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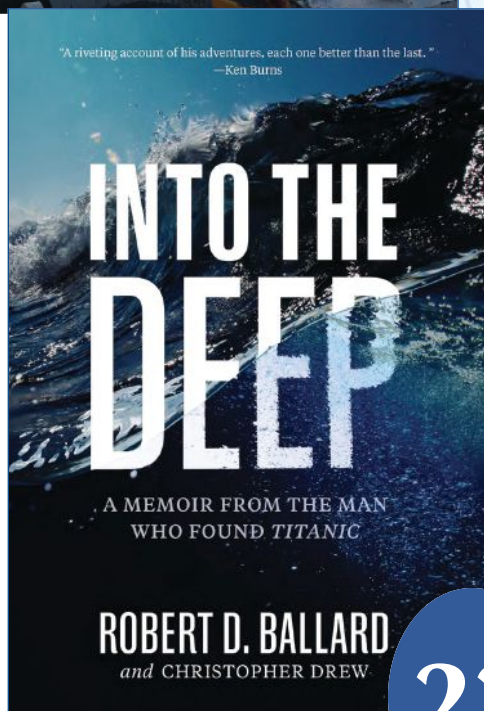
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COVER IMAGE

A team from Linden Photonics tests a precision-wound fiber-optic pack by deploying off the back of a speed boat into the waters of Lake Boon in Massachusetts August 2019. Optical transmission was maintained at speeds over 45 MPH for a distance of more than 1 km. All fiber was retrieved after testing. (Credit: Stephen O'Riorden)

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Less environmentally damaging method of UXO disposal ... DOE ocean energy project updates ... Carbon capture and storage developments ... New hydraulic passive heave compensation winch for North Sea ... NOAA's patented lionfish trap.

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)) Scholarship for Students to Pursue Career in Marine Electronics. The International Marine Electronics Alliance (IMEA), a supporting organization of the National Marine Electronics Association (NMEA), has launched a marine electronics industry scholarship for 2021. Scholarships will be awarded to two individuals who aspire to a career in marine electronics. The IMEA scholarship program is focused on students who are entering into or currently enrolled in a trade school marine technology program. NMEA also invites all member companies to sponsor a scholarship at a value of \$2,500 or more to increase the number of individual scholarships that get awarded in 2021. The IMEA Scholarship includes free attendance (either virtual or in person) at both of the entry-level NMEA Marine Electronics Installer Certification training courses: the Basic Marine Electronics Installer Training and the Basic NMEA 2000 Installer Training classes. Additionally, a \$2,500 tuition payment will be made in the recipient's name directly to a marine trade school. All applicants must fill out the IMEA Scholarship online application at: www.imea-marine.org or www.nmea.org. Applications must be submitted by August 13, 2021.

)) Fugro Finishes First Phase of Transpacific Bifrost Cable System. Fugro has completed the first phase of its marine site characterization project for Alcatel Submarine Networks (ASN) to support the Bifrost Cable System, a new undersea fiber-optic cable system that will connect the west coast of North America, Guam, Indonesia, the Philippines and Singapore. The transpacific route segments off the west coast of North America have now been surveyed, and the project will soon continue on the Indonesia segment through the Celebes and Java Seas. ASN is installing the cable system for a consortium comprising Keppel, Facebook and Telin to meet increased demand for broadband connectivity between the west coast of North America and Asia-Pacific. As a trusted partner to ASN, Fugro's involvement is spanning the life of the development, from initial planning and cable design to routing and installation. Fugro's work on the project began last November with a desk study to support permitting activities, followed by an ongoing geophysical and geotechnical campaign that will conclude in Singapore. Fugro's integrated acquisition, processing and analysis capabilities are providing ASN with near-real-time geodata deliverables to inform the cable manufacturing process and guide optimal cable routing and burial depth.

)) Biden-Harris Administration Approves First Major Offshore Wind Project in U.S. Waters. U.S. Secretary of the Interior Deb Haaland and Secretary of Commerce Gina Raimondo have announced approval of the construction and operation of the Vineyard Wind project: the first large-scale, offshore wind project in the United States. The 800-MW Vineyard Wind energy project will contribute to the Biden-Harris Administration's goal of generating 30 GW of energy from offshore wind by 2030. The project will be located approximately 12 nautical mi. (nm) offshore Martha's Vineyard and 12 nm offshore Nantucket in the northern portion of Vineyard Wind's lease area. It will create 3,600 jobs and provide enough power for 400,000 homes and businesses. The federal approval adopts mitigation measures to help avoid, minimize, reduce or eliminate adverse environmental effects that could result from the construction and operation of the project.

)) Hibernating Zebrafish Show How Astronauts Can Be Protected Against Radiation. NASA plans to return to the Moon and onward to Mars in the coming years. New research led by Queen's University Belfast and published in the journal *MDPI Cells* has shown the zebrafish could help humans reach Mars by understanding how a form of hibernation, known as induced torpor (a state of reduced metabolic activity) may provide radio-protective effects. Hibernation is a physiological condition found in many species that protects them against harsh conditions, such as food scarcity and low environmental temperatures. Replicating hibernation may therefore protect astronauts against the harsh conditions of space flight, which include challenges such as radiation exposure, bone and muscle wastage, advanced aging and vascular problems. The researchers believe if astronauts hibernate on their journey, those difficulties may be solved. To conduct their study, the researchers exposed zebrafish to radiation like what would be experienced on a six-month journey to Mars. Induced torpor in one group of zebrafish exposed to the dose of radiation led to lower metabolic rate and a radioprotective effect in these zebrafish.

)) Crowley Joins Ship Recycling Transparency Initiative. Crowley Maritime Corp. has become the first U.S.-owned, and 13th overall shipowner-operator, that will publicly disclose its ship recycling policies, practices and process through the Ship Recycling Transparency Initiative (SRTI) website: www.shiprecyclingtransparency.org. SRTI is an independent initiative hosted by the Sustainable Shipping Initiative. It reflects a collective effort by the shipping industry, investors, cargo owners and broader stakeholders to improve ship recycling policy, practice and performance. SRTI adopts a voluntary market-driven approach to sustainable ship recycling practices. As an online platform, it promotes exchange of information on ship recycling practices and guidelines, and helps ensure greater transparency in the maritime sector. Crowley is headquartered in Florida and operates more than 160 commercial and public sector vessels globally, including container ships, tank vessels, tugboats and barges. Crowley's ambition is to be the most sustainable and innovative maritime and logistics solutions provider in the Americas by 2025. **ST**

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Wind Propulsion Can Help Achieve Emissions Targets

The world has been coming together to address the challenge of climate change, and maritime industries are playing an important role.

All maritime industry decision makers, and the entire shipping community, should fully assess and utilize all available power solutions that deliver the necessary deep, swift cuts in carbon emissions over the next decade commensurate with responding to the climate emergency. To that end, readily available and proven wind-propulsion solutions must be integrated into the heart of decarbonization efforts.

Direct wind propulsion provides abundant, free energy that is immediately accessible to shipping worldwide without the need for costly land-based infrastructure or logistics investment. Wind technology helps de-risk shipping from its dependency on bunker fuels. While emerging alternative fuels come with multiple challenges, such as cost, availability, density and quality, wind propulsion can side step the uncertainties surrounding alternative fuels.

Whatever size or type of commercial vessel, wind-assist or primary wind-propulsion systems quickly provide credible, practical, robust, scalable and economically viable solutions. A dozen large ocean-going vessels running on such systems were already in operation by the end of the first quarter of 2021, along with more than 20 small sail cargo and cruise vessels.

The potential exists for 20 to 30 percent of the global fleet's energy requirement to be delivered by wind systems. By adopting wind solutions as part of a hybrid propulsion approach, vessel owners and operators can substantially deliver on the International Maritime Organization's (IMO) initial emission savings targets for 2030, thus providing a critical component for achieving the IMO's further target reductions by 2050.

A U.K. government-commissioned study forecasts up to 45 percent penetration of wind technologies into the global fleet by 2050. An EU-commissioned report on wind estimates up to 10,700 installations are possible by 2030, including roughly 50 percent of bulkers and 67 percent of tankers.

Wind propulsion reduces demand, cost and power storage requirements for alternative fuels, which can help accelerate the take-up and cost-efficiency of these fuels.

All shipping industry decision makers should be part of establishing a multi-stakeholder international working group to evaluate and quantify wind propulsion's potential contribution to decarbonize the global fleet. They should promote a hybrid approach to decarbonization that integrates wind propulsion with operational and vessel optimization, along with eco-fuels.

A comprehensive strategic review of shipping industry decarbonization efforts is needed, covering all criteria, designations and databases/resources in use. This review should incorporate wind propulsion into all calculations and include a full life cycle analysis of all alternative propulsion systems and fuels so that industry can fully appreciate the merits of each proposed system. The review should quantify all externalities, including infrastructure development and production costs of all alternative propulsion systems and fuels, along with their direct and indirect climate impacts.

Industry decision makers should ensure a level playing field is created and maintained for all power systems and ensure removal of market and non-market barriers, as well as fair and balanced allocation of R&D resources to transcend the current narrow, fuel-centric approach. A fully integrated alternative propulsion approach to decarbonization will create a proportionate, measured strategy to achieve ambitious industry emissions targets. **ST**

Protecting Killer Whales in Salish Sea

Cabled Underwater Listening Station Monitors Ship Noise

By Nicole Chorney • Jack Hennessey • David Hannay

On the west coast of southern British Columbia (B.C.) and Washington state, the Salish Sea connects the major port cities of Seattle and Vancouver to the North Pacific Ocean. These coastal waters, which include the Strait of Georgia, the Strait of Juan de Fuca, Puget Sound and connecting passes, are a major thoroughfare for merchant shipping. In addition to the multitude of private and smaller vessels, in a typical year, the Salish Sea sees more than 12,000 large merchant ship transits and more than 300,000 crossings by B.C. and Washington ferries. These busy waters are also home to over 37 species of marine mammals, 172 species of birds and 253 species of fish; 108 of these species are considered at risk or vulnerable to extinction. Of particular concern are the Southern Resident killer whales (SRKWs). This population of orcas has been considered endangered since 2001, when it numbered 78 individuals. As of February 2021, only 75 individuals remain.

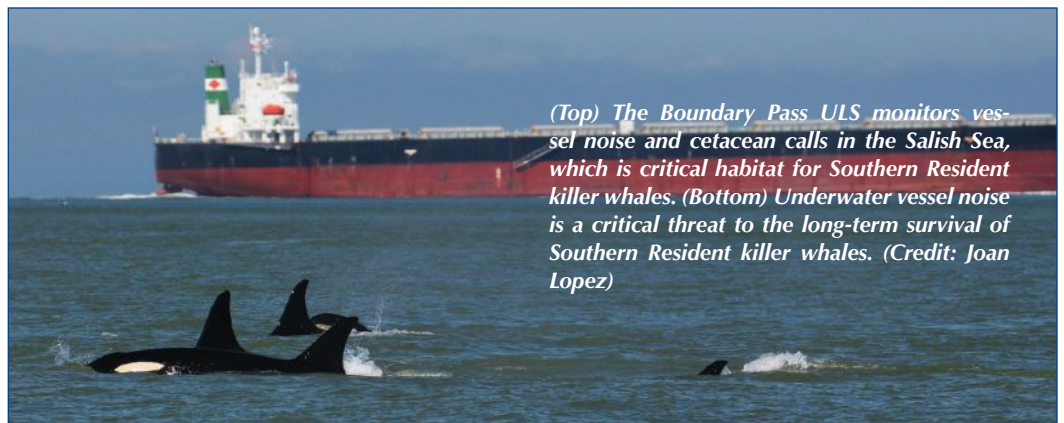
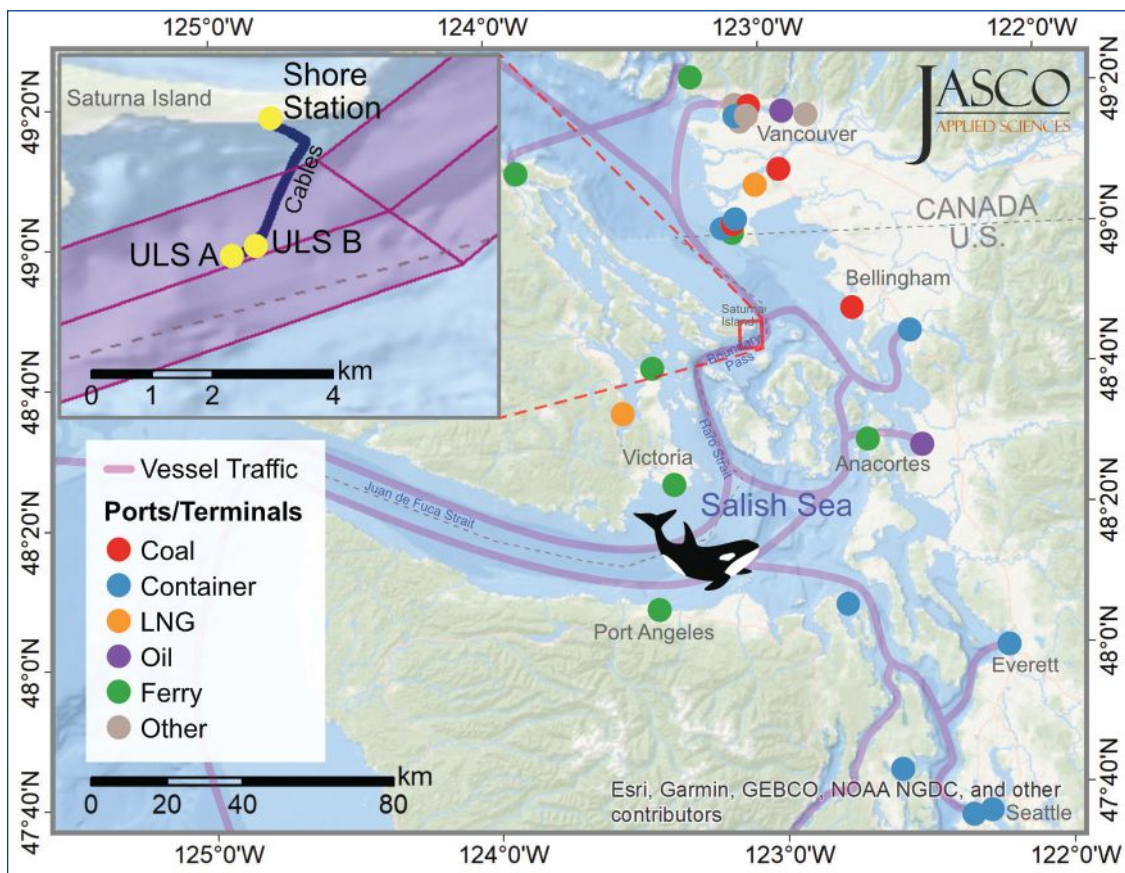
In addition to scarcity of available prey, a critical threat to the long-term survival of SRKWs is underwater noise from vessels. Like many marine animals, SRKWs use hearing, not vision, as their primary sense. Underwater noise from vessel traffic disturbs and causes stress to the whales and masks their vocalizations and echolocation clicks, which are fundamental to their foraging, navigation and social behavior. When vessels are present, whales are observed to travel more and hunt less. With projected increases in capacity from proposed and approved expansions of port, LNG, oil and export facilities, especially in Canada, the annual number of large vessel transits in the Salish Sea is expected to surpass 16,000 within the next few years. This will undoubtedly increase underwater noise pollution in SRKW habitat if preventive actions are not taken.

