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A member of Explosive Ordnance Disposal Mobile Unit (EODMU) 11 free-fall jumps out of a C-130 Hercules aircraft assigned to the Wyoming Air National Guard 153rd Airlift Wing as part of maritime insertion training run by Explosive Ordnance Disposal Training and Evaluation Unit (EODTEU) 1 off the coast of San Diego in July 2020. (Credit: U.S. Navy, Garrett LaBarge)

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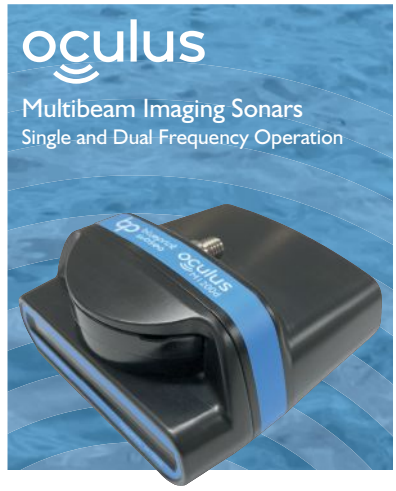

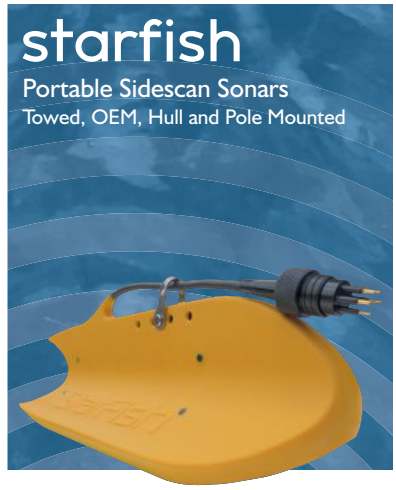

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editorial

***Scott T. Price**, Chief Historian, U.S. Coast Guard*

Ocean Stations' Role In the Korean War

Established under President Franklin Roosevelt in 1940 and active until 1977, the U.S. Coast Guard's (USCG) Ocean Station program proved to be a vital Korean War mission (1950-1953). The program provided vessel-based meteorology, among other services, in patrol areas shaped like a square, with sides 210 mi. long. Ocean Stations represented a postage stamp in square miles compared to the vast expanse of the Atlantic and Pacific Oceans. In the Pacific, prior to the outbreak of the Korean conflict, Coast Guard cutters were stationed at the Nan (N) and Oboe (O) Ocean Stations. When the conflict began in Korea, the service added more stations in the North Pacific, including Queen (Q), Sugar (S), Uncle (U) and Victor (V). The new stations provided complete weather data and greater search and rescue coverage for the trans-Pacific merchant and military traffic brought on by the war.

Cutters assigned to Ocean Stations hosted teams of meteorologists from the U.S. Weather Bureau to conduct weather observations, assisted by specialists among the Coast Guard crew. The cutters also served as high-seas aids to navigation, checkpoints for military and commercial maritime traffic, communication "relay" stations for aircraft on transoceanic flights, and medical service providers to merchant ship crews.

Ninety-five percent of war material bound for Korea went by ship, but nearly half of the personnel went by air, making the Ocean Station vessels a vital link in the United Nations' military logistics effort. Cutters were assigned to Ocean Station duty to augment their search and rescue capabilities in case aircraft had to make a water landing. The Coast Guard also established a chain of Pacific air search and rescue detachments, including bases in the Philippines, Wake Island, Midway Island and Hawaii.

With the addition of new Ocean Stations, the Coast Guard sought more vessels to augment the already extended cutter fleet. Fortunately, the U.S. Navy turned over a number of destroyer escorts (DEs), which the Coast Guard re-commissioned as cutters. These old war-horses had served as convoy escorts in World War II, 33 of which had been manned by Coast Guard crews. The DEs were re-armed with depth charge racks and numerous anti-aircraft guns, and retrofitted with a large shelter on the stern for weather balloon storage. The first ex-DEs to join the fleet were CGC *Koiner* and CGC *Falgout*. Once commissioned, the new cutters underwent shakedown training under the supervision of the Navy and then sailed for their new homeports.

