Chinese economy), we see a gradual recovery in oil prices over the next 6 to 12 months. This is not to say there will not be further dips.



Oil prices are volatile. But the long term trend is upward.

The huge inventory of oil in the market will limit near term price increases and the ability of shale production to rapidly ramp up will likely hold prices within the two digits over the next few years. But we see prices getting back to \$60 to \$70 by the end of the decade. We also see the potential for a supply shock that could send the price of oil into three digits within this time frame. A supply disruption in the Middle East

is still a continuing threat. Mideast oil fields are in a volatile region.

Meanwhile the brakes have been firmly applied to deepwater project starts. The last major FPSO contract was awarded in January 2015 – an FPSO to be used offshore Ghana. There also was a tentative contract in July 2015 for a production semi to be used in the GOM. These two contracts – plus orders for a handful of floating regas vessels – have been the total order intake over the past 15 months. This is far below the historical order intake pattern. Contracts for an average of 12 FPSOs and 3 other oil/gas production floaters have been placed annually over the past ten years.

3. Petrobras' Problems are a Major Hit to the Market

Running in parallel with the overall market downturn has been an unprecedented implosion in Petrobras. The Brazilian oil company has been embroiled in a corruption investigation that has led to a financial and contracting meltdown. Petrobras' situation needs to stabilize and begin improving before the company can again be a major driver of production floater contracts.

Unfortunately, Petrobras' problems have not been easing. The company's credit rating was reduced to junk status in 2015 – and was further downgraded by rating agencies in Q1 2016. S&P in mid-February cut Petrobras' bond rating from BB+ to BB and Brazil's sovereign rating from B+ to BB with negative outlook. Moody's in February downgraded all ratings for Petrobras as well as ratings based on Petrobras' guarantee to B3 from Ba3.

The impact of the financial pressures on Petrobras operations and capital spending are obviously being felt. In March Petrobras announced plans to lay off 12,000 staff – a 15% personnel reduction. Reports are circulating that the (already downsized) plan to invest \$93 billion in capital projects over the next five years looks about to be cut to \$80 billion. The Brazilian government is dealing with many problems and is increasing unable to provide financial backup to Petrobras. The Brazilian economy is deteriorating at an alarming rate – with GDP falling 3.8% in 2015, expectations of a similar decline this year and unemployment nearing 10%.

One piece of good news is the deal Petrobras has negotiated with China to access financing. In late February Petrobras signed a term sheet with China Development Bank to access loans up to \$10 billion in exchange for supplying oil to Chinese companies. But this news is overwhelmed by bad news that seems to flow daily about the company – and the Brazilian economy.

The impact of this implosion on the floating production sector has been huge. Petrobras is the biggest player in the sector. It has more than 50 floating production units (mostly FPSOs) at various stages of planning. No other operator comes close to this projected procurement level.

At the moment it appears that the Petrobras situation is not going to be resolved anytime soon. The political situation in

Brazil is deteriorating and no one seems to be able to bring closure to the corruption investigation. Resolution could extend into 2017 – maybe later. Meanwhile Petrobras will be a weakened player and its ability to invest in new production floaters will be severely constrained.

4. FLNG Contracts Impacted by the LNG Glut

The FLNG market is looking a bit weak as a result of the LNG supply glut that has developed over the past year. Two FLNGs under construction have hit obstacles. One unit, the almost completed Exmar Caribbean LNG barge, is without a field as a result of the field operator's decision to terminate the LNG project in Colombia. The other unit, PFLNG Dua under construction in Korea, has been "re-phased" by Petronas to curtail capital expenditures – and construction will likely be suspended once the hull is finished.

Several planned FLNG projects have also run into barriers. In March 2016 Woodside decided to shelve its plan to use an FLNG to produce the Browse gas complex offshore Australia – saying market conditions did not warrant the investment decision. In the same month the Indonesian government rejected Inpex' plan to use an FLNG on the Abadi field – saying a land based LNG plant is required.

Earlier, in mid-Feb 2016 Hoegh announced it was terminating its FLNG projects -- and took a \$37 million impairment charge against its FLNG assets. Hoegh joins Excelerate in exiting the FLNG sector. Excelerate in Sept 2015 decided to cancel its planned project to create an FLNG terminal in Texas, saying the project is not viable under current market conditions.

5. FSRU Contracts Have Been the Bright Light

FSRU contracts have been the bright light in the floating production sector. Five contracts or term sheets for floating regas units have been signed over the past year. However, some pending contracts for FSRUs are proving hard to tie down. The price of LNG has fallen significantly – which should provide incentive to switch to natural gas and generate requirements for regasification terminals. But the price of fuel oil has fallen as well – reducing budget pressure on power plant managers to switch to cheaper fuels.

Then there is the difficulty of financing FSRU projects. An FSRU moored offshore can require \$500+ million investment in infrastructure. This can be hard to finance. Unlike FPSO and other oil/gas export projects, an FSRU feeds gas to a local off-taker. The ability to finance such deals is limited by the creditability of the off-taker and the willingness/capability of the government to provide a sovereign guarantee.

Overall, we see the FSRU market continuing to be strong – but given the financial barriers to these projects, closing deals will require patience and financial creativity.

6. Forecast of Production Floater Orders

Looking forward, 242 floating production projects are in

various stages of planning. Of these projects, 59% likely involve an FPSO, 10% another type of oil/gas production floater, 24% a liquefaction/regasification floater and 7% a storage/offloading floater. 44% of the projects are at stage of planning where a production/storage system contract is possible within the next five years – provided the underlying markets drivers support the investment decision.

But obviously the underlying drivers need to improve before investment activity rebounds and planned projects turn into orders for floating production systems. Until there is improvement in oil prices, field operators will be reluctant to invest in new production equipment. In late March we examined the projects in the planning stage to identify those likely to reach an investment decision over the next five years – assuming underlying drivers improve. Of the 242 projects in the planning pipeline, we see 107 of these projects reaching the investment decision by end 2020. Based on our analysis, we see near to mid-term projects in the planning stage potentially generating contracts for 82 production floaters between 2016/20. The forecast includes 46 FPSOs, 11 oil/gas FPU's, 4 FLNGs and 21 FSRUs. We also expect orders for around 25 FSOs.

In making this forecast, we have assumed that the price of oil will remain in the \$40 to \$50 range through 2016 – then

climb to the \$50 to \$60 range in 2017/18 and to \$60 to \$70 in 2019/20. We have also assumed Petrobras' problems will continue through 2017 – limiting the company's capability to finance new projects. But from 2018 onward Petrobras will be fully back in the market and/or the operating rights to some pre-salt blocks offshore Brazil now managed by Petrobras will be contracted to international players.

Further, we have assumed there will be significant (20 to 30%) cost reductions in the deepwater supply chain as competition for available contracts tightens, local content requirements ease and operators negotiate more favorable revenue sharing arrangement with resource owners. The result will be to lower the breakeven price of new deepwater projects.

A list of 19 projects we see potentially producing orders for production or storage floaters over the next 18 months is provided in the accompanying table. Details for these near term projects – as well as details for 88 other projects in the planning stage that have potential to produce EPC contracts over the next 18 to 60 months -- are provided in the March 2016 WER Floating Production Report. We indicate in the report when the EPC contract is likely to be awarded with the next five years – within the next 18 months, 18 to 36 months or three to five years out.

Potential Production Floater Contracts Over the Next 18 Months

Planned Project	Type Unit	Field Operator	Country	Region
Sepia	FPSO	Petrobras	Brazil	BRAZ
Jasmine	FPSO	Mubadala	Thailand	SEA
Libra Pilot	FPSO	Petrobras	Brazil	BRAZ
Ca Rong Do	FPSO	Repsol	Vietnam	SEA
Liuhua	FPSO	CNOOC	China	CHINA
Rosebank	FPSO	Chevron	UK	NE
Madura MDA/MBH	FPSO	CNOOC/Husky	Indonesia	SEA
Penguins	FPSO	Shell	UK	NE
Mad Dog 2	SEMI	BP	USA	GOM
Opti #3	SEMI	LLOG	US	GOM
Liuhua 11-1	TLP	CNOOC	China	CHINA
Liuhua 16-2	TLP	CNOOC	China	CHINA
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Sergipe regas terminal	FSRU	GPE Sergipe	Brazil	BRAZ
Ghana Regas Terminal	FSRU	VRA/GNPC	Ghana	AFRICA
Port Qasim Regas Terminal #2	FSRU	Gov't of Pakistan	Pakistan	SWA/ME
Abu Dhabi Regas Terminal	FSRU	ADNOC	UAE	SWA/ME
Block B8/32	FSO	Chevron	Thailand	SEA

Decommissioning Market to Boom to 2040

Subsea Well Removal is a Leading Cost Driver

Ben Wilby, Analyst, Douglas-Westwood

North Sea decommissioning has long been considered an area of huge potential opportunity for a variety of companies, which to date has not been fully realized. Decommissioning has moved extraordinarily slowly – there have been limited removals within the region as platform operators have preferred to pay steady maintenance & operations costs each year, rather than the substantial amounts required for decommissioning work. Nevertheless, times are changing.

Typically, producing fields are less affected by fluctuations in oil prices than those at the pre-sanctioning stage; however, the long-term nature of the current oil price collapse has forced operators to consider revising their standard operating model in favour of decommissioning. Many North Sea platforms are late in life – far past their initial production expectations – and are only producing through utilising costly life extension practices. As a result, high oil prices are required just to break even on these fields. This was not an issue at \$100 oil, but

it has become a growing problem with prices dipping below \$30. Recent growth to ~\$40, while positive, is unlikely to stop major decommissioning work.

A rapid recovery in oil price is not expected, with many forecasting Brent to remain under \$100 per barrel in 2020. When field operators take the age of many North Sea assets into consideration, it becomes clear that it does not make financial sense to keep running them. Consequently, Douglas-Westwood (DW) expects a spate of abandonments by the end of the decade, with decommissioning concept selection starting at this time as well. The North Sea is an extremely mature region; large scale oil & gas production started in the 1960's and many platforms installed at this time are still in the water, with a number still producing. The high level of initial installations has led to substantial numbers of assets that are of a significant age – maintenance costs of these are high and tend to rise year-on-year (though the oil price collapse has stymied this somewhat). This will be of major concern for operators



Prospects for a buoyant rig decommissioning has inspired innovative new ship designs. Vessels such as the Pioneering Spirit, a Single Lift Vessel (SLV), effectively alter market dynamics.

(Photo Allseas)

who have seen their budgets slashed repeatedly over the last 18 months, resulting in a tightening of their available operating expenditures.

The Impact of Single Lift Vessels

In DW's North Sea Decommissioning Market Forecast 2016-2040, which covers Denmark, Germany, Norway and the UK, decommissioning expenditure has been split into two different scenarios. In Scenario 1 (S1) DW assumes that all decommissioning will be completed using currently available methods, with most removals utilizing the reverse installation method. In Scenario 2 (S2) DW includes the potential impact that Single Lift Vessels (SLVs), such as the Pioneering Spirit could have on the market.