Salish Sea Noise Reduction Initiatives

Both the Vancouver Fraser Port Authority (VFPA) and Transport Canada have introduced noise reduction initia-



One of two ULS acoustic observatories being deployed in Boundary Pass in May 2020. Each observatory is connected to shore by 2.8 km of fiber-optic cable.



(Top) The Boundary Pass ULS monitors vessel noise and cetacean calls in the Salish Sea, which is critical habitat for Southern Resident killer whales. (Bottom) Underwater vessel noise is a critical threat to the long-term survival of Southern Resident killer whales. (Credit: Joan Lopez)

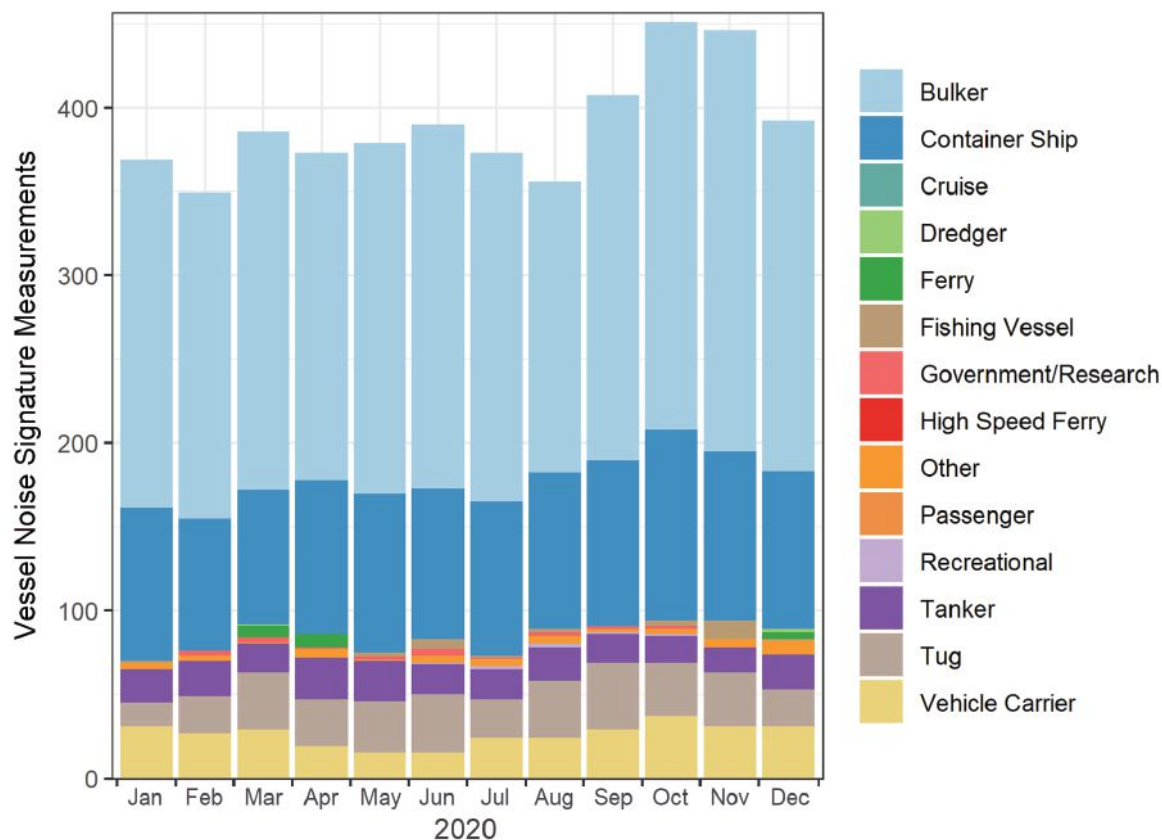
tives in and around SRKW critical habitat areas. In 2014, VFPA launched the Enhancing Cetacean Habitat and Observation (ECHO) program with the aim to better understand and mitigate the impacts of shipping activities on whales on B.C.'s south coast. Noise reduction measures have included seasonal voluntary ship slowdowns starting in 2017 and lateral displacements of vessel traffic away from key foraging areas starting in 2018. Since 2015, ocean acoustics company JASCO Applied Sciences, headquartered in Halifax, Canada, has completed over a dozen studies addressing underwater noise in the Salish Sea for the ECHO Program, Transport Canada, BC Ferries, whale watch associations and other stakeholders.

Under the aegis of the ECHO Program, a cabled underwater listening station built on JASCO's technology was deployed in 2015 in the Strait of Georgia beneath

a shipping lane leading to the Port of Vancouver. Integrated into Ocean Networks Canada's Victoria Experimental Network Under the Sea (VENUS), the listening station operated continuously for more than 2.5 years, cataloging the noise signature of every passing vessel, documenting ambient noise, and detecting and identifying marine mammal calls.

Boundary Pass Underwater Listening Station

Continuing the success of the Strait of Georgia listening station, JASCO was contracted by Transport Canada under its Whales Initiative to develop, deploy and operate for a longer term a cabled observatory in the Salish Sea. The five-year \$9.5 million Boundary Pass Underwater Listening Station (ULS) project has three main goals: first, to systematically measure, adhering to internation-



The standard-compliant vessel measurements captured by the ULS, shown here for each month of 2020, are informing numerous vessel-quieting initiatives.

al standards, the underwater noise emissions of nearly every large commercial vessel calling ports in southern British Columbia; second, to detect and localize/track vocalizing cetaceans; and third, to document the underwater noise environment over many years. Boundary Pass, a 23-km-long strait along the Canada-U.S. border, was chosen for its narrowly spaced shipping lanes that allow vessels traveling in both directions to be measured from one observing location, its deepwater that satisfies measurement standards, and for its location in important SRKW critical habitat.

The ULS consists of two acoustic/oceanographic observatories installed on the seabed 190 m below the shipping lanes of Boundary Pass, about 50 km south of Vancouver. Each observatory incorporates two tetrahedral hydrophone arrays, video cameras with LED lights, an acoustic projector for daily sound level calibrations of the hydrophones, a CTD sensor, an ADCP, and various self-monitoring sensors to ensure consistent system performance. The temperature, current and salinity readings are required metadata for standards-compliant vessel source level measurements. The collected data are

transmitted to a shore station on Saturna Island via twin fiber-optic cables for immediate automated analysis and online reporting of ship noise measurements and marine mammal detections.

The design of the ULS had to meet challenging operational specifications. Determining the bearing of an acoustic signal requires a tetrahedral array of four hydrophones, and two such arrays spaced 300 m apart are needed to enable the spatial localization of the signal source through beamforming and triangulation. Each hydrophone is sampled at 512,000 samples per second to capture sounds up to 256 kHz—above the highest frequencies produced by or audible to any marine mammal, including cetacean calls and echolocation clicks. These acoustic data must be multiplexed with the information streams from the cameras and oceanographic sensors. The data are continuously streamed and processed in real time at 96 megabits per second, yielding 1.1 terabytes of data each day. The rugged seascape of Boundary Pass includes high-energy shore wave zones, steep sub-sea terrain, sharp rocky outcrops, high tidal currents (up to 4.7 kt.), and moving gravel waves, all of which pose substantial threats to cables and equipment. To circumvent the high-energy intertidal zone, the quadruple-armored fiber-optic cable enters the sea through a directionally drilled conduit through the bedrock. Extending from shore, the cables are pinned to the seabed where they run down a steep rocky slope, then are laid along the seabed along a shallower slope out to the station's

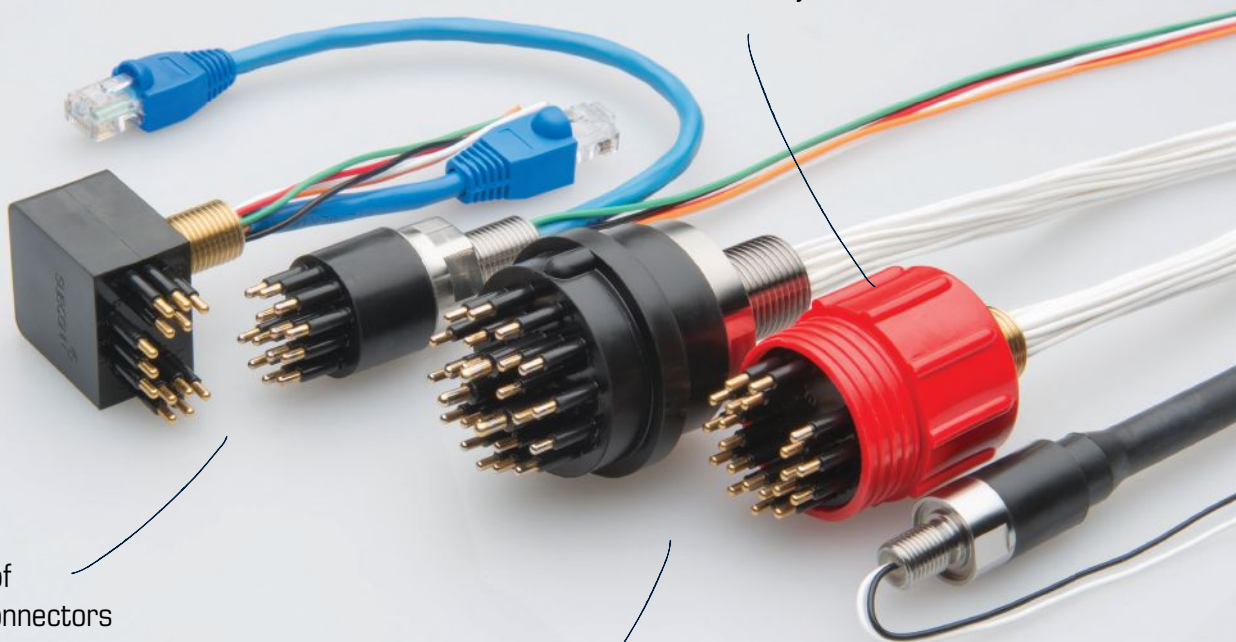


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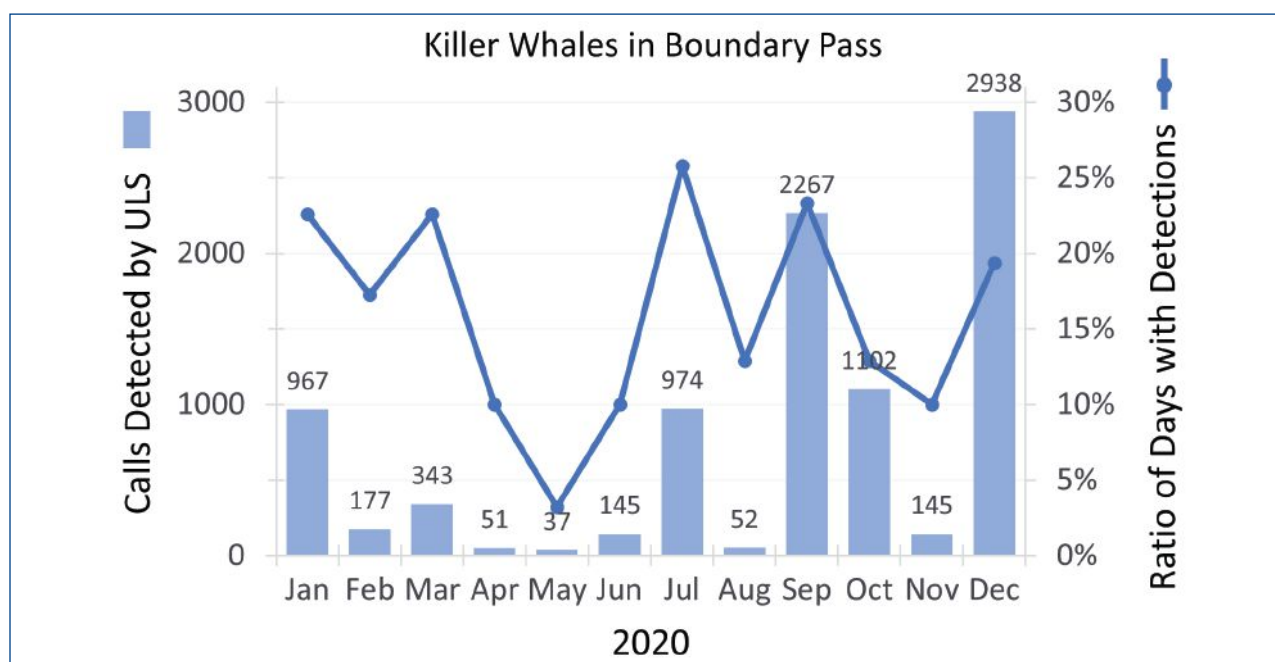
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The killer whale calls detected by the ULS, shown here for all ecotypes for 2020, are revealing new information about their presence throughout the year.

location at 190 m depth. The precise cable route was determined by multibeam sonar survey and ROV inspection to avoid hazardous seabed features. Over 2.8 km of cable connect each observatory to the shore station.

ULS Technical Features

To minimize the risk of any down time, the ULS was designed with multiple layers of redundancy. First, it consists of two identical acoustic observatories, each with its own cable to shore. If one observatory were to fail entirely, the other alone can still satisfy the basic project requirements. Second, each observatory has two independent hydrophone arrays with their own JASCO OceanObserver data acquisition and processing system (www.jasco.com/oceanobserver). This ensures continuity of acoustic data capture in the event of hydrophone or acquisition unit failure. Finally, the telemetry system includes two data multiplexers (designed by MacArtney Canada Ltd. of Dartmouth, Canada) on each observatory and redundant pairs of both optical fibers and electrical power conductors in each subsea cable.

To minimize expensive at-sea time for repair and maintenance, the entire observatory frames can be disconnected and swapped out. During scheduled servicing trips planned at intervals of one to two years, the two observatories will be replaced with new ones and the retrieved systems returned to shore facilities for refurbishing, hydrophone replacement and laboratory calibration in preparation for the next service swap.

A considerable technical challenge was to terminate the cables underwater in a way that would allow reliable recovery of the observatories throughout their 10-year design life. Schedule and immediate cost precluded the use of wet-mate connectors, so the cables were ended directly at the frames to be partially brought to the surface at each servicing. This solution drew upon technologies developed for offshore wind and tidal energy applications. Because of the known presence of shifting gravel waves on the seafloor, the termination had to be rated to the full breaking load of the cable so the cables can be lifted out of the sediment if they become buried.

The quality of acoustic data captured in high-current environments can be substantially compromised by noise from vibrating components and water flow over the hydrophones. Various strategies based on JASCO's extensive experience with underwater moorings were adopted to overcome this. All the hydrophones are encased by stainless steel protective cages, over which fabric flow shields are mounted. The observatory frames are made of 2-in. solid round bar to drive their resonant frequency below 30 Hz, and individual components are structurally stiff or heavy enough that their resonance amplitudes are so small to be inconsequential. The cables are precisely routed and meticulously installed to prevent suspensions that could lead to noisy strumming in currents and failures by mechanical fatigue.

The connection point of the cable terminations to the frames must have a high range of motion to avoid torque moments on the frames and cables during deployment and retrieval, which could result in damage. An elaborate tensioning mechanism was designed to route the cables through this joint, avoiding stress on the dry-mate connectors and keeping the connector cables shielded from water currents.

The ULS systems are powered by four independent 400-VDC power supplies. A key concern with operat-

ing ocean observatories is that stray electric current flow from supply lines to the surrounding saltwater will lead to rapid electrolytic corrosion, which can quickly lead to catastrophic failure. To mitigate this, the power circuits are fully isolated, so a failure of the insulation of a single conductor will simply shift the potential of that circuit branch to earth to minimize stray current. Sophisticated monitoring systems on shore continuously measure the resistances of all conductors to earth so that any insulation failures can be detected immediately, and the circuits automatically powered down before damage occurs. Resistance monitoring also enables tracking the subsea cable health over time. As a final measure, numerous large sacrificial anodes are installed on the cable terminations and the ULS frames to protect unpainted sections against corrosion.

