

SEA TECHNOLOGY

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The Buyers Guide's **Industrial Firms and Products** and **Services listings** will now be featured in the print version of the January 2019 issue of *Sea Technology*! (These sections will be exclusive only to the print version of the January e-book).

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The **Ocean/Marine Market overview** that has appeared in the *Buyers Guide* in the past will be supplanted by **January's Review & Forecast** offerings.

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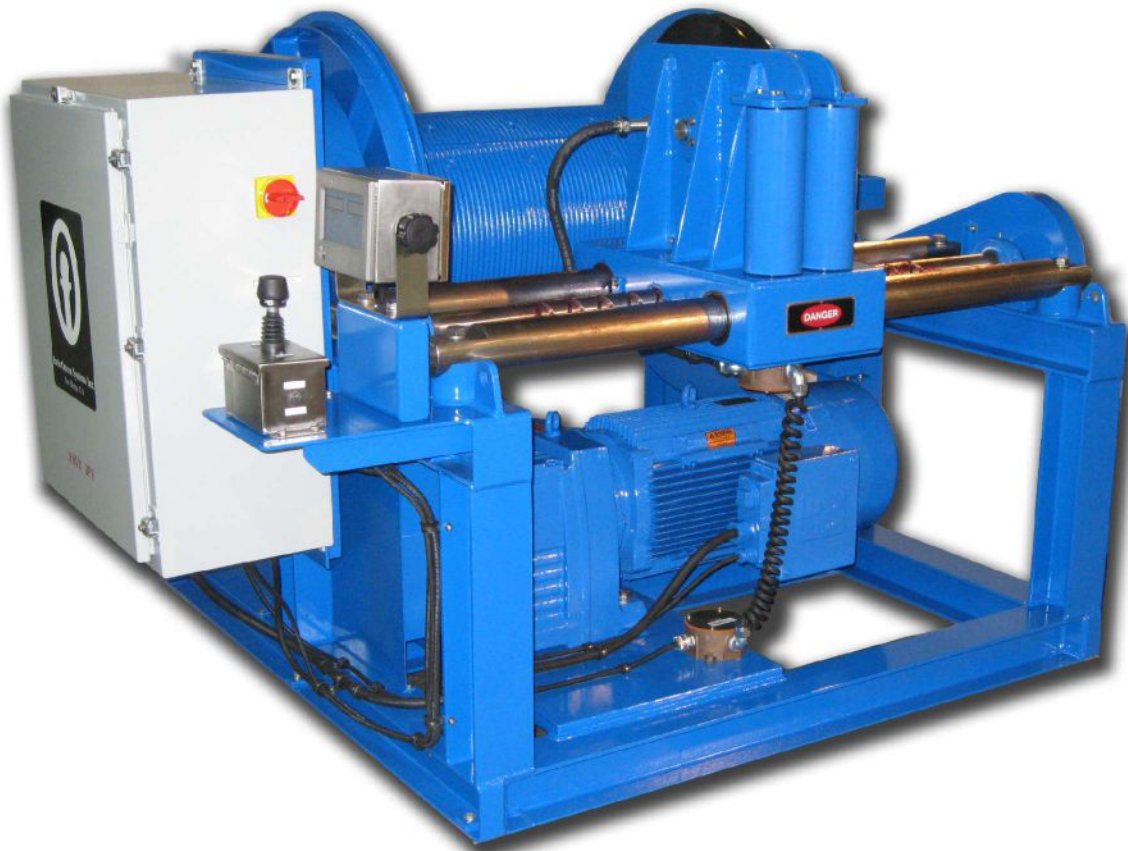
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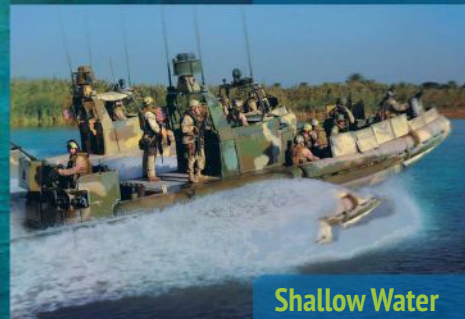
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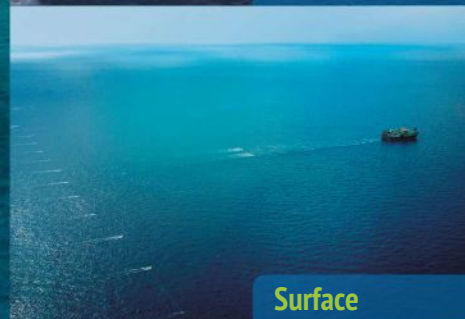
ROV image courtesy of NOAA Okeanos Explorer Program INDEX-SATAL



Deep Water



Shallow Water



Surface



Downhole



- Dry-Mate and Wet-Mate Connectors
- Penetrators
- Cable Assemblies
- Cable Terminations
- Custom Encapsulation and Molding

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COVER IMAGE

Georgia Institute of Technology's "Icefin" characterizes sub-ice environments using sonar, chemical and biological sensors. This photo was taken under the ice in December 2017 in the Ross Ice Shelf, Antarctica. The hybrid ROV/AUV is modular, field portable, weighs 130 kg, can explore depths of 1 km, and has a range of 3.5 km using Linden Photonics' buoyant STFOC tether. (Credit: Justin Lawrence, Georgia Institute of Technology)

NEXT MONTH

SEG 2018 ... Deep-learning technology to automatically detect and mark typical anomalies for underwater pipeline inspections ... New seabed technology to improve cost-effectiveness of seafloor massive sulfide exploration ... ARGGONAUTS seafloor mapping concept for XPRIZE ... Autonomous underwater helicopter design.

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TOTAL OCEAN MARKET COVERAGE

2018

JANUARY

Annual Review & Forecast

FEBRUARY

Instrumentation: Measurement, Processing & Analysis

***Oceanology International*, March 13-15, Excel London, U.K.

***Canadian Hydrographic and National Surveyors' Conference*,
March 26-29, Victoria, Canada

MARCH

Electronic Charting/Vessel Management/Ports &
Harbors/Dredging/Homeland Security

APRIL

Offshore Technology/Alternative Energy & Ocean Engineering

***Offshore Technology Conference*, April 30-May 3, Houston, TX

***AUVSI XPONENTIAL 2018*, April 30-May 3, Denver, CO

***OCEANS '18 MTS/IEEE Kobe / Techno-Ocean 2018*,
May 28-31, Kobe, Japan

MAY

Communications, Telemetry, Data Processing

***BlueTech Expo*, June 4, Washington, DC

***CLEAN PACIFIC 2018*, June 19-21, Portland, OR

***UDT 2018*, June 26-28, Glasgow, U.K.

JUNE

Seafloor Mapping/Sonar Systems/Vessels

JULY

Deck Gear, Cable, Connectors, Power Systems & Salvage

***SNA West Coast Symposium*, August 23, San Diego, CA

AUGUST

Geophysical Exploration/Seafloor Engineering

***Dynamic Positioning Conference*, October 9-10, Houston, TX

***SEG 2018*, October 14-19, Anaheim, CA

SEPTEMBER

Ocean Resources Development & Coastal Zone Management

***Offshore Energy 2018*, October 22-24, Amsterdam,
The Netherlands

***EURONAVAL 2018*, October 22-26, Paris Le Bourget, France

***OCEANS '18 MTS/IEEE Charleston*,
October 23-25, Charleston, SC

OCTOBER

Environmental Monitoring, Remote Sensing & Pollution Control

***International Water Conference*, November 4-8, Scottsdale, AZ

***Naval Submarine League Annual Symposium*, November 7-8,
Arlington, VA

***CLEAN GULF*, November 13-15, New Orleans, LA

NOVEMBER

Undersea Defense/Antisubmarine Warfare

***SNA Annual National Symposium*, January 15-17, Arlington, VA

DECEMBER

Diving, Underwater Vehicles & Imaging

***Underwater Intervention 2019*, February 5-7, New Orleans, LA

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- *Sea Technology Buyers Guide/Directory*
(2019 edition closes October 5, 2018)
- *Sea Tech e-News*
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- *Fish Farmers Phone Book/Directory*
- *Fish Farming News*
- *Commercial Marine Directory*
- Compass Research Bureau reports
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Safety Concerns for Hybrid, Electric Ships

Each year there are more and more hybrid or fully electric ships navigating waters worldwide. All modern commercial vessels may soon have some form of energy storage on board.

These ships range in type from ferries transporting thousands of people daily to offshore supply vessels that maintain safety in critical oil rig operations. The ships increasingly rely on lithium-energy storage as their power source, with modern designs containing more than 1,000 individual modules (batteries). The technology has proven itself reliable and powerful, however, safety concerns linger and should be an utmost consideration for this new technology.

Not all battery systems are equipped with the same safety systems. Testing and certification for battery systems aboard ships has increased, but room remains to raise the bar higher.

One of the biggest risks for batteries is thermal runaway. Thermal runaway occurs if the lithium-ion cells used in marine batteries are subjected to mechanical abuse, suffer from internal manufacturing defects, or operate over or under the correct voltage or temperature. Heat is generated within the lithium-ion cells and causes a reaction between the cathode material and electrolyte. This can result in the cells' temperature increasing until they vent toxic and flammable gases. If ignition occurs, these gases can be a fire hazard.

Currently, there are many battery solutions on the market that use an air-cooling system to try to maintain safe internal temperatures. The effectiveness is questionable, and the reliance on a thin-layer, fire-resistant separator between cells only reduces the fire risk from thermal runaway—it does not prevent it. It is far more sensible to take all reasonable precautions to eliminate thermal runaway from occurring in the first place.

Liquid cooling is the only safety system currently tested and proven to prevent thermal runaway. Liquid cooling prevents batteries from entering thermal runaway by simply extracting more heat than the cells can produce. Similar to an engine block of an automobile, a low-pressure, high-volume closed loop of chilled water is circulated through the battery. Taken a step further, coolant can be circulated through the alloy core of the battery, around each individual cell, enabling removal of more thermal energy than the cells can produce when in an overcharge or damage scenario.

In comparison, forced-air cooling only cools the external surfaces of the module and is ineffective at eliminating hot spots in the cells. An air-cooled battery requires around 3,500 times more air-flow volume than water-flow volume to achieve the same heat removal.

Effective internal thermal barriers are an essential part of lithium-battery safety systems. In the event of a damaged cell within a module, dangerous gases can be released. It's important for every supplier to create safe venting for battery systems to reduce risk of a secondary explosion.

Given the rapid uptake of the use of large-format lithium-ion batteries in commercial marine vessels, energy storage system safety is lacking. Current standards leave significant potential for hazardous situations to arise that could lead to loss of life and great environmental cost.

It is the responsibility of industry and regulators to do everything possible to ensure a major incident does not occur. Unfortunately, the majority of the industry has responded to price pressure from owners and operators by reducing costs and, subsequently, safety systems to meet the bare minimum of requirements. The industry should take steps to guard against the consequences of inaction. **ST**

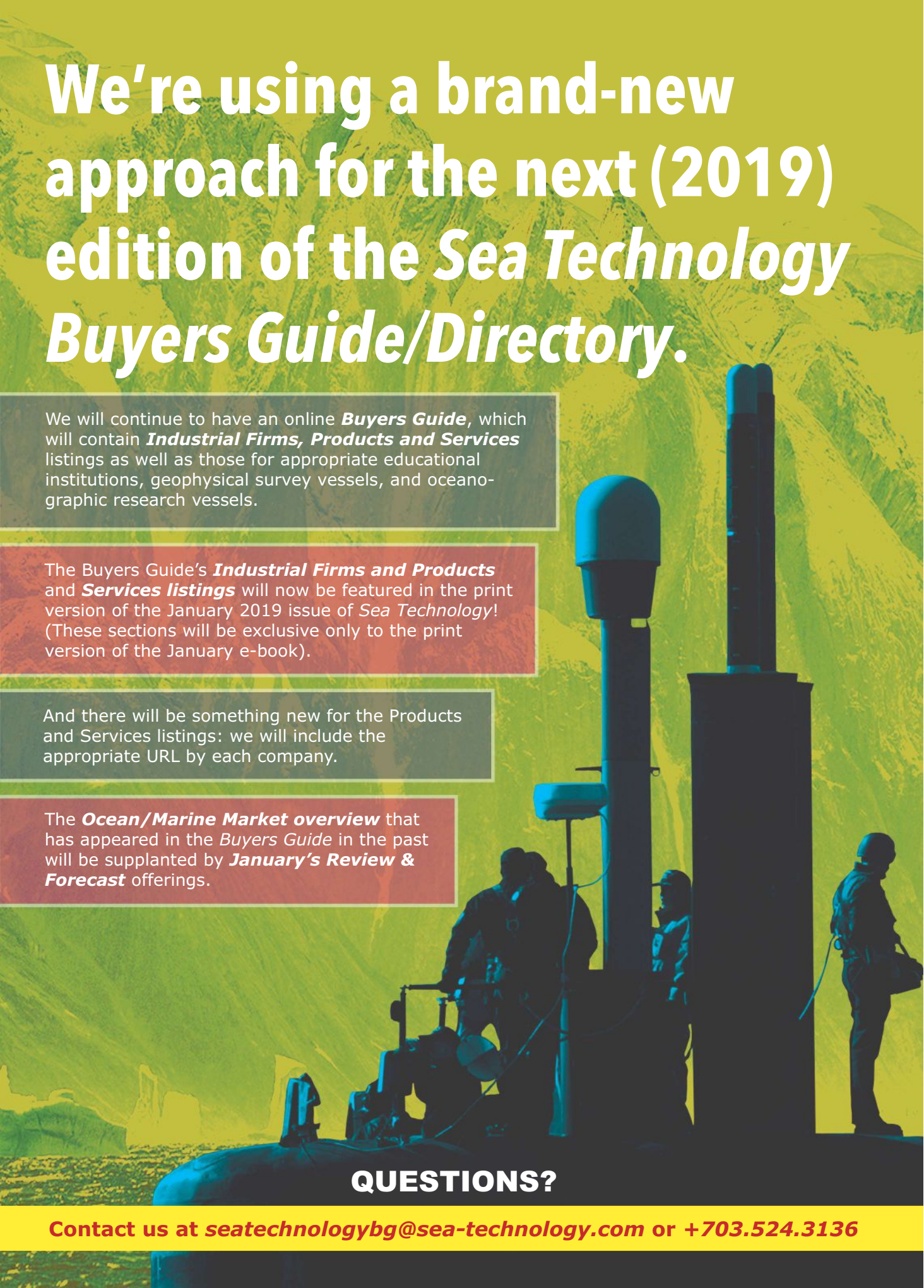
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)) Oil, Gas Industry Acknowledges Safety Cuts While Increasing Emphasis on Digitization. New research from DNV GL reveals that 46 percent of senior professionals in the sector believe there has been underinvestment in inspection and maintenance of infrastructure and equipment in recent years. Twenty-eight percent said that they expect to increase spending on safety in 2018. Sixty-one percent will maintain current budgets, and 5 percent plan to cut investment. The findings appear in “The State of Safety” report from DNV GL’s research on the outlook for the oil and gas industry in 2018. Based on a survey of 813 senior sector players, the report also affirms expectations for digital technologies to bridge the gap between long-term cost efficiency and enhanced safety in projects and operations. While cost efficiency has been a high priority for more than 82 percent of senior industry professionals since 2015, 40 percent of respondents believe digital tools and technologies have already improved safety over the past three years. Many new investments in safety will be aimed at digitizing safety monitoring, processes and responses this year.