The *Koiner*'s operations provide a good example of Ocean Station duty. After its shakedown cruise, the cutter arrived in Seattle, where it joined a hodge-podge fleet of ex-Navy seaplane tenders and 255-ft. Coast Guard cutters. *Koiner* next deployed for Ocean Station Nan in the North Pacific. There, the cutter steamed for three weeks in circles within the Ocean Station square before being relieved by the cutter *Lowe*, another converted DE.

During the Korean War, Ocean Station cutters assisted several merchant ships and aircraft in distress in the North Pacific. In 1950, Station Nan was the busiest of all the Ocean Stations, with cutters providing nearly 360 radar fixes per patrol. CGC *Forster* assisted the largest number of vessels while on patrol. During the war, the Pacific Ocean Station cutters assisted over 20 merchant and Navy vessels and one transoceanic airliner.

Unsung but always ready, the Ocean Station cutters insured the timely and safe arrival of United Nations' troops and supplies throughout the Korean conflict. Ocean Station cutters averaged over 700 hr. on station and steamed an average of 4,000 mi. per patrol at the start of the war, and these numbers rose when the patrols were lengthened and expanded. Twenty-four cutters served on the stations in the Korean War, earning their crews Korean Service Medals. The Ocean Stations' service in the Korean conflict is yet another forgotten chapter of the long blue line. **ST**

)) Report Makes Case for Zero-Carbon Future for Shipping Industry. Transitioning the shipping industry to carbon-free fuels and renewable energy will eliminate emissions approximately equivalent to those of Japan or Germany while empowering local communities and economies, according to a new report by Ricardo, released by Ocean Conservancy: https://oceanconservancy.org/protecting-the-arctic/take-deep-dive/zero-carbon-shipping. The report presents a case for the widespread adoption of "electrofuels" to transition the international shipping industry from being one of the largest emitters of greenhouse gas emissions to a zero-carbon future. These electrofuels are synthetically derived from hydrogen or ammonia and produced using renewable energy, as a drop-in replacement for fossil fuels. The Zero-Carbon for Shipping report presents South and Central American case studies that demonstrate how existing technologies, such as electrofuels and renewable energy, will do a lot of the work required to transition the shipping industry to a zero-carbon future. South and Central America have a lively shipping industry with total imports and exports to the region of around $1 trillion. In combination with an increase in wind and other renewable energy sources, South and Central America are primed to lead the shipping industry away from fossil fuel dependency.

)) World's First Fleet of Commercial Autonomous Exploration Vessels. The maritime and scientific community has an ambitious target to map the entire ocean floor by 2030. Volvo Penta and Danfoss Editron have been commissioned by Grovfjord Mek. Verksted (GMV) shipyard to power the world's first fleet of autonomous robot exploration vessels for commercial use. Ocean Infinity has invested in the Armanda fleet of advanced unmanned vessels that will be fully diesel-electric. These fully hybrid-electric vessels will be powered by Volvo Penta DC gensets and Danfoss DC grid controls. The engine's low fuel consumption will reduce CO_2. This fleet of autonomous vessels will provide new opportunities for deep-sea exploration. Each vessel will be able to launch separate ROVs that will reach depths of up to 6,000 m and carry out surveys on pipeline routes, as well as collect vital seismic data. Currently, ROVs need to be tethered to manned research vessels. This new fleet of autonomous surface vessels will mean that ROVs can be operated without a nearby host vessel, via satellites from onshore facilities in Texas in the U.S. and Southampton in the U.K.

)) **First Recipient of Don Walsh Ocean Exploration Award.** The Marine Technology Society (MTS) and the Society for Underwater Technology (SUT) have announced that Dr. Edie Widder is the inaugural recipient of the Captain Don Walsh Award for Ocean Exploration. Widder is an MTS member, MacArthur fellow, deep-sea explorer and conservationist who combines expertise in oceanographic research and technological innovation with a commitment to reversing the worldwide trend of marine ecosystem degradation. The award is named after American oceanographer, explorer, retired naval officer and marine policy specialist Captain Don Walsh. Walsh and co-pilot Jacques Piccard were aboard the bathyscape Trieste when it made its record descent on January 23, 1960 into the deepest point of the world's oceans, the Challenger Deep in the Mariana Trench. The award recognizes outstanding, sustained, international contribution to the development, application and propagation of marine technology toward the advancement of ocean exploration. The award also aims to spotlight role models who will inspire early-career marine technologists, scientists and engineers. A specialist in bioluminescence, Widder has been a leader in helping to design and invent new submersible instrumentation and equipment to enable unobtrusive deep-sea observations. "Edie Widder is a perfect exemplar of what young members of our community can aspire to. She and Don Walsh provide an inspiration to us all," said SUT President Ralph Rayner.