The ULS data are received at a climate-controlled shore facility on Saturna Island that houses the subsea network control, acoustic data control, data storage, and power management systems. An AIS receiver station logs the identification, position, course and speed of passing vessels, and a GPS-based time server enables synchronization of the two sensor arrays to 1-millisecond accuracy. Because hydrophone data quality depends on clean power without voltage spikes or rapid phase shifts, a sophisticated line conditioner supported by an uninterruptible power source and on-demand backup generator provides ultraclean constant power through the fluctuations and outages that are frequent on Saturna Island. The resulting electrical power noise is essentially undetectable in the pristine acoustic data obtained.

Data Processing with Online Results

Following four days of deployment and several days of extensive on-site testing, the Boundary Pass ULS was officially commissioned on June 10, 2020. Once received at the shore station, data from each sensor array are demultiplexed and processed to quantify ambient and vessel sound levels and detect sounds from killer whale, humpback whale, Pacific white-sided dolphin and fish. When killer whale and dolphin sounds are detected, the system automatically disables the calibration projector and ADCP, so the sounds produced by these devices do not disturb nearby animals. The data are then fed to JASCO's advanced automated data-processing framework, PortListen (www.jasco.com/portlisten-1). PortListen performs further analyses and provides immediate online access to the results through its cloud-based data portal. The automatic mammal detections are later verified by a bioacoustics analyst so that any false detections can be identified. Also, through this portal, clients can examine and listen to each detected marine mammal call, view ship noise emission measurements, and download vessel noise signature reports. Ambient noise results are available in multiple formats on daily, weekly and monthly time scales.

Ship Noise Results and Initiatives

During the months-long preparation for the deployment of the ULS—that encompassed design, procure-

ment, route surveys, assembly, testing, construction and permitting—JASCO conducted interim monitoring with temporary acoustic recorders. Six consecutive deployments on the seabed of calibrated Autonomous Multi-channel Acoustic Recorders (www.jasco.com/amar-g4) and water current profiling sensors were performed between August 2018 and June 2020. These recorders captured high-quality acoustic data over the entire period, and yet, by comparison, the cabled ULS arrays have proven much less affected by flow and mooring noise. The reduced background noise of the ULS data yields higher acceptance rates of the ship radiated noise measurements, with more measurements meeting the minimum signal-to-noise ratio required by the measurement standards.

The ULS's ship noise measurement system is fully automated. The noise report for each passing ship that broadcasts its position via AIS is available online for quality review within minutes of the vessel transit. The Boundary Pass ULS project, including the initial autonomous recorders and now the cabled monitoring systems, has captured standards-compliant noise emission measurements of more than 12,000 vessel passes. Combined with the Strait of Georgia measurements, the ECHO Program database of systematic vessel noise measurements now contains over 19,000 signatures, making it the largest such database in the world. These results are enabling a variety of initiatives, including investigating the amount of quieting that can be achieved by slowing ships near critical SRKW habitat areas. The results have been used to develop ship noise emissions models for predictive marine sound mapping, which are being used to assess noise effects of Salish Sea marine terminal developments and modifications to shipping lanes near feeding areas. The ship noise measurements are also informing discussions with international vessel certification organizations to refine and align quiet ship notation methods. The goal is to increase the implementation of these notations and thus achieve quieting of ship noise on a global scale. In April of this year, a newly built merchant vessel received the first-ever underwater environmental noise emissions notation from Det Norske Veritas (DNV); hopes are high that more vessels will soon follow this path.

Whale Detections and Results

The ULS project has detected over 16,000 humpback whale calls and over 21,000 killer whale calls. Many thousands of these calls have been identified as SRKW calls and reveal new information about where the animals spend the winter. Unlike other whales that have predictable seasonal migration patterns, killer whales tend to follow their food source, which for SRKWs is primarily salmon. SRKWs generally spend the summer and fall in the Salish Sea, feeding on salmon that spawn from rivers such as the Columbia and Fraser. In winter as salmon densities decrease, the SRKWs expand their range as far south as Monterey Bay, California. Although expected to be mostly absent from Boundary Pass in winter, SRKWs were detected by the ULS at least once each month from October 2020 through April 2021. A unique feature of

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the ULS yet to be fully exercised, its ability to track the location of individual animals, will enable counting of calling whales in passing pods of SRKW.

The Boundary Pass ULS has just passed its first operational anniversary at full capacity. With ongoing funding from Transport Canada and the VFPA, JASCO will operate the station and deliver its results until at least March 2023. It is hoped that the success of the project in achieving its conservation goals will lead to its being extended for many years into the future. Already, much knowledge about the habits and habitat of the charismatic and endangered Southern Resident killer whales has been collected through the project. Visit www.jasco.com/boundary-pass-uls to listen to calls from SRKW and other whales and watch some great underwater video of giant Pacific octopus and other creatures.

Acknowledgments

JASCO is grateful to all the project partners that helped make this project a success, including: ITB Subsea, Hemmera, MacArtney Canada, Terra Remote Sensing and GeoSpectrum Technologies Inc. Development, deployment and operation of the ULS is funded by Transport Canada under the federal government's Whales Initiative. Data analysis is funded by the VFPA's ECHO program. The authors thank Roberto Racca, Art Cole and Julien Delarue for their valuable contributions.

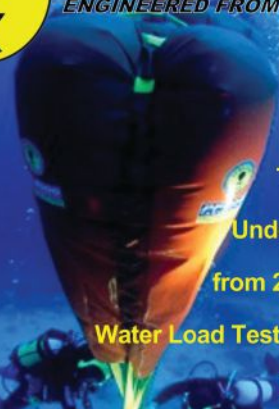
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David Hannay is chief science officer and a principal of JASCO Applied Sciences and has worked as an acoustics scientist with JASCO since 1989. He is project manager for the Boundary Pass Underwater Listening Station. He holds an M.S. in physics (underwater acoustics) and a B.S. in physics from the University of Victoria.



Autonomous Offshore Power System

The Key to Providing Energy and Data as a Service Offshore

By Reenst Lesemann



The \$2 trillion global ocean economy is beginning a massive transition. There is mounting pressure in the offshore commercial, defense and research markets to move away from the people-, carbon- and capital-intensive status quo to an operational environment that can be less expensive, safer, cleaner and more connected.

In pursuit of this goal, significant resources and effort have been invested to deliver novel, innovative hardware and services, including autonomous unmanned surface and subsurface vehicles and all-electric subsea operating equipment. These solutions offer the promise of substantial cost and emissions savings, along with new capabilities, such as remote command and control of mobile assets and real-time, conditions-based monitoring.

But these innovations require power, and the ocean is a power desert.

Today, performing any marine operation requires a substantial, carbon-intensive effort to bring people and power on site. Moving away from this model creates a

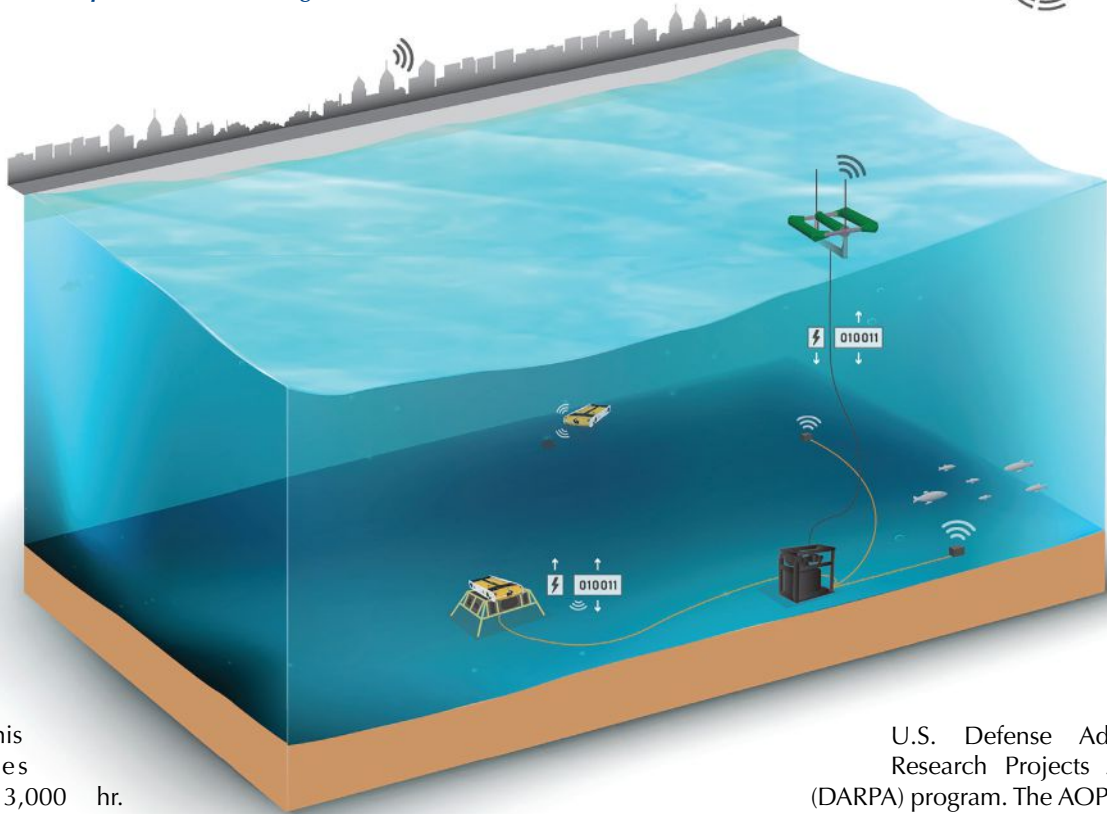
significant problem. How do customers and suppliers decarbonize and decentralize their activities—losing traditional power generation methods along the way—as demand for electric power at sea increases?

Successfully navigating this transition without manned assets in place requires significant innovation in how power and data are handled at sea. In response, a new class of system is being developed and tested to fill this gap: autonomous offshore power systems (AOPS). Think of an AOPS as the combination of a charging station, a data server and a cell tower out in the ocean.

The goal of an AOPS is to cost-effectively provide energy and data as a service (EDaaS) for offshore remote assets, delivering a 24/7 supply of clean energy and bi-directional data transfer and processing.

The Missing Piece of the Puzzle

C-Power is a leader in the emerging AOPS sector, with decades of wave energy technology development experi-



ence. This includes over 13,000 hr. of prototype system testing and tens of thousands of hours of modeling, design and engineering. The company is developing a portfolio of products for the full range of customers' power and data needs, including the SeaRAY AOPS, which is coming on the market now.

The SeaRAY AOPS provides local power generation, energy storage, and real-time data and communications capabilities for mobile and static assets located on the surface, subsurface or seafloor. It is intended for the low-power market; a market segment that runs roughly from tens of watts to tens of kilowatts, with applications for all offshore industries: energy, defense and security, aquaculture, science and research, and communications.

An AOPS offers an extensive list of potential benefits for customers and suppliers, including enabling offshore assets to: be more autonomous and persistent while performing increasingly complex tasks; collect, process and transmit richer data sets more often; enable the drive toward electrification and net-zero operations; and do any or all of these functions more cost-effectively, more safely and with less environmental impact through a reduction in manned offshore operations.

An AOPS, like C-Power's SeaRAY, is the missing piece of the puzzle for enabling resident, unmanned, electric assets and infrastructure.

From Concept to Commercialization

C-Power's focus on kilowatt-scale systems was initiated in 2016 when it designed, built and delivered a 100-W, floating wave energy converter (WEC) for a

U.S. Defense Advanced Research Projects Agency (DARPA) program. The AOPS product line builds from the DARPA system and the demonstrated market need where energy cost per kilowatt-hour is less important than lowering the customer's total cost of ownership and enabling new autonomous, resident and digital capabilities. A follow-on project, co-sponsored by the U.S. DOE, led to development of the SeaRAY AOPS and a Hawaii deployment that will be discussed later in this article.

In 2018, C-Power initiated a survey of potential customers on what they needed from a kilowatt-scale renewable power generation system. This survey included end-users and Tier One and Tier Two suppliers within the offshore energy industry, who identified a clear need for a solution that enables new autonomous, digital and resident capabilities; is simple and cost-effective to deploy, operate and retrieve; would survive extreme ocean conditions; and would offer a pathway to reduced offshore operational costs and emissions.

Comments from the survey that captured the essence of the responses included: "I just need an outlet in the ocean to do what I want to do" and "The problem to solve is always how to get the power in [to the asset] and the data out." This market input was critical and drove an expansion of the targeted product features beyond the original scope of a WEC for local power production only to a system also capable of providing both energy and data as a service. From this input, the SeaRAY AOPS was born.

AOPS Design

There are three essential components within an AOPS: the surface system, station-keeping and the sea-

***“The SeaRAY AOPS provides local power generation, energy storage,
and real-time data and communications capabilities
for mobile and static assets
located on the surface, subsurface or seafloor.”***

floor base unit. The surface component contains the power generation and communications and control systems. Station-keeping is handled by a highly survivable, combined power/data/mooring line to facilitate noncomplex logistics. The Halo seafloor base unit contains the energy storage system (ESS), payload interfaces and seafloor control, and acts as the gravity anchor. Drifting configurations of the AOPS are also available; a prototype system has been sold into a U.S. Navy R&D project. Payloads can be mounted on the surface, in the water column and on the seafloor, and multiple payloads can be supported simultaneously by the AOPS.

The power generation system is based on C-Power's advanced wave energy capture and conversion technology. It works by capturing and converting ocean wave energy into electricity, which charges the ESS. The supported assets receive their power supply from the ESS in order to ensure uninterrupted operation regardless of sea state.

For ultrareliability, C-Power has designed the AOPS so that the ESS always resides between the power generation system and the operating payload. The intermediate ESS is necessary because potential peak loads can exceed the generation capacity of the AOPS, and there is a need to separate the variability of the renewable energy resource from the required reliability and availability of the payload's energy supply. Rechargeable batteries are the primary energy storage medium in the near term, but “power-to-x” capability, such as hydrogen or ammonia for offshore charging of unmanned surface vessels, is coming.

The SeaRAY AOPS is easy to transport and deploy, with excellent power-to-weight ratios. All AOPS components can be handled with a forklift dockside. The entire system, from surface to seafloor, can be shipped in standard ocean containers and deployed with small, lightly crewed vessels. The AOPS is designed to survive the worst storm conditions and be agnostic to the type and number of assets it supports.

AOPS Use Cases

In its most basic application, an AOPS is deployed primarily in support of an offshore asset, such as a subsea vehicle or a sensor package, or an activity, such as monitoring a decommissioned wellhead.

Broadly, there are four primary applications. One is supporting AUVs for unmanned permanent and campaign-based monitoring, inspection and light-intervention tasks. This offers substantial cost and carbon savings

while enabling new capabilities not possible today.

A second application is a data gathering system. This represents the biggest market opportunity for AOPS deployment, and it involves powering sensors and monitoring equipment used in the ocean across all industries. An example use case could include both mobile and fixed monitoring equipment to ensure the integrity of a subsea reservoir and infrastructure for both oil and gas and carbon capture and sequestration applications.

A third application for AOPS is to provide primary, redundant or emergency power for both brownfield and greenfield sites. For brownfield sites in which an infrastructure upgrade is planned, or the electrical cable has failed or is failing, an AOPS provides a cost-effective, reliable solution for power and data delivery.