)) XPRIZE to Crowdsource Design Ideas. The XPRIZE Foundation announced a global open call to innovators to help it design future XPRIZES in five key areas: Off-Grid Energy for the Developing World, Saving Coral Reefs, Disaster Prediction, Lifting Farmers Out of Poverty and Feeding the Next Billion. For the first time, XPRIZE will use the HeroX crowdsourcing platform to source hundreds of XPRIZE designs, and submitting teams may be selected to compete to further develop their concepts for future XPRIZES. “Building on HeroX and our annual Visioneering Summit, we look forward to taking the crowd’s participation to the next level and empowering the public to architect the future,” said Dr. Peter H. Diamandis, XPRIZE founder and executive chairman. Prizes are valued in total at more than \$100,000. The designers of the best concepts submitted through HeroX will work with XPRIZE experts to refine their prizes before taking a global stage later this year at the Visioneering Summit. There are three phases to HeroX: Ideation, Design Hackathon and Visioneering Summit. XPRIZE invites the public to choose a focus area and submit a design concept with a video pitch by July 23. To learn more, visit www.herox.com/xprizevisioneers-2018-design-challenge.

)) Need for Coordination to Prepare for Global Sulphur Cap. The International Chamber of Shipping (ICS) fears “chaos and confusion” unless the UN International Maritime Organization (IMO) urgently resolves some serious issues concerning the successful implementation of the 0.5 percent sulphur in marine fuel cap, effective globally January 1, 2020. Such chaos would have serious consequences for the movement of the world’s energy, raw materials and manufactured products; about 90 percent of global trade is carried by sea. By the start of 2020, “It is still far from certain that sufficient quantities of compliant fuels will be available in every port worldwide,” said ICS Chairman Esben Poulsson, “and in the absence of global standards for many of the new blended fuels that oil refiners have promised, there are some potentially serious safety issues due to the use of incompatible bunkers.” Poulsson said that at the moment no one knows what types of fuel will be available or at what price, specification or quantity. ICS members also expressed serious disappointment at the apparent intention of the European Union to press on with the implementation of a regional CO₂ reporting system at variance to the global system already agreed by IMO, believing it risks seriously distorting maritime trade and global shipping markets.

)) US Navy Revives Second Fleet. The U.S. Navy has reestablished the Second Fleet, which was disestablished in 2011. This fleet will exercise operational and administrative authorities over assigned ships, aircraft and landing forces on the East Coast and northern Atlantic Ocean; plan and conduct maritime, joint and combined operations; and train, certify and provide maritime forces to respond to global contingencies. “Our National Defense Strategy makes clear that we’re back in an era of great power competition as the security environment continues to grow more challenging and complex,” said Chief of Naval Operations Adm. John Richardson. “That’s why today, we’re standing up Second Fleet to address these changes, particularly in the north Atlantic.” The move reflects the new National Security Strategy’s emphasis on combating global powers such as Russia.

)) NOC Scientists Investigate Human Impacts in Open Ocean. On May 19, the RRS *James Cook* left Southampton, U.K., for a research expedition to the Porcupine Abyssal Plain – Sustained Observatory (PAP-SO) in the northeast Atlantic Ocean. This expedition aims to answer fundamental questions about how potential environmental and ecological stressors are influencing the open ocean from surface to seabed. Researchers will be tracking the flow of the greenhouse gas carbon dioxide from the air into the surface ocean, and the eventual fate of carbon in the ocean depths. Another key activity is making detailed measurements of litter and plastic accumulation in the open ocean. In order to understand the harm that plastics may cause, there must be a better understanding of the factors controlling its distribution and fate. Led by the U.K. National Oceanography Centre (NOC), the team will use a variety of tools, including instruments fixed to a floating buoy, specialized sediment traps to collect sinking particles, and samplers of the water and the seabed 3 mi. beneath the surface. A research expedition to the PAP-SO is undertaken every year to service a mooring that has a range of sensors measuring variables such as temperature, oxygen and nutrients. Each year, new and innovative ocean measuring equipment is tested at this site. **ST**

Custom Penetrators, Cable Assemblies

Bespoke Components for DeepFlight Super Falcon 3S Personal Sub

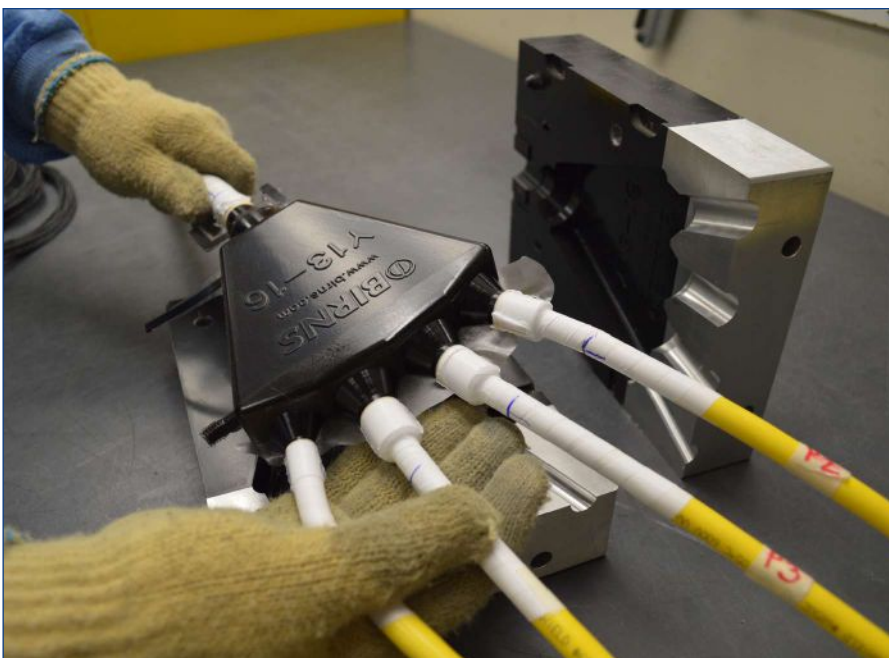
By Amy Brown

Providing connectivity for today's advanced manned submersibles is both an art and a science. Engineers can now develop bespoke solutions that deliver high-performance characteristics, fit into highly specific dimensions, and conform to the form, fit and function of these vehicles using out-of-the-box approaches.

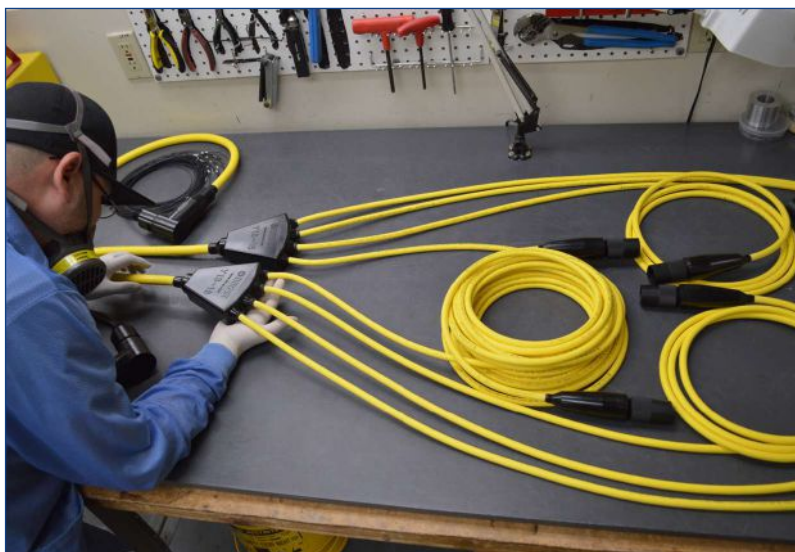
A recent example of such customization came when DeepFlight, from Point Richmond, California, was designing a new manned submersible, the DeepFlight Super Falcon 3S, a state-of-the-art craft that was introduced to the industry in late 2017 and officially launched at Four Seasons Resort Maldives at Landaa Giraavaru in May 2018.

The Super Falcon 3S is DeepFlight's first vehicle that can carry up to three occupants (one pilot, two passengers) and was specifically designed for ocean tourism at resorts and other locations. The submersible is 8 by 3.3 by 1.4 m (26.2 by 10.8 by 4.6 ft.) and weighs 3,400 kg (7,500 lb.). Its endurance/autonomy is up to 8 hr., and the vehicle is rated to 100 m (330 ft.). The sub required the design of new custom, high-density, ABS-certified penetrators and cable assemblies from BIRNS Inc. of Oxnard, California, for a wide range of functions on the vehicle.

For years, DeepFlight has been developing and marketing innovative new electric



(Top) Cable conductors are soldered to in-board and outboard sides of a P25 insert by a J-STD-001 Class 3 and WHMA-A-620-A Class 3 certified technician. (Bottom) A complex junction is removed from its mold after the polyurethane solidifies.



(Top to bottom) EH-7 cable is inspected before moving on to final IR testing. Final continuity testing is carried out on each assembly, to ensure that all circuits are operational. Two EH-3 penetrator assemblies transmit primary power from the port battery to the pressure hull for inboard electronics.

submarines that are lightweight, intuitive to operate and provide a unique, three-dimensional underwater flight experience, with a simple cockpit enabling operators to safely dive with minimal training. Most personal submarines are based on designs for research-focused tasks, making them heavy and complex to operate, but the DeepFlight Super Falcon 3S was specifically designed for tourism and ease of operations. The sub is also the first composite-hulled submarine to be certified by Lloyd's Register. The use of composites allows the company to build high-strength, low-weight craft that are the most lightweight submarines on the market. DeepFlight is committed to being environmentally friendly, so its submarines do not have skids (and, therefore, cannot land on reefs or the seafloor), have low acoustic emissions and are low voltage, meaning they are safe to operate around swimmers and marine life.

The custom penetrator assemblies are robust systems that safely and reliably transmit electrical power or signal through a pressure boundary without compromising its integrity. One of the many advantages of penetrators is that they decrease the complexity of electrical systems and reduce dependence on operator skill, requiring minimal maintenance, and are suitable for long-term deployment in harsh marine environments. To that end, the BIRNS custom penetrators featured polyurethane overmolding on the outboard side, with robust inserts and O-rings, and rigorous ABS-compliant testing protocols.

Assembly Functions

The DeepFlight Super Falcon 3S required a total of 16 penetrator assemblies for functions on board ranging from navigation and communications to battery power. The penetrators had 1.5-in. hex flats and anodized 1-in. aluminum shells, versus the standard stainless, as they were to be mounted to an aluminum bulkhead and DeepFlight needed the materials in contact to be the same to avoid galvanic corrosion. DeepFlight's hull and pressure bottle penetrations for the project were already designed but did not match any standard penetrator sizes, so BIRNS adapted a BIRNS Millennium 3P connector shell with 1-20 UNEF threads to fit the system and developed custom 25 pin inserts for the assemblies. These custom penetrators had cables using 20 to 16 AWG conductors and conductor counts from two to 24 with maximum voltage per wire of 44 V, maximum current of 4 A continuous per conductor and maximum power required of 250 W, and came in a range of cable design configurations.

For navigation and other relevant functionality on the sub, BIRNS supplied two EH-2 assemblies, each with a single P25 penetrator, with a 27-in. Y cable leading to four wetmate five-pin connectors. This cable harness connected the depth transducer, altimeter, Trittech MicronNav tracker and Micron data modem to the pressure

“The sub is in frequent use at its first resort in the Maldives, introducing travelers to unique new views and ways to experience flight in the ocean.”

hull. Two EH-7 single penetrator Y cable assemblies that led to four wetmate connectors on a 16-in.-length cable formed a cable harness to connect the elevator and rudder control signals from the pressure hull to the control surface actuators. A set of two EH-8 single penetrators with Y cables formed a cable harness, which connected the thruster control signals from the pressure hull to the vehicle's main thrusters.

DeepFlight Super Falcon 3S's communication system allows the pilot to verbally communicate with the surface support craft through a cable harness that connects the UQC underwater telephone signals from the pressure hull to the UQC transducer, which then broadcast and receive underwater communi-

cations. This is supported via two EH-1 assemblies, which each feature a single penetrator attached to a DeepFlight-furnished transducer and a 10-in. external cable.

The system's lithium-iron phosphate battery connectivity is sustained with two EH-3 double-ended penetrators with 7-in. cables that connect the primary power for electronics inside the pressure hull from the port battery to the pressure hull. Two EH-17 double-penetrator, double-ended assemblies with 8-in. cables connect the input power from the charging port to the port battery. Two additional EH-18 double-penetrator, double-ended assemblies each have 8-in. cable lengths and connect the input power from the starboard charging port to the star-

board battery. General backup power is connected with two EH-4 double-ended penetrator assemblies with 7-in. cables, forming a cable harness that connects the backup power for electronics inside the pressure hull from the starboard battery to the pressure hull.

Penetrator Development

The P25 inserts were carefully constructed, with 25 gold-plated copper-alloy contacts for strong electrical performance and were insulated with glass-reinforced epoxy (GRE) for advanced dielectric characteristics. They were cured in a custom 40-ton hydraulic transfer press that allows computer-controlled precision for injecting GRE and tested per BIRNS ABS-approved Test Procedure ETP-6510-101 (Electrical Penetrators-Submersible and Non Submersible Pressure Vessels for Human Occupancy). The initial testing sequence requires the inboard sides of the inserts to be subjected to helium pressure (1,000 psi) testing. After the successful helium testing phase, with no evidence of leaks, cracking, extrusion or other signs of failure, the cable conductors were soldered to both inboard and outboard sides of the insert by J-STD-001 Class 3 and WHMA-A-620-A Class 3 certified technicians.

The insert assemblies then underwent continuity and insulation resistance (IR) testing procedures. The IR testing requires that all 25 conductors be individually tested at a test voltage of 500 +/-50 V DC (707 V AC) for interference between one another and the penetrator shell—a minimum reading of 200 MΩ is required to pass. Once that test was successful, the shell was attached to the penetrator.