)) **Winners Selected for Global-X.** The International Global-X Challenge, launched in April by the U.S. Office of Naval Research Global (ONR Global), has selected four winning projects that will demonstrate revolutionary capabilities for the U.S. Navy, Marine Corps, commercial marketplace and the public. The awards, totaling over $1.1 million, fall under two challenge areas: "Multifunctional Maritime Films for Persistent and Survivable Platforms and Warfighters" and "Object Detection and Identification in any Medium." The winning projects involve: biofilm that will resist biofouling to replace traditional hull coatings; a robust quantum-limited diamond-fiber magnetometer that may achieve nanotesla sensitivity for long-term, wide-area maritime surveillance; a self-sustained electrical biochip to detect flow and small traces of chemicals; and neuromorphic event-based sensors that can quickly detect submerged vehicles and objects and enable celestial navigation without breaking the water surface. The selected international teams will have nine months to demonstrate that their concepts successfully meet objectives. **ST**

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Solution to GPS Hacking

Space-Terrestrial Hybrid Navigation Combats Security Threats

By RAdm. Nick Lambert • Dana A. Goward

In March 2017 NATO's Exercise Joint Viking in northern Norway didn't go quite as planned. Targeting systems malfunctioned, it was difficult to keep track of troops, and navigation wasn't what it should have been. The problem? Just across the border, Russian troops had used jammers to disrupt Global Positioning System (GPS) signals.

Things went so well for Russia that the following September they again disrupted GPS signals over a broad area. This time it was in the Baltic during their "Zapad" exercises with Belarus. One side effect was phone service outages in Latvia, Norway and Sweden's Oeland islands for several hours.

Shortly thereafter, the United Kingdom's defense minister, then Gavin Williamson, warned that the primary threat to Britain from Russia was not a direct invasion. Rather, it was damage to infrastructure that could cost thousands of lives.

"The plan for the Russians won't be for landing craft to appear in the South Bay in Scarborough and off Brighton Beach," he told the *Telegraph* newspaper. "What they are looking at doing is they are going to be thinking 'How can we just cause so much pain to Britain?' Damage its economy, rip its infrastructure apart, actually cause thousands and thousands and thousands of deaths, but actually have an element of creating total chaos within the country."

The following week, the U.K. government released a "Blackett Report" outlining the nation's critical dependence on "satellite-based position and timing," services that are now almost exclusively provided by GPS. The report found a huge number of threats and vulnerabilities across all British infrastructure sectors. The study built on a previous London Economics Report that showed a five-day disruption of satellite navigation services costing the nation at least £5.2 billion.

Among the Blackett Report recommendations was a proposal for a terrestrial system that could operate alongside GNSS, corroborating the positioning, navigation and timing (PNT) information from satellites and providing similar services when signals from space are not available.

Widespread Dangerous Hacking

While Russian jamming is very much a concern for the U.K., the problem has not been confined to northern Europe. Nor has it been just the province of the Russian military. The following are some examples.

A European Union project called "STRIKE3" monitored satellite navigation frequencies in numerous locations over three years and found almost 500,000 examples of signals that could interfere with GNSS reception. About 50,000 of these were judged to be from intentional jammers operated by individuals attempting to avoid paying tolls or the monitoring of their activities.

The German Aerospace Center (DLR) placed detectors on a cargo ship on a year-long voyage from Europe to the Far East and back. They found interfering signals on satellite navigation frequencies nearly everywhere the ship traveled. Most were found in and around ports, but they were also detected during coastal transits and sometimes in the open ocean.