A fourth application is recharging. USVs and electric ships are being introduced to our oceans, just as electric vehicles have begun to proliferate on land. Typically, a USV will have to go to port for recharging. Just adding more batteries isn't the answer. An AOPS can act as an offshore recharging station, substantially improving the utilization and efficiency of the USV by avoiding unnecessary trips to port.

SeaRAY AOPS Hawaii Demonstration

A SeaRAY AOPS supporting multiple subsea assets will be deployed this summer for six months in a project co-sponsored by the U.S. Department of Energy (DOE) and U.S. Navy off Marine Corps Base Hawaii on the island of Oahu. The SeaRAY AOPS will use wave energy to support multiple subsea assets simultaneously, including: a Saab Sabertooth AUV, operating in untethered mode; Franatech methane emissions sensor; BioSonics long-range, automated, marine life and swimmer detection, tracking, and reporting system; and a third-party met-ocean data gathering system.

Power generation performance at the Hawaii location is expected to be nearly 9 MWh per year. The same system will produce approximately two times the power at more energetic locations, such as the North Sea, and can be scaled to produce more or less power depending on the customer's requirements, including for less energetic environments, such as the Gulf of Mexico. This configuration has been designed to survive a 100-year sea state off the U.S. Oregon coast ($H_{m0}=17.31$ m, $T_e=16.57$ s).

For the Hawaii deployment, the seafloor base unit is EC-OG's Halo system. It acts as the gravity anchor for the AOPS and provides 55 kWh of energy storage, along with

the subsea payload power and communications interfaces. EOM Offshore is the supplier of the combined mooring, power and data (fiber-optic) line. BIRNS provided custom electro-optical, high-voltage cable assemblies for a number of interconnects within the AOPS. While C-Power is partnering with RigNet for satellite-enabled communications, data will be uploaded to and from the cloud via an LTE connection during this deployment. For marine operations, Sea Engineering will handle the AOPS and payload deployments with the 84-ft. MV *Kupa'a*. The entire AOPS weighs approximately 15 tons.

The Sabertooth AUV will execute daily missions during a multi-week deployment and will operate simultaneously with the BioSonics seafloor sensor package, demonstrating the concept of a resident offshore monitoring, inspection and light-intervention system with both mobile and static assets.

Hibbard Inshore will operate the untethered Sabertooth, which will carry three onboard instruments: an R2Sonic Sonic 2024 multibeam echosounder, a 2G Robotics underwater laser scanner and an ASL acoustic zooplankton fish profiler.

The Sabertooth will receive mission plans from shore, transmitted downstream wirelessly through the AOPS. Data collected during missions will be transmitted upstream through the AOPS to the cloud. The Sabertooth will have a separate docking cassette connected to the AOPS's seafloor base unit via an umbilical. Remote operation of the Sabertooth without a topside vessel rep-

resents the first time worldwide that a resident subsea vehicle will be supported by an in-situ renewable energy system. It is also the first time that a package of static seafloor sensor assets has been supported by an AOPS.

Testing of the C-Power SeaRAY AOPS is included in the Navy's Coastal Trident 2021 (CT21) program, which is the largest sustained port and maritime security program in the United States and regularly involves the participation of more than 150 public and private sector organizations. For CT21, there are multiple objectives with the Hawaii deployment, including demonstrating: delivery of near-real-time results of persistent, repeated infrastructure surveys to monitor infrastructure integrity using change detection techniques; real-time intrusion detection, tracking and reporting capabilities for both surface and subsurface "swimmers"; and fish and mammal detection, tracking and reporting.

EDaaS Unlocks the Ocean Economy's Potential

C-Power recently quoted a North Sea customer who needs to install and operate multiple leak detection systems for nontrawlable offshore fields. The alternative solution to an AOPS was running new electricity-carrying umbilicals, as there is no excess power or data capacity within the current infrastructure. This is a very common issue and partially drives the brownfield upgrade opportunity mentioned previously. A battery-only solution had already been rejected.

The customer sought to run two sensors. The primary sensor would draw less than 30 W, run 10 min. every hour and require 9.6 kbps of data throughput. The customer also wanted additional bandwidth (56 kbps) and higher energy supply for additional equipment. The additional 30-W load would run continuously. The AOPS would be directly connected to the customer's seafloor lander, which would serve as a gravity anchor for the AOPS.

The proposed C-Power EDaaS solution offers the customer an opportunity to avoid the engineering, manufacturing and installation costs of new umbilicals, while providing the ability to easily add more power and bandwidth. This is just one example of the benefits of an AOPS in the offshore environment.

By providing reliable energy and data capabilities that were not previously possible, C-Power's autonomous offshore power systems can help unlock the autonomous, digital, low-carbon innovations that are on the cusp of transforming the ocean economy. **ST**

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Reenst Lesemann is the CEO of C-Power. He has 30 years of operational, executive and financial experience. He previously co-founded a seed and early-stage venture fund, Tall Oaks Capital Partners, where he served as managing director and CFO. He has run a series of successful businesses, including a maritime logistics spin-off, TradeSource Inc., that he created, led and managed. During his career, he has been responsible for all aspects of business management, including strategic planning, marketing and information services. His customers have been based in over 20 countries and ranged from Fortune 50 corporations to small businesses. Lesemann graduated with honors from the University of North Carolina with a bachelor's degree in history. He also holds an M.B.A. from the University of Virginia Darden School of Business.

Camera Network System

HTML5 App for One-Touch Onboard Monitoring of Designated Areas

By Carl Hitchcock

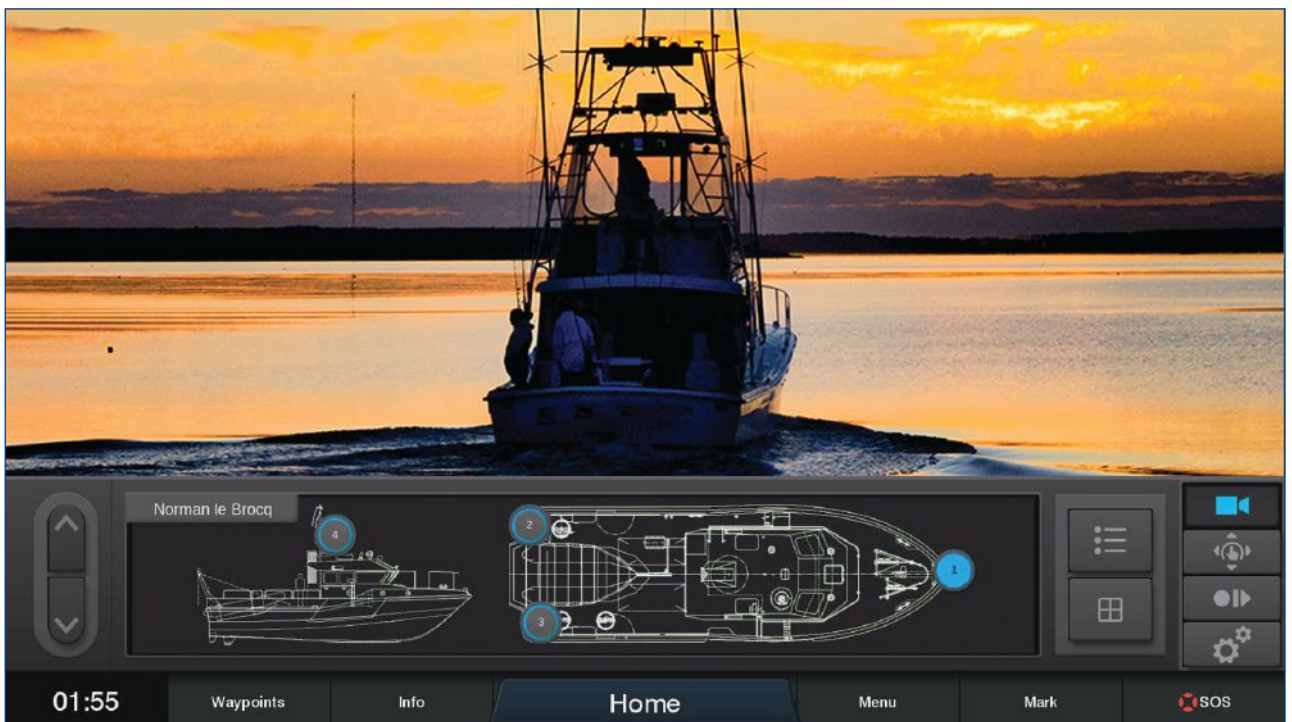
Iris Innovations has been developing and manufacturing boat cameras and ancillary products since 2003. With our new CMAC (camera management and control) systems, and our recent decision to manufacture camera housings from marine-grade stainless steel, the company has delivered the most comprehensive and feature-rich camera control interface available on the market, accompanied by a whole range of high-end, yet affordable, corrosion-proof marine cameras.

Although there will be many boaters out there that either have no requirement for cameras or don't see the val-



ue, our rapidly developing business, which turns 20 next year, is testament to the fact that as technology evolves and high-definition video becomes more integrated into our daily lives, more and more people are using cameras to achieve solutions in a host of applications, from onboard security and situational awareness to device monitoring,

IRIS-S460 rugged marine IP dome camera. (Below) You can upload deck plans and configure device selection icons for one-touch control.





(Top) IrisControl camera control panel with virtual joystick. (Left) IP-only CMAC system, shown here as a package with four IRIS-S460 cameras and the IRIS-PoE4 power-over-Ethernet injector.

available in three lens options, including a very useful 1.8-mm wide-angle model. Built-in infrared LED illuminators provide cover at night to a range of 10 m, making this super-rugged, high-definition camera the perfect option for deck, hoist and winch monitoring. Its wide operating temperature range also means it can be used in icy conditions, as well as the hottest engine room. The camera can be powered via a 12-VDC input or via PoE (power over Ethernet), which means only a single CAT5 cable is required to hook up the camera, simplifying installation and thus reducing costs.

Camera Management and Control System

Iris's CMAC system is unique as the first and only dedicated camera management system available in the industry. Available in a number of configurations, the system functions as the central hub into which your cameras, alarms and devices feed.

CMAC incorporates a built-in network video recorder module with an anti-vibration, removable hard drive for surveillance purposes, but the real killer feature is the IrisControl HTML5 app that's hosted by the system. When hooked up to a compatible chart plotter, users can scan in their deck plans and photos and then drag and drop device icons and controls onto the plan in order to provide one-touch operation. Simply scroll to the desired deck and hit the camera icon to switch video.

access control, sports fishing and recreational purposes.

The most recent trend in camera usage we've seen has been in deck equipment and hazardous-area monitoring. As crew safety and the performance and operation of critical deck equipment are paramount, operators and owners are realizing that cameras placed strategically around vessels not only provide the cover necessary to operate safely and efficiently but also free up crew members for other, less risky activities.

Compact Dome Camera

Our new IRIS-S460 compact 316 stainless steel IP dome camera measures a mere 6 cm in diameter and is

There's even an intuitive instruction feature that lets you configure certain events when an automation icon is selected. For example, if you are coming into dock stern, you can hit the appropriate automation icon on the deck plan to turn multiple PTZ (pan tilt zoom) cameras to automatically spin and point at pre-defined memory positions.

In addition to deck plans, photos can be uploaded and used to represent device positions and preset views. The most obvious use here is to upload a photo of your engine room, then configure preset icons over critical areas or instrumentation dials. If you need to check the reading on a dial, select the engine room map then hit the view icon, which in turn will automatically select associated cameras, turning and zooming to display the desired view.

As CMAC sits on your multifunction display (MFD) network, you can run the app on any connected chart plotter, further reducing costs and simplifying installation. The app's virtual joystick provides smooth, pinpoint accurate control of PTZ cameras and all other extended features supported by compatible cameras. Having the control interface hosted on the MFD also has another huge benefit of freeing up valuable helm space, and because the system features a built-in computer, as new



CMAC hybrid models interface with multiple video formats (IP, CVBS, AHD, HD-TVI and HD-CVI).

features are released (such as AIS tracking and alarm system interfacing scheduled for this fall) users can download updates from boat-cameras.com to a USB drive and upload onto their device.

CMAC is available as an IP-only network camera model or as a hybrid model supporting IP, composite video, AHD, HD-TVI and HD-CVI formats. Models can be ordered without the record function if desired. Currently, the IrisControl app runs on the Garmin OneHelm platform, with versions for Raymarine and Navico devices in the pipeline for release soon. **ST**

Carl Hitchcock is the CEO of marine camera manufacturer Iris Innovations. Currently based in the U.K., he has been involved in the design and development of some of the most innovative marine camera products on the market. His experience in the CCTV market spans over 30 years, during which time he has developed an in-depth knowledge of all aspects of the industry.



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Q&A: Christopher Drew

Christopher Drew is the co-writer of “Into the Deep: A Memoir From the Man Who Found *Titanic*,” with legendary deep-sea explorer Robert D. Ballard. The book was published earlier this year. Drew, a former *New York Times* reporter, is also the co-author of “Blind Man’s Bluff: The Untold Story of American Submarine Espionage.” He took some time to discuss his new book with Ballard and his take on one of the pioneers of ocean discovery.

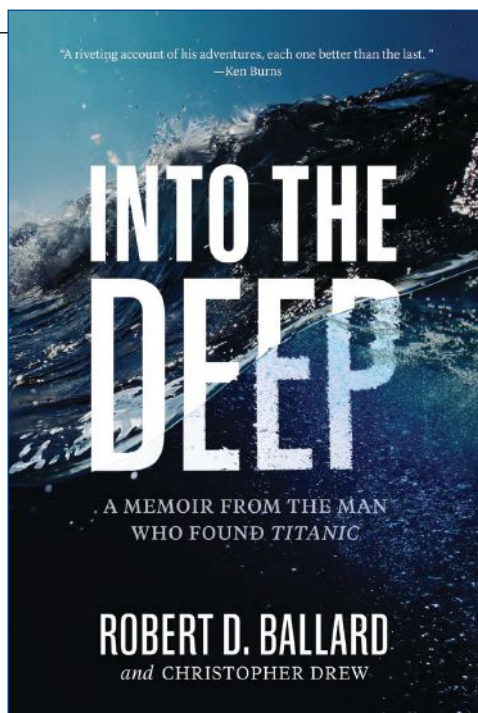
How did you meet Ballard?

I’d been fascinated by *Titanic* and all of Bob’s discoveries, and when we were researching ‘Blind Man’s Bluff,’ I’d heard that he had worked with the Navy on sensitive undersea projects. It turns out that he was amazed by how much we were able to reveal about submarine spying in our book. So while we didn’t meet then, we were aware of each other’s work.

What was the catalyst for you to co-write this book with him?

When Bob was looking for a co-author for his memoirs, he told his editors that he’d love to have me join him since I knew the undersea world. But given how many books and TV shows he’d done, I wanted to make sure that there were fresh and revealing stories to tell.

We met over lunch, and Bob was his usual spellbinding self. But about halfway through, I got up and took two of his books out of my briefcase and placed them on the table. ‘Everything you’ve been telling me is fascinating, but a lot of it is in these books,’ I said. ‘What else do you have that’s new and interesting?’



That was the acid test, and when he responded with several great stories I hadn’t seen anywhere, I was hooked.

Can you describe the process of co-writing the book? Did you interview him over a period of time to sort out the narrative, or did he write a section that you would then edit, etc.?