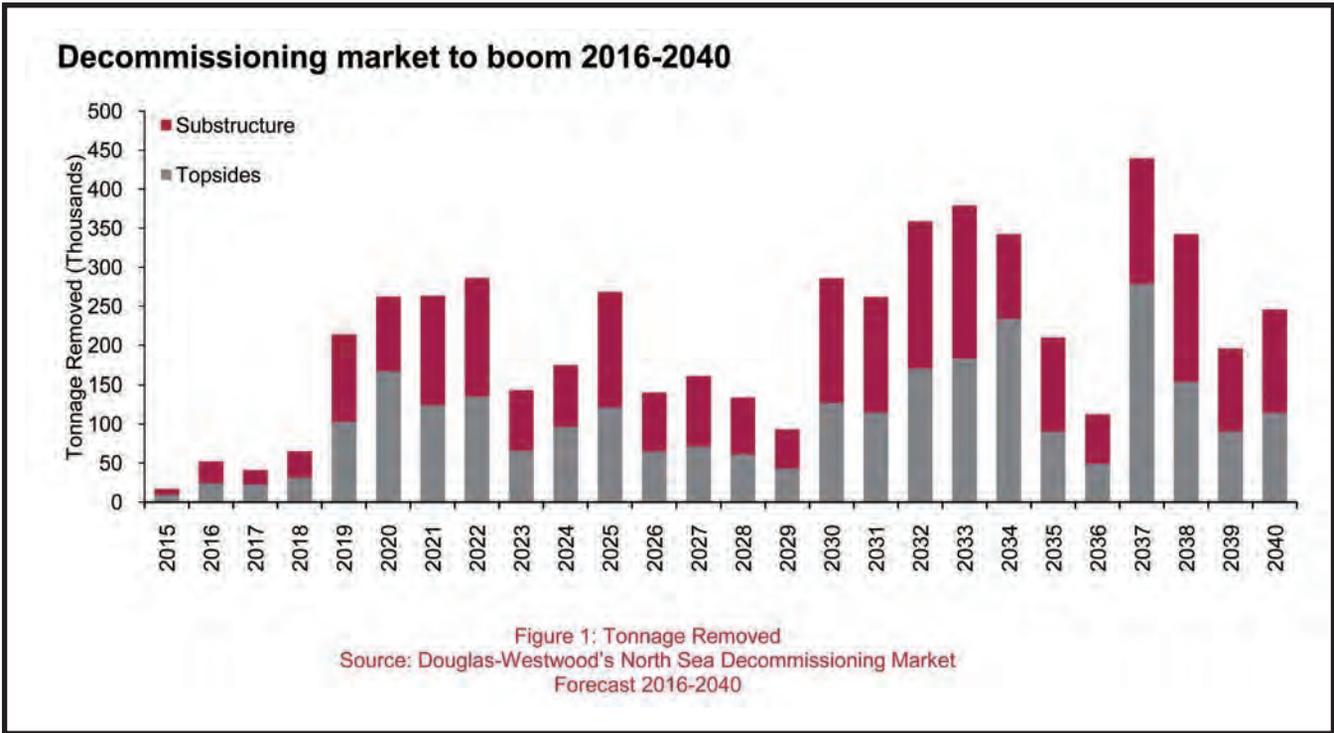
The difference to overall spend is clear. In S1 DW anticipates a total decommissioning cost for the four countries of \$82 billion 2016-2040, but this decreases to \$70B in S2. This is due to the fact that much less time will be required at the

field itself, bringing down the costs of hiring vessels which are one of the main drivers of spend. In addition, the harsh weather conditions typical in the North Sea mean that decommissioning work for a field could see long delays when conditions are unfavourable – bringing the cost up significantly. With SLVs the actual lifting work can be completed quickly, reducing this issue substantially.

It should be noted however, that S2 will only become a reality if early jobs by the Pioneering Spirit are completed successfully, the day rate is competitive, and operators, who have often been unwilling to try new techniques, fully embrace the SLV concept. If there is the demand from operators, DW anticipates that the SLV fleet size will begin to grow as additional vessel companies compete.

Well P&A and Removal to Represent over 50% of Expenditure

The North Sea has had a large number of well installations,



both surface and subsea, since first production in the 1960's. DW forecasts that over 50% of these will need to be removed over the forecast period, with costs being over 50% of the total spend in both scenarios as well. This will be primarily driven by subsea trees in Norway and the UK, with the costs of subsea well plugging, abandonment and removal being far higher than for surface wells. This is a result of the need to utilise vessels to work on subsea wells, which massively increases costs compared to surface well work. Well work is a fairly niche area, with a limited number of companies in the market which makes this a potential area for bottlenecks and high costs.

Outside of well abandonment the cost for essential decommissioning works varies between the two scenarios. Removal of the topside and substructure will account for a huge amount of expenditure in S1 (26%) but only 10% of the total in S2. This demonstrates how cost savings can be made by utilising SLVs, which can complete the removal of the heaviest platforms with one lift rather than via reverse installation methods. Deconstruction work onshore will cost 38% more in S2, compared to S1. This is because the topside is delivered in one large piece, meaning that more of the topside deconstruction work is completed onshore than in S1 where modules are often removed one at a time. In theory, despite higher onshore

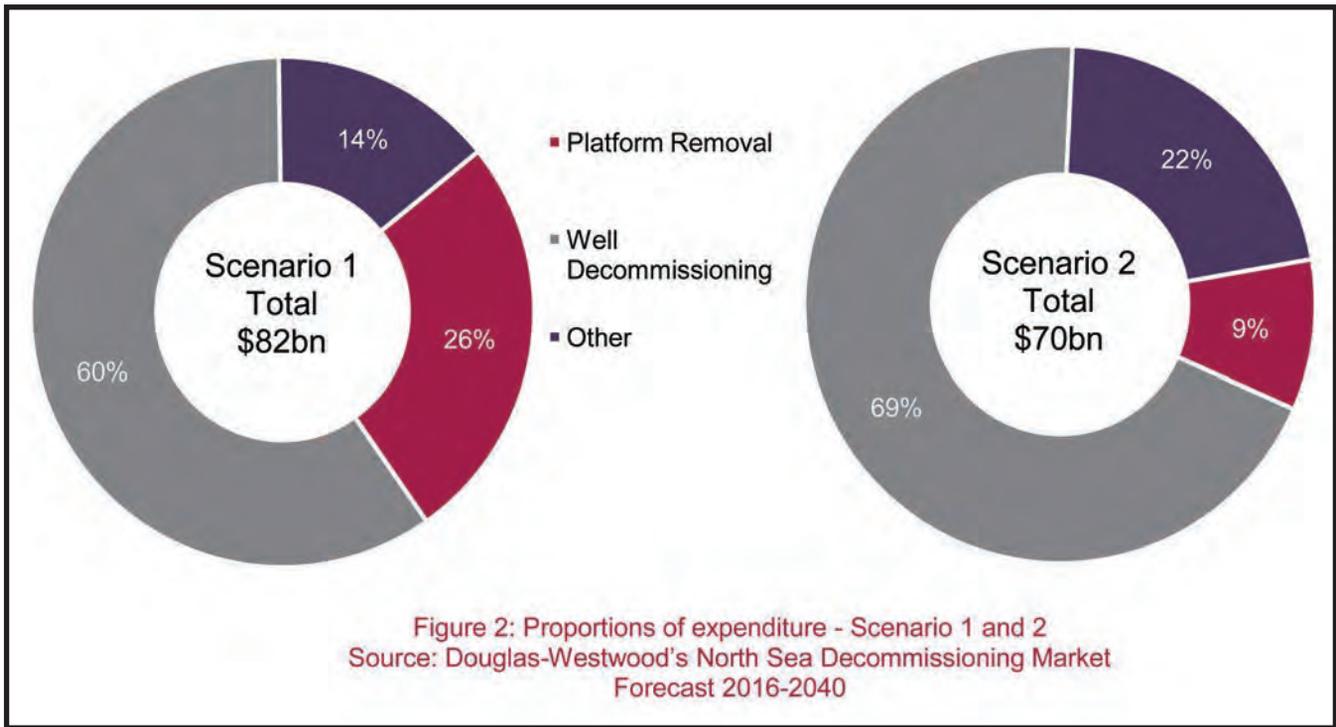
deconstruction costs the benefits of SLV use far outweigh the negatives as this method will be less time consuming, cheaper overall and, crucially for operators, safer.

UK to Dominate Spend

The UK has high levels of installed infrastructure (more than the other countries in the report combined) and also has an extremely mature basin. As a result of this the UK will dominate removals which will also lead to the highest spend – well over half of the amount of all countries in the report.

In total, DW anticipates removal of 285 platforms and over 4,000 wells in the UK over 2016-2040, leading to expenditure of \$50B in S1 and \$44B in S2. Consequently, the UK represents over 50% of spend over the forecast period in both scenarios. Large-scale decommissioning work is also expected to start earlier in the UK than in other countries and DW forecasts that 146 platform removals will take place 2019-2026 – 51% of all removals in the UK over the forecast. Due to this, the country should be an area of focus for companies looking to capitalise on the need to remove infrastructure. Those companies that obtain a strong reputation in the UK will benefit when countries such as Norway require high levels of decommissioning in later years.

Norway will see the second highest spend which will be



concentrated at the end of the forecast period, with the country being less mature than the UK. As a result it will account for 32% of all spend over the forecast with 79% of this coming in the last ten years. However, as a direct result of the low oil price there have been a number of Norwegian projects that have already been shut in early or are scheduled to be abandoned in the next year. This includes Det Norske's Jette field which is shutting down production after only three years and ExxonMobil's Jotun field which has both a fixed platform and FPSO.

Though it has a much smaller offshore industry, it is important to consider the impact Denmark will have on the forecast. Due to its smaller size decommissioning will peak in two different periods, with no decommissioning activity expected outside of these peaks. The first will be the removal of the Dan and Halfdan hubs; while in the mid-2030's DW expects to see decommissioning work start on the Siri and Gorm hubs.

Summary

Overall, the ramping up of the decommissioning industry represents a terrific opportunity for specialist companies tasked with removing the large tonnage installed in the North Sea over the last 50 years. Companies that can operate safely, efficiently and establish strong, competitive reputations will be in an excellent position to capitalise.

For platform operators responsible for undertaking decommissioning work, the current downturn represents a chance to be rid of operating assets that were only commercial at high oil prices, as well as abandoned platforms that are current liabilities, requiring extensive maintenance work for no material return. However, there will be huge costs involved to remove these assets, causing problems for many companies in the short-term.

The Pioneering Spirit and other SLVs point towards a new way of operating that could potentially be quicker, cheaper and reduce risk. The proof, however, will be in the success of early jobs completed by the Pioneering Spirit – if both the Yme and Brent removals are completed with little incident and day rates are competitive, SLVs will be an ideal solution for removing the largest platforms in the North Sea.

The Report

Douglas-Westwood's North Sea Decommissioning Market Forecast 2016-2040 considers the potential market for decommissioning in Denmark, Germany, Norway and the UK. It features details on the number of platforms and wells to be removed, the weight of these removals and the cost, which is split into the various components that impact it.

<http://www.douglas-westwood.com/report/oil-and-gas/north-sea-decommissioning-market-forecast-2016-2040/>



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The Chase for \$2m Prize (& much, much more!)



Nine teams (plus two alternates) are the finalists vying for the \$2 million purse in the U.S. Department of Energy (DOE) Wave Energy Prize. Last month MTR spoke with Alison LaBonte, Marine and Hydrokinetic Technology Program Manager in the U.S. Department of Energy's (DOE) Wind and Water Power Technologies, for her take on the program and the technological development it engenders.