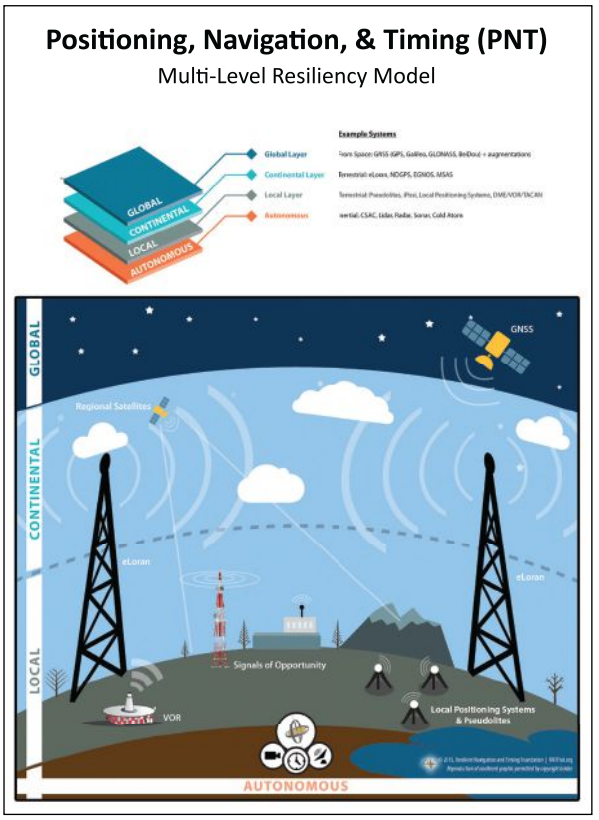
Russia security forces protecting VIPs across the country have regularly demonstrated the ability to cause hundreds of GPS users to report they are far from their actual locations. One study of the impact of this on maritime operations showed almost 3,000 ships affected.

Hackers have demonstrated how to deceive multiple global satellite navigation systems simultaneously and how to force automobiles in auto-drive mode off the road.

China has used GPS spoofing at oil ports to hide Iranian oil shipments by making shipboard receivers report they are orbiting buildings well inland. China has also regularly jammed GPS in the South China Sea near man-made islands they have constructed in order to extend

their territorial claims. Iran used GPS spoofing and jamming to lure a U.K. oil tanker into its waters to justify seizing it.

And, of course, jamming of GPS and other satnav signals is a regular occurrence in conflict zones. Pro-Russian forces in Ukraine use jamming to frustrate surveillance drones monitoring the cease-fire accord. The commander of U.S. Special Operations Command has described Syria and the Eastern Mediterranean as the "most aggressive jamming environment the world has seen." This resulted in the U.S. Maritime Administration issuing regular official warnings to shipping in the area.



System-of-systems approach needed to protect GPS and users.

Solutions Identified

Despite these challenges and the U.K. government's official reports, until recently, few specifics have been published on what must be done to address this problem to protect shipping and other critical infrastructure.

In March, a year-long study sponsored by the European Space Agency (ESA) called Maritime Resilience and Integrity of Navigation (MarRINav) was released. Focused on ensuring continued operation of the U.K.'s critical maritime activities, its implemented recommendations would also help protect other infrastructure sectors. The report strongly recommended that the U.K. should establish a "hybrid system" of space-based and terrestrial PNT capability to protect against natural, accidental and malicious interruption or interference with satellite-based navigation.

The 1,174-page report concluded that a combination of existing global navigation satellite systems (GNSS), a relatively inexpensive terrestrial system navigation and timing system called eLoran, and the short-range R-mode VDES maritime navigation system would adequately protect the U.K., its coastal waters and EEZ (exclusive economic zone). It also recommended local positioning systems, such as Australia's Locata system, to reinforce port cargo operations.

Benefits

The MarRINav project is part of the European Space Agency's NAVISP program investigating PNT systems, both terrestrial and space based. Europe has long recognized that the weak signals from satellite navigation alone are inadequate for safety-of-life and other critical functions. The project's initial focus on maritime derives from the U.K.'s long maritime tradition as an island nation, with maritime commerce being especially critical to its economy and society. The report documents that maritime navigation is also a particular concern for the U.K. as its waters are some of the busiest in the world. Transits approach 500,000 a year in some places, such as the Dover Strait, so maritime navigation must be a no-fail proposition as far as possible; a genuine challenge when factoring in the growth of offshore renewables, other water-space uses such as aquaculture, and the evolution of smart shipping and autonomous vessels.

Primed and coordinated by the blue economy solutions firm NLA International, MarRINav was a team effort by eight analytic, academic and nonprofit entities. "Nobody on the team sells equipment or had any interest in the outcome other than getting the analysis right," said Jonathan Turner, a co-founder at NLA International who lauded the team effort.