The assemblies were then overmolded in BIRNS's NAVSEA S9320-AM-PRO-020 certified molding

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The DeepFlight Super Falcon 3S and three occupants underway from the Four Seasons Resort Maldives at Landaa Giraavaru. (Inset) The composite-hulled DeepFlight Super Falcon 3S was specifically designed for tourism and ease of operations and offers the experience of flight in the ocean.



facility (certified for fabrication of U.S. Navy submarine outboard cables). The overmolding process began with wire terminations being encapsulated with epoxy adhesive, and polyurethane subsequently injected into mold cavities to harden and cool. This sealed the penetrator/cable interface, provided strain relief, precluded discontinuous bending and added elastomeric mechanical strength to the junction. Many of the penetrator assemblies for the project also had complex junction molds, splitting into two segments (Y molds) or up to four segments. These challenging overmolds require particular care during the process; the technician must ensure that there is sufficient slack for the wires in the mold cavity, to avoid sealing them in with too much tension, while keeping these high-density wires centered in the mold and not allowing any wires to touch the mold cavity. If that were to happen, it could create a direct leak path into the assembly and could allow water ingress, which might cause it to short.

Each penetrator assembly was then tested for continuity and IR once again, prior to formal ABS witness acceptance testing. Next, the complete assembly was subjected to a dielectric withstanding voltage (Hi-Pot) Test—where each conductor is tested at 1,480 V DC for 60 sec., before automatically moving to the subsequent channel, with a reading below 29 μ A required to pass. Then, a six-cycle saltwater hydrostatic pressure test was performed, in which the outboard side of the penetrator is held to pressure of 1,000 psi. During the sixth cycle, while under pressure, the entire penetrator was given another extensive IR test at 500 V DC for the 25 conductors, testing between each conductor and all other conductors, and between each conductor and the test

chamber. The penetrators were then cleaned with a mixture of soap and water. The entire ETP-6510-101 testing procedure was overseen by an on-site ABS inspector, who verified the integrity and accuracy of all tests performed. All relevant documents, calibration certificates, drawings, procedures and data capture points pertaining to testing were reviewed and manually approved by the ABS inspector underwriting the results of the testing. This on-site inspection was conducted once for the insert helium leak testing and once during hydrostatic pressure testing and electrical testing after termination and polyurethane overmolding.

When the completed assemblies were shipped to DeepFlight's team in California, they were inspected and tested by applying vacuum pressure to all completed assemblies to verify seal integrity before installation on the sub. The testing of the complete system continued during sea trials before heading to the team's submarine base in the Maldives. The penetrator assemblies continue to perform well since the successful launch of the DeepFlight Super Falcon 3S line, and the sub is in frequent use at its first resort in the Maldives, introducing travelers to unique new views and ways to experience flight in the ocean.

Acknowledgments

The author would like to thank the team at DeepFlight for providing valuable data and images for the development of this article. **ST**

Amy Brown is the chief marketing officer for BIRNS Inc. and is responsible for developing and managing a comprehensive set of strategic marketing and communications programs.

BLUETech EXPO

2018 - A Successful Event

The 2018 inaugural BlueTech Expo and Networking event was a great success and we thank all exhibitors and attendees, with special thanks to the House Oceans Caucus and the U.S. Senate Subcommittee on Oceans, Atmosphere, Fisheries, & Coast Guard.

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BlueTech Expo

The emergence of blue technology continues to be an economic force impacting a wide range of industries in business-to-government, business-to-business and business-to-consumer markets. This was clearly evident by the success of a new annual Washington, D.C., ocean technology event: BlueTech Expo.

The inaugural event was held June 4 and was jointly organized by the International Ocean Science and Technology Industry Association (IOSTIA) and *Sea Technology* magazine. It is designed to foster a greater connection between government officials and policy makers around the expanding innovations in the marine/ocean technology sector.

Exhibition

BlueTech Expo is a unique two-tiered event on Capitol Hill, the seat of the U.S. Congress. This year, the first component was a technology exhibition held in the Rayburn House Office Building, one of three expansive office buildings where U.S. Representatives, their staff and committees have their offices and conduct much of their business. The event was co-sponsored and promoted by the House Oceans Caucus, a body of lawmakers who share a keen interest in ocean issues.

The exhibition consisted of two-dozen diverse ocean technology companies and was sponsored by Fugro and 3D at Depth. The primary objective of the event was to



educate lawmakers and staff on the capabilities and critical role ocean technology play in our understanding of the oceans, national security and the blue economy. The exhibition drew steady traffic during the day, and exhibitors benefited from the opportunity to discuss their solutions with lawmakers, staff and prospective customers.

B-to-G Networking

After a short break following the exhibition, BlueTech Expo reconvened in the Hart Senate Office Building for the second component: the business-to-government networking event.

The gathering pulled industry and government together to discuss talk ocean issues and business opportunities and the networking event attracted a diverse audience of more than 100 key government, industry and NGO decision makers, who enjoyed drinks and an impressive rooftop view of the Capitol building.

Coming Up

IOSTIA and *Sea Technology* magazine would like to thank the sponsors Fugro and 3D at Depth, the House Oceans Caucus and Sen. Sheldon Whitehouse (D-R.I.) for their support, plus a very special thank you to all the exhibitors and attendees.

Based on the strong support and feedback, BlueTech Expo will return in 2019 with an expanded program. It will take place June 4 in Washington, D.C. Visit www.BlueTechExpo.org in the coming weeks for updates on BlueTech Expo 2019. **ST**



New Era of Humpback Whale Research

Using a Wave Glider SV3 to Search for Whale Song

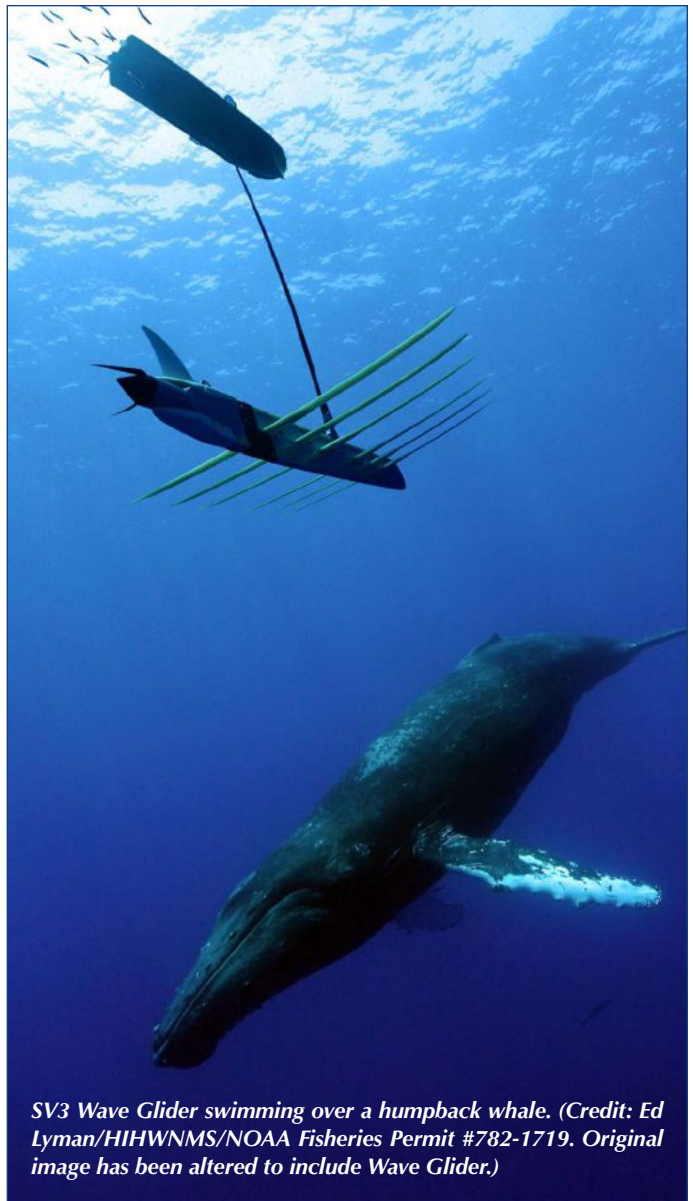
By Maya Goodoni • Beth Goodwin • Kurt Kiesow

For more than 15 years, Jupiter Research Foundation (JRF), based in Los Altos, California, has immersed itself in science and technology research and development with the primary objective of learning and creating something new. Over the years, JRF has broadcast live whale song to the world, analyzed electrical signals from single-cell organisms, developed an autonomous ocean-going amateur radio and microscope and co-invented a high-tech, ocean-going, unmanned surface vehicle, the Wave Glider (WG) that has revolutionized how researchers monitor the world's oceans. This invention led to the formation of Liquid Robotics, a Sunnyvale, California, business that was acquired by The Boeing Co. of Seattle, Washington, in 2016.

JRF has recently embarked on its most ambitious project yet: the Humpback Pacific Survey (HUMP-ACS). This mission combines two of JRF's passions: humpback whales and radio technology.

Background

A humpback whale's migration of 6,000 mi. is one of the longest of any mammal. It is well known that North Pacific humpback whales migrate from their northern, summer feeding grounds to nearshore, winter breeding grounds in Mexico, Hawaii, Japan and the Philippines. Some studies suggest there may be humpback whales congregating in deeper waters between these nearshore grounds; however, scientists have not documented this. These studies include a photo-identification record of a humpback whale that traveled between Mexico and Hawaii in one winter season and the study called "Structures of Population, Levels of Abundance, and Status of Humpback Whales" on migratory destinations. Moreover, there are anecdotes of humpback whales near atolls far to the south and west of Hawaii. Previous song studies show there is mixing of humpbacks throughout the north Pacific, but it is not known when or how this occurs. While in their breeding grounds, humpbacks sing a song. Fifty years



SV3 Wave Glider swimming over a humpback whale. (Credit: Ed Lyman/HIHWNMS/NOAA Fisheries Permit #782-1719. Original image has been altered to include Wave Glider.)

ago, this fascinating discovery was made by listening to the sounds of the ocean. This discovery helped create the modern conservation movement "Save The Whale." The subsequent album produced by Dr. Roger Payne, "Song of The Humpback Whale," is the most successful natural history recording ever made.

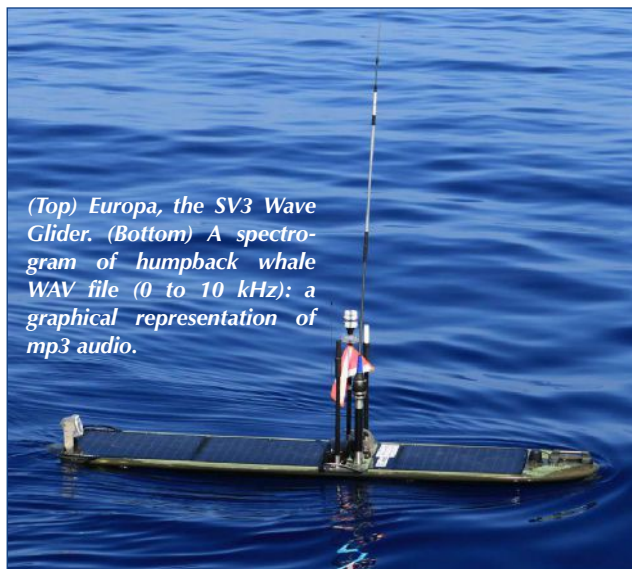
Today, it is still unclear why only male humpback whales sing. Dr. Jim Darling, a humpback whale song expert from Whale Trust Maui in Hawaii, is in pursuit of this mystery. Darling and his team hypothesize the song

may be a way for individual males to recognize how closely associated they are with other males and may determine if specific males cooperate or compete for females. Darling's research focuses on comparing songs from different regions within the North Pacific Basin to identify the similarities and differences between them.

JRF is exploring the hypothesis that humpback whales may be congregating around shallow-water seamounts between Hawaii and Mexico, which provide diverse ecosystems for marine life. Even one record of a humpback song in the deep waters would be significant and could lead to further investigations. Furthermore, tracking their song and migration patterns could shed some light on biological responses to environmental changes, including climate change and global warming.

The HUMPACS Mission

JRF has partnered with Darling to search for humpback whales by listening for their song in the deeper waters between their known breeding grounds. To perform this mission, they used a Wave Glider SV3, called Europa, to transect the Pacific between Hawaii and Mexico. Europa is a wave- and solar-powered unmanned surface vehicle made by Liquid Robotics. The vehicle is loaded



(Top) Europa, the SV3 Wave Glider. (Bottom) A spectrogram of humpback whale WAV file (0 to 10 kHz): a graphical representation of mp3 audio.

with high-tech listening and monitoring gear that contain sound triggers and satellite uplinks to collect, record and transmit data. JRF programmed Europa to store all recordings on an onboard solid-state drive, although they can request audio files at will. If JRF hears something of interest, they can command Europa to survey that area before proceeding.

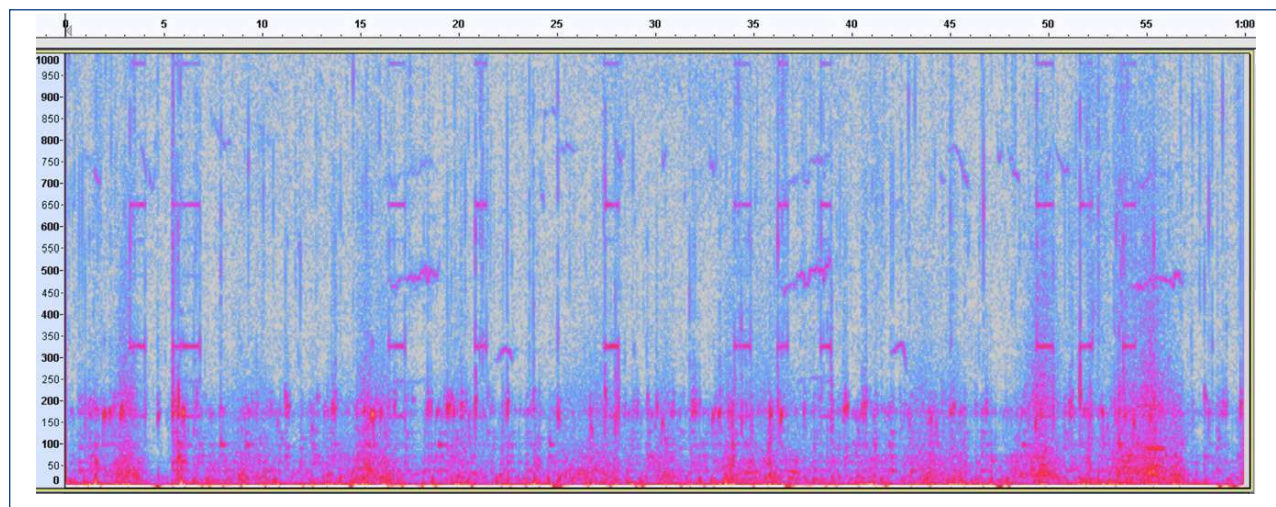
The mission is a little like searching for a needle in a haystack. However, the humpbacks' song has a vast range of frequencies and amplitude; therefore, it is a

large needle in a haystack. The data they collect are critical to studies of behavior and abundance of humpback whales in the North Pacific Basin.