By Greg Trauthwein

In a contest designed to fast-track development of Wave Energy technology, the least mature of all renewable energy technologies, the U.S. Department of Energy put its money where its mouth was, conducting a 20-month contest dangling a \$2 million prize for the innovator who could best devise a technology to maximize energy capture from waves

“When I came onboard with the Department of Energy four years ago, I saw that (wave power) was a technology that was the youngest (of the renewable energy types),” said LaBonte, who said that today wave energy is where wind energy was 20 years ago.

The purpose of the Wave Energy Prize is to provide an “Apples to Apples” competition, working to identify the most promising technologies and configurations to maximize wave energy capture cost-effectively.

Teams must meet or beat the ACE threshold, (ACE being a benefit-to-cost ratio), which was selected by the Wave Energy Prize as a metric appropriate for comparing low Technology Readiness Level Wave Energy Capture (WEC) concepts when there is not enough data to calculate the levelized cost of energy—itsself a cost-to-benefit ratio—from a device. ACE is determined by dividing, in essence, the wave energy extraction efficiency of a WEC by its structural cost. Finalists were determined based on their potential to achieve the doubling of the current state-of-the-art ACE value of 1.5 meters per million dollars (m/\$M) to 3 m/\$M during 1/20th scale tank testing at the MASK Basin, making them eligible to win the grand prize.

From the Beginning

Early on the contest was simply a test to see if it could draw a large enough number of quality contestants from diverse technological backgrounds to make the competition compelling, said LaBonte. “We drew 92 registrants, and 66 complet-

ed their technical submissions, which allowed us a great pool to down select to the 20 qualified teams to move forward to the small scale tank testing. From those 20 teams, 17 teams completed through all of the steps (numerical modeling, 1/50th size prototype, running in a test tank, etc.). “Then we selected from there the nine finalist teams and two alternates, each which has shown that they have the potential to exceed our minimum bar of doubling energy capture,” said LaBonte.

Registration started in April 2015, and the winner will be crowned November 16, 2016. “This is an enormous amount of effort in a short time,” LaBonte summarized.

Open Source Information

While the \$2 million in prize money is the tangible driver for the teams, the U.S. Department of Energy – and in fact the world of renewable energy stakeholders – are set to benefit handsomely from the contest.

“Most notably (the competition was critical in) attracting the new expertise from a diverse set of industries that can be leveraged toward wave energy,” said LaBonte. “We’re also drawing an audience from investors, and from the public. Finally, we’re driving the entire sectors understanding of the key attributes and metric by which to measure these devices, so when any agency, any investor, any country is looking to quickly accelerate wave energy projects in their domain they are able to leverage this open source of the data and metrics.”

These are interesting times for renewable energy, as even with oil and gas prices in the doldrums for nearly two years, “the technology that came online with the most new generation capacity was wind energy technology, so we’re still seeing steady growth in the renewable energy sector,” said LaBonte.

While the development of technology is one link, the incorporation of the tech into real-world use is another. “We are investing to meet near term goals of deployment in early

adopter markets that have alternative use for wave energy conversion, such as a Navy base or community with high cost of electricity, communities that realize that they should invest in technologies today to start realizing those early adopter markets,” said LaBonte. “In parallel we have to look at the big picture in terms of where we have to get to reach utility scale electricity generation, and bring cost-competitive solutions to those markets.”

In fact, she contends that it is the role of the innovators to help shape the markets: “Their role is to change the equation for what’s driving the markets. If they are able to innovate to a degree where their costs turn around and open up a new market, where their devices or their technology is now competitive, the market will be there,” said LaBonte.

The Finalists

DOE said that nine teams have been named finalists in the Wave Energy Prize. The nine finalists and two alternates, identified from the 17 remaining official qualified teams, will continue their quest to double the energy captured from ocean waves and win a prize purse totaling more than \$2 million. Each of the finalists and alternates will now receive seed funding from DOE to develop 1/20th scale models of their wave energy converter (WEC) technologies. These models will be

tested at the nation’s most advanced wave-making facility, the Naval Surface Warfare Center’s Maneuvering and Seakeeping (MASK) Basin at Carderock, Md., beginning in the summer of 2016.

Official finalist teams are:

- AquaHarmonics (Portland, Ore.)
- CalWave (Berkeley, Calif.)
- M3 Wave (Salem, Ore.)
- Oscilla Power (Seattle, Wash.)
- RTI Wave Power (York, Maine)
- Sea Potential (Bristol, R.I.)
- SEWEC (Redwood City, Calif.)
- Wavefront Power (Team FLAPPER) (Research Triangle Park, N.C.)
- Waveswing America (Sacramento, Calif.)

Alternate teams are:

- McNatt Ocean Energy (Annapolis, Md.)
- Wave Energy Conversion Corporation of America (WECCA) (North Bethesda, Md.)

www.waveenergyprize.org

Alison LaBonte, DOE

Alison LaBonte is the Marine and Hydrokinetic Technology Program Manager in the U.S. Department of Energy’s (DOE) Wind and Water Power Technologies Oce. As the Program Manager, Alison is responsible for the development and execution of the nation’s strategy for advancing marine renewable technologies to be viable, cost-competitive contributors to the clean energy economy.



Alison came to Washington, D.C. in 2009 as an American Association for the Advancement of Science (AAAS) fellow, and spent her fellowship term at the White House Office of Science and Technology Policy and the DOE Geothermal Technologies Program.

Before her AAAS fellowship, Alison applied her technical expertise integrating scientific instrumentation with Canada’s NEPTUNE offshore cabled observatory (Postdoctoral Fellowship: University of Victoria), and designing, prototyping, and deploying new seafloor sensors (Engineering internship: Monterey Bay Aquarium Research Institute).

Alison’s degrees are in Oceanography (PhD: Scripps Institution of Oceanography), and Mathematics (BS: University of California, Los Angeles).

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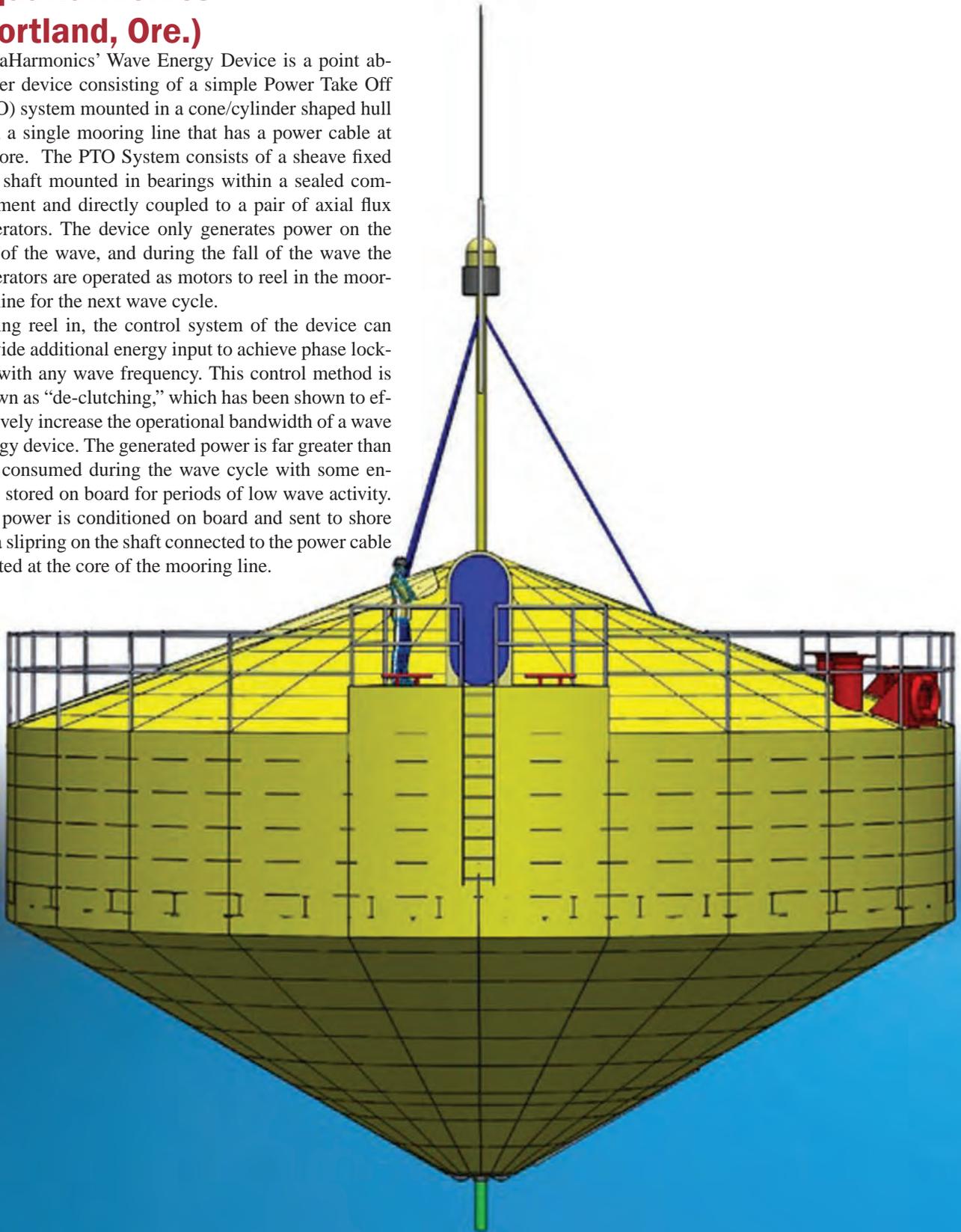
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AquaHarmonics (Portland, Ore.)

AquaHarmonics' Wave Energy Device is a point absorber device consisting of a simple Power Take Off (PTO) system mounted in a cone/cylinder shaped hull with a single mooring line that has a power cable at its core. The PTO System consists of a sheave fixed to a shaft mounted in bearings within a sealed compartment and directly coupled to a pair of axial flux generators. The device only generates power on the rise of the wave, and during the fall of the wave the generators are operated as motors to reel in the mooring line for the next wave cycle.

During reel in, the control system of the device can provide additional energy input to achieve phase locking with any wave frequency. This control method is known as "de-clutching," which has been shown to effectively increase the operational bandwidth of a wave energy device. The generated power is far greater than that consumed during the wave cycle with some energy stored on board for periods of low wave activity. The power is conditioned on board and sent to shore via a slipring on the shaft connected to the power cable located at the core of the mooring line.





CalWave (Berkeley, Calif.)

CalWave provides a solution to harness the renewable power of ocean waves to produce electricity and freshwater. The device is a novel Wave Energy Converter (WEC) called the WaveCarpet that is simple and scalable. The approach was inspired by the ability of a muddy seafloor to effectively absorb over passing ocean waves within only a few wavelengths. The unique converter design uses a synthetic-seabed-carpet that has the ability to extract wave energy the same way. The technology is based on research conducted at the Massachusetts Institute of Technology (MIT) and the University of Califor-

nia, Berkeley. The Wave Carpet operates submerged, allowing it to survive stormy seas while causing no visual pollution or posing any collision danger. The WaveCarpet has the advantage of being:

- 1) Survivable:** Due to the fact that the carpet is fully submerged, it is able to survive the strong momentum of stormy seas.
- 2) Passive:** The device poses no visual pollution to the ocean surface and no collision danger to boats and sea life.
- 3) Simple:** High, broadband and omnidirectional absorption efficiency of ocean waves.
- 4) Scalable:** The modular design allows the device to scale in width for setting a desired output power capacity.