"For example, user requirements were gathered and documented by the U.K.'s General Lighthouse Authority, continual engagement with users was led by the U.K.'s Knowledge Transfer Network, and a 'next steps' plan was developed by Taylor Airey Limited."

London Economics also contributed to the report, finding that establishing the systems recommended would provide the U.K. a good return on investment. Their cost-benefit analysis showed a return of 2.2 times on an investment in the systems needed to implement MarRINav's recommendations. This was a very conservative figure as the analysis only considered benefits to container ship operations in 10 U.K. ports. The total benefit to maritime commerce, other infrastructure and the overall U.K. economy would be much greater.

The project team made every effort to consider all aspects of PNT in maritime commerce, including critical infrastructure, vessels, ports, pilotage and aids to navigation. All phases of logistics operations were covered, from truck-borne containers on road networks through departure port nodes, short sea-shipping routes, open-ocean transits, destination ports, and hinterland road and logistics networks.

While MarRINav focused on U.K. maritime, the authors contend that the report's methodology and findings can be used by any nation and across all forms of critical national infrastructure. "Nations' coastlines, commerce, infrastructure and requirements are all different," said Alan Grant, a vice president of the Royal Institute of Nav-

igation. "But part of the intent with the MarRINav effort was to create something that could be used for more than just the U.K. and maritime."

Implementation of the report's recommendations will also benefit defense and maritime security. National military support systems and infrastructure can be more secure and stable at home, enabling a more reliable defense industrial base, while systems such as eLoran are easily adapted and deployable for forward operations. The U.S. Air Force operated an expeditionary version of Loran in the 1970s, for example.

Integration and Use

To be most effective, these systems must be integrated with each other in a bridge navigation suite.

A great example of how nonintegrated systems and inadequate training can lead to trouble is the case of the *Royal Majesty* in June 1995. While on passage from Bermuda to Boston, it grounded on the Rose and Crown Shoal off Nantucket. In short, the GPS reverted to dead reckoning mode shortly after sailing, probably due to an antenna failure, unbeknown to the bridge team. The GPS remained in dead reckoning (DR) mode and was the principal PNT source plotted on the paper chart and fed to the autopilot for the next 48 hr. or so. As the ship proceeded northwards, it drifted some 17 mi. off track to the west of its planned course, ultimately grounding. Visual navigation marks and buoys were misinterpreted and made to "fit the picture," thus corroborating the bridge officers' confidence in the ship's assumed positioning and progress, enabling them to believe the incorrect GPS information. Secondary aids to navigation such as Loran-C, radar and depth sounder were not used to corroborate GPS, so there was little information to disrupt their belief and confidence in the false position. This is a phenomenon known as "confirmation bias" where people seek data that confirms expectations and, if they fit the picture, do not question the veracity of those data. For the *Royal Majesty*'s bridge team, the dawning realization of being lost, the incredulity, the acceptance and the management of panic probably all happened in the last few minutes prior to, as and after the ship grounded.

In the case of *Royal Majesty*, all the navigation sensors were "stand alone" and did not automatically cross-check each other. Modern ship bridge suites can have all navigation sensors integrated into one system that will alarm when they start contradicting each other. Then, even if the bridge team can't immediately determine which sensor is wrong, they are at least alerted to the problem and can take precautionary measures, such as stopping the ship, while the problem is sorted out.

No navigation system or combination of systems is perfect, but a system-of-systems approach is the nearest we can get to a cost-effective silver bullet. The idea with MarRINav is to safeguard ships, the global logistics supply chain, the environment, and Britain's national and economic security by equipping mariners with as many affordable tools as possible.

An overview of MarRINav was presented recently in a webinar hosted by the Royal Institute of Navigation and is available at: tinyurl.com/y69hteaj.

An abstract, executive summary, summary report and the entire final MarRINav report, along with 11 technical work packages, can be viewed at: https://marrinav.com/marrinav-reports. **ST**

RAdm. Nick Lambert is a co-founding director of NLA International Ltd., a blue economy solutions company promoting the environmental, social and economic benefits of understanding, monitoring and governing our seas and oceans more effectively. He is particularly interested in the Polar Regions and is engaged in a variety of situational awareness, fisheries and aquaculture management, marine autonomous systems, and vessel efficiency projects.