The HUMPACS mission, covering more than 2,000 nautical miles, is the first survey of seamounts from Hawaii to the Baja California Seamount Province searching for these humpback whales. Ships, satellites and submarines have surveyed the Pacific; however, never at the slow pace of 1.5 kt. over several months while recording the acoustic soundscape 24/7, collecting sea surface temperatures, salinity levels, ocean currents, weather data and taking above and underwater photos, and certainly never from an unmanned surface vehicle.

Soundscapes, Marine Ecoacoustics

Ecoacoustics is a relatively new field of science. It is the study of sounds and their relationship with the environment over a wide range of scales (both spatial and temporal). Scientists investigate sounds to understand their evolution, functions and properties under environmental stressors and changes. They use these sounds as tools to monitor ecological factors, such as biotic and abiotic relationships, animal behavior, diversity, abundance and distribution.



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Scientists have gained much knowledge and a better understanding of the ocean and how humans are affecting it by using hydrophones to record marine acoustics. JRF's acoustic data may contribute to ecoacoustics by establishing a benchmark of the soundscape patterns along Europa's path, which could support marine conservation and resource management efforts.

Building the Acoustic Payload

To be able to detect whales from miles away and ensure no recorded data were lost, JRF's acoustic payload required significant software and hardware engineering. They acquired a "smart" digital hydrophone called the icListen HF, made by Ocean Sonics of Nova Scotia, Canada. The icListen can record a wide range of frequencies and target most cetaceans.

During the design phase, and anticipating the perils of an ocean journey, they attached the hydrophone to Europa's subsurface component, or "sub," to prevent loss due to entanglement or predation. However, being directly connected, the hydrophone picked up self-noise from the platform, which interfered with acoustic sampling. Therefore, JRF embarked on a design to decouple as much of the self-noise as possible from the hydrophone and enlisted the help of a veteran acoustician, Michael Holt, who has designed devices for similar purposes. Holt helped them create a mount that would be durable but not too heavy, biofouling resistant and still enables sound transference. To construct this, JRF used a thick-walled 3-in. type K copper pipe, which is an excellent biofouling deterrent and provides mounting strength. They mounted it to the center of the sub to avoid drag or any change in the sub's performance.

To mask mechanical noise, Holt first designed an inner casing tube out of low-density polyethylene to house the hydrophone. To keep it from hitting the bottom or the sides of the tube, they manually cut 15 circles of polyurethane open-cell foam to encase the hydrophone. JRF then sealed the tube and filled

it with medical-grade castor oil, which closely matches the acoustic impedance of seawater. After testing it for leaks, they slid the inner casing into the outer copper pipe modified with 250 drilled holes, which reduced interference within the frequencies of interest.

Data Analysis

During the mission, which started in January and ended in April 2018, the JRF team was periodically transmitting short sound files back to shore via satellite as a contingency for system loss or failure. The Ocean Sonics hydrophone allowed them to set five "triggers" (or epochs) that detect sounds above desired decibel levels and within the desired frequency ranges of whales. The triggers were also used to help filter out specific frequency ranges, such as self-noise.

When the epoch detected a whale, JRF would request a fast Fourier transform (FFT) text file that displayed the relative strength of frequencies sampled over time. Subsequently, they would download the FFT into the Ocean Sonics' software program Lucy, where they could view it as a spectrogram (a graphical representation of the audio). If JRF confirmed there was something of interest from the FFT, they could request an actual mp3 audio file via satellite. Using specialized software, they had the ability to detect humpback whales' sounds by listening to and looking at the different frequencies in the mp3. For reference, baleen whales' frequency range is 20 Hz to 22 kHz, and the humpback whales' song is thought to be 80 Hz to 4 kHz.

The team is currently processing more than 800 surface and underwater pictures, sea surface temperature and salinity data, as well as analyzing more than 2,000 hr. of acoustic data. So far, the data have revealed some unusual sounds, which have yet to be substantiated. Conclusive results will be published in a scientific journal.

A Second Payload: HF Voyager

The HF Voyager is an entirely autonomous high-frequency (HF)

radio station integrated onto Europa. It is a project of the Jupiter Research Amateur Radio Club (JRFARC), a group of amateur radio operators affiliated with JRF. HF Voyager is designed to allow two-way communications with amateur radio operators worldwide and supports a new communication mode that has taken the amateur radio world by storm: FT8. With shorter transmit-receive cycles making for quicker contacts, FT8 is the ideal mode for communicating with this remote station in the Pacific Ocean. Ham operators call the Voyager on the 20-m amateur band, and (if propagation permits) the Voyager will respond with telemetry, including location and other data. The Voyager's responses occur from areas that are rarely occupied by human sailors.

JRFARC has taken off-the-shelf components and customized and integrated them for this application. Additionally, the system supports other digital-mode HF protocols: PSK-31 for two-way communications, and WSPR (transmit only), which will allow them to create a propagation study based on the contacts received over the course of this transpacific mission.

You can visit the JRF website to track Europa's progress, receive updates and view the HUMPACS data portal at www.jupiterfoundation.org and the JRFARC HF Voyager portal at www.jrfarc.org.

Acknowledgments

The HUMPACS mission would not be possible without the contributions of our engineering team, both in

Hawaii and California. Special thanks to Murray Taylor, Adam Taufmann, Kevin Rea and Ravi Mulam. **ST**

Maya Goodoni recently obtained a B.A. in environmental studies and will commence an environmental science graduate program at the University of Hawaii at Hilo. She enjoys environmental and marine research and public outreach. Her goal is to help create more resilient socioecological systems.



Beth Goodwin, a U.S. Coast Guard-licensed captain, has spent more than 30 years identifying marine mammals throughout the eastern tropical Pacific. She is a co-founder of Liquid Robotics and has an M.A. in physiology and behavioral biology from San Francisco State University and a B.A. in marine biology from University of California, Santa Cruz.



Kurt A.F. Kiesow III is a co-founder of both Jupiter Research Foundation (JRF) and Liquid Robotics. He has integrated numerous payloads and sensors in the maritime environment and currently manages several technical programs at JRF. Kiesow is an active amateur radio operator and serves as the president of the JRF Amateur Radio Club.



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NOIA 2018 Annual Meeting

The National Ocean Industries Association (NOIA) held its Annual Meeting April 11 to 13, 2018 at the Ritz-Carlton in Washington, D.C., with more than 150 members in attendance. Speakers included members of Congress and the Trump Administration, academics, policy leaders and industry executives. Among other topics, presenters and attendees discussed the policy outlook for the industry, the development of a new Five-Year Program, geophysical exploration and the status of permit applications in the Atlantic and business opportunities for U.S. companies in Mexican waters.

Safety in Seas Awards

During the meeting, EnVen Energy Corp. and Deepwater Wind were awarded 2018 NOIA Safety in Seas

(SIS) Awards. Compass Publications Inc. sponsors the SIS awards. Outgoing NOIA Chairman Dave Welch presented the awards this year.

EnVen Energy Corp. received the Culture of Safety Award in recognition of its remarkable safety culture transformation between 2013 and 2017. David Carmony, chief operations officer for EnVen Energy accepted the award. EnVen's integrated approach to cultural transformation included improvements in communication, training, job safety analyses, safety and compliance audits and incident investigation management. As a result of these improvements, EnVen's total recordable incident rate (TRIR) saw a 75 percent improvement.

Deepwater Wind received the Safety Practice Award in recognition of safety innovations during and after the



(Left to right) Steve Weyel, CEO, EnVen Energy Corp.; David Carmony, COO, EnVen Energy Corp.; NOIA Chairman David Welch; and Jeff Grybowski, CEO, Deepwater Wind.

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“Focusing on seismic permitting challenges in the Gulf of Mexico and the Atlantic, as well as efforts to remedy obstacles, Sykes and Clark discussed their outlooks for exploration in the Gulf, including the geophysical needs and programs envisioned to support exploration and continued production.”

installation of Block Island Wind Farm in Rhode Island, including the design and use of a crew transfer vessel (CTV) and a transfer/ascent/descent system using self-retracting lifeline (SRL) fall-arrest technology. Jeff Grybowski, president and CEO of Deepwater Wind, accepted the award. Deepwater Wind logged more than 40,000 offshore person-hours without a safety incident during Block Island Wind Farm's first year of operation.

Speakers

Following a heartfelt and rousing NOIA welcome, House Majority Whip Steve Scalise (R-La.) discussed a wide range of policies affecting the offshore industry and captivated the NOIA audience by recounting his near fatal gunshot attack last summer.

Scalise talked openly of faith, family and friends that saw him through his ordeal, and how truly grateful he feels to return to a job he loves so dearly. As whip, his primary job is to find 218 votes for the House's legislative priorities, and he provided his unique perspective on last year's near miss to repeal the Affordable Care Act and this year's success on tax relief.

NOIA members also warmly welcomed Secretary of Energy Rick Perry. Speaking on the Trump Administration's energy policies, Perry provided insight on the active role that the Department of Energy plays in global energy markets. Drawing upon lessons learned while he was governor of Texas, Perry said he believes that most energy shortages are due not to a lack of resources, but rather to a failure of imagination and policy. Creating more regulations that favor one source of energy over another is, therefore, not the best way to increase the availability of affordable and reliable energy.

Environmental Protection Agency (EPA) Administrator Scott Pruitt joined NOIA President Randall Luthi for a friendly, wide-ranging talk that repeatedly underscored the need for regulatory certainty and broke down EPA's progress on reforming policies to provide greater accountability. Pruitt also discussed EPA's efforts to promote stewardship rather than strict prohibition.

Interior Assistant Secretary for Lands & Minerals Management Joe Balash shared an insider's view of the department's priorities, saying that “all of the above energy” is a “principle, not a slogan” within his team. He added that the Interior Department is continuing its efforts to ensure regulations are smart, fair and effective and provided an overview of rules and processes that Interior is currently reexamining.

RAdm. Linda Fagan, deputy commandant for operations, policy and capabilities for the U.S. Coast Guard,

spoke on the significant challenges facing the U.S. maritime sector. Changing dynamics in the Arctic and other areas require more attention given by policy makers to ensure the Coast Guard is able to respond to new needs. In addition, Fagan spoke about energy production in the Gulf of Mexico and along the Atlantic seaboard, as well as growing cybersecurity challenges that maritime operators are facing.

Vali R. Nasr, dean of the Johns Hopkins School of Advanced and International Studies, delivered insight and clarity into the tumultuous situation in the Middle East. Providing a timely look into the geopolitical dynamics of the region, Nasr provided analysis of the conflict in Syria, the role of Iran in the region and Russia's influence in the region. Nasr also examined the impact of the region's diminished energy dominance.

Panel Discussions

NOIA's Geological & Geophysical (G&G) Committee hosted a panel discussion entitled “Regulatory Challenges to Continued & Expanded Access & Production.” The discussion was moderated by IAGC President Nikki Martin and featured BP's Gulf of Mexico/Canada Regional President Starlee Sykes, Deep Gulf Energy CEO Richard Clark and NOAA Chief of Staff Stuart Levenbach. Focusing on seismic permitting challenges in the Gulf of Mexico and the Atlantic, as well as efforts to remedy obstacles, Sykes and Clark discussed their outlooks for exploration in the Gulf, including the geophysical needs and programs envisioned to support exploration and continued production. Levenbach provided a regulatory outlook with a valuable perspective on the Trump Administration's initiatives to ensure continued geophysical activities supporting exploration and production (E&P) in the U.S. Outer Continental Shelf (OCS).

A panel on “Mexico Gulf of Mexico Chapter III: A Major View” tackled Mexico's rapidly growing offshore industry. Moderator Carri Lockhart, senior vice president of offshore development and production of Statoil, was joined by panelists Enrique Hildalgo, president of ExxonMobil Exploration and Production Mexico; Raymundo Piñones, general director of the Mexico Association of Hydrocarbons (AMEXHI); Luis Martinez, chief of staff for the National Agency for Safety, Energy & Environment (ASEA); and Martin Stäuble, vice president of exploration for North America and Brazil for Shell.

The panelists provided a firsthand account of the challenges and opportunities found offshore Mexico. Each underscored the remarkable speed in which Mexico is developing its offshore resources, pointing to a vibrant

dialogue between industry and regulators. Providing a private sector perspective, Stäuble said that mature infrastructure in the U.S. Gulf of Mexico gives the area a significant advantage compared to the Mexican Gulf of Mexico.

NOIA's Offshore Renewables Committee hosted a special panel on the market opportunities the fast-growing U.S. offshore wind industry offers for the oil and gas supply sector. The panel was moderated by Stephanie McClellan, director of the Special Initiative on Offshore Wind (SIOW), who also presented a market update of the U.S. offshore wind industry. Panelists included James Bennett, chief of the Office of Renewable Energy Programs for the Bureau of Ocean Energy Management (BOEM); Alejandro de Hoz, vice president of U.S. Offshore Wind for Avangrid Renewables; and Andrew Cooper, branch manager at Fugro USA. The session provided an update of offshore wind development in the U.S., from the perspectives of both the private sector and U.S. government, and highlighted growing opportunities for the U.S. oil and gas supply and vendor chain.

Walter Cruickshank, acting director of BOEM, and Katharine MacGregor, principal deputy assistant secretary for Lands and Minerals Management, led a discussion on the offshore regulatory outlook during a session hosted by NOIA's Technology Policy Committee. Chevron Senior Advisor Greg Kusinski moderated the session. Cruickshank and MacGregor provided an insider's look at BOEM and Interior's regulatory agenda, detailed progress on the new Five-Year Program and shared what their agencies hope to achieve once the first analysis of the OCS in nearly 35 years is finalized.

“...an insider's look at BOEM and Interior's regulatory agenda, detailed progress on the new Five-Year Program and...what their agencies hope to achieve once the first analysis of the OCS in nearly 35 years is finalized.”

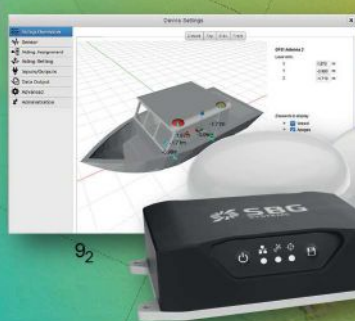
ress on the new Five-Year Program and shared what their agencies hope to achieve once the first analysis of the OCS in nearly 35 years is finalized.

NOIA's Public Affairs & Education Committee held a panel discussion on industry outreach that featured Lynne Hackedorn, Robert Moran and Georgetown student and IPAA/PESA Petroleum Academy graduate Paige Jefferson. Moderated by Halliburton Vice President for Industry Affairs Galen Cobb, the panelists spoke on ways the offshore industry, and companies of varying sizes, could engage in Washington, D.C., and in local communities, as well as reach out to the next generation.