Waveswing America (Sacramento, Calif.)

The Archimedes Waveswing is a submerged point-absorber wave energy converter which uses the change in pressure caused by passing waves to expand and contract a large piston. The piston houses a linear generator which converts the relative motion of the two parts directly into electricity. The unique operating principle of the device provides a gearing effect resulting in amplification of the effective wave height, thus producing a highly effective point absorber. The device is tension-tethered to the sea bed anchor via a structural leg which also carries a flexible power cable for export of electricity ashore.

The device was originally invented by Fred Gardner in Holland in 1994 and a previous variant was tested offshore Portugal at large scale. The recent innovations have enabled down-scaling of the device, thus improving the energy yield per unit volume and hence reducing the cost of power produced. Initial systems will be rated at 50kW and designed to meet power needs in isolated situations and island communities where the cost of alternatives is high. The technology is expected to progress to utility scale as learning is gathered through early deployments. The current design although novel, is based on many years of experience.





Wavefront Power (Team FLAPPER) (Floating Lever and Piston Power Extractor) (Research Triangle Park, N.C.)

Wavefront Power's Very Large Flapper Array (VLFA) is being developed for utility-scale power production from deepwater ocean swell waves.

The design will introduce a number of innovative, patent-pending technologies that will enable for the first time the economic capture of deepwater wave power.

Operating at depths up to 100 meters, the device is expected to be rated at approximately 5 MW with a capacity factor of 48% based on an annualized average wave density of 30 kW per meter.

The VLFA generally falls into the oscillating wave surge converter category of wave energy collection devices. While intellectual property concerns prevent us from disclosing many of the VLFA's internal mechanisms, general operation is characterized by a conversion of the kinetic energy of wave swells

into electrical energy through a power conversion chain including a hydraulic

power take-off, hydraulic motor and electrical alternator.

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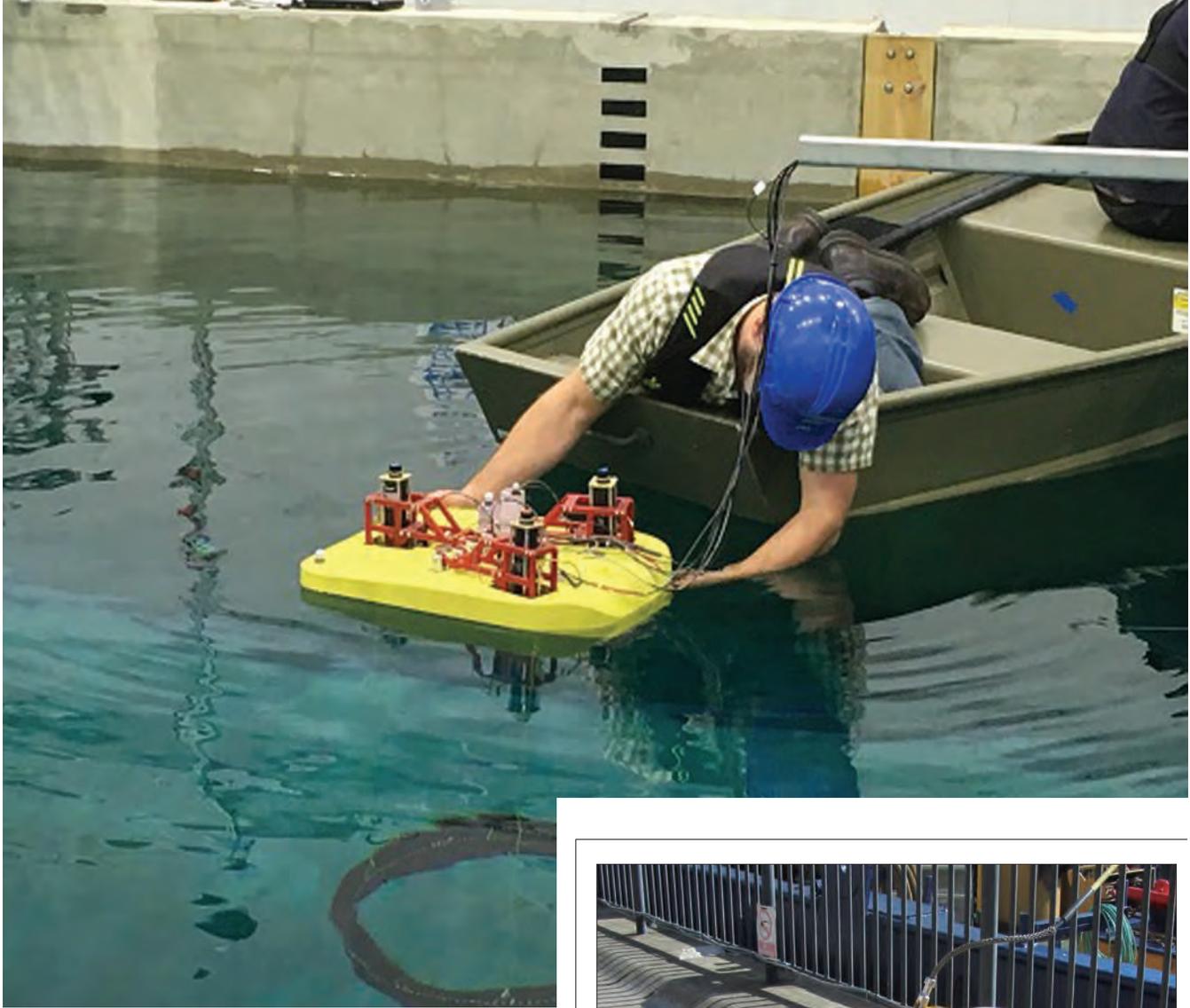
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M3 Wave (Salem, Ore.)

M3 Wave's entry into the Wave Energy Prize competition is NEXUS, a mid-column variant of its venerable DMP/APEX submerged pressure differential technology. The system harnesses the pressure wave under ocean swell while stationed above the ocean floor but still safely under the surface, protected from surface hazards. All power, electrical, and mechanical systems are inside protected dry chambers – there are no exposed mechanical joints or sliding seals.

NEXUS turns the pressure fluctuations under ocean waves into alternating expansion and compression cycles of air inside an enclosed pipe. Power is harnessed with a bi-directional air turbine. M3 Wave proved the viability of the underlying conversion technology during pilot testing of their APEX variant in 2014 off the coast of Oregon. NEXUS is positioned higher up the water column, dramatically increasing device power output while preserving the robustness and deployability aspects of APEX.





Oscilla Power (Seattle, Wash.)

Oscilla Power's Triton wave energy converter is a two-body point absorber, consisting of a large surface float connected by flexible tethers to a submerged heave plate. As ocean waves excite the surface float, it reacts against the heave plate, generating tension changes in the tethers. These tension changes are applied to a linear drivetrain, consisting of a hydrostatic load amplification system and a variable reluctance generator that translates the low displacement, high force mechanical energy input into electrical energy in a simple, highly reliable manner that is unachievable in the ocean environment with conventional generators. Triton's advantages over conventional point absorbers include greater energy production, lower capital costs and lower maintenance costs.



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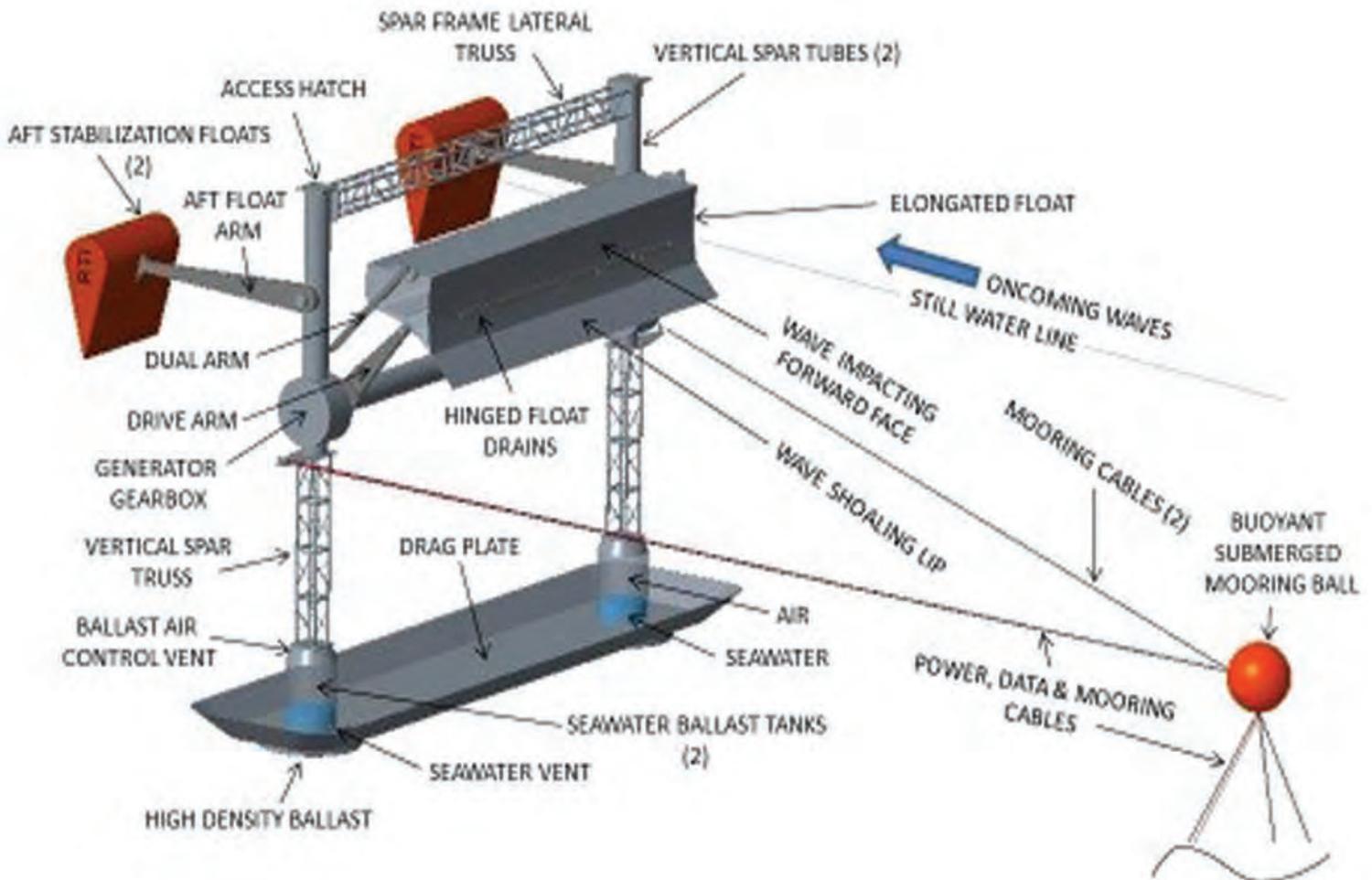
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info@dwtek.com.tw
dwtekmarine.com

RTI Wave Power (York, Maine)

The RTI F2/F2D Wave Energy Converter (WEC) development objective is the lowest Capital Cost per Megawatt of output combined with secure survivability in severe seas. WECs must weigh less to cost less. Intercepting maximum energy containing wave front per unit WEC vessel volume, which like ship volume, determines WEC weight and cost. This is only realizable with WECs utilizing single or adjacent multiple Elongated Wave Front Parallel (EWFP) floats. To concurrently capture a majority of both heave and surge

energy the RTI F2/F2D utilizes elongated swing arms to attach its EWFP float directly to a generator in its motion stabilized floating twin vertical spar frame which constrains the float to move concurrently upward (for heave capture) and rearward (for surge capture) on wave crests and return forward and downward on subsequent wave troughs. The F2/F2D WEC utilizes RTI's floodable and submergible floats and seawater ballasted frame to place its EWFP float safely below severe sea wave troughs. The RTI F2/F2D is covered under US Patents 9,127,640, 8,614,520, U.S. Published Application 2015/0082785 and pending U.S. and International Applications.