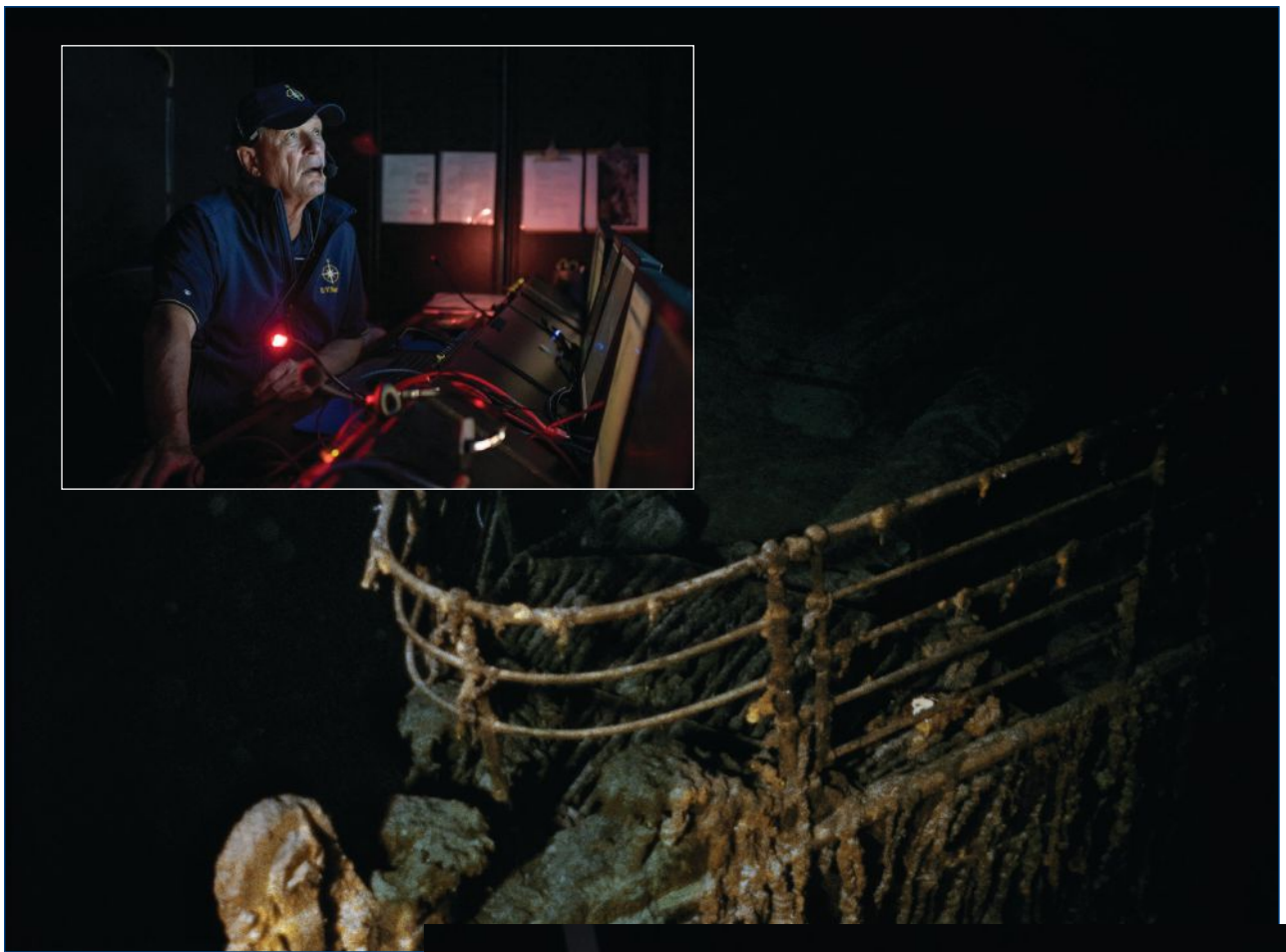
Bob had drafted random scenes and stories, and after we read them, my wife, Annette, and I got on the phone with him for two marathon sessions. Then I went up to his house in Connecticut for four days of talks.

My goal was to go through every important mission and event and learn the backstories that he’d never talked about—the relationships involved, how he’d felt as things were unfolding, and what it was about his background and personality that enabled him to find things others couldn’t.

We wanted the book to be a memoir, something more personal than Bob had written before. He got into that, saying over time that we’d put him on the couch and got him to reflect on his life in ways he’d never had time to do. We did 200 hours of interviews with him, transcribed the tapes and tried to capture his voice in how we phrased everything.

Ballard is a legendary figure in ocean exploration. What characteristics and life events do you think drove him to be a pioneer?

Bob was a much slower learner as a child than his older brother, who became a physicist, and despite all his bravado, Bob had an inferiority complex that moti-



(Above) Returning to Titanic in 1986, a year after the discovery, with Alvin and the smaller Jason Jr. robot, Ballard and his team photographed every inch of the wreck, including the bow. (Credit: Robert Ballard and Martin Bowen/Woods Hole Oceanographic Institution) (Above inset) Ballard's ship, Nautilus, plied the Pacific waters off the island of Nikumaroro in 2019, searching for any sign of Amelia Earhart's lost plane. In the cool, dark control room, he kept a 24-hr. vigil. (Credit: Gabriel Scarlett/National Geographic Image Collection) (Right) Ballard launched Hercules off the deck of Nautilus, sending the ROV in search of any vestige of Amelia Earhart's plane. (Credit: Jesse Goldberg/National Geographic Image Collection)



vated him to push himself harder. Combine that with his fascination as a boy with the sea and the Disney version of '20,000 Leagues Under the Sea,' and it was inevitable that he would push to make his mark as a modern-day Captain Nemo.

The book is full of colorful tales. Which are the most memorable to you?

One disclosure in the book is that President Reagan personally approved Bob's search for *Titanic* as part of Reagan's psych ops war aimed at making the U.S.S.R. fear U.S. capabilities.

Bob tells how he persuaded the Navy to fund his robotic camera systems to survey two sunken nuclear subs, *Thresher* and *Scorpion*. A submarine admiral initially said 'that's crazy' when Bob asked if he could use any



Ballard also deployed an ASV to search close to the reef for Earhart's plane, where he dared not take Nautilus. (Credit: Jesse Goldberg/National Geographic Image Collection)

extra time to look for *Titanic*. But John Lehman, the Navy secretary, conjured up for Reagan how freaked out the Soviets would be if Bob could release photos of *Titanic*'s grand staircase 12,500 ft. deep, and Reagan responded: 'Absolutely, let's do it.'

Ballard is most known for discovering the Titanic. What are some of his other discoveries that are lesser known but significant?

Bob was involved in several major scientific discoveries, and the book recounts how he found the wrecks of *Bismarck*, *PT-109*, *Yorktown*, ancient Roman and Phoenician ships, and even a Turkish jet that was shot down by a Syrian missile.

How does Ballard's dyslexia come into play in his career? Was it a hindrance, or was it something he learned to deal with early on, and how?

How do you deal with not being able to read quickly? You read twice as long. That's how Bob reacted as a kid trying to keep up with his brother.

He also reminded himself of how boxers get back up after they're knocked down as he pushed through early failures.

He came to see that his visually oriented mind was an asset, helping him picture the undersea terrain in 3D.

He didn't actually realize that he was dyslexic until he read a book, "The Dyslexic Advantage," at age 72, with

tears streaming down his face as it 'explained me to me.'

Ballard's lifelong work has blended human exploration with technology. What do you think the future of ocean exploration will look like with regard to the human element and the technological aspect?

Bob has helped bring about the transition from manned submersibles to remote-controlled vehicles that can keep the cameras on station so much longer. He likes to say that this lets scientists 'move their spirits' to the spots they are exploring and collaborate more easily with others who are also watching remotely.

Now, like others, he is moving toward autonomous vehicles.

Ballard is almost 80, but he's still exploring. He's on the hunt for Amelia Earhart's missing plane. What are his plans for that search?

Bob didn't find Amelia's plane off one island in 2019, and he's working with others to develop a pack of deep-diving autonomous vehicles that could scour other possible locations. He plans to resume the search once the vehicles are ready.

Anything you want to add or emphasize?

The joys of exploring can be summed up, Bob says, in this quotation from J.R.R. Tolkien: 'Not all those who wander are lost.' **ST**

Offshore Technology Conference



Programming is complete for the 2021 Offshore Technology Conference (OTC), which will be held August 16 to 19 at NRG Park in Houston, Texas, as an in-person event with virtual components. Both experiences offer access to a world-renowned technical program and engagement opportunities, with exhibitors showcasing the latest technologies revolutionizing the offshore energy sector.

OTC is where energy professionals meet to exchange ideas and opinions to advance scientific and technical knowledge for offshore resources and environmental matters. The conference attracts attendees from more than 100 countries.

It is sponsored by 13 nonprofit organizations in the energy industry that work cooperatively to develop the technical program. Revenue from the event directly benefits the membership of these societies.

Technical Program

The OTC 2021 technical sessions will continue the expansive coverage of topics from past conferences and the future of offshore energy. In addition to recurring topics, sessions will focus on the current state of the industry, reducing costs and improving overall value, breakthrough technologies, industry-leading safety practices, and more.

Highlights of the 2021 technical program include:

The Enhanced Role of Digital Solutions. The OTC program committee recognizes the industry focus on topics related to remote operations, minimally staffed facilities, and the enabling role of data management and digital solutions.

Energy Transition. OTC member societies are actively involved in the future of alternative and innovative ener-

gy sources. The OTC program will continue to include topics on marine renewables.

Cost Reduction and Safety Aspects. There will be a focus on further advancement of cost reduction, improving safety, and enhancing the overall economic results in our industry through technology, processes and collaboration.

New Areas of Opportunity. The OTC program will promote new opportunities in countries for the offshore sector while, at the same

time, examining the hurdles to meaningful progress in facilitating industry collaboration and mitigating the risk as the offshore industry enters these new areas.

Event Highlights

Executive Dialogue Series. The Executive Dialogue Series is a new initiative aimed at engaging in a thoughtful discussion around corporate shifts, offshore resource development, emerging technologies, and the future of the offshore energy sector. Executives will discuss innovations, transformations, new technologies, real-life applications of new technologies, post-pandemic priorities and strategies, and other topics.

Keynote Speaker Series. The Keynote Speaker Series will provide attendees diverse perspectives and share lessons learned and success stories. Speakers range from engineers to CEOs to government representatives and academia. Some of them work in companies from all over the world, from those operating in the most remote to the most mature fields, and in countries with new operational prospects.

Around the World Series. Attendees will find presentations, panel discussions and special sessions focused on international development and new areas of opportu-



nity. The subjects covered are timely and essential to the future of offshore developments. This year's series will be held Tuesday and Wednesday at OTC. Hear the latest information from principals representing the Arctic, Brazil, Canada, Guyana, Israel, the Netherlands and Norway.

Ground-Breaking Innovations and Leading Providers of Products, Services. Whatever you are looking for in offshore energy, you will find it within the OTC exhibits. The exhibition will be held on the virtual platform and in one indoor location: NRG Center. Here, you will find countless networking opportunities while learning of new trends, technologies and equipment.

OTC Emerging Leaders Program. This program will recognize a group of young professionals, representing each of OTC 2021's sponsoring, endorsing and supporting organizations. OTC will recognize emerging leaders who are revolutionizing the offshore energy sector through their services to the industry, innovation, and focus on safety in the workplace.

Showcase of Emerging Energy Companies. The Rice Alliance at OTC is a partnership between OTC and the Rice Alliance for Technology and Entrepreneurship at Rice University in Houston.

The showcase event will be held virtually and will present up to 50 emerging energy companies available for investment.

It offers a great opportunity for OTC attendees to learn more about these evolving businesses and enable potential partnerships.

Attendance is complimentary with your OTC registration.

Industry Awards

The conference will feature the OTC Distinguished Achievement Awards Event Reception to recognize the OTC Distinguished Achievement Award recipients, raise funds for the 2021 beneficiary, United Against Human Trafficking, and provide an excellent opportunity for industry leaders to network with colleagues from around the world. This is a ticketed event that will be held the evening of Sunday, August 15 at the NRG Center.

The Distinguished Achievement Award recipients are: Joe Fowler for individual achievement and the Abu Dhabi National Oil Co. (ADNOC) for institutional achievement in recognition of its cutting-edge Panorama digital command center.

The Heritage Award will be presented to Edward Heerema in recognition of his long-term continuous, distinguished service in management and leadership of offshore installation for the deepwater industry, as well as Russell Hoshman for his long-term continuous, distinguished service in safety and environmental stewardship for the offshore industry.

The awards for innovative technologies are part of the Spotlight on New Technology program, which is exclusively for OTC exhibitors. The program showcases products that recently entered the marketplace and are already advancing the offshore energy sector. There will be 14 awards presented this year, including five small business recognitions. The awards will be presented on August 16 at NRG Park.

Additional information about OTC 2021 can be found at: <http://2021.otcnet.org>. **ST**

international

French Maritime Cluster

AMSSI (Agora for Maritime and Submarine Sustainable Innovations) has been created by the French companies Alcatel Submarine Networks, iXblue and SeaOwl. Other members will soon join them to accelerate the emergence of innovative projects.

This partnership aims to be a maritime innovation cluster to promote French R&D and innovation.

Germany Funds Undersea Robotics System

The German Federal Ministry for Economic Affairs and Energy is providing €12 million as part of the Maritime Research Program for the development of a novel autonomous submersible robotics system that will enable autonomous monitoring of underwater installations in the deep sea with a significantly reduced carbon footprint. The funding will go to the nine participants in the CIAM (Cooperative Development of a Comprehensive Integrated Autonomous Underwater Monitoring Solution) project.

Unmanned submersible robotic systems with unprecedented autonomy will be developed and built, without the need for costly support vessels, to monitor oil and gas pipelines, hydrogen lines, renewable energy power cables and telecommunications cables, and help prevent damage to these underwater assets.

Ocean Infinity Acquisition

Ocean Infinity has acquired Abyssal, a company that develops and implements proprietary software solutions for the offshore industry to improve the safety and efficiency of subsea operations. Abyssal will help shape Ocean Infinity's software development capability as it continues to grow and provide ever expanding robotics and data acquisition services to its marine customer base.

Abyssal's technology includes a managed cloud data platform, synthetic environments, advanced 3D visualization and operation management system tools.

ChartWorld License Agreement

ChartWorld and ZeroNorth have entered into a joint solution partner agreement. ChartWorld will license access to its route network, port database and navigational safety systems, complementing ZeroNorth's vessel optimization platform.

A spin-off of Maersk Tankers, ZeroNorth is an independent tech start-up that aims to digitize shipping to help ship operators optimize voyages, maximize earnings and cut CO₂.

Japanese Hydrogen Consortium

Kawasaki Heavy Industries Ltd., Yanmar Power Technology Co. Ltd. and Japan Engine Corp. have formed a consortium of Japanese engine manufacturers to pursue joint development of hydrogen-fueled marine engines for ocean-going and coastal vessels to establish a world-leading position in hydrogen engine technologies.

By cooperating on common fundamental technologies, basic experiments and analysis of hydrogen combustion, materials and sealing techniques, as well as classification society requirements, each company aims to bring hydrogen-fueled engines to the market by 2025.

Global Mercy Passes Sea Trial

Stena RoRo is leading the project for the construction of the *Global Mercy*, the world's largest civilian hospital ship. After several years of construction at the Tianjin Xingang shipyard in China, the official sea trial has been completed, with good results. The shipyard will present the ship for delivery this summer, and the vessel will then sail to Antwerp in Belgium on its maiden voyage, where some members of the crew will board and medical equipment will be supplemented. This will be followed by a visit to Rotterdam, after which the *Global Mercy* will be ready for its first mission in West Africa.