Next Meeting

The next NOIA Annual Meeting will take place October 3 to 5, 2018 at the Hyatt Regency Hill Country Resort in San Antonio, Texas. **ST**

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VHF Maritime Mobile Band

A New System to Declutter AIS Channels

By Dr. Sanjin Valcic • Dr. Srdan Zuskin • Dr. David Brcic

Nowadays, AIS technology is being used beyond the identification and tracking of ships. This has resulted in the congestion of its channels and degradation of its efficiency. Meanwhile, the need for modernization of the Global Maritime Distress and Safety System (GMDSS) has prompted research and development of new solutions for data exchange in the VHF maritime mobile band. The International Telecommunication Union (ITU) proposed possible systems for data transmission, based on the land mobile communication system, Terrestrial Trunked Radio (TETRA), which could be used in the VHF maritime mobile band.

The International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) has developed a technological concept, the VHF Data Exchange System (VDES), to solve congestion of AIS channels. The VDES additionally supports the International Maritime Organization's (IMO) strategy implementation plan for e-navigation and the modernization of the GMDSS with essential digital communications. As part of the improved provision of services to vessels through e-navigation, Maritime Service Portfolios (MSPs) have been identified as the means of providing electronic information in a harmonized way.

Maritime service portfolios.	
Maritime Service Portfolio	Identified Services
MSP1	Vessel Traffic Service (VTS) Information Service (IS)
MSP2	Navigational Assistance Service (NAS)
MSP3	Traffic Organization Service (TOS)
MSP4	Local Port Service (LPS)
MSP5	Maritime Safety Information Service (MSI)
MSP6	Pilotage service
MSP7	Tugs Service
MSP8	Vessel Shore Reporting
MSP9	Telemedical Assistance Service (TMAS)
MSP10	Maritime Assistance Service (MAS)
MSP11	Nautical Chart Service
MSP12	Nautical Publications Service
MSP13	Ice Navigation Service
MSP14	Meteorological Information Service
MSP15	Real-time Hydrographic and Environmental Information Service
MSP16	Search and Rescue (SAR) Service

At the World Radiocommunication Conference – 2012 (WRC-12), it was resolved to consider regulatory provisions and spectrum allocations to enable possible new AIS terrestrial and satellite technology and new applications to improve maritime radiocommunication in general. It was recognized that advanced maritime communication systems, such as the VDES, may support the implementation of the GMDSS modernization and e-navigation, requiring a review of the Radio Regulations to accommodate advanced maritime communication systems. The ITU developed the technical characteristics of the VDES, which were partly adopted at WRC-15.

Revision of Radio Regulations' Appendix 18

At WRC-15, the table of transmitting frequencies in the VHF maritime mobile band, Appendix 18 of the ITU's Radio Regulations, was revised. As a result, from January 1, 2017, the adjacent two-frequency channels 80, 21, 81, 22 were identified for use by the digital systems described in ITU's Recommendation ITU-R M.1842-1, which are operating on multiple 25-kHz contiguous channels (100-kHz bandwidth). In addition, the adjacent two-frequency channels 23 and 83 are identified for use by the same digital systems that use two 25-kHz contiguous channels (50-kHz bandwidth), and the two-frequency channel 82 is split on two single-frequency channels for utilization by the same systems.

Furthermore, from January 1, 2017, the adjacent two-frequency channels 24, 84, 25, 85, 26 and 86 were identified for the utilization of the VDES. From January 1, 2019, the channels 24, 84, 25 and 85, which are intended for the VDES, may be merged to form one duplex channel with a bandwidth of 100 kHz to operate the terrestrial component of the VDES.

Adjacent channels 27, 87, 28 and 88 may be used for possible testing of future AIS applications until January 1, 2019. The two-frequency channels 27 and 28 may be used as single-frequency channels: 1027 and 1028 for lower frequencies, and 2027 and 2028 for upper frequencies. From January 1, 2019, these channels will be divided into two simplex channels, because channels 2027 and 2028 are designated as ASM 1 and ASM 2 channels, which are used for VDES application specific messages (ASM).

Maritime VHF Data Exchange System

While the VDES technology concept was developed to solve AIS channel congestion, it also allows a wide variety of information envisaged by the strategy implementation plan for e-navigation, which also potentially supports the modernization of the GMDSS. The VDES could have a significant positive impact on the provision of maritime information services, such as maritime safety

Maritime VHF channels and frequencies used for the VDES.			
Channel		Frequencies for ship and coast stations (MHz)	
		Ship stations (ship-to-shore) Ship stations (long-range AIS) Ship stations (ship-to-satellite)	Coast stations Ship stations (ship-to-ship) Satellite-to-ship
AIS 1		161.975	161.975
AIS 2		162.025	162.025
75 (long-range AIS)		156.775 (ships transmitting only)	
76 (long-range AIS)		156.825 (ships transmitting only)	
2027 (ASM 1)		161.950 (2027), SAT up 1	161.950 (2027)
2028 (ASM 2)		162.000 (2028), SAT up 2	162.000 (2028)
24/84/25/ 85 (VDE1)	24/84/25/85/26/ 86 (SAT)	100/150-kHz channel 1024/1084/1025/1085, lower frequencies merged, VDE1-A, ship-to-shore 1024/1084/1025/1085/1026/1086, ship-to-satellite, SAT up 3	100/150-kHz channel 2024/2084/2025/2085, upper frequencies merged, VDE1-B, ship-to-ship, shore-to-ship 2024/2084/2025/2085/2026/2086, satellite-to-ship, SAT downlink
24 (VDE1)	24 (SAT)	157.200 (1024)	161.800 (2024)
84 (VDE1)	84 (SAT)	157.225 (1084)	161.825 (2084)
25 (VDE1)	25 (SAT)	157.250 (1025)	161.850 (2025)
85 (VDE1)	85 (SAT)	157.275 (1085)	161.875 (2085)
	26 (SAT)	157.300 (1026)	161.900 (2026)
	86 (SAT)	157.325 (1086)	161.925 (2086)

information (MSI), general data communications at high data rates, locating, vessel traffic management, satellite communications, etc.

The VDES uses a two-way data exchange on channels from the VHF maritime mobile band in: ship-to-ship; ship-to-shore and shore-to-ship; and ship-to-satellite and satellite-to-ship directions. The data exchange using the VDES is as follows: AIS – standard AIS report; ASM (navigational, meteorological and hydrographical information); VDE (VHF data exchange) – general exchange of information; and SAT – data exchange between ships and satellites.

The AIS 1 and AIS 2 are the AIS channels used for the terrestrial link in accordance with ITU's Recommendation ITU-R M.1371-5. These channels are also used as the uplinks for receiving AIS messages by satellite. The long-range AIS channels 75 and 76 are also channels used as uplinks for receiving AIS messages by satellite. The ASM 1 (channel 2027) and ASM 2 (channel 2028) are the channels used for application specific messages; the VDE1-A (single or merged channels 1024, 1084, 1025, 1085) is ship-to-shore VDE channels, and the VDE1-B (single or merged channels 2024, 2084, 2025, 2085) is shore-to-ship and ship-to-ship VDE channels. The SAT Up1 (channel 2027) and the SAT Up2 (channel 2028) are used for receiving ASM by satellite, while the SAT Up3 (single or merged channels 1024, 1084, 1025, 1085, 1026 and 1086) is used for ship-to-satellite VDE

“Information regarding the safety of navigation and protection of the environment can be transmitted through the VDES. In addition, safety-related information could use the broadcast aspect of the VDES, both terrestrial and satellite, such as meteorological and hydrographical information.”

uplinks, and the SAT downlink (single or merged channels 2024, 2084, 2025, 2085, 2026 and 2086) is used for satellite-to-ship VDE downlinks.

VDES Technical Characteristics

The ASM should be capable of receiving on two parallel channels and transmitting on two independent channels using different time division multiple access (TDMA) schemes depending on the application and mode of operation, using the same principle as in AIS. Two separate TDMA receiving processes should be used to simultaneously receive on two independent frequency channels, and one TDMA transmitter may be used to enable TDMA transmissions on one of two independent frequency channels. The modulation scheme for digital transmission is $\pi/4$ quadrature phase-shift keying (QPSK) with the transmission bit rate of 19.2 kbit/s. The modulation technique and transmission bit rate provide the transmission of 512 bits in one time slot, which is defined as in the AIS (26.67 ms).

The data transmissions for the purpose of the VDE are made within the spectrum allocated for the VDE1-A and VDE1-B. The spectrum may be used as 25-, 50- or 100-kHz channels. As for the ASM, the VDE uses TDMA techniques in a synchronized manner for the channel accessing. Moreover, the VDE uses adaptive modulation and coding to maximize spectral efficiency and throughput, i.e., the data rate. The modulation schemes are $\pi/4$ QPSK, 8-PSK and 16-quadrature amplitude modulation (QAM), which could be used on 25-, 50- and 100-kHz channels. When using $\pi/4$ QPSK modulation technique, the transmission bit rate on the 25-kHz channel is 38.4 kbit/s. While using the 8-PSK and 16-QAM modulation, the transmission bit rate on the 25-kHz channel is 57.6 kbit/s and 76.8 kbit/s, respectively. When using the same modulations on 50- and 100-kHz channels, the transmission bit rate is doubled and quadrupled, respectively.

The channels for the satellite link were introduced in the ITU's recommendation, but they were not accepted and established at WRC-15. It was only resolved to consider modifications of the Radio Regulations, including new spectrum allocations to the maritime mobile-satellite service to enable a new VDES satellite component, while ensuring that this component will not degrade the current terrestrial VDES components, ASM and AIS operations and not impose any additional constraints on existing services in these and adjacent frequency bands.

Possible VDES Applications

The VDES operates within the existing AIS environment, simultaneously supporting requirements for the

GMDSS communications, including distress, urgency and safety-related messages. Therefore, the VDES applications need to be uniquely identified and operated in a manner that ensures there is no unnecessary repetition of messaging to avoid data collisions and channel congestion.

In order to assist the end-users in identifying possible options for the implementation of the VDES, a number of potential scenarios have been developed by IALA, in line with e-navigation MSPs. These scenarios include: SAR communications, maritime safety information, ship reporting, vessel traffic services (VTS), charts and publications, route exchange and logistics.

The VDES could use both addressed and broadcast communications to support SAR response, as an alternative to GMDSS communications. After the implementation, the VDES satellite component (VDES-SAT) may be an effective means to extend the VDES to areas outside the coastal VHF coverage. The VDES-SAT may deliver information in a broadcast, multicast or unicast mode to a wide area, addressing many ships using only minimal radio spectrum resources (max 150 kHz). As a communications medium, the VDES may be used to relay distress alerts and locating signals (SART, EPIRB, MOB, etc.). Additionally, the VDES can be used in SAR planning, execution and decision making.

Information regarding the safety of navigation and protection of the environment can be transmitted through the VDES. In addition, safety-related information could use the broadcast aspect of the VDES, both terrestrial and satellite, such as meteorological and hydrographical information. This also includes the ability to send information to a predetermined area or an area of particular interest.

Ship reporting may include mandatory and voluntary reports required for a number of purposes by vessels to various shore authorities. Information forwarded through the VDES may transfer the reports for integration into national and/or regional systems. The information may also be sent to the ship agent, owner, service provider or VTS. This ship reporting could use the addressed aspect of the VDES.

The VDES could be used to monitor vessels and autonomously provide information to these vessels based on the predetermined parameters as defined by the shore authority. Additionally, the VDES could be used for the provision of VTS information services (IS), navigational assistance services (NAS) and traffic organization services (TOS).

The provision of the up-to-date and adequate information on charts and publications could use the addressed

and broadcast aspects of the VDES. Moreover, the route exchange could also take the advantage of the addressed and broadcast aspects of the VDES. In this way, the route exchange could enhance safety by providing early indication of changes in route that may be due to fatigue, weather conditions or condition of the vessel (malfunction).

Logistical elements where the VDES may be an appropriate communication method include: transfer of vessel loading plan, tug operations, pilotage operations, stores/supplies/ship bunkers, and waste removal.

Conclusion

The ITU has developed the technical characteristics of the VDES, which integrates AIS, ASM and VDE, using the timing and frame structure of the AIS. The AIS channels are primarily used for the surveillance and the safety of navigation purposes in ship-to-ship use, ship reporting and vessel traffic services applications, while its other currently used applications are deployed onto the new channels.

The VDES is an adaptive system, depending on the propagation characteristics and mode of operation, and can achieve 32 times higher data rate when compared to AIS. These technical characteristics were accepted at WRC-15, and Appendix 18 of the ITU's Radio Regulations was revised in order to allocate the frequency spectrum for the terrestrial component of the VDES. When considering the implementation aspects of the VDES there is

a growing need for the establishment of a future VDES satellite component to offer potential enhancements to maritime safety, including the GMDSS, and expand the system from coastal areas to global coverage. Hence, further research is essential, including the mobile-satellite service reallocation and the consideration of the potential impact of possible modifications to the provisions of the Radio Regulations on sharing and compatibility with other services and systems in the VHF maritime frequency band and adjacent frequency bands.

The VDES will have a very important role in improving communications to enhance maritime capabilities and supporting the strategy implementation plan for e-navigation.

References

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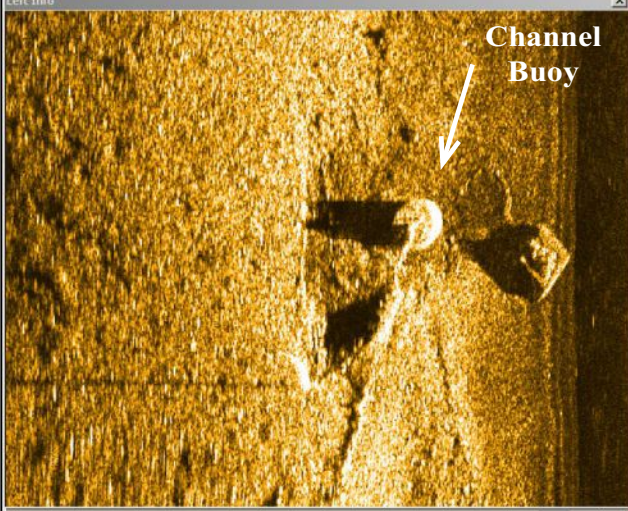
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Riptide Implements Open Architecture Autonomy On US Government UUV Mission Controllers

Riptide and Draper will implement the maritime open architecture autonomy (MOAA) that Draper developed as an extensible open architecture framework for autonomous mission controllers for AUVs through millions of dollars of investment and decades of research and development. Draper has received approval from the Naval Undersea Warfare Center Division Newport to provide MOAA as an option on all Riptide UUVs sold to the U.S. government or government-purposed vehicles.