RTI F2D



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Sea Potential (Bristol, R.I.)

The DUO wave energy converter is a new design concept that simultaneously captures power from both the heave and the pitch/surge motions induced by wave action. The additional modes of power capture have the potential for increased efficiency in terms of energy capture per unit cost compared to devices operating in a single mode or single direction. The DUO's patented configuration, which connects oscillating bodies with angled pre-tensioned cable linkages and a Power Take Off system, enables power capture from pitch motions to be exploited simultaneously with heave motions. The DUO's primary power absorption is achieved by damping the relative heave and rotational motions of the oscillating structures. This produces a significant increase in power capture (and energy production) compared to devices that capture power from a single mode of motion. The increased power capture and the associated engineering innovations can produce major reductions to the costs of generating electricity from wave energy resources.



SEWEC (Redwood City, Calif.)

SEWEC is an oscillating water column (OWC) wave energy converter – a device that operates in a similar fashion to the most successful shore based wave energy converters, such as the Limpet (https://en.wikipedia.org/wiki/Islay_LIMPET). The difference is that SEWEC is free-floating and specially adapted to withstand the more challenging offshore, deep water environment where available energy levels are higher and more widespread than those available nearshore. The SEWEC device extends the proven OWC concept, enabling devices to be moored offshore in a much wider range of locations than conventional shore-based devices. Unlike shore-based OWC's, only minimal site work is required to set up a SEWEC wave energy farm – the devices are simply towed out to their moorings.

The Wave Energy Prize targets offshore wave energy capture and uses conversion efficiency and capital cost as key metrics to compare the competing entries. SEWEC scores well on both counts – its simplicity and robustness result in low capital costs and the highly efficient OWC principle delivers great conversion efficiency.

Only large-scale deployment of low-cost, robust and efficient devices can fully exploit the huge and as yet largely untapped renewable energy resource surging in the world's oceans. So Team SEWEC is eagerly participating in the WEP competition – a great way to identify the really serious contenders.



McNatt Ocean Energy (MOE) (Annapolis, Md.)

The MOE wave energy converter (WEC) is a hinged raft. Wave forcing and the bodies' dynamic responses leads to a motion about the hinge (called flex), which drives a power take-off mechanism that converts the kinetic energy into electricity. It has seven degrees of freedom.

The innovation of the MOE WEC is in the design of the shapes of the bodies, which dramatically improves its dynamics and thus power absorption. The configurations are based around varying the ratio and position of the water-plane area to the submerged volume, where the water-plane area affects the hydrostatic restoring force and the volume affects the mass and added mass. By changing these values one can induce coupling between the modes and tune the resonant response to improve performance in wavelengths that are significantly longer than the overall length of the machine.

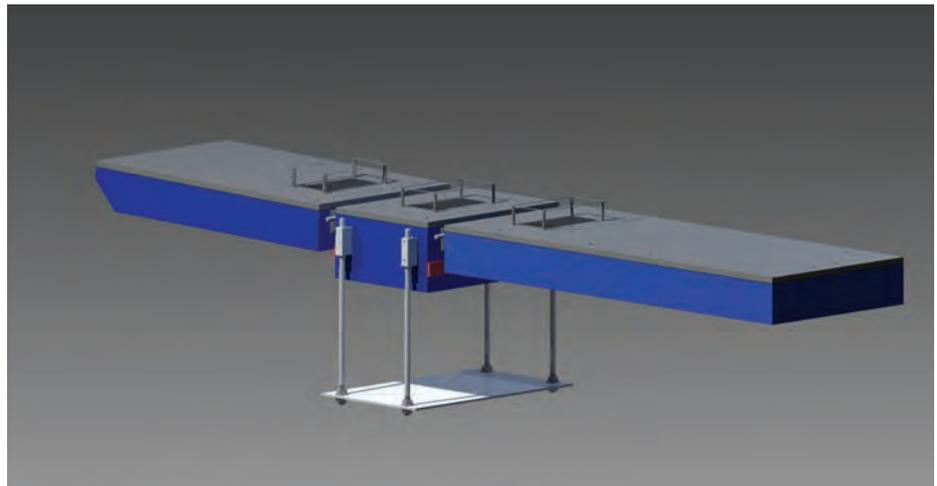
Consequently, although the power take-off is solely in flex around the hinge, there is extensive cross-coupling with other degrees of freedom, and when excited by wave action the device responds not only in flex but substantially in heave and



also pitch and surge. This results in greater cancellation of the incoming wave and a broader bandwidth response than a standard hinged raft.

Wave Energy Conversion Corp. of America (WECCA) (North Bethesda, Md.)

Wave Energy Conversion Corporation of America (WECCA) has developed its patent-pending Advanced Wave Energy Conversion System (AWECS), which physically presents as three articulating barges, securely anchored offshore, which survived nine years of WEC platform concept testing off the west coast of Ireland. The fore and aft barges are propelled by continuous, undulating, emission free, ocean waves



surrounding the world's continents. Power Take Off devices are connected at leveraged hinge points to the center barge via robust hinges. The relative motions of the fore and aft barges, compared to the "weight dampened center barge", provide opportunity to cost effectively capture and transform ocean wave energy into electricity. AWECS electricity is then "conditioned" for local grid requirements. The AWECS is constructed from lightweight, durable composite material providing strength, maintenance advantages

and long term environmental cost benefits to operators and consumers. Designed to constantly sense and dynamically tune its physical characteristics, the system is able to extract the maximum energy through resonance relative to changing wave climates. When hazardous storm conditions are sensed, the AWECS is designed to submerge and hover at safe depths, until storm conditions subside, then surface again to generate electricity.

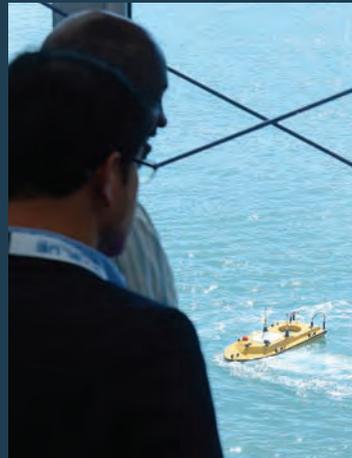
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Soft Solutions for Hard Problems

By Alexander MacLeod, Project Services Manager, Cambla

As uncertainty around the fluctuating oil price remains, the industry must continue to evolve. It is more important now than ever that companies search for effective and innovative methods to streamline their processes, in order to adapt to the challenging climate. For those willing to develop technological advancements to meet the needs of the industry, there is still an abundance of opportunities available. Alexander MacLeod, Project Services Manager at independent project services consultancy, Cambla, discusses how the company has developed a cost effective and efficient solution to subsea planning challenges.

Challenging Industry Climates

There is no doubt that 2015 was one of the most challenging years the oil and gas industry has faced. As the drastic drop in the price of oil continues to affect companies across the globe, many businesses are looking at new ways to diversify and thrive during this difficult time. The development of new innovation and technology remains key for significant improvements in the industry moving forward.

At Cambla, we were quick to recognize that the fluctuating oil price has driven major oil operators to undertake more complex projects with the aim of boosting production to replace aging fields. These companies can no longer afford to risk any project oversights or delays and vessel operators are now under immense pressure to identify occasions where their fleet is not being utilized to its full potential.

Declining production in mature, shallow water basins has also led to an increase in subsea operations and resulted in operators deploying extra vessels to support more complicated field developments.

This has resulted in a significant rise in the number of vessels operating offshore, increasing the risk of multiple vessels arriving at the same location at the same time. If only one vessel can operate, the other would be delayed before commencing operations, or would be required to leave the field

and return to port. Vessel operation costs are extremely high, ranging from £50,000 to £250,000 per day. Disruptions or delay to the planned schedule can result in a huge loss in production and significant costs for the operator.

In response to these challenges, Cambla developed state-of-the-art software to improve the accuracy and efficiency of planning subsea and marine operations. The Schedule Animation Tool (S.A.T.) is a multi-user application that provides an accurate visual representation of a vessel's location and planned activities, making it easier for operators to understand Simultaneous Operations (SIMOPs), construction sequences and plan integrated operations across the globe.

We recognize that innovative technology is fundamental to sustaining the subsea market during the current downturn, and S.A.T is a particularly useful resource for companies operating a large vessel fleet or planning a complex subsea project, as it offers full fleet management support. The main benefit of using the tool is that it helps to eliminate any conflicts between vessels by showing where each vessel will be for the duration of the project and highlighting any issues. This allows schedules to be optimized so that operations are not interrupted or delayed, resulting in many hours of saved office time and a substantial saving in vessel costs.

The technology is a world-first developed to improve the accuracy of planning subsea operations, and significantly reduces the associated costs, time and safety risks. S.A.T allows project teams to align schedules and choose the most appropriate sequence of activities, ensuring delays and loss of production time are minimized.

Typically, paper-based Gantt chart schedules are used to plan vessel operations. However, this method is laborious and cumbersome, and is quickly becoming outdated and ineffective. S.A.T enables transformational schedule engagement across all project stakeholders by representing the schedule as an accurate animation, and removes the need for time-consuming analysis of paper-based schedules.



The Technology

The software works by taking the client's schedule information from various sources or different formats and converting it into 4D models using Primavera P6 or Microsoft Project as the data repository. It will then identify occasions when vessels are required to be in close proximity to other vessels or installations. This in turn generates a list of relevant SIMOPs or close approach risk assessments required to be carried out in advance. Logistics are tested to understand port utilization and the checking of transit durations.

Operational on desktop and tablet browsers, Cambla can tailor the software to meet client requirements and create bespoke models to suit. The software can be easily and quickly updated when a current vessel schedule becomes available, ensuring the animation is updated on a regular weekly or monthly cycle.

Unlike paper-based schedules, the models can be accessed securely online by the whole project team, eliminating the need to transfer extensive paperwork.

S.A.T. has been designed to be web-based so it can be accessed anywhere, at any time, from any computer. This approach offers multiple-user access, which allows more than one team member to use the software at any one time, ensuring the whole project team is aligned to the same schedule. The information is stored centrally, eliminating the requirement to share files via email and ensuring the same data is displayed across the animation.