Communications Network Concept Demo

Elcome International and Broadcast Solutions have completed a live proof-of-concept (POC) demonstration of a maritime mesh network for coastal operations. The POC demonstration, which involved a land-based station and several vessels, confirmed the advanced capabilities of the system, including live messaging and video conferencing between headquarters and mobile units at sea.

The maritime mesh network leverages advanced software-defined tactical radios with multiplexing modulation technology, specialized antennas and IP collaboration tools to communicate across interconnected cells. The multi-node network can sustain secure low-latency broadband connectivity with offshore vessels roaming across a wide operating area offshore.

Subsea Cables Expand Transatlantic Internet

Aqua Comms DAC, the owner and operator of America Europe Connect-1 (AEC-1), America Europe Connect-2 (AEC-2) and CeltixConnect-1 (CC-1), and Telia Carrier, an Internet backbone provider, have successfully completed a trial with Ciena to offer 400-GbE commercial services between New York and Frankfurt.

Aqua Comms has also upgraded two transatlantic submarine cable routes with Ciena's GeoMesh Extreme submarine network solution, allowing AquaComms to deliver transatlantic capacity and 400-GbE service from New York to London, with the help of Telia Carrier's ongoing terrestrial service.

Widening, Deepening of Suez Canal

Egypt has begun work to widen and deepen the southern part of the Suez Canal where a hulking vessel ran aground and closed off the crucial waterway in March. The width will expand about 40 m to the east, on the side of the Sinai Peninsula, and deepen to 72 ft., from 66 ft. That part of the canal is 30 km long.

Work will also include a 10-km-long extension of a second lane of the waterway that opened in 2015. That would bring the double-lane stretch of the canal to 82 km, allowing more vessels to pass through the canal.

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The *Ever Given*, a Panama-flagged, Japanese-owned ship, ran aground in the single-lane stretch of the canal on March 23 before it was extracted six days later after a massive salvage effort by a flotilla of tugboats.

Collaboration on Seabed Mapping

Seabed 2030 and Esri have agreed to collaborate on assembling a global compilation of high-resolution bathymetric data. Seabed 2030 is a collaborative project between The Nippon Foundation and GEBCO to inspire the complete mapping of the world's ocean by 2030 and to compile all bathymetric data into the freely available GEBCO Ocean Map.

SPICE AUV Purchase

Modus Subsea Services Ltd. has acquired two complete, integrated SPICE AUV systems from Kawasaki Heavy Industries Ltd. SPICE AUVs provide a wide range of autonomous services and data acquisition down to 3,000-m depth.

Sonar, Battery Orders for Kraken

Kraken Robotics Inc. has received new purchase orders for a 6,000-m-rated AquaPix MINSAS 120 sonar and SeaPower batteries totaling over \$1.2 million from a new AUV customer. Kraken's batteries and sensors will be integrated on this customer's survey-grade AUV to expand its capabilities and duration for naval, scientific, and commercial applications.

General Atomics Opens New Office

General Atomics Electromagnetic Systems (GA-EMS) has opened an office in Patuxent River, Maryland, to serve as a customer engagement center supporting maritime and naval aviation programs and business growth initiatives in the region. James Donnelly, GA-EMS's director of Maritime Program Operations, will be responsible for leading office operations.

Bollinger Turns 75

Bollinger Shipyards, a designer and builder of steel military and commercial vessels, is celebrating its 75th anniversary. President and CEO Ben Bordelon's grandfather started the company in 1946 as a small machine shop in Lockport, Louisiana, to service the local agriculture and oil industries. Today Bollinger Shipyards is under its third generation of family ownership and is the largest privately owned and operated shipbuilder in the U.S., with 11 shipyards. The most recent shipyard, Bollinger Houma, was added with the acquisition of Gulf Island Fabrication Inc.'s Terrebonne Parish shipyard facilities.

Yara Expands to Poland

Yara Marine Technologies has opened a shop in Poland to serve turnkey deliveries as part of its green tech expansion, including shore power and WindWings, a wind-assisted propulsion and route optimization system that can reduce fuel consumption and CO₂ emissions by 30 percent on average. The new site will also offer on-board repairs and upgrades. **ST**

Federal Sand to Restore Florida Shoreline

The U.S. Bureau of Ocean Energy Management (BOEM) has signed an agreement with St. Johns County, Florida, granting the county up to 1.1 million cubic yards of sand from federal waters for shoreline restoration along 5 mi. of South Ponte Vedra Beach.

The project will alleviate sand loss caused by erosion due to Hurricanes Matthew and Irma, two powerful storms that struck the area in 2016 and 2017, respectively. Damage from Hurricane Matthew reached approximately \$10 billion across the United States, while damage from Irma approached approximately \$50 billion.

In addition, the project will fortify the beach and dunes against future storms, the impacts of climate change, restore environmental habitats (e.g., for shorebirds and nesting sea turtles), and increase and maintain recreational opportunities in St. Johns County. The sand comes from an area in federal waters about 8 mi. offshore and 6 mi. north of St. Augustine Inlet.

More frequent and powerful storms along the coastal U.S. coupled with sea level rise leads to greater demand for sand resources used to restore and protect coastal communities and habitats. BOEM has the authority to convey Outer Continental Shelf sand resources for shoreline resiliency and beach or wetland restoration projects undertaken by federal, state or local governments.

US House Bill to Combat Plastic Waste

Reps. Haley Stevens (D-Mich.), the Chairwoman of the U.S. House Science Subcommittee on Research and Technology, and Anthony Gonzalez (R-Ohio) introduced bipartisan legislation to reduce plastic waste and improve the global competitiveness of the U.S. plastics recycling industry. House Committee on Science, Space and Technology Chairwoman Eddie Bernice Johnson (D-Texas) and Ranking Member Frank Lucas (R-Okla.) are original co-sponsors of the legislation.

The Plastic Waste Reduction and Recycling Research Act directs the establishment of a plastic waste reduction and recycling research and development program, calls on the federal government to develop a strategic plan for plastic waste reduction, and calls for the development of standards for plastics recycling technologies.

At least 8 million tons of plastic end up in the oceans every year and make up 80 percent of all marine debris from surface waters to deep-sea sediments, according to IUCN. Marine species ingest or are entangled by plastic debris, which causes severe injuries and deaths.

US Senate Bill to Conserve Fisheries

The bipartisan Forage Fish Conservation Act, introduced by U.S. Sens. Richard Blumenthal (D-Conn.) and Roy Blunt (R-Mo.), will help conserve fisheries and ensure science guides the management of forage fish populations. Forage fish, such as herring, shad, anchovies and sardines, support marine ecosystems as a critical base of the food web and are vital for larger ocean wildlife and

commercial and recreational anglers. However, current laws don't fully consider the importance of forage fish in all fishery management plans, leaving them vulnerable to overfishing.

"From salmon and snappers to seabirds and whales, the entire ocean food web depends on forage fish," said Jessie Ritter, director of water resources and coastal policy for the National Wildlife Federation. "Scientific, sustainable management of fisheries will help declining forage fish populations recover, and ensure they can support other fish and other wildlife that are critical to anglers and cherished by coastal communities."

Revival of UC Santa Barbara's Ocean and Coastal Policy Center

Charles Lester, former executive director of the California Coastal Commission, is revitalizing UC Santa Barbara's Ocean and Coastal Policy Center (OCPC) to carry forward work on pressing coastal management issues, from the protection of public shoreline access to the challenge of community adaptation to sea level rise. Lester has spent the past 2.5 years reframing the center, which has been inactive since 2010. With \$680,000 in funding from two large grants on the way, he's poised to begin work.

California has earned a reputation for successfully managing coastal resources, development and public access. The state's fishery management and network of marine protected areas have served as a model worldwide. Its coastal management program, nearly 50 years old, is renowned for regulating growth and development and protecting the public's right to access the beach.

Practical and effective solutions are needed to help communities address the accelerating social, economic and environmental challenges driven by climate change. Lester plans to develop the center into a resource that can help guide the response to these challenges.

US House Bill Tackles IUU Fishing

Rep. Jared Huffman (D-Calif.) and Rep. Garret Graves (R-La.) have introduced the Illegal Fishing and Forced Labor Prevention Act, a comprehensive bill to end illegal, unreported and unregulated (IUU) fishing, expand transparency, and stop seafood fraud while strengthening U.S. leadership on issues that threaten the oceans, consumers and human rights.

A report by the International Trade Commission found that the U.S. imported \$2.4 billion worth of seafood derived from IUU fishing in 2019.

The new legislation would ensure that all seafood sold in the U.S. is safe, legally caught, responsibly sourced and honestly labeled. If passed, this bill would provide consumers with more information about the seafood they eat, require fish to be tracked from boat to plate, increase vessel transparency, prevent illegally caught and sourced seafood from entering the U.S., and protect workers and those that rely on a healthy ocean. Additionally, the bill would allow the U.S. to take stronger action against countries who fail to address IUU fishing and human rights abuses in the seafood sector. **ST**

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Small Tactical UAS



Orbiter 4 can perform long-range, long-endurance (over 24 hr.) maritime patrol missions. Its EO/IR and MPR payloads are ideal for maritime monitoring, gas and oil rig protection, illegal activity tracking, and search and rescue. Aeronautics Ltd.

Sonar, Sub-Bottom Profiler Combo

2050-DSS is a tri-frequency side scan sonar system, where any two operator-selectable frequencies can be run simultaneously. The system can be provided with a 120-, 410- and 850-kHz towfish, or a 230-, 540- and 850-kHz towfish. Both towfish options are equipped with a 2- to 16-kHz sub-bottom profiler that uses a PVDF panel receive hydrophone. EdgeTech.

Fast, Light ROV

Flunder is a powerful observation/work-class ROV based on the Commander MK III that incorporates six new-generation thrusters (400 W each). They have a vectorized dis-

tribution (four horizontal and two vertical) and a modified control system. The power of the motors can be increased on demand up to 900 W each. Mariscope Meerestechnik.

Heavy-Duty Engine

C90 170 Stage V features an optimized fuel map that avoids the need for a urea-based after-treatment system, resulting in a 30% reduction of HC, NOx and PM emissions versus the previous version. The keel cooling system can operate in sandy, muddy and shallow water. FPT Industrial S.p.A.

Pollution Monitoring

Combining expertise in remote-sensing science, Earth observation data, machine learning and high-performance computing, SeaScope provides critical sea surface slick intelligence for a range of industries to strengthen situational awareness of the interaction between offshore assets, coastal facilities, local vessel activity and the natural marine environment. CCG.

RF Interference, Jam Prevention

GAJT-410MS is GPS anti-jam technology for the commercial and de-

fense marine markets. This low-size, weight and power variant has jammer direction-finding capabilities for enhanced situational awareness in the marine environment. Hexagon | NovAtel.

Wind Turbine Bolt Check



Bolt-Check measures and maintains the right tension of bolted joints to meet the exact needs of the wind turbine industry to increase safety and reliability and minimize the risk of failure and downtime. It can digitally track individual bolts over their lifetime, which helps ensure that each bolt remains at its optimal tension. R&D A/S.

Virtual Classroom

Virtual Classroom, now integrated with the Ocean Learning Platform, is a collaboration tool that bridges the gap between learning conducted in training centers and learning carried out remotely. Supporting a wide range of learning pathways, Virtual Classroom connects crew, educators and crewing teams in a single platform, ensuring a consistent training record anywhere in the world. Ocean Technologies Group.

A large, red, industrial-grade metal release mechanism is shown in the foreground, with a ship's deck and rigging visible in the background. The sun is low on the horizon, creating a warm glow. The text "SEA CATCH" is prominently displayed in the top left, with "Toggle Release Technology" underneath. In the bottom left, "McMillan DESIGN, INC." and "www.seacatch.com" are listed. On the right, the slogan "Safety occurs with a Sea Catch release" is written in large, bold letters, followed by the tagline "Designed exclusively for the safe release of a line or object under load." in smaller text.

SEA CATCH
Toggle Release Technology

McMillan
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**Safety occurs
with a Sea Catch release**
Designed exclusively for the safe release of a line or object under load.

Drone Software Update

A new path-following function for SeaDrone allows the user to draw a curve on the map. SeaDrone's software then automatically generates the optimal trajectory for the vehicle to follow. SeaDrone Inc.

Network Video Recording

Poseidon NVR is a high-reliability server-grade system that provides full control of a vessel's security and monitoring. It supports up to 24 cameras and holds a total of 800 hr. of footage, offering 24/7 recording with an overwriting buffer in place. Oceanic Systems (UK) Ltd.

Power-over-Ethernet Flowmeters



The latest editions of the electromagnetic flowmeter ProcessMaster and mass flowmeter CoriolisMaster can be installed wherever needed. Four-wire Ethernet combines classic outputs with future communication protocols. Previously hidden data in field devices, such as measurement values on density, conductivity or concentration of the medium, can be unlocked. ABB.

Mobile Inspection App

The new app facilitates efficient safety inspections and reporting in ShipManager's QHSE software. Shipowners and managers can digitalize and streamline the workflow, recording and follow-up of their onboard safety inspections with this app. DNV.

Sunlight Readable Touch Screen

SRMHETRP-15C has a 15-in. screen with over 1,500 nits of brightness. The five-wire resistive touch screen can be activated by a bare or gloved finger, pen, stylus or other object. The waterproof, stainless steel, panel-mount enclosure may be flush mounted into a wall or control panel. TRU-Vu Monitors Inc.

Underway Profiling Winch

Vigo is fitted with a 500-m Dyneema line and uses a self-adapting control algorithm to give a consistent SV or CTD profile depth independently of vessel speed. This winch offers underway profiling in a portable package. C-MAX Ltd.

Offshore Wind Cable Stability

This integrated solution complements the Balmoral FibreFlex cable protection system. It enables up to a 75% movement reduction in sub-sea environments, with potential corresponding trebling of cable life. Balmoral Comtec Ltd.

Unmanned Surface Test Vessel

The 27-ft. Proteus is outfitted with Sea Machines Robotics' SM300 autonomy system. The USV is for testing and development of autonomy capabilities and sensor fusion to support the evolving needs of government and commercial customers. Huntington Ingalls Industries Inc.

Deepwater Nodule Collector

QC2000 enables vessel productivity up to 1,000 Te per hour. It has minimal impact on the seabed and surrounding environment. SMD.

USV Control System

V-PILOT is an integrated autopilot and mission planning system that uses an embedded vessel controller and a shoreside user interface to connect to existing GPS, thrusters, steering and associated command systems. It can be used for small and large unmanned vessels for inshore and coastal survey and inspection operations. Reygar Ltd.

Wave Radar

WV100 Wave Analyzer PC software works with new X-band and S-band radars and can display wave data on both the radar screen and a PC display. Knowing wave height, direction and period is critical in order to guarantee the security of crew and cargo in heavy seas. These data also enable the most efficient navigation and facilitate safe management of port traffic. Furuno USA Inc. **ST**



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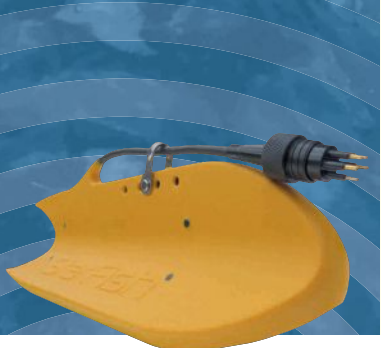
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environmental monitoring

Underwater Camera Network To Monitor Ocean Life

The ocean wildlife and diverse ecosystems of the U.K. Overseas Territories (UKOTs) will soon be more visible than ever thanks to pioneering work to establish a major network of underwater camera deployments. Funded as part of the U.K. government's Blue Belt program, scientists from Cefas, the University of Western Australia and partners in the UKOTs are working with Blue Abacus to supply and analyze the data collected from 66 nonintrusive stereo Baited Remote Underwater Video Systems (BRUVS), which will be deployed in open-ocean and coastal habitats.