Patrol Boats Delivered to Curacao Coast Guard

Four new high-speed patrol boats manufactured by Metal Shark for the Dutch Caribbean Coast Guard (DCCG) have been commissioned on the island of Curacao. The new vessels are the first to be delivered under a 12-boat order announced last year. The 38 *Defiant* monohull patrol boats are the result of a multiyear effort by the DCCG to replace its fleet of open-cockpit RIBs. The new vessels will serve as the DCCG's main interceptors, patrolling the territorial waters of Aruba, Bonaire, Curacao, St. Eustatius, St. Maarten and Saba.

Remote Survey Trials Include Successful Acoustic Jumper Metrology

An acoustic jumper metrology was successfully conducted using the Sonardyne Connect software in conjunction with 4D Nav's remote survey system in the Gulf of Mexico. Acoustic long baseline (LBL) data and pressure sensor data were collected at a network operations center onshore in Houston. The direct interface to the Sonardyne 6G transceiver enabled by the Connect software allowed full control of LBL data collection, as well as logging of pressure sensor data for depth loops.

Multispectral Challenge Produces Mathematical Solutions for Multispectral Backscatter Data

M. Timo C. Gaida from Delft University of Technology was recognized as the winner of the Multispectral Challenge at GeoHab 2018. R2Sonic launched the Multispectral Challenge following the introduction of the multispectral mode available with R2Sonic's multibeam echosounder Sonic. Given that each frequency provides different acoustics returns, it was believed that the multispectral mode could be a game-changer for bottom characterization. The challenge was to develop an algorithm to determine bottom type based on multispectral data.

Kraken Synthetic Aperture Sonar Receives Military Standard Certification

Kraken Robotic Systems Inc. completed military standard certification testing of the KATFISH-M, a ruggedized version of its KATFISH towed synthetic aperture sonar platform. KATFISH-M incorporates a synthetic aperture sonar in a compact, lightweight and hydrodynamically stable towed body. It uses advanced signal processing

and algorithms to provide real-time detection and classification against underwater mine threats.

Titanic Survey Expedition Rescheduled to 2019

OceanGate has rescheduled its 2018 *Titanic* Survey Expedition to the summer of 2019. To conduct the first manned expedition to *Titanic* since 2005, OceanGate built Titan, a five-person submersible designed to dive to depths of 4,000 m. Deep-sea testing began in April near Marsh Harbor in the Bahamas, but upon arrival the sub's electronics sustained lightning damage that affected more than 70 percent of its internal systems, preventing testing and delaying the mission.

Waterjet Robotics Receives Funding For Continued Product Development

Waterjet Robotics U.S.A. has secured a seven-figure funding package with Decathlon Capital Partners. The company's products are used throughout the international marine industry for removing vessel coatings for surface preparation in an automated and environmentally sensitive manner. This market consists of ships, barges and other large vessels, both commercial and military, in drydocks at the 3,000 shipyards that service the more than 80,000 vessels at repair facilities worldwide.

65,000 Square Kilometers of Data Earn NOAA Recognition for Fugro

Fugro's leadership in advancing global ocean mapping has earned it a formal commendation from NOAA. Over the past year, the company has contributed more than 65,000 sq. km of high-resolution, crowd-sourced bathymetry data to NOAA in support of the seabed 2030 mapping project. Fugro is collecting the seabed data while transiting between offshore survey projects.

310-Year-Old Spanish Shipwreck Discovered

The wreck of the Spanish Galleon *San Jose* was discovered on November 27, 2015 and recently made public. The search was performed by the Woods Hole Oceanographic Institution (WHOI) REMUS 6000 AUV equipped with an EdgeTech 2200 side scan sonar. The *San Jose* was a 62-gun flagship galleon of a Spanish fleet carrying gold, silver and emeralds from the mines of Peru back to Spain. It was sunk June 8, 1708 in a battle with the British off of Cartagena, Colombia.

BIRNS Earns ISO 9001:2015 Certification

The BIRNS Quality Management System is certified to ISO 9001:2015 by DNV GL after an audit of its business and manufacturing processes. The ISO 9001:2015 standard focuses on risk-based thinking and accountability in all organizational processes, leadership involvement and demonstrated commitment to understanding the needs and expectations of interested parties, with the result of continual improvement.

KVH Connectivity Added to 45 BW Group Vessels

BW Group has chosen KVH's connectivity services for 45 additional vessels in its fleet. The two companies will also pursue a connectivity contract for BW's LPG

and LNG vessels that have had KVH's VSAT systems and services. BW's fleet includes product tankers, LPG and LNG carriers, FSRUs, dry bulk carriers, chemical tankers, offshore vessels and crude carriers.

COVE Continues to Welcome New Tenants

Four more ocean technology companies have signed on to be located at the Centre for Ocean Ventures and Entrepreneurship (COVE). The new tenants include Sensor Technology, Enginuity, Pisces Research Project Management and MacArtney Canada. COVE is a collaborative facility for applied innovation in the ocean sector that is located in Halifax Harbor, in Nova Scotia, Canada. Its mission is to propel the ocean economy by providing marine infrastructure and a collaborative space in which a community of ocean enterprises can grow and prosper.

Decatur Marine Audit & Survey Authorized to Conduct AWO Audits

The American Waterways Operators (AWO) approved Decatur Marine Audit & Survey to conduct audits of AWO members as part of its Responsible Carrier Program (RCP). Towing vessel operators are determining how to meet new U.S. Coast Guard (USCG) Subchapter M regulations establishing vessel safety and inspection requirements. AWO's RCP has been accepted by the USCG as a system that meets Subchapter M requirements.

Trident Acquires Italian Cruise Ship Construction Company

Trident Maritime Systems completed acquisition of Newsystem srl. Trident is a provider of turnkey marine systems and solutions for government and commercial vessel new construction, retrofit and repair both in the U.S. and internationally. Newsystem is a provider of out-fitting systems and solutions for the cruise ship new construction market. The company is located near Bergamo, Italy, and operates in shipyards throughout Italy.

Twin Disc Celebrates 100th Anniversary

Twin Disc is celebrating 100 years with local, national and international events throughout the year. Twin Disc entered the marine market in the 1930s, manufacturing countershaft reduction gears with 100 percent reverse power.

During WWII, it converted its operations to the production of essential war materials, especially Higgins Boats and artillery tractors, for which it was awarded the Army-Navy "E" Award. It has grown into a leader in innovative propulsion equipment on vessels worldwide and within numerous heavy industries.

Identity of Steamboat *Pulaski* Confirmed

Blue Water Ventures International and Endurance Exploration Group have verified the identity of the Steamboat *Pulaski* using several artifacts recently recovered. The *Pulaski* sank in 1838 off the coast of North Carolina. The new discoveries were facilitated by advanced nitrox-enriched diving, which allows divers longer bottom time to explore the site and create better working grids on the seafloor. **ST**

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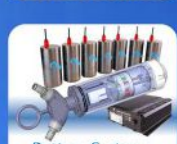
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Scottish Underwater Training Center Revived with Industry Support

The Underwater Centre, a facility for testing sub-sea equipment located in the Scottish Highlands, has received support from Oil & Gas UK, Subsea 7, TechnipFMC, Premier Oil and Highlands and Islands Enterprise. It will operate as a nonprofit company funded and supported by its members. Representatives of Subsea 7, TechnipFMC and Premier Oil will join the board of The Underwater Centre, which began operating in May.

WWI Australian Submarine Located

A joint U.S.-Australian expedition to survey Australia's first submarine *HMAS AE1* has provided detailed new images of the 103-year-old shipwreck, which lies on the seafloor off the Duke of York Islands in Papua New Guinea. The Royal Australian Navy's *HMAS AE1* was lost at sea on September 14, 1914. It was the first loss for the RAN and the first Allied submarine loss in World War I. The recent survey was undertaken by Microsoft co-founder Paul Allen's research vessel *Petrel* and coordinated by Find AE1 Ltd.

IMO Approves Fleet Safety Solution

The International Maritime Organization's Maritime Safety Committee has approved Inmarsat's Fleet Safety solution as a new service to support the Global Maritime Distress & Safety System (GMDSS). Ship owners and operators currently deploying FleetBroadband or Fleet One will be able to access GMDSS-approved safety services, as well as new safety features only available via the Inmarsat Fleet Safety system. Inmarsat intends to create a new generation of stand-alone terminals that incorporate FleetBroadband and MST into a single device and deliver speeds in excess of 1 Mbps.

Teledyne Marine to Collaborate on Development of Saudi Arabian Technology

Teledyne Marine and Research Products Development Co. (RPDC) are collaborating on global commercialization of new technologies developed within Saudi Arabia. A first success is the award of a development contract that will integrate a unique sensor design developed by Saudi Aramco. The integrated sensor can perform both ultrasonic thickness readings and cathodic protection voltage measurements at a single touchdown, reducing inspection costs for shallow-water pipelines, minimizing inspection safety hazards and enabling the inspection of hard-to-reach sections.

New Chinese Icebreaker Fitted With Moving Vessel Profiler

The Polar Research Institute of China has chosen AML Oceanographic's MVP300 as the profiling system for their new icebreaker, *Xuelong 2*. With expedition objectives ranging from climate change research to natural resource studies, the MVP will be a critical system

in support of realizing the icebreaker's mandate. This is the second contract for the MVP300 within the last four months and includes instrumentation, installation and training services.

Next-Generation Open Ocean USVs To Be Developed with Grant

The next generation of USVs, the accession class from Unmanned Survey Solutions (USS), will proceed with development with a grant from Marine-i, partly funded by ERDF (European Regional Development Fund). USS, based in Hayle, Cornwall, introduced inception-class Mark 1 and Mark 2 USVs to the market for surveying in shallow coastal or inland areas. The next generation accession-class USV is larger, for use in the open ocean.

Search for Malaysian Airlines Flight MH370 Concludes

Ocean Infinity has concluded its current search for the wreckage of Malaysian Airlines Flight MH370. During the course of its operation, Ocean Infinity searched and collected high-quality data from more than 112,000 sq. km of ocean floor in challenging conditions and terrain. The total area covered, in a little more than three months of operational days, is in excess of the initial 25,000 sq. km target and almost the same area as the previous search achieved in 2.5 years.

DeepOcean Launches Cable Repair Service

DeepOcean 1 UK Ltd. has launched a subsea cable repair service called Reconnect to reduce the likelihood of cable damage and subsequent failure through periodic inspection and maintenance, as well as reducing the impact upon the operator should a cable failure occur. The service includes fault identification and fault location services, cable decommissioning, recovery and disposal, and support from engineering, geotechnical and operational experience.

Newport Shipping Opens Three New Offices

Newport Shipping Group opened new offices in New York City, Shanghai and Athens to expand its presence in key shipowning and ship repair communities around the world. The Athens, Istanbul, Shanghai and Singapore offices are focused on ship repair and technical needs, while New York and the London headquarters manage corporate and international operations.

STEM Subjects Encouraged by European Marine Energy Centre Ambassadors

STEM Ambassadors from the European Marine Energy Centre (EMEC) are volunteers who seek to raise the profile of careers in science, technology, engineering and mathematics (STEM) among students. EMEC has a significant resource in STEM subjects, covering chemistry, environmental science, marine engineering and renewable energy.

EMEC's STEM Ambassadors' first assignment was during Orkney School's Japan Week, after an invitation to attend St. Andrew's Primary School to discuss the connection between Orkney and Japan in renewable energy.

UMAR|WSR Cooperates to Expand Operations

The UMAR|WSR Group is expanding its operations into Singapore, the Middle East and Russia following the signing of cooperation agreements with two of its main principals, Lagersmit of the Netherlands and the Detyens Shipyard in Charleston in the U.S. Under the agreement, UMAR|WSR will represent the interests of Lagersmit in Dubai, Oman and Qatar and the interests of Detyens in Singapore, the United Arab Emirates and Russia. It already acts for both companies in Cyprus and Greece.

DNV GL Releases Cybersecurity Notation

Classification society DNV GL announced the release of its first class notations to help shipowners and operators protect their assets from cybersecurity incidents. The new class notations, "cyber secure," help owners and operators protect vital systems from cybersecurity threats. They will be published on the DNV GL rules page in July 2018.

Trade Mission to France Led By Marine Renewables Canadian

Representatives of Canada's marine renewable energy industry traveled to Cherbourg, France, to showcase expertise and capabilities to an international audience in a trade mission that included 30 delegates to the seventh International Conference on Ocean Energy (ICOE). The conference is a significant event for the emerging global marine renewable energy industry aimed at building partnerships and sharing recent experiences from project and technology development.

DP World Joins World Ocean Council

DP World has become the first company in its sector to join the World Ocean Council (WOC). DP World operates multiple related businesses, including marine and inland terminals, maritime services, logistics and ancillary services to technology-driven trade solutions. The announcement was made on World Oceans Day in June.

New Corrosion Consortia Provides Data for Better Research in Corrosion Solutions

NACE International has formed the NACE Corrosion Consortia, a service facilitating corrosion mitigation research for companies, government bodies, research organizations and universities. The NACE Corrosion Consortia is engaging multiple organizations to perform research in key industries including maritime, offshore (wind energy), fish farming, additive manufacturing, construction and architecture.

Forum Energy to Distribute Electric ROVs In Netherlands and Belgium

Forum Energy Technologies expanded its operations in Europe by appointing a new distributor for subsea vehicles across the Netherlands and Belgium. Seascope Subsea Technology BV will represent Forum Energy Technologies for the sale of the company's ROVs in the two countries, including its recently launched electric ROV, the XLe Spirit. **ST**



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Fast Tilt-Acceleration Logger



For fast sampling of tilt-acceleration and depth of subsea gear, Star-Oddi announces the new Starmon tilt. The instrument can record as fast as 100 times per second. The large memory stores nine million recordings, and its battery can last ten years. Star-Oddi hf.

Mobile Identification App

A new app allows long-term traceability through automatic identification of Ecofloat parts or vehicles. The app uses near field commu-

nication as part of a passive radio frequency identification system that allows customers to easily reorder products, look up product information and design new buoyancy from a smart phone. Trelleborg.

New Release of Pipeline Software

Version 19.0 of the cloud-based Pipeline Toolbox software features a range of improved calculations and applications to enhance the user experience, along with an embedded new license manager that strengthens security. Technical Toolboxes.

Multibeam Sounder

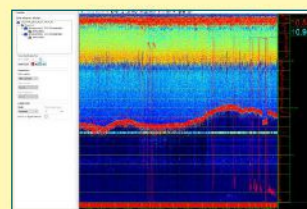
The F3X multibeam sounder offers significantly more power than previous models, as well as long pulse time that equates to more energy in the water and increased clarity in

shallow and medium depths of 50 to 500 m. The F3X, with an 80-kHz transducer, provides the ability to operate as a sounder in depths of 1,000 m. WASSP.