Upgrades and Future Development

The software was recently trialed with a major EPC company with the primary objective of gathering initial feedback to allow further improvements. We received a significant amount of valuable and positive feedback, and launched an upgraded version of the software in September 2015, following client demand.

A number of upgrades have been made to the new tool

which offer increased fleet management capabilities, an enhanced data input system, a function to display fixed infrastructures including oil and gas platforms, FPSOs, and wind turbines and a listing of all scheduling issues. The animation models can now also be produced faster, significantly reducing the man-hours required to plan vessel operations.

As part of Cambla's continued development process in 2016, we will be further enhancing the software with additional features. These will include:

- **Additional object types** – This will give the user the ability to add the correct shapes for drill rigs, jack ups and other objects, in order to model their behaviour correctly
- **Sequence checking** – This feature will allow further automatic error checking of the schedule to ensure that activities carried out on various vessels are executed in the correct order
- **Display of project infrastructure** – This will allow the display of pipelines, umbilicals and cables, and their status, on the animation
- **Progress monitoring** – This feature will allow the user to see the progress of each piece of project infrastructure
- **Schedule robustness reports** – This is a new error check that will examine the quality of the schedule when 'what-if' changes are applied
- **Exportable error reports** – This will allow the comprehensive error reports that are already produced to be exported for easier distribution, and to allow necessary modifications to be actioned quickly
- **Revision of the screen layout** – This revision will ensure more efficient use of the screen to allow for maximum information to be displayed
- **Scaling of vessels** – New high zoom levels will provide a true scale animation of vessels and infrastructure, to effectively and thoroughly monitor their statuses
- **Animation legend** – This feature will further enhance the user's ability to identify each vessel and its purpose

Douglas



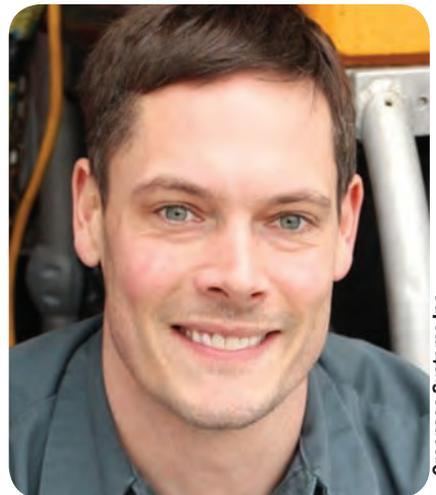
Saab Seaeeye

Grava



Seafloor Systems

LaShelle



Greensea Systems Inc.

Saab Seaeeye Honored by MTS

Saab Seaeeye won the Corporate Excellence Award from the Marine Technology Society. The award is given in recognition of an organization’s contribution to the industry and to ROV technology. Chair of the Marine ROV Committee, Chuck Richards, presented the award at the Underwater Intervention show in New Orleans to James Douglas of Saab Seaeeye. MTS’ Marine ROV Committee promotes the exchange of technical information concerning ROVs, robotics and artificial intelligence across industry, defense, academia and other organizations, on an international basis.

Grava Named VP at Seafloor Systems

Seafloor Systems announced that Josh Grava, former Sales Manager, North America, RESON Teledyne Marine, is joining John Tamplin, President, Seafloor Systems, Inc. in a newly created position, Vice President Sales. Grava will manage U.S. and International sales and rentals for all multibeam hydrographic sonar systems. Grava joined RESON in 1997, straight from University of California Santa Barbara, as sales and marketing assistant. In 2004, he expanded his sales reach within RESON to include the SeaBat Multibeam systems. For the past 12 years with RESON (two

years with Teledyne Marine), Grava has managed and grown SeaBat customer accounts in North America, and established solid customer relations within the Multibeam community.

Greensea Names LaShelle Production Manager

Greensea Systems, Inc. announced that Jason LaShelle joined the firm as Production Manager. LaShelle will plan, coordinate and control manufacturing processes for the company, ensuring a high level of efficiency. LaShelle comes to Greensea from the U.S. Coast Guard, where he was in charge of systems integration and quality assurance. He has a BS in Technical Management from Embry-Riddle Aeronautical University and is currently working on his MS in Operations and Project Management at Southern New Hampshire University. He also holds certifications as a USCG approved 100 Ton Master Captain and a Rescue SCUBA diver.

Jacques Cousteau’s Calypso Shipped for Renovation

Jacques Cousteau’s ship Calypso, star of the “Undersea World of Jacques Cousteau,” was loaded on March 14 in Concarneau, France for shipment to Turkey, where the legendary oceanographic vessel will undergo renovations. From



(Photo: The Cousteau Society)

1951, Calypso sailed the world undertaking scientific explorations until January 8, 1996, when she was involved in a mooring accident and sank. Now raised and once renovated, the Calypso will remain at the service of science and education, as Jacques Cousteau wished.

In order for the latest round of renovations to be performed, a team of specialists from CMA CGM freight forwarding and logistics solutions subsidiary CMA CGM LOG was mobilized to source a customized solution to transport the vessel to the repair yard.

CMA CGM LOG, working closely with CMA CGM teams, selected and chartered a suitable vessel Abis Dusavik, as the 40-meter, 110-ton Calypso had to be loaded on to a vessel large enough to have two cranes with the power to lift her yet small enough to berth in the port of Concarneau.



Photo: Dr. Bill Koski (LGL Limited)

AZFP for Zooplankton research in Pangnirtung Fiord

Sarah Fortune, PhD candidate at the University of British Columbia and guest student at Woods Hole Oceanographic Institution in collaboration with Dr. Steve Ferguson from Fisheries and Oceans Canada and University of Manitoba as well as LGL Limited and VDOS Global LLC, conducted several days of zooplankton backscatter observations in Pangnirtung Fiord with co-located Optical Plankton Counter data. The four-frequency (125, 200, 455 and 769 kHz) AZFP with cage and floatation from ASL's lease pool was shipped to rendezvous with the Arctic equipment. The instrument was deployed in Pangnirtung Fiord in the Canadian territory of Nunavut and floated at the surface off a small locally contracted vessel (Peter's Expediting & Outfitting). Unfortunately, extreme and unusual ice conditions (the presence of thick, multi-year ice) prevented deployment in Cumberland Sound where she conducts most of her PhD research near bowhead whales. Fortune was encouraged by the collected data because it demonstrates the potential to record rapid and fine-scale zooplankton data in a way that she couldn't before. She expects that it will be particularly interesting to compare the OPC and AZFP data. Fortune anticipates conducting field research during the summer of 2016 in Cumberland Sound and she hopes to redeploy the AZFP close to bowhead whales to study their feeding behavior.



(Image: Cammell Laird)

Rendering of the new polar research vessel to be built by Cammell Laird

RRS Boaty McBoatface: Really?

By Eric Haun

RRS Shackleton, RRS Endeavour, RRS Falcon, RRS Fish 'N' Chips and RRS Kanye are just a few of the suggestions submitted in an open campaign to name the U.K.'s next state-of-the-art polar research vessel. But leading the vote is a name that's even more out of the ordinary: RRS Boaty McBoatface.

The U.K.'s Natural Environment Research Council (NERC) last week issued a call for the public to recommend names for the country's new £200 million polar research ship. "We would like the name to be inspirational and about environmental and polar science, to help us tell everyone about the amazing work the ship does," the NERC said in a press release announcing the naming campaign.

Though Boaty McBoatface doesn't come anywhere near fitting those guidelines, it is perfectly apt for another of the NERC's criterion: "We don't want it to be a name we have already used for one of our science ships."

The naming contest has drawn a great deal of attention from the Internet, causing the voting site to encounter "technical issues" due to "overwhelming interest," NERC said. Yet votes have poured in by the thousands, with Boaty McBoatface pulling far ahead with more than 33,600 votes. In second place, with more than 3,000 votes, is RRS Henry Worsley, honoring the British explorer who died attempting the first unaided solo crossing of the Antarctic earlier this year. Other top vote getters, still many thousands of votes behind Boaty McBoatface, include RRS Usain Boat, RRS Thanks for All the Fish, RRS It's Bloody Cold Here and the ingenious RRS Boat. However, despite the public's rallying for Boaty McBoatface, the vessel's name will ultimately be chosen by a NERC panel.

The new vessel will become one of the world's most technologically advanced when it sets sail in 2019. To be built by Northwest England's famed Cammell Laird shipyard, the vessel will replace RRS Ernest Shackleton and RRS James Clark Ross to aid extended scientific research missions in both Antarctica and the Arctic.

GD Buys Bluefin Robotics

General Dynamics Mission Systems has acquired Bluefin Robotics, a manufacturer of unmanned undersea vehicles (UUVs) that perform a wide range of missions for the U.S. military and commercial customers. Bluefin Robotics will become part of General Dynamics Mission Systems' Maritime and Strategic Systems line of business.

Harris CapRock Connectivity Assists Oceaneering ROV Ops

Technology from Harris CapRock Communications is enabling Oceaneering International, Inc. to remotely pilot and automatically control its NEXXUS remotely operated vehicle ROV. Harris CapRock is providing satellite bandwidth and service to operate the ROV, which enables the pilot to execute assignments ranging from simple video monitoring to highly complex vessel inspection tasks. The satellite link enables Oceaneering to pilot the ROV from offshore, from another vessel, or from an onshore command center. Harris CapRock's innovative data/video communications technology was originally developed to aid technical support personnel onshore to help diagnose faults offshore.

Kraken Wins WHOI Contract

Kraken Sonar Systems Inc. won a \$465,000 contract by the Woods Hole Oceanographic Institution (WHOI). Kraken has been contracted to deliver a deep-sea rated AquaPix Miniature Interferometric Synthetic Aperture Sonar, a Real Time Embedded SAS Signal Processor and related engineering services. Delivery of the system is planned for July 2016.

Subsea 7 Wins BP Contract Offshore Egypt

Subsea 7 S.A. won a major contract by BP, and partner DEA (Deutsche Erdoel AG), for the development of the Giza, Fayoum and Raven subsea fields offshore Alexandria, Egypt. This is the second phase of the West Nile Delta

project, where the field development will be at depths of up to approximately 800 meters. Subsea 7 said it defines a "major contract" as being over \$750 million. The contract scope includes engineering, procurement, installation and pre-commissioning of the subsea infrastructure from twelve wells, with 80 kilometers of umbilicals and 220 kilometers of pipelines. It also includes the installation of the export lines from the subsea location to the Idku terminal.

Novacavi to Perform Subsea Monitoring for ENI

Novacavi has been called in to provide a specially designed custom pressure resistant cable for a new submarine hydraulic digital profile meter to be laid on the seabed close to a gas extracting platform. Installation of this monitoring system may reach a depth of 100 meters to survey and to take permanent readings of the subsidence cone caused by gas extraction.

SeeByte, ASV Partner

SeeByte and ASV announced a commercial partnership where the two companies will collaborate to bring new advanced capabilities and solutions to the field of maritime autonomy. This agreement sees SeeByte and ASV build upon previous collaborative work to develop the next generation of adaptive autonomy by working together across the fleet of ASV platforms and SeeByte's software solutions. SeeByte's smart software can be integrated onto unmanned vehicles to offer adaptive autonomy. This allows vehicles to react and adapt their missions according to feedback from their sensors and to collaborate with other vehicles in the fleet.