These BRUVS will form the Global Ocean Wildlife Analysis Network, which will provide information on ocean biodiversity and ecosystems found in the vast maritime and coastal areas of the UKOTs

in the Atlantic, Indian, Pacific and Southern Oceans.

The UKOTs involved in the project are: Anguilla, Ascension Island, British Antarctic Territory, British Indian Ocean Territory, British Virgin Islands, Cayman Islands, Montserrat, Pitcairn, St Helena and Tristan da Cunha.

BRUVS will enable a benchmark of understanding of the marine species in specific areas, allowing the UKOTs to make more informed decisions about protecting and managing these diverse ecosystems.

Alien Raindrops Are Similar In Size to Earth Rain

Raindrops on other planets and moons are close to the size of raindrops on Earth, despite having different chemical compositions and falling through vastly different atmospheres, a new study in AGU's *Journal of Geophysical Research*:

Planets finds. The results suggest raindrops falling from clouds are surprisingly similar across a wide range of planetary conditions, which could help scientists better understand the climates and precipitation cycles of other worlds.

Raindrops on Earth are made of water, but other worlds in our solar system have precipitation with other composition. On Venus, it rains sulfuric acid. On Jupiter, it rains helium and mushy ammonia hailstones. On Mars, it snows carbon dioxide, or dry ice. On Saturn's moon Titan, it rains methane, or liquified natural gas. On Neptune, scientists suspect it rains pure carbon in the form of diamonds. It could even rain iron or quartz on some planets if the conditions were right.

The new study looking at the physics of how liquid droplets behave while they fall from clouds finds only droplets in clouds within a limited size range, between about a tenth of a millimeter to several millimeters in radius, can reach the surface of rocky planets as rain. This



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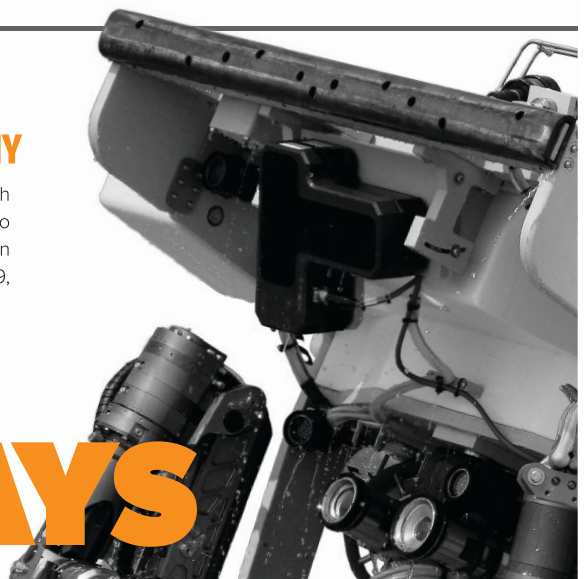
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PATHWAYS



is a fairly narrow size range, given that raindrops increase about a million times in volume during their formation inside a cloud.

The results show the maximum size of liquid droplets that fall as rain is similar across varying planetary conditions. Different types of liquid droplets would max out around half to six times the size of water rain on Earth, depending on the strength of the planet's gravitational pull (the stronger the gravitational pull, the smaller the raindrop).

The findings will help scientists better simulate the conditions on other planets, as precipitation is a key component in a planet's climate and nutrient cycles. Modeling what precipitation might look like on a distant world could also help researchers interpret observations of exoplanetary atmospheres made by space telescopes.

Monitoring Stations for River Medina

Cowes Harbour Commission (CHC) and OceanWise Ltd. have completed a stakeholder benefit project to install two environmental monitoring stations on the River Medina to provide harbor users with tide and weather data, allowing commercial and leisure vessels to make timely safety-related navigational decisions.

A fixed weather station at Shepards Marina provides tide height and visibility information, and a floating weather station in the main harbor provides information on harbor wind speed and direction, temperature, and barometric pressure. The tide and weather sensors feed data to the online Cowes Weather Station that has just been launched at: cowesharbourcommission.co.uk/cowes_weather_station.

For Cowes, OceanWise uses the Valeport tide gauge and Biral visibility sensor. Data from all the sensors are collected and transmitted using OceanWise's smart telemetry service and data management and display system, Port-Log, for use by Cowes pilots and commercial vessels, and publication online.

OceanWise has installed similar systems at other U.K. ports, includ-

ing ABP Southampton, London, Dover and Liverpool.

Rehabilitating Herring Habitat

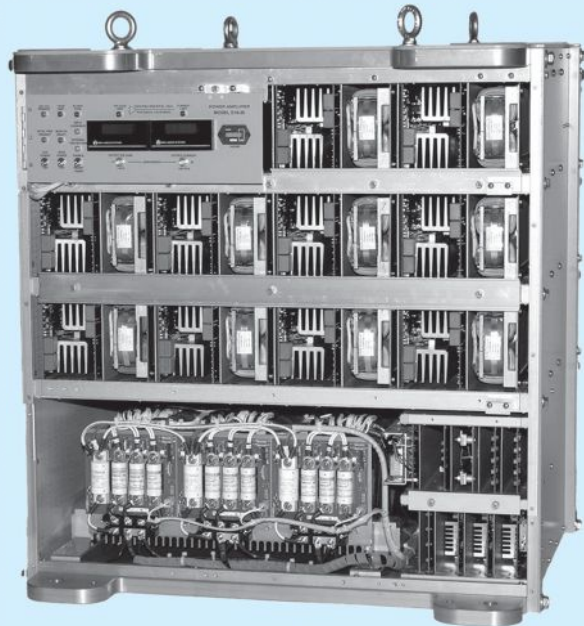
The Salish Sea Community Guardians have created an action plan to provide First Nations traditional herring spawning habitat recovery and protection in key herring spawning areas in waters around southern Vancouver Island. The plan involves the construction

of two types of habitat curtains suspended below floating docks and log booms. These curtains (of synthetic materials or hemlock and cedar branches) provide spawning sites for deposit of herring eggs.

ASL Environmental Sciences Inc. deployed an acoustic zooplankton fish profiler (AZFP) to detect herring populations in the area. Preliminary analysis shows encouraging signs of local herring schools. **ST**

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Launch of Microsatellite

The Norwegian Space Agency has announced the successful launch of the NorSat-3 maritime tracking microsatellite built by Space Flight Laboratory (SFL) in Toronto. NorSat-3 launched aboard Vega Flight VV 18 from the Guiana Space Center in French Guiana.

NorSat-3 is the 17th SFL satellite launched in the past eight months. NorSat-3 carries two instrument payloads. The primary device is an AIS receiver that acquires messages from civilian maritime vessels to provide information on ship locations and marine traffic. The microsatellite is also equipped with an experimental navigation radar detector developed by the Norwegian Defence Research Establishment to augment the AIS receiver.

Combining a navigation radar detector and AIS receiver will potentially provide much better mar-

itime awareness for the Norwegian Coastal Administration, Armed Forces and other maritime authorities. Detections of navigation radar from ships will provide the ability to verify the accuracy of received AIS messages and to detect ships whose AIS messages have not been received.

SFL developed the 16.5-kg NorSat-3 microsatellite on its space-proven next-generation Earth Monitoring and Observation (NEMO) platform under contract to the Norwegian Space Agency with funding from the Norwegian Coastal Administration. SFL also built the NorSat-1 and -2 maritime tracking microsatellites now in orbit and is currently developing the NorSat-TD (technology demonstrator) satellite slated for launch in 2022.

Grant for XOCEAN

XOCEAN has secured a grant

of €1.7 million from the European Maritime and Fisheries Fund and CINEA through the Blue Economy Window program to bring to market XOCEAN's low-carbon USVs aimed at the commercial ocean data collection sector.

The funding will support the product market launch in Europe, North America and Asia.

XOCEAN's USV platform offers significant benefits, including safety with operators remaining onshore, efficiency with 24/7 operations and ultralow emissions (emitting 1,000 times less carbon than traditional survey vessels).

To date, XOCEAN has operated in 14 countries, delivering over 100 projects, including seabed surveys on 16 offshore wind farms.

OTC New Tech Award for Subsea7 NESP

Subsea 7 and Xodus Group, an autonomous subsidiary of Subsea 7, received a Spotlight on New Technology Award at the 2021 Offshore Technology Conference (OTC) in

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Houston for Subsea 7's Nano Engineered Sensor Platform (NESP).

The advanced nano-engineered sensor platform was selected based on its innovative technology, broad appeal to the energy industry, and significant impact with benefits beyond existing technologies.

Subsea 7 NESP, developed in collaboration with Xodus, can continuously monitor fatigue and corrosion offshore, reducing OPEX. The wireless nano-technology sensor can be deployed efficiently and easily across any operating asset. Subsea 7 NESP, which requires no power supply or batteries, offers a scalable, cost-effective, zero-maintenance solution to extend asset life and improve uptime.

New Iridium GMDSS Provider

IEC Telecom has signed a partnership agreement with Iridium to become one of the official Iridium GMDSS service providers.

For a long time, the GMDSS market was limited to only one satellite technology provider. This has changed with the introduction of the Iridium GMDSS service in December 2020.

Offering truly global coverage, Iridium has become the only operator providing this type of service for vessels navigating in sea area A4, which includes the polar regions (*Sea Technology*, May 2021).

Joint Digital Solution For Vessels

Höegh Autoliners will onboard four additional vessels to a joint digital solution combining KONGSBERG's Vessel Insight and MAN Energy Solutions' PrimeServ Assist.

Following the signing of a digitalization partnership between Kongsberg Digital and MAN Energy Solutions in May 2020, the combined infrastructure was initially trialled by Höegh in a two-vessel pilot project that has now been successfully completed.

The agreement between MAN Energy Solutions and Kongsberg Digital came about as the companies realized that their separate efforts in the maritime digitalization space were complementary. Kongs-

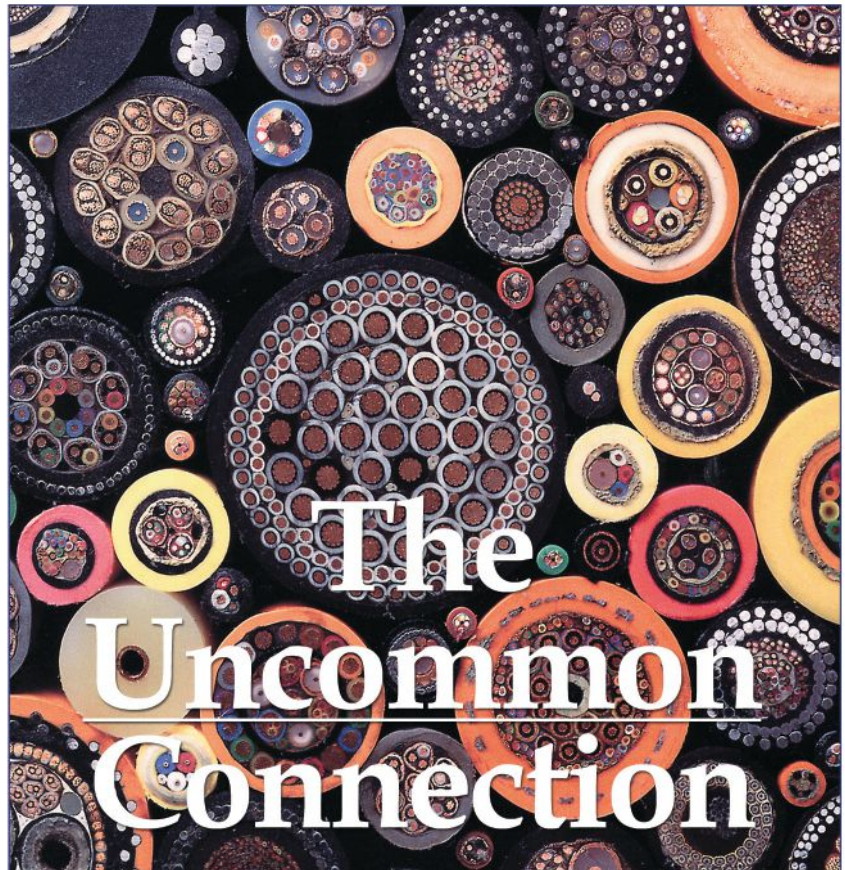
berg Digital's Vessel Insight, a data infrastructure solution, is a natural match with MAN PrimeServ Assist digital solution for optimization of engine use and maintenance.

Patent for Forecast Algorithm Inspired by Autonomous Cars

Signal Group's artificial intelligence-driven voyage forecasting algorithm, Carrier Path Prediction Based On Dynamic Input Data, has

been awarded a U.S. patent. The algorithm is inspired by self-driving cars. It uses graph theory to achieve reliable predictions in a space of high uncertainty.

The algorithm's mathematical generality helps the progressive integration of new input parameters. It also facilitates the expansion of solutions to all types of merchant ships, such as tanker, dry bulk, LNG and LPG vessels. **ST**



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Naval Group Delivers OPV to Argentina

The second Argentinian offshore patrol vessel, OPV 87 A.R.A. *Piedrabuena*, was delivered to the Argentine Navy. This delivery is part of the contract signed by Naval Group with Argentina in 2018 for the delivery of four multimission patrol vessels.

A.R.A. *Bouchard* (formerly *L'Adroit*) was delivered last December, two months ahead of schedule. With the delivery of the A.R.A. *Piedrabuena*, the first of three new patrol vessels to be built for Argentina, the program is progressing as scheduled and will continue at a pace of one delivery every six months.

Dutch Navy Chooses SEMA AUV

The Netherlands Royal Navy has appointed RTsys to supply seven portable and recoverable ASW training targets. The Dutch Navy chose the SEMA AUV for its easy operation and wide range of acoustic training capabilities. These acoustic features will allow both Dutch and Belgium forces to train in real conditions when it comes to the localization and tracking of a submarine.

Intelsat Comms Supports Danish Defense

Intelsat General Communications LLC (IGC), a wholly owned subsidiary of Intelsat, has been awarded a six-

year contract with the Danish Ministry of Defence Acquisition and Logistics Organisation (DALO).

Intelsat provides DALO with full-time Ku-Band satellite communication capacity. Intelsat also facilitates communications between DALO's Danish hub, which is co-located with an Intelsat teleport, and ships operating in the North Atlantic Ocean, including the Labrador Sea and the Baffin Bay.

IGC has been the prime provider to DALO in support of the Danish Navy in the North Atlantic since 2007.

Silverstream, Shell Awarded for Green Tech

Clean technology company Silverstream Technologies has been jointly awarded the Royal Institution of Naval Architects' QinetiQ Maritime Innovation Award, alongside Shell Shipping & Maritime for the recent retrofit installation of the Silverstream System on board the Shell-chartered LNG carrier *Methane Patricia Camila*.

The award recognizes innovations that are making significant improvements in the design, construction and operation of oceangoing vessels. It has been presented to the companies for their efforts to drive forward the use of proven efficiency technologies within shipping.

Trials of the Silverstream on board the *Methane Patricia Camila* demonstrated 6.6 percent net savings generated by the system.

NAVAIR Approves TE Connectors

TE Connectivity has received Naval Air Systems Command (NAVAIR) approval for its CeeLok FAS-X connector product line for MIL-DTL-32546. Designed with standard 38999 shells and reliable AS39029 contacts, TE's CeeLok FAS-X connector is currently the only MIL-DTL-32546 approved solution for high-speed networking for both military and aerospace applications.