Wide Angle Conversion Lenses

The UWL-400F 24-mm and UWL-04F 28-mm wide-angle lenses are "wet" wide-angle lenses for compact housings. UWL-400F features a wide field of view and zero minimal focus distance for extra sharp wide angle and close focus images. UWL-04F has a 160° field of view. Fantasea Line.

Single-Beam Data Viewer



A new online SBES Echogram view displays single-beam echogram data to control a single-beam device. The new features eliminate the need for external visualization or command and control software, enabling more screen space for survey information. Teledyne PDS.

Deep-Sea Camera System

A new pressure-activated self-contained camera system is activated by a pressure switch in an intelligent battery pack that can be programmed at the surface to turn the camera on and off at specific depths. It can also independently or concurrently activate any instrumentation that is connected to it. OSIL.

Satellite Terminal

ST 6100 includes a satellite terminal with a built-in antenna and accelerometer, expanded memory and enhanced GPS. It is environmentally sealed and can be used to remotely control equipment, including reclosers, pipelines, meters and generators operating in extreme environments. ORBCOMM.

Automated Oil Blending

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oil with oil products has three new models, B500 Mk2, B1000 Mk2 and B3000. The technology has been enhanced with integrated software that automates the system to produce fit-for-purpose cylinder lubricants using data received from sensors on board. Maersk Fluid Technology A/S.

Internet Antenna



The weBBoat 4G PRO antenna receives 4G/3G and Wi-Fi signals and amplifies and redistributes them throughout the vessel. It offers simultaneous internet access for up to 32 devices, including networked onboard systems. Glomex Marine Antennas USA.

Satellite Wi-Fi Hotspot

Sat-Fi2 connects up to eight personal smart devices to a private satellite Wi-Fi network where cellular service is unavailable. The Sat-Fi2 app facilitates email, text, talk and file sharing, plus S.O.S. capabilities that allow direct communication with GEOS to facilitate search and rescue. Globalstar Inc.

USV Launch and Recovery

A universal, low-cost launch-and-recovery system for USVs includes a self-floating dock that can be operated with any standard crane or davit. It is compatible with variants of platforms such as RIBs and FRCs. RC Dock.

Ultra-Portable ROV

The CCROV is a portable underwater robotic system with 4K video, an underwater automatic hover function and six thrusters. It uses battery and DC power supply via cable and dives to 100 m. VxFly Intelligent Information Technology Co Ltd.

Maintenance Management

The SeaStock Management Solution

assumes management of onboard maintenance including condition surveys, ordering, logistics, communication, business and technical reviews, optimizing products for individual requirements, and crew education. Jotun A/S.

Bathymetric Data Workflow

HIPS and SIPS now support drag and drop for raw sensor files, with raw data automatically processed and georeferenced. Version 11.0 has a georeference bathymetry function that initiates sound velocity correction, load tide, apply tide, merge and compute total propagated uncertainty. Teledyne CARIS.

Online Crew Training

A Videotel Performance Manager (VPM) update includes online training with a suite of eLearning material accessible on any web-enabled device. Content is automatically repurposed for mobile, tablet and web browsing. KVH Videotel.

AIS Transmitter

The Simrad V3100 Class B AIS allows a vessel to be detected at greater range and provides transmission to satellite-based AIS receivers. The package can negotiate a regular transmission time slot with other AIS units, facilitating more frequent and reliable position updates in areas with high AIS activity. Navico A/S.

Multi-Site Cybersecurity

ICS Shield is a technology security management solution for securing connected industrial control system environments with multiple physical sites and automation equipment types. It enables secure management of remote field assets through a single security operations center. Honeywell Process Solutions.

Cable-Laying Software Updates

MakaiLay software including Auto-Slack and Auto-NAV generates the optimal sequence of instructions for a cable engine and vessel DP to accurately install a submarine cable with the target bottom tension along the desired route. Makai Ocean Engineering Inc. **ST**



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MARAD Grants For US Shipyards

The U.S. Department of Transportation's (USDOT) Maritime Administration (MARAD) made available \$19.6 million in federal funding to support capital improvements and employee training at small U.S. shipyards. The grants are provided through the Small Shipyard Grant Program and help eligible shipyards modernize operations, increase efficiency and reap the benefits of increased productivity. The grants, to be awarded in July, are for U.S. shipyards with less than 1,200 production employees.

Pilot Program Allows States to Manage Recreational Red Snapper Fishing in Gulf

U.S. Secretary of Commerce Wilbur Ross commended the innovative, two-year pilot program that grants partial management responsibility of the Gulf of Mexico red snapper fishery to the five Gulf states. Red snapper caught by private anglers in state and federal waters off Alabama, Mississippi, Florida, Louisiana and Texas will be covered by the program. The U.S. Department of Commerce and NOAA Fisheries encouraged the states to submit exempted fishing permit applications to test new and innovative ways to manage recreational red snapper fishing. The permits allow those states to manage recreationally caught red snapper in state and federal waters and test data collection methods. Each state will set its 2018 and 2019 private angling red snapper season, monitor red snapper landings, and close the private angling season when the state's assigned quota is reached.

Royalty Rates to Stay the Same For Offshore Oil, Gas for Now

U.S. Secretary of the Interior Ryan Zinke announced that the Department of the Interior will not lower royalty rates for future offshore oil and gas lease sales at this time.

On February 28, the Royalty Policy Committee (RPC), re-chartered by Zinke in 2017, made its initial recommendations, including one to set a royalty rate of 12.5 percent on all Outer Continental Shelf (OCS) lease sales at all water depths through 2024. Since then, an improving economy, federal tax reforms, higher energy prices and greater regulatory certainty have led to positive market conditions, prompting Zinke's determination to keep the royalty rate in 200 m of water and deeper at 18.75 percent.

US Coast Guard Tests Eco-Friendly Buoy Moorings

The U.S. Coast Guard uses navigational buoys to direct water traffic and to protect vulnerable benthic ecosystems such as seagrass communities and coral reefs in U.S. waters. However, most buoys are currently attached to the seafloor by concrete anchors, also called sinkers, and heavy metal chains that can have just as significant

an impact on marine life. Sinkers can damage life on the seafloor under their heavy footprint, and when the connecting chains are lax, they can scrape off seagrasses, seaweeds and corals around the sinkers as waves and wind push the buoys around.

The Coast Guard has been struggling to find a solution for more than 20 years. It reached out to the Department of Homeland Security (DHS) Science and Technology Directorate (S&T) for help. S&T organized a prize competition January 2016 that yielded a simple, effective buoy mooring system: Instead of a concrete sinker, Cole Keaoulu Santos, an innovator from Hawaii, proposed a narrow screw anchor; instead of a heavy metal chain, he suggested an elastic rope to prevent scraping of the seafloor. For the next two years, the Coast Guard will test the buoy moorings' durability, then prepare a final report to support future decisions.

National Marine Sanctuary Foundation Award Winners

Every year, the National Marine Sanctuary Foundation honors individuals and organizations whose professional or personal accomplishments make a difference in ensuring a healthy future for the ocean and Great Lakes.

Gordon and Betty Moore received the Lifetime Achievement Award this year for their critical leadership on environmental conservation and science. Through their foundation's work on scientific discovery, on-the-water conservation programs and using financial markets to support conservation, they are driving innovation.

Will Benson received this year's national Volunteer of the Year Award. He works to build and strengthen partnerships between the recreational fishing community and Florida Keys National Marine Sanctuary.

The BBC received the Conservation Innovation Award for the groundbreaking documentary series "Blue Planet II." By introducing viewers to amazing species and seascapes and the challenges facing the ocean, BBC is inspiring new ocean guardians.

BSEE Proposes Reducing Regulations On Blowout Preventers, Well Control

The U.S. Bureau of Safety and Environmental Enforcement (BSEE) is proposing to update regulations covering offshore oil and gas drilling operations to improve reliability, safety, efficiency and environmental stewardship, and reduce unnecessary burdens on operators. BSEE reviewed the existing regulations in response to Executive and Secretary's Orders. The Proposed Blowout Preventer Systems and Well Control Rule was submitted to the Federal Register in April to open the 60-day public comment period.

BSEE analyzed all 342 provisions of the 2016 Well Control Final Rule and determined that 59 of those provisions—less than 18 percent of the 2016 Rule—were appropriate for proposed updating and revision. The proposed revisions would amend the testing protocol for blowout preventers, modify capability requirements for ROVs, remove duplicative verification requirements, and codify recent revisions to industry standards. **ST**

offshore oil & ocean engineering

OTC Spotlight on New Technology

Teledyne Marine was recognized by the Offshore Technology Conference (OTC) with a 2018 Spotlight on New Technology Award for the FlameGuard P5-200, a flame-proof ceramic electrical penetrator for use as part of the fire-resistant envelope of an offshore surface wellhead and Christmas tree system.

The penetrator is a key technology element in a 5-kV electrical feed-through system that provides three-phase power to downhole electrical submersible pumps (ESPs) in offshore dry trees.

The ceramic material was developed by the New Product Development team at the Teledyne Oil & Gas Technology Development Center, in partnership with the advanced materials scientists at Teledyne Scientific, in response to customer demand for a fire-resistant, downhole electrical penetrator.

Expro was also awarded a Spotlight on New Technology award at OTC for its Next Generation Landing String (NGLS), comprising a five-phase program of work to deliver a complete landing string package, including a range of new functionality across its 7 3/8 valves.

It incorporates a highly debris-tolerant ball mechanism and hydraulic latch mechanism, dual seal protection for both environment and control systems, increased cutting capability, and a fail "as is" retainer valve with the ability to close after a blowout preventer shear scenario.

The system can save millions of dollars per well, compared to traditional methods.

First CSP Offshore Trinidad and Tobago

Aquaterra Energy has completed the delivery of a Sea Swift conductor supported platform (CSP) for

DeNovo Energy in the Gulf of Paria, offshore Trinidad and Tobago. This is the first platform of its kind to be installed in the country and was completed in just 10 months.

Located in the Iguana field, the Sea Swift was installed from a jack-up rig in 27-m water depth, accommodating up to four wells and including local power generation, manifolds and a control system.

Drilling of the first of a three-well development campaign has commenced, using the Well Services Rig 110.

Fugro Seeks Hydrocarbon Seeps Off Brazil

Working for the multiclient geoscience data company TGS, Fugro continues the hunt for hydrocarbon seeps, this time offshore Brazil.

Two modern, purpose-built vessels—*Fugro Brasilis* and *Fugro Searcher*—have been deployed to acquire high-resolution multibeam echosounder and sub-bottom profiler data in the Campos and Santos Basins.

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The survey is designed to mirror TGS's successful 2016 to 2017 Gigante and Otos projects in the Gulf of Mexico.

Covering an area of approximately 200,000 sq. km, Fugro will use the data to identify and recommend the most prospective locations to target for geochemical sampling.

Fugro has reported increased confidence in identifying seabed

expressions of hydrocarbon seeps and this has led to continued vigorous demand for its combined multibeam mapping and surface geochemistry sampling services.

Artificial Intelligence For Structural Monitoring

WFS Technologies, University of Aberdeen and OGIC announced a joint technology project to design and build the world's first Ex-

tremeEdge OLM (On-line Monitoring) system for offshore subsea and platform structures. At present, asset integrity and fatigue monitoring of North Sea offshore subsea structures is largely carried out manually by divers or ROVs. This is not only hazardous and expensive, but information on the integrity of the structure is not available in real time and the quantity and quality of the data are insufficient to drive performance-enhancing big data analytic techniques. This can impact on production levels, or even lead to failure, due to suboptimal predictive model correction and latency.

The project builds on WFS's Seatooth through-water wireless communications, subsea Internet of Things (SIoT) and real-time wireless fatigue monitoring technologies.

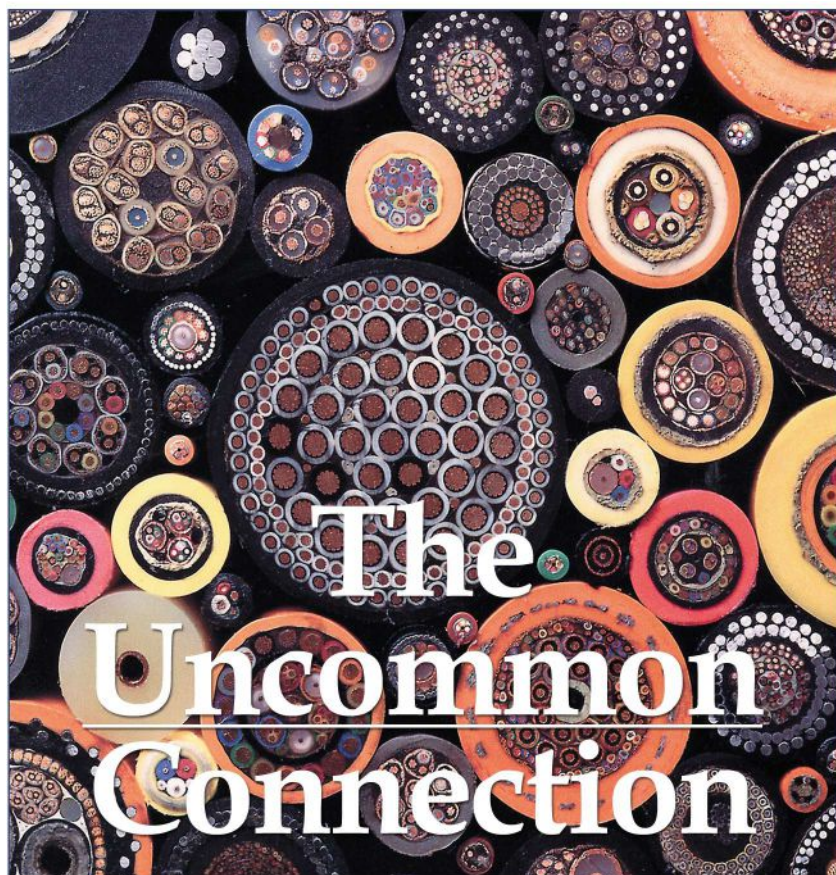
The project, jointly funded by WFS and OGIC, will focus on advancing technology to monitor subsea structures using specially designed SIoT smart sensor devices incorporating edge AI (artificial intelligence).

The completely autonomous SIoT devices will be attached to the structure with the capability to operate for more than 10 years due to the use of intelligent algorithms that will optimize battery usage.

Shell Invests Further In US GOM

Shell Offshore Inc., a subsidiary of Royal Dutch Shell plc, has made a final investment decision for Vito, a deepwater development in the U.S. Gulf of Mexico (GOM) with a break-even price estimated to be less than \$35 per barrel. This decision sets in motion the construction and fabrication of a new, simplified host design and subsea infrastructure. Vito is scheduled to begin producing oil in 2021. It is expected to reach peak production of about 100,000 barrels of oil equivalent (boe) per day. The development currently has an estimated, recoverable resource of 300 million boe.