Kongsberg Opens in Panama

Kongsberg Maritime has established a new country office in the Republic of Panama. Opened in January 2016 and situated in the 'Canal Zone' close to Panama City, Kongsberg Maritime Panama will service merchant fleet

customers transiting the Canal and the extensive tug sector in the region, in addition to providing support for ongoing or planned land reclamation dredging and new port and terminal construction projects.

Polarcus Buys \$11.5m Streamer Package

Polarcus Limited announced the purchase of a complete marine seismic in-sea acquisition system from Dolphin Geophysical AS, for \$11.5 million. The Streamer Package comprises 12- x 8,100-meter active streamers and all peripheral in-sea equipment. Polarcus said the purchase provides its planned seismic CAPEX requirements for the next three years, and is within the company's previously guided CAPEX budget for 2016.

Floating Wind off Hawaii

The U.S. Bureau of Ocean Energy Management (BOEM) has received another unsolicited lease request for an offshore wind resource development project off Oahu, Hawaii. With this latest request, BOEM has now received a total of three unsolicited wind energy lease requests from two potential developers: two lease requests from AW Hawaii Wind, LLC (AWH), the AWH Oahu Northwest Project and the AWH Oahu South Project; and one from Progression Hawaii Offshore Wind, Inc. (Progression), the Progression South Coast of Oahu Project.

Each project proposes an offshore floating wind energy facility with a capacity of approximately 400 megawatts (MW) of renewable energy. The energy generated by the projects would be transmitted to Oahu by undersea cables.

BOEM said it has already completed a review of the unsolicited lease request from the second applicant, Progression Hawaii Offshore Wind, Inc., and has deemed the request complete and confirmed that the company is legally, technically and financially qualified to pursue an offshore wind energy lease.

The sea's the limit! Oceans'16

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Track that Pipe!

Pipeline monitoring and tracking is big business. These technologies promise to make the process less laborious and increasingly accurate.

IKM Subsea last year won an interesting contract from Norske Shell which commenced last month. To fulfill its mission, the Merlin UCV ROV is successfully integrated to the Siem Pride. In addition to the ROV service, IKM Subsea provides IMR related engineering, maintenance of Norske Shell's tool pool, as well as handling survey through business partner iSurvey. The scope of work this year includes inspections on Norske Shell's deepwater field Ormen Lange and Draugen, including pipeline surveys, structure inspections, wellhead inspections, and AMT recovery.

Dedicated to the project is the Merlin UCV, an ultra-compact work class ROV customized for IMR and drill support. The Merlin UCV represents a fully electrical ROV system using a seven thruster propulsion system configured to provide excellent thrust and lifting capability ratio due to the compact size. Due to these factors, it's estimated less time to perform scope of work compared to conventional hydraulic ROVs.

Leopard for Pipeline Work

Operators are finding the Saab Seaeye's Leopard ROV ideal for pipeline survey and inspection work.

The Leopard, with its combination of 11 thrusters and advanced control and technology, is designed to handle a full pipeline survey spread and stay steady on task. Recently it spent two continuous months with operator CCC Underwater Engineering (Abu Dhabi) working 24 hours a day, seven days a week, often in 40°C heat, on a 570 km pipeline inspection project.

Having experienced the collective capability of the Leopard's new iCON control architecture and its flexibility and tooling options, CCC concluded that the Leopard had a "work class way of thinking."

Operators like that the Leopard can not only take larger tools and survey equipment than is usual for an electric ROV, but its third vertical thruster amongst the 11 on board, gives it an ability to remain stable in flight even when a significant

amount of additional equipment is installed.

For crucial and demanding tasks such as detailed inspection or tooling operations, an option available through the iCON control system is an ability to automatically keep station, which allows the operators to concentrate on the task at hand – thus reducing their workload.

With iCON the Leopard effectively thinks for itself, providing the operator with more information about the status of the vehicle and the environment in which it is operating.

iCON also manages redundancy by isolating a problem in the water and finding ways to keep the vehicle working. The operator also gets greater information to make maintenance simpler and quicker, along with remote internet access for upgrades and support.

Equipment changes are also easier, as distributed intelligence and building-block simplicity avoids the need to partially dismantle the ROV to reach a central electronic heart.

IKM Subsea Work class ROV, Merlin UCV.



IKM

Saab Seaeye Leopard



Saab Seaeye

WFS Cuts Cost of Monitoring Pipeline Temperature

WFS Technologies (WFS) launched Seatooth PipeLogger Thermal Insulation (TI), an asset integrity monitoring and flow assurance product designed to reduce the cost of monitoring process temperature of subsea pipelines and jumpers with up to two inches of thermal insulation.

The Seatooth PipeLogger TI incorporates an RTD (Resistance Temperature Device) housed in a novel mount designed to trap heat from the insulated pipeline. Process temperature is measured without penetration of thermal insulation or pipe wall. Each system is calibrated to provide an accuracy of better than 10 percent and repeatability of better than 2DegC. An integrated data logger records process and seawater temperature.

Data is harvested wirelessly by diver, ROV or AUV using Seatooth subsea radio. Alternatively, the system can be configured to provide real time data through a Seatooth-enabled Subsea control module (SCM). The wireless communications range of standard Seatooth devices through seawater, the seabed, concrete blankets and the splash zone is 5-10 meters. Wireless communications range can optionally be extended to 35 meters through seawater or 150 meters through the splash zone.

The Seatooth PipeLogger TI incorporates Seatooth Endure, innovative technology designed to extend the battery

life of subsea wireless systems to up to 15 years. Systems are depth rated to 200m or 1,000m, are compact and weigh less than 5 kg in seawater. They are suitable for deployment by mini-ROV operating off a rig or small vessel or by diver. Deployment and recovery is facilitated by use of diver straps or ROV clamp. An optional protection cover is available for systems buried in the seabed, under concrete blankets or under rubble.

Target applications include subsea pipeline temperature profile monitoring, upheaval buckling monitoring, replacement of broken process temperature sensors and over-temperature monitoring of flexible.

New Pipe Crawler Launched

Deep Trekker Inc. announced the unveiling of a new breed of pipe crawlers now available in the U.K. from Planet Ocean Ltd. The DT340 Pipe Crawler is completely self-contained in two carrying cases, requiring no dedicated service truck to operate. Along with onboard batteries, the system requires no generators or additional power source.

LED shadow-less illumination is designed to make it easier to examine entire pipe system in detail with the static camera or optional pan and tilt camera. From the handheld controller, adjust the LED brightness, zoom into areas of interest and adjust the focus on demand. Magnetically coupled wheel drives require zero maintenance, meaning there are no dynamic seals anywhere on the

DT340 for you to grease or replace. Similarly, the optional tracks system is made from steel cord reinforced polyurethane, ready to maneuver over any obstacles you may encounter.

The JW Fishers Way

Two pieces of equipment that have proved effective tracking subsea pipes and cables are the pinpointing magnetometer and the cable tracker from JW Fishers. The pinpointing magnetometer is a sensitive instrument that locates iron and steel pipes buried up to 16 ft. in the bottom, and the cable tracker is powerful enough to detect a power or communications cable at more than 30 ft. away.

One company using the cable tracker is Marine Technologies Inc. (MTI), a commercial diving company and heavy marine contractor in Baltimore, Md. President Terry Clark said, "We recently used our CT-1 on a project in New York tracking utility lines running under the Hudson River near the new Tappan Zee Bridge. Once all of the existing lines were successfully located with the cable tracker, our team installed 15,000 feet of new fiber optic cable six feet below the natural bottom of the river. We chose Fishers cable trackers because of their reliability and ease of operation, which are important with the remote locations we often work in. We have several CT-1 trackers and have used them on projects in places as far away as South America and Europe. Over the years they have performed flawlessly for us."

Seatooth PipeLogger Thermal Insulation.

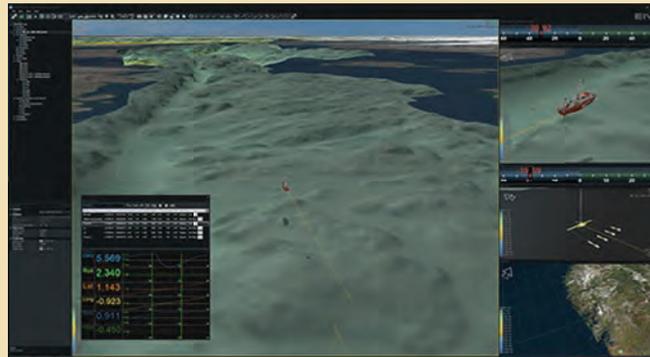


Deep Trekker DT340 Pipe Crawler.



NaviPac4

NaviPac 4 is the result of a major overhaul of the survey navigation and positioning software developed by EIVA. The new software generation introduces both new and improved features, making for an even more effective tool as part of the NaviSuite software suite for offshore and shallow water operations. These features include a new configuration tool, Li-DAR navigation capability and new Helmsman's Display, just to mention a few. Moreover, NaviPac 4 brings visualization and processing features from EIVA NaviModel, the NaviSuite solution for 4D modeling and visualization. This also means that the software now offers a native, real-time 3D engine. The strategic aim of all NaviSuite development activities sums up what the announcement of NaviPac 4 offers users, as it allows them to:



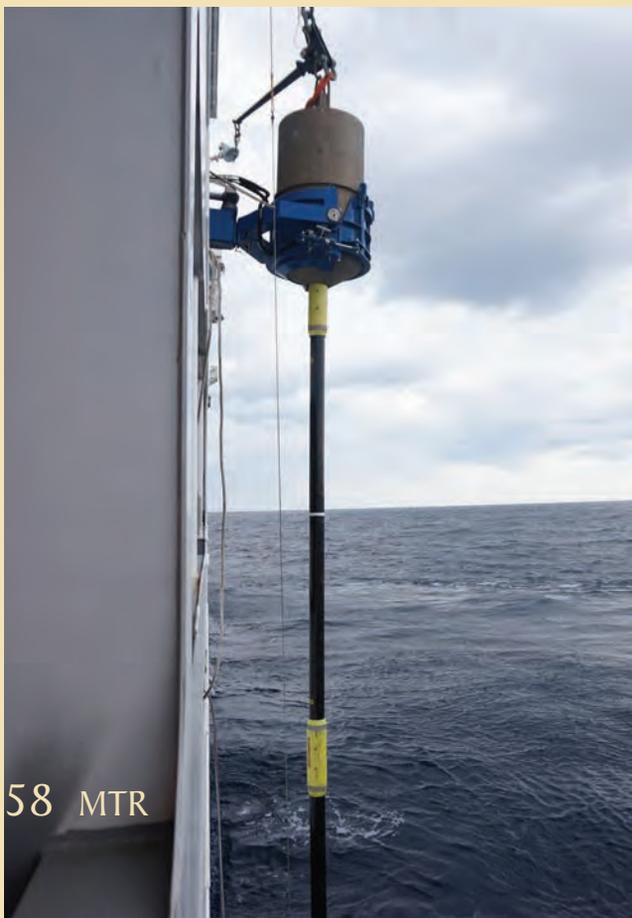
Eliminate the number of solutions required to carry out survey and construction operations; Standardize their setup by using the same software for different types of operations; Simplify and automate the operation workflow to reduce operator time. IMO Type Approval for Gyro Compass with INS.