Meeting one of the most demanding and stringent military standards for connector quality and performance, this connector combines rugged reliability with signal integrity to support current high-speed protocols.

Two More SeaBats for Danish Navy

The Danish Navy has recently acquired two additional Teledyne SeaBat T20-R multibeam echosounders with integrated navigation systems, expected to be used primarily in Greenland. The two systems have been delivered and are already in use. The Royal Danish Navy uses SeaBat multibeam systems as the primary sensor for hydrographic surveys in Denmark and Greenland. The multibeam systems produce accurate bathymetry for charts crucial to navigation safety.

UK Funding for Sonardyne, SeeByte Tech

Sonardyne and SeeByte have been awarded U.K. Defence Science and Technology Laboratory (Dstl) funding to enhance and extend the future operational capability of autonomous and remotely operated systems in challenging battlespace domains.

The collaboration is the second phase of the U.K.'s Defence and Security Accelerator's Autonomy in Challenging Environments competition. **ST**

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Nontoxic Corrosion Inhibitor

ChampionX has secured two contracts worth a combined £2.8 million to deliver its next-generation, nontoxic chemicals to two major North Sea operators. The company's corrosion inhibitor product line has been developed to enable E&P organizations to economically extend the life of their assets in a sustainable way.

Corrosion inhibitor chemicals are widely used as a preventative measure in pipeline systems and are deployed from wellheads to processing facilities and export lines. This infrastructure is typically made of carbon steel and exposed to dissolved acidic components such as CO₂ and organic acids in the presence of water, which creates a continuous threat of corrosion.

ChampionX's latest range of corrosion inhibitors meet the strict North Sea environmental regulations and use active components that are biodegradable, making them nontoxic to marine life.

First DNV Smart Notation For Offshore Unit

A semisubmersible drilling platform from China Merchant Heavy Industry, *Shen Lan Tan Suo*, has become the world's first offshore unit to receive DNV's Smart notation compliance certificate.

The voluntary Smart vessel notation from DNV provides a framework for assessing and visualizing digital vessel features and shows that a vessel is utilizing enhancements that improve operations, efficiency and reduced environmental impacts.

The Smart notation demonstrates that the data collection infrastructure of *Shen Lan Tan Suo*, and its ability to ensure reliable and safe data collection from multiple systems on board, has been subject to quality assurance from an independent third party.

The rig has also been awarded the qualifiers D-INF(P) for data-driven verification processes, and EEN, which recognizes solutions that

provide improved energy efficiency and reduced harmful emissions, focusing on technologies that are considered cost, energy and emission-efficient for the operation of the vessel.

Robotic Valve Controller For Offshore Brazil Fields

TechnipFMC has been awarded a subsea contract from Petrobras for the Marlim and Voador fields offshore Brazil. TechnipFMC will supply up to eight manifolds for production and injection, utilizing the all-electric robotic valve controller (RVC). The contract also includes associated tools, spares and services.

The RVC is robotic technology that replaces traditional subsea hydraulics, as well as thousands of mechanical parts, while providing real-time data and analysis on system performance. This results in a manifold that is smaller, less complex and less costly with a significantly reduced carbon footprint. Moreover, the RVC's software can be remotely upgraded and maintained subsea, increasing the overall reliability and availability of the subsea system.

Fugro Supports Mero 1

Fugro is providing positioning and construction support services for Jumbo Maritime, an offshore installation contractor, on the Mero 1 deepwater field development located approximately 180 km off the coast of Rio de Janeiro.

Using its Starfix Navigation Suite and augmented reality QuickVision camera system, Fugro is supporting Jumbo in the safe and efficient installation of 35 subsea torpedo piles and 24 mooring lines down to water depths of 1,980 m. This critical infrastructure will be used to anchor the Mero 1 floating production unit and associated equipment.

Collaboration on AUXROV Distribution in US

Aleron Ltd., specialists in complete ROV and tooling solutions,

have a new partnership with SEA.O.G Offshore. The U.S. company, with bases in Houston, Texas, and New Bedford, Massachusetts, provides maritime support services for the oil and gas and renewable industries. The new partners will collaborate to bring Aleron's intelligent AUXROV system to SEA.O.G Offshore's key market network in the U.S., with clients benefiting from fast system access and extensive technical support.

The Aleron AUXROV system delivers power and positioning for underslung tools, including rock grabs, mass flow excavation tools, rock bag deployment frames and cutting tools. The AUXROV has the capacity to control tools conventional ROVs are unable to operate, offering users a reliable multipurpose system to support a diverse range of applications, including wind farms, decommissioning and UXO surveying.

Funding for Digital Twinning

Welaptega, an Ashtead Technology company, has launched a \$500,000 initiative to develop a product to enable digital twinning of underwater infrastructure without the need for offshore personnel.

Funding for the Unmanned Digital Twinning Project has been awarded by Canada's Ocean Supercluster. In collaboration with Whitecap Scientific, SubC Imaging and Nova Scotia Community College SEATAC division, the new digital twinning technology will develop an intuitive bridge between Welaptega's and Whitecap Scientific's technology systems.

Upon successful launch of the project, conventional offshore ROV and vessel crew will be able to confidently collect high-quality image data for post-processing digital twins, guided by real-time 3D reconstruction, to give feedback on image quality and coverage.

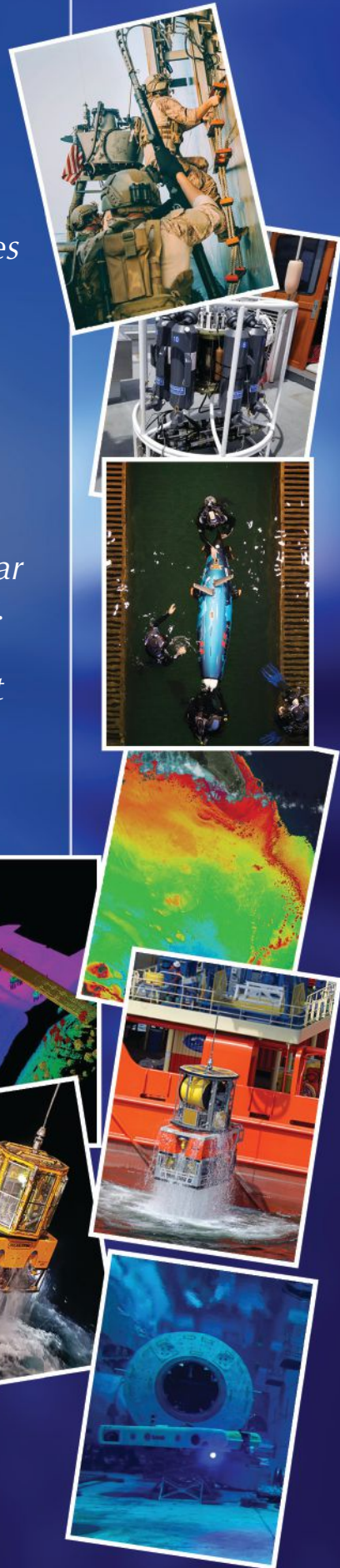
Digital twins digitize replicas of physical assets, used for integrity management, simulations, and the general visualization of remote infrastructure to maintain the economic viability of assets, increase safety and reduce risk. **ST**

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contracts

Clarins, Paris, France, has signed a letter of commitment to environmentally friendly maritime transport that commits Clarins to reserve 20 percent of its exports to the U.S. for movement aboard sailing cargo ships between Saint Nazaire - Montoir de Bretagne, France, and Baltimore starting in 2023. Neoline.

Marlink, Oslo, Norway, has signed an agreement to upgrade the hybrid VSAT network solution on a 150-vessel fleet, with additional bandwidth to enable new data, applications and reporting. Scorpio Shipmanagement.

Sterling PlanB, Vancouver, Canada, is entering into an exclusive agreement for the sales and distribution of energy storage systems in Japan. This move reflects the growing awareness that energy storage technology will be an essential component of the evolution of zero-carbon shipping. NYK Trading Corp.

Silverstream Technologies, Addlestone, U.K., has secured an order to install its air lubrication technology, the Silverstream system, on two environmentally friendly newbuild ro-pax vessels, the first of which is starting to be built at China Merchants Nanjing Jinling Shipyard (Weihai). Finnlines.

OneLearn Global, Limassol, Cyprus, has signed a memorandum of understanding to collaborate in the field of education and training. This will encompass marine and offshore technology, marine robotics and maritime digitalization. Cyprus Marine and Maritime Institute.

Kraken Robotics Inc., St. John's, Canada, has received an order for a 3,000-m-rated AquaPix MINSAS 120 synthetic aperture sonar from an American AUV manufacturer. Delivery is expected in 2021. Undisclosed.

Modus Subsea Services Ltd., Darlington, U.K., has been awarded a

contract to perform survey services in connection with a new cable corridor requirement in Ofotfjorden, northern Norway. The campaign will use the Modus Hybrid AUV (HAUV) system. Undisclosed.

Kongsberg Digital, Kongsberg, Norway, has signed a partnership agreement to make three new software solutions available to Vessel Insight subscribers via the Kognifai Marketplace: Vessel Health, Automated Reports and Fuel & Emission Optimization. MarineInsight by io-Currents. **ST**

meetings

Note: The coronavirus (COVID-19) pandemic could affect event dates. Check event websites for the latest updates.

AUGUST

August 16-19—AUVSI XPONENTIAL, Atlanta, Georgia. www.xponential.org.

August 16-19—Offshore Technology Conference, Houston, Texas. www.otcnet.org.

August 17-18—CLEAN PACIFIC, Renton, Washington. www.cleanpacific.org.

August 23-27—World Water Week, Virtual. www.worldwaterweek.org.

August 30-September 2—Oceans In Action, Gulfport, Mississippi. www.mtsociety.org/oceans-in-action.

August 31-September 2—MAST Europe, Toulon, France. <https://mastconfex.com/europe2021>.

August 31-September 2—Subsea Tieback, Galveston, Texas. [OffshoreEvents@endeavorb2b.com](mailto:shoreEvents@endeavorb2b.com) or www.subseatiebackforum.com.

SEPTEMBER

September 7-10—SPE Offshore Europe, Aberdeen, Scotland. +44

(0) 1224 253807, gillian.george@bigpartnership.co.uk or www.offshore-europe.co.uk.

September 10—AUVSI XPONENTIAL, Virtual. www.xponential.org/xponential2021.

September 13-17—London International Shipping Week, London, England. +44 1296 682104, ljacobs@elabor8.co.uk or <https://londoninternationalshippingweek.com>.

September 19-24—Underwater Minerals Conference, St. Petersburg, Florida. lazevedo@immsoc.org or www.underwaterminerals.org.

September 20-22—Oi Middle East, Abu Dhabi, United Arab Emirates. www.oceanologyinternationalmiddleeast.com.

September 20-23—Global OCEANS 2021 San Diego – Porto, California and Virtual. <https://sandiego21.oceansconference.org/global-oceans-2021-san-diego-porto>.

September 20-24—NMEA/RTCM Conference & Expo, Orlando, Florida. 410-975-9425, mreedenauer@nmea.org or www.expo.nmea.org.

September 21-23—Sea Asia, Singapore. www.sea-asia.com.

September 26-October 1—SEG21, Denver, Colorado. seg.org/AM.

September 29-October 1—Lakebed 2030 Conference, Virtual. 231-995-2500 or marinecenter@nmc.edu.

OCTOBER

October 5-7—Deepwater Operations and Topsides, Platforms & Hulls Conference and Exhibition, Galveston, Texas. OffshoreEvents@endeavorb2b.com or www.offshore-event.com.

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Asbjørn Halsebakke is the director of marine technical solutions at Yaskawa Environmental Energy/The Switch, headquartered in Helsinki, Finland.



He has a background in the electrical and electronic manufacturing industry. He earned an M.S. in power electronics from Høgskolen i Narvik (HiN) and has technical skills in electrical wiring, as well as experience in management, research and development, and sales.

It's difficult to break established patterns of behavior. Once something becomes the norm, it is accepted and viewed as conventional wisdom, even when it's not in the slightest bit smart.

And that's what has happened with shipbuilding.

There's always a focus on capital expenditure (CAPEX). What will this ship cost? Can we make it any cheaper? How does it compare to what I can get from Yard B? If we can save money, or undercut the competition, it's surely good for business, yes?

In an industry where the smallest margins are seemingly a matter of commercial life and death, the race to the bottom continues to gather pace. But who will be the winners?

I understand that shipowners and yards feel a huge financial strain, especially during this time of global disruption and associated economic pain. If you can save money, you do. Why wouldn't you?

Well, maybe because it'll end up costing more.

Yards are under pressure to push out vessels as cheaply as possible. This comes from owners, but it also comes as a result of the established norm: build quickly, often without having an owner lined up, sell quickly, and move on to the next project.

But being cheap isn't the same as delivering value. CAPEX savings

for owners can be far outstripped by costs in operating expenditure (OPEX) over a vessel's lifetime—or even over the first few years of operation.

There's extreme short-term pressure that fuels the need for short-term savings. But it's often bad for everyone: Yards are forced to slash prices, owners don't get the best value solutions, and society gets poor environmental performance and standards.

We need to reboot the system. And green, sustainable solutions should be the first factor.

I can already hear a couple of virtual groans. "Green! But green technology costs more!"

Unfortunately, that's usually the case. And that's why yards don't tend to offer truly green solutions in their newbuilds, unless specifically pressured. Which, as yet, doesn't happen enough.

So, yes, CAPEX may be more. But what if OPEX could be considerably less? Wouldn't you rather spend \$50,000, for example, on a car that costs virtually nothing to run and has a higher resale value than one that is \$40,000 and costs another \$5,000 a year to run? And what if that initially more expensive car were simpler and more reliable to own and better for your children, better for the world? It's not, or shouldn't be, a difficult decision.

But forget the car. We're talking about ships. So, let me use my own company as an example.

Yaskawa Environmental Energy/The Switch makes innovative drive train technology that is market proven. Our solutions convert energy sustainably, store energy effectively and consume energy responsibly. Two of our main offerings are: DC-Hub, which can use any electrical energy source, thus, future-proofing vessels, and permanent magnet machines, which convert mechanical energy to clean, green electrical power. Used together, these help

deliver huge vessel efficiency gains, reducing fuel burn by up to 35 percent and maintenance costs by 10 to 20 percent.

By spending a little more in overall project cost, you unlock huge business efficiencies over the vessel's lifetime—potentially providing return on investment after a couple years—and preventing tons of greenhouse gas emissions.

Less pollution, less fuel, less maintenance, less cost. What more reasons do you need to choose a green solution?

Once the demand is there, the yards will meet it. But the yards should move to create that demand, too.

Surely there's a business opportunity to integrate green technologies into newbuilds, marketing them as responsible and hugely cost-effective assets that will deliver long-term benefits. In a market where everyone is focused on price, why can't smart yards differentiate themselves as pioneers in value and as partners to owners, looking after their business needs, reputations and the environment, rather than simply being suppliers that fulfill orders and ignore OPEX, moving from one project to the next?

Governments have a role to play, too. By rewarding yards and owners for greener building initiatives, they can provide incentives while positioning their national industry as the shipbuilders of the future, focused on quality, environmental stewardship and value.

Shipbuilding is a business, and businesses must make money. The way that truly benefits all of shipping's myriad stakeholders is not by cutting costs, but by providing value. This is the focus of smart owners, and smart yards need to wake up to a new way of working.

If we keep focusing on short-term CAPEX, we'll all end up paying in the long term—and nobody wants that. **ST**

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