"With a lower-cost developmental approach, the Vito project is a very competitive and attractive opportunity industry wide," said Andy Brown, Shell upstream director. **ST**



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Sonar Refit For Superyacht

Marel Electronics, FarSounder's dealer in Greece, commissioned a FarSounder-500 on a refit project of a 120-m superyacht. Marel was contracted to supply, connect, integrate and commission the system. Chalkis Shipyard in Greece mounted the sonar directly on the hull per the drawings provided by the ship's naval architect with the guidance and assistance of FarSounder.

Bridge officers expect this to increase the ship's safety when approaching coastal shallow-water areas. Up to now, they had to rely on tenders and divers to check the seabed and waters ahead.

Climbing Robot for Mooring Chain Inspection

A robot designed to hook onto, and scale up and down, large mooring chains, both subsea and in the air—with a nondestructive testing

(NDT), ultrasonic imaging system on board that scans for critical defects—has undergone successful field trials. It will identify issues such as fatigue cracking.

The groundbreaking climbing robot, RIMCAW (Robotic Inspection of Mooring Chains in Air and Water), is the result of a year-long project that secured funding from Innovate UK, the government agency behind finding and driving the innovations that will grow the U.K. economy. It is being delivered by collaborative partners Computerised Information Technology Ltd., Innovative Technology and Science Ltd., London South Bank University and TWI Ltd.

Multibeam Sonar For Stonehenge

Josh Gates from the Travel Channel series "Expedition Unknown" traveled to Great Britain to explore the origins of Stonehenge. From

high in the air to deep under the sea, he found an unexpected network of monuments that could have inspired one of history's most mystical locations.

Teledyne BlueView's 3D multi-beam scanning sonars were used to find and map what is believed to be the original inspiration for Stonehenge. A video clip is available at <https://tinyurl.com/yctv6hpb>.

Team Collaboration Software On the Rise in Shipping

Software company SEDNA Systems (SEDNA) has reported a major uptake in the use of team collaboration and transaction management software by shipping companies. SEDNA predicts 2018 will be a breakthrough year in the wider adoption of these tools. Using cloud-based technology, 4.35 million messages were sent in 2017, and early evidence in 2018 indicates further rapid growth.

According to Bill Dobie, founder & CEO of SEDNA, this trend is set to have a transformative impact



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on commercial operations in the shipping sector: "When it comes to shipping's digital transformation, the industry's attention has been focused on vessel-based technologies, but there are also huge inefficiencies in the shore-based operations of many organizations. Personal email systems like Outlook were never meant for team collaboration or business transactions. For fast-moving environments, such as

the offices of shipowners, brokers, charterers and traders, these outmoded tools are productivity killers. By contrast, team collaboration tools such as SEDNA can save users up to two full-time hours per day."

Kalmar Fully Electric by 2021

Kalmar, part of Cargotec, has committed to reduce emissions in cargo and material handling operations by fostering eco-efficient tech-

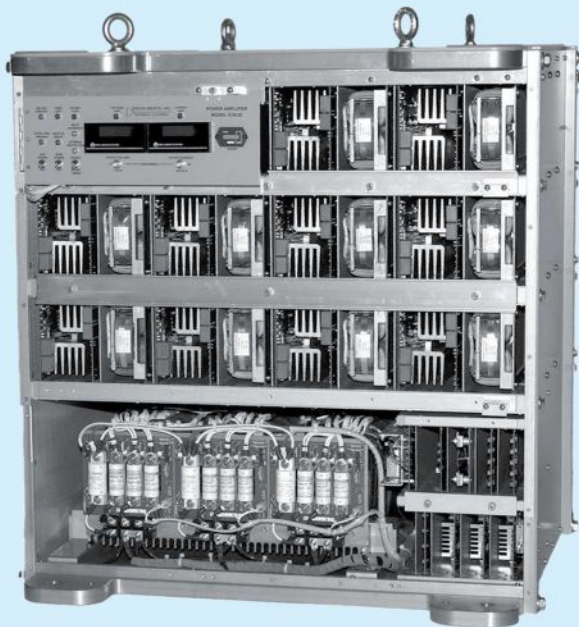
nologies. Kalmar's full offering will be available as electrically powered versions by 2021, in line with Cargotec's sustainability roadmap.

More than 50 percent of Kalmar cargo handling equipment is already available with electric power sources. Kalmar has also introduced its future vision for mobile equipment: the Kalmar Future Generation; driverless vehicles will enter logistic operations in industrial and material handling, expanding the benefits of automation to the full logistics chain.

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Machine Deep Learning For Autonomous Navigation

ASV Global is leading a research project in partnership with BMT to enhance the safety and reliability of autonomous navigation using deep-learning machine vision systems trained with simulated and real-world data. Partly funded by Innovate UK, this project will enhance situational awareness for a USV to operate in extreme and congested marine environments.

The Synthetic Imagery training for Machine Vision in Extreme Environments (SIMVEE) project will build on ASV's existing, COLREG cognisant, autonomous collision avoidance and path planning capability. BMT's REMBRANDT simulator will train and validate ASV Global's vision algorithms to detect and classify objects at sea.

'Honeycomb' Material Could Superpower Batteries

Scientists at the University of Missouri have created a material that could extend the life of batteries in electronics by more than 100 times. Semiconductor diodes and amplifiers, often made of silicon or germanium, are key in modern electronic devices. A team has developed a 2D, nanostructured material by depositing a magnetic alloy on the honeycomb structured template of a silicon surface. The new material conducts unidirectional current. The magnetic diode paves the way for new magnetic transistors and amplifiers that dissipate very little power, increasing the efficiency of the power source. **ST**

contracts

Alfa Laval, Lund, Sweden, has signed fleet agreements for the supply of its ballast water treatment technology PureBallast 3 for dozens of vessels, the majority of which will handle large flows of more than 1,000 m³/h. Polsteam and Nova Ship Tech SA.

Tuco Marine ApS, Faaborg, Denmark, will deliver an 8-m ProZero vessel to serve as a platform for dive operations, crew transfer, underwater inspection and research, maintenance of machinery and recovery of sunken assets. Fiskå Undervannsservice AS.

Techano AS, Kristiansand, Norway, has secured a multiple offshore winch contract for a major upgrade project of a large North Sea rig, including production of different winch types, interface customization, DNV approvals and various controls. The company will also build a unique, modularized subsea crane for a Dutch pipelay operator. Undisclosed.

Newport Shipping, London, England, has added to its global network of ship repair yards, bringing the company's tally of ship repair yards to six, totaling 13 drydocks and providing annual drydocking capacity for more than 1,000 vessels. PaxOcean.

CR Ocean Engineering LLC, Parsippany, New Jersey, will supply exhaust gas cleaning systems for oil/chemical tankers and heavy-lift vessels. The scrubbing systems will enter commercial operations between summer 2018 and early 2020. Songa Shipmanagement Ltd.

ABS, Houston, Texas, will provide classification and certification services for an existing fleet of 114 vessels and future vessel acquisitions, including transitioning vessels to ABS class and verifying compliance with the Canada Shipping Act. Canadian Coast Guard.

ODE, London, England, has been awarded a consultancy framework agreement for the provision of client representatives during construction activities for the East Anglia ONE Offshore Windfarm. ScottishPower Renewables. **ST**

meetings

AUGUST

August 21-22—Oceans In Action Workshop, Gulfport, Mississippi. laurie.jugan@usm.edu or www.mtsociety.org.

August 23—SNA West Coast Symposium, San Diego, California. 703-960-6800, navysna@aol.com or <https://navysnaevents.org/wcs>.

SEPTEMBER

September 4-6—ENGenious, Aberdeen, Scotland. chris.brand@bigpartnership.co.uk or www.engeniousglobal.com.

September 4-7—SMM, Hamburg, Germany. nora.ebbinghaus@hamburg-messe.de or www.smm-hamburg.com.

September 9-12—IFAC Conference on Control Applications in Marine Systems, Robotics, and Vehicles, Opatija, Croatia. zoran.vukic@fer.hr or <http://ifac-cams2018.com>.

September 18-19—Ocean Renewable Energy Conference, Portland, Oregon. msanders@oregonwave.org or <http://oregonwave.org/2018-conference>.

September 22-25—SEG 2018, Keystone, Colorado. kathybasel@gmail.com or www.seg2018.org.

September 24-26—Submarine Networks World, Singapore. enquiry.sg@terrapinn.com or <https://goo.gl/sZqf4>.

September 25-28—The National Marine Electronics Association and the Radio Technical Commission

for Maritime Services International Conference & Expo, Palm Beach Gardens, Florida. 703-527-2000, info@rtcm.org or www.nmea.org.

OCTOBER

October 1-3—Commercial UAV Expo Americas, Las Vegas, Nevada. KMcdonald@divcom.com or www.expouav.com.

October 1-3—Shallow Survey, St. John's, Canada. 709-778-0556, Paul.Brett@mi.mun.ca or www.shallow-survey.com/Home.

October 1-5—PLOCAN Glider School, Gran Canaria, Spain. carlos.barrera@plocan.eu or <http://gliderschool.eu>.

October 3—Marine Data Management Workshop, Southampton, England. sgaf@bodc.ac.uk or <https://bit.ly/1JINjm9>.

October 3-4—International Conference on Marine Renewable Energy and Maritime Hydrogen Technology, Florø, Norway. maria@maritimsfj.no or <https://bit.ly/2GW2Eo2>.

October 3-4—OilComm and FleetComm, Houston, Texas. 713-343-1875, tle@accessintel.com or www.oilcomm.com.

October 9-10—Dynamic Positioning Conference, Houston, Texas. <http://dynamic-positioning.com>.

October 9-10—RECISO EnviroSpill, Abu Dhabi, United Arab Emirates. marco@bme-global.com or www.recsoenvirospill.com.

October 9-11—Sea Tech Week, Brest, France. Jaqueline.rosec-despres@lequartzcongres.com or www.seatechweek.eu.

October 9-11—Teledyne Marine Technology Workshop, Cannes, France. margo.newcombe@teledyne.com.

For more events, visit sea-technology.com/meetings. **ST**

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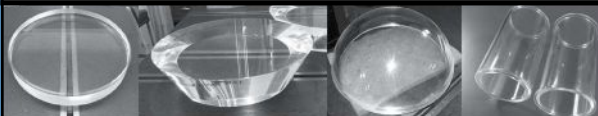


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The Challenges of Powering Future-Forward Ships—Patrick Le Fèvre

Patrick Le Fèvre is the chief marketing and communications officer for Powerbox. He is a degree-qualified engineer with a 25-year track record of success in power electronics. He has pioneered the marketing of new technologies, such as digital power and technical initiatives to reduce energy consumption. Le Fèvre is involved in environmental forums, where he shares his expertise on clean energy.



The public is aware of self-driving cars and other exciting projects in the automotive industry, but far fewer people have heard about unmanned ships and associated projects that will operate large fleets of vessels capable of navigating from port to port without operational crews. Although in its early stages, projects such as the Maritime Unmanned Navigation Through Intelligence In Networks (MUNIN) have investigated the feasibility of such technologies. The use of unmanned ships will require extreme reliability from the main generator through to the single point-of-load, and the demands placed on power designers will be far beyond anything experienced to date.

Future generations of power supplies for unmanned ships are still under definition. It is important to understand the specificity of the marine segment in terms of environmental needs and regulations. International regulations and standards applying to the marine industry are very complex, requiring an in-depth knowledge of the application and where it will be operated. Power designers must be knowledgeable about marine-specific voltage distribution, combining DC and AC networks, safety regulations and many other aspects, such as operational zones that can vary widely from ship to ship and with the nature of the cargo.

Every country with a maritime sector has its own certification authority with specific demands for local certification, forcing power designers to keep track of the final application where the power supplies will be installed. In general, there is a common group of standards and qualification processes that have similar roots for all countries' certification, though from country to country and maritime subsegments there are also a number of more specific requirements that increase complexity. There is no de facto percentage of common versus specific standards, thus requiring power designers to start any new project by reviewing a large number of documents prior to designing anything—time consuming but very necessary, hard work.

Marine power supply designers typically combine the requirements from all countries active in marine construction and operation to establish a cross-reference table with equivalence and specific action in the case of major deviations; for example, higher demands on shock and vibration. The toughest requirements per category are then selected and used as reference for designing, verifying and qualifying the final power supply. This is done in close cooperation with the final customer.

Combining this design methodology with an in-depth knowledge of local standards and regulations results in a test protocol that meets international and local requirements. This test protocol is then applied to all products, simplifying not only the final approval, but also confirming the power supply can be used for replacement or system upgrade purposes in any country.

With the increased amount of embedded electronics, the marine industry requires more functionality in a smaller space. Nowadays, ship owners want to equip their vessels with broadband internet connec-

tions for both passengers and crew.

As a further example, position tracking systems are built-in and require very compact power supplies operating in a confined environment without a fan. Such power supplies have to be designed for optimized conduction cooling. This requires a high degree of integration of the power circuits. The efficiency needs to be as high as possible because a small housing also means that the cooling surface is smaller. The latest resonant circuits and switching control methods achieve efficiency levels up to 95 percent, and power designers are exploring new technologies such as digital control and new-generation gallium-nitride (GaN) power FET transistors, maintaining high efficiency from very low to high loads.

This is an ongoing process that is mandatory for future unmanned ships where maintenance during operation is almost impossible. Reliability and zero downtime are the rule. Accordingly, power supplies should be able to be connected in parallel for redundancy operation. This requires power designers to integrate more into a smaller package.

Existing power solutions for the marine industry have proven their robustness, and power designers are exploring new technologies to improve efficiency and decrease power consumption and dissipation. Unmanned ships will require a level of reliability that will be close to a mythical zero-faults level and the ability for power supplies to be monitored from a central office anywhere in the world. For the power designer, it will be an incredible challenge to combine state-of-the-art technologies in switching, thermal management, control and intelligence. We are close to a new era where power supplies will become self-controlled and able to diagnose early signs of failure to apply corrective action. This is no longer a dream; it is soon to be a reality. **ST**

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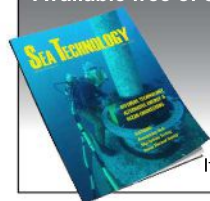
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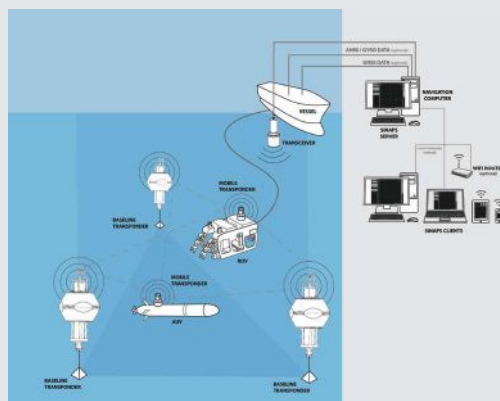
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