www.eiva.com

Giant Piston Corer

OSIL engineers have recently returned from Japan following the successful completion of Sea Trials for a 42m Stainless Steel Giant Piston Corer in conjunction with local agents Kyokuto Boeki Kaisha Ltd. The 42m Giant Piston Corer and handling system forms a major part of the suite of equipment on board the new state-of-the-art research vessel Kaimei supplied to JAMSTEC.

www.osil.co.uk



58 MTR



Kongsberg

MGC R3 Compass

Kongsberg Maritime received IMO Type Approval (Wheelmark) for its MGC R3 COMPASS system. The gyro compass fits well into the range of offerings from Kongsberg for navigation and ship control systems. The MGC R3 COMPASS integrates Kongsberg's already established Motion Reference Unit (MRU) platform with high-end gyro compass technology, providing a reliable and accurate solution for any navigational purposes. Acting both as a gyro compass and full Inertial Navigation System (INS), the system outputs heading, roll, pitch, heave and position data. Data is distributed via Ethernet and serial lines to ensure efficient distribution to multiple users on board the vessel.

www.km.kongsberg.com

HIPS & SIPS 9.1

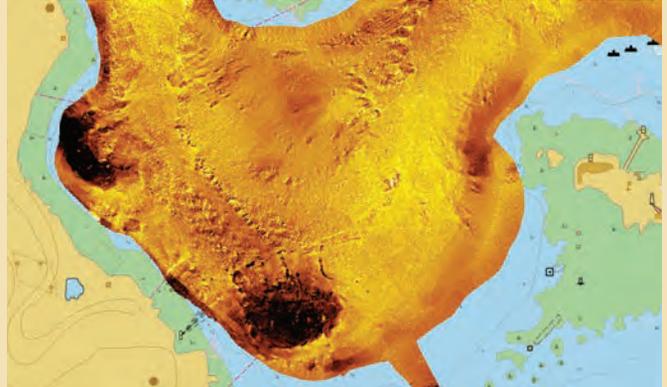
CARIS to announced the release of HIPS and SIPS 9.1. This new version includes an alternative method of processing backscatter data which produces high quality mosaics and is based upon industry-recognized algorithms and techniques. The SIPS Backscatter engine is a single additional step at the end of a traditional multibeam bathymetry workflow. It is a fresh approach to acoustic imaging by considering both the geometric and radiometric aspects in order to get a fully processed imagery mosaic.

It also factors in environmental conditions as well as sea-floor topography in the computation. The user can also choose to apply an Angle Varying Gain correction for angular sediment response.

In a user friendly way, this new mosaic creation method has been implemented into the standard HIPS and SIPS workflow, with many of the required parameters being captured directly from raw data files.

Other improvements within version 9.1 include a simplified user experience for imagery products and additional support for converting Klein bathymetry data. This version also offers

a notably faster import of many formats into CARIS HIPS and SIPS, and in some cases the data conversion if 50-100% faster. www.caris.com



Mosaic of Reson 7125 data over Plymouth Harbour, UK, processed in SIPS Backscatter

SB10 Sea Beam

A new laser system from Laser Tools Co., Inc. called the SB10 Sea Beam assists in size measurements at a distance that's certified waterproof to over 1,000 feet.

This system is used to scale unusual objects, fish, reefs, artificial structures and mechanical fixtures at depths where divers can't explore or the cost is too great.

The SB10 Sea Beam Laser Scaler shoots two laser beams 75 millimeters apart that the remotely operated vehicle (ROV) views by camera. The laser dots or lines are measured using video capture techniques and the range and size of the target is analyzed. This saves time and is safer than a diver's underwater exposure.

The SB10 Sea Beam is 2.5" long and 4" wide, mounts directly to a ROV and weighs less than 90mg when immersed.

www.lasertoolsco.com



Photo: Laser Tools

www.marinetechologynews.com



(Photo: Sonardyne)

Sonardyne

Sonardyne debuted an expanded lineup of ROV and AUV navigation solutions at Oceanology International. New additions to the company's Lodestar AHRS and SPRINT INS product lines mean that there is now a model to suit all underwater vehicle applications and budgets. As all versions utilize the same small, lightweight subsea housing, users can now switch capability without the need to fit different hardware - saving both vehicle payload space and operational expenditure. The company is also launching one of the smallest combined INS and DVL instruments on the market. Being manufactured in the U.K., in one facility, export procedures are considerably simplified.

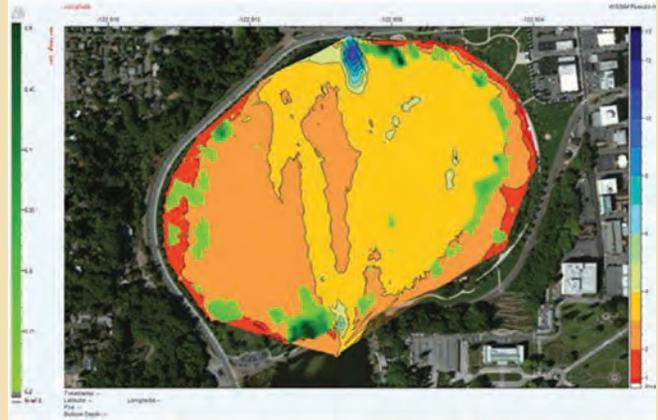
www.sonardyne.com

Aquatic Habitat Mapping Software

Bathymetry and plant height map created with Visual Habitat 2.0 data. BioSonics has released Visual Habitat 2.0 (VH2), specialized software for the assessment and mapping of aquatic habitat features including seagrass, bathymetry and various substrate types.

This upgraded version includes tools to generate full-color, interpolated maps with bathymetric contours. VH2 allows users to interpolate and form gridded data using three different methods: Triangulated Linear Interpolation, Inverse Distance Weighting and Ordinary Kriging. Users can print maps directly or export results as KML, shapefile or image files for use in Google Earth or ArcGIS. VH2 also automatically computes grid statistics including the area, water volume and plant and volume. Existing users can download VH2 at no cost and a demo version is available for new users.

www.biosonicsinc.com



(Image: BioSonics)

Buoyant Hybrid Cables

With the rise of smaller inspection class ROVs, the need for neutrally buoyant hybrid tethers has become clear, says Linden Photonics Inc. Linden Photonics has introduced a new buoyant hybrid cable with extreme flexibility. By carefully controlling the specific gravity of the cable, a density can be achieved to allow the cable to float just behind the ROV. The precise control of buoyancy is critical so that the ROV is neither pulled up nor dragged down. Smaller ROVs are highly maneuverable and their versatility is hampered by a tether with large diameter or low flexibility.

www.lindenphotonics.com

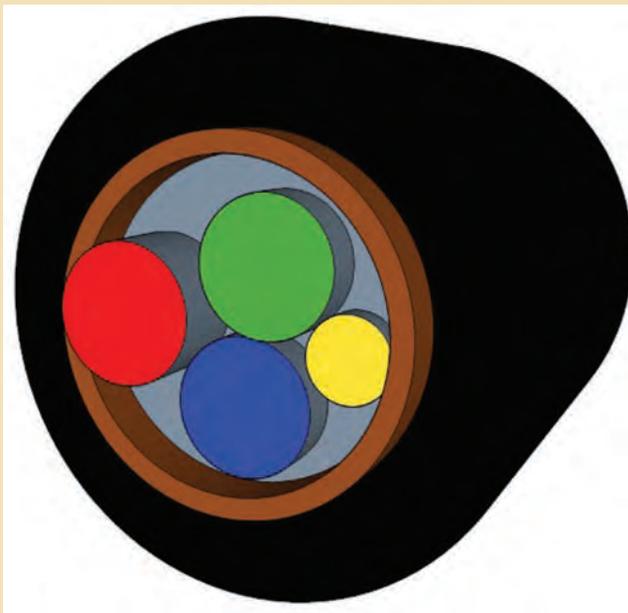
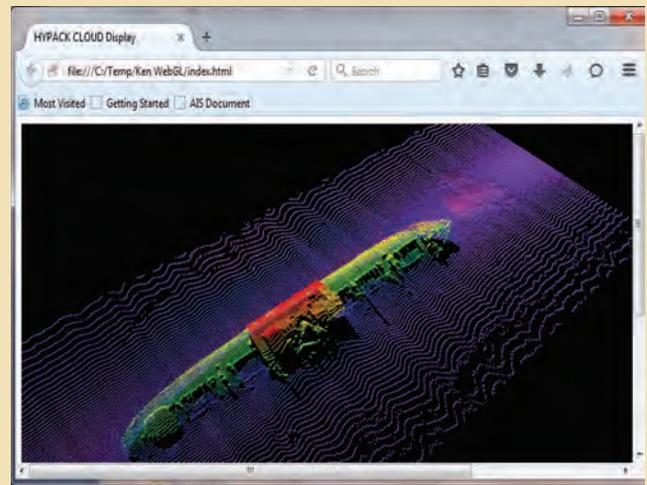


Image: Linden Photonics

60 MTR



Hypack

HYPACK 2016

HYPACK 2016 has received its official release, following several weeks of final adjustment. The new release of the HYPACK 2016 software offers users technology aiming to further aid in attaining required objectives. According to the developers, new features in HYPACK 2016 include high-density laser data acquisition, multi-detect multibeam support, multi-day acquisition and processing, post-processed positioning (PPK) in HYSKAN, SBET editing tool, many new exported reports to PDF, support four-channel magnetometers, dual head water column logging, sound velocity interpolation by position in MBMAX, TIN MODEL volumes features, CastAway CTD probe into HYSWEEP survey and the sound velocity program, a new marine search software package and more.

www.hypack.com

April 2016

Aquatic Habitat Mapping Software

Kongsberg Maritime has unveiled innovative new additions to its Seapath range of integrated Heading, Attitude and Positioning sensors at Oceanology International 2016 (stand D600). The new Seapath 130 series is a compact, portable take on the Seapath technology used by hydrographic surveyors globally. As an easy to deploy solution for Kongsberg's leading multibeam, single beam and sonar systems, the Seapath 130 series is suited for operation on a diverse array of survey platforms, including vessels of opportunity. A compact and robust integrated INS/GNSS system, Seapath 130 is developed specifically for hydrographic surveying where high precision heading, position, roll, pitch, heave and timing are critical measurements. The product combines dual frequency GNSS receivers, inertial technology and processing algorithms in a compact and portable package. Designed for easy transport and quick integration on board, the portability offered by the Seapath 130 series makes it the ideal companion for the new Kongsberg EM 2040P multibeam system. Seapath



(Image: BioSonics)

130 is also optimized to work with other KONGSBERG developed hydroacoustic systems including the M3 Sonar and Geoswath Plus shallow water multibeam, in addition to EM and EA echo sounder models and configurations.

Kongsberg offers three Seapath 130 variants, ensuring suitability for a wide range of survey applications. The Seapath 134 with MRU H provides 0.03° roll and pitch accuracy and is ideal for shallow water surveys. The Seapath 135 with MRU 5 delivers up to 0.02° roll and pitch accuracy making it an optimal solution for surveys in deep water. The Seapath 136 with MRU 5+ MK II provides up to 0.008° roll and pitch accuracy, so can be used for surveys with high angular coverage in deep water.

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