Dana A. Goward (SES, retired) is the president of the nonprofit Resilient Navigation and Timing Foundation. He formerly served as the maritime navigation authority for the United States and is a member of the National Positioning, Navigation, and Timing Advisory Board, which independently advises the U.S. government.

Roadmap for Unmanned ASW

Upgrading the Seagull USV with Deterrence Capabilities

By RAdm. (retired) Yaron Levi

With surging activity offshore by manned submarines and unmanned underwater assets, the importance of anti-submarine warfare (ASW) in deterring those activities is increasing. Since traditional ASW demands costly and extensive operations, relying on air patrols and dedicated large naval vessels, naval ASW efforts are often insufficient. But navies can change that submarine-ASW balance by delegating some of the missions to unmanned platforms. When implemented en masse, this new capability would deny the submarines' inherent stealth and achieve deterrence at a much lower cost. That's where Elbit Systems' multi-mission USV "Seagull" is heading.

Elbit Systems' Seagull USV charts a secure path for the HMS Ocean in a joint naval drill with the U.K. Royal Navy in Haifa, Israel, December 2017. (Credit: Galina Kantor)

Seagull USV Platform

The Seagull can self-deploy to its operational area or be ferried by other vessels or aircraft to a forward location. It is powered by two diesel engines running two propellers. When operating ROV or dipping sonars, Seagull maintains station-keeping with dynamic positioning using lateral thrusters. The boat can endure up to four days at sea and maintain mission seakeeping at up to sea state five. The unmanned boat has inherent satellite communications (satcom) and line-of-sight networking, providing situational awareness and remote control of the sensor and mission payload on board.

Its patented autonomous navigation system features safe sailing and obstacle avoidance that conform to international regulations. It features a robust, modular hull that accommodates multiple mission-payload suites supporting specific missions such as mine countermeasures (MCM), electronic warfare and deception, and hydrographic surveying. ASW is the most recent mission the Seagull has assumed. The Seagull can operate from port or mothership, with two unmanned vessels controlled simultaneously from the same mission control system.

With a shallow draft, the Seagull's aluminum hull is quiet and relatively immune to torpedo attack. At the same time, as an unmanned platform, it isn't likely to become a worthy target for a submarine. The Seagull USV can be built from composite materials.

ASW Toolbox Concept

Specially designed for unmanned operations, the Seagull can be quickly reconfigured to carry out multiple missions and operate different payloads employed in a multidimensional "toolbox" concept. Such a toolbox comprises sensors of different types and complementary platforms providing access to other domains, such as underwater and aerial vehicles. By employing multiple sensors as part of Elbit Systems' ASW toolbox, the Seagull provides the centerpiece for a broad ASW campaign that denies the enemy freedom of action underwater, deterring an adversary from any attempt to compromise maritime sovereignty.

Elbit Systems' ASW toolbox has multidimensional capabilities, similar to the Seagull's MCM toolbox. The lat-

(Top) Seagull integrated with TRAPS sonar. (Bottom) Seagull torpedo trial. The first trial to remotely launch a torpedo took place in Haifa, Israel, April 2016. (Credit: Galina Kantor)

ter comprises the sonars and communications on board the USV, rotary-wing drones, and UUVs. The company's roadmap for the ASW kit includes the integration of towed, reelable active-passive sonar (TRAPS) on the USV; deployment of dipping sonars by rotary-wing unmanned aerial system (UAS) and sonobuoys dropped by fixed-wing UAS; and operation of UUV and a fixed-array sonar, a kind of acoustic ASW barrier. The integration of those capabilities creates a comprehensive, centrally controlled, multi-static array of active and passive sonars, denying a submarine its main advantage of stealth.

The information obtained by those sensors is merged into a unified tactical picture, including tactical situations and possible and verified threats. Automatic decision tools support the complete process, ranging from threat assessment through to mission planning and mission execution.

Elbit Systems has developed, tested and demonstrated different elements of its ASW toolbox since 2016. In sea trials undertaken by Elbit Systems UK in October 2019, Seagull performed a series of live demonstrations of unmanned mission capabilities under the U.K. Defense Science and Technology Laboratory (DSTL) Progeny Maritime Research Framework. Launched in 2018, DSTL's £200 million Progeny framework supports science and technology research for current in-service capabilities and next-generation maritime technology and unmanned systems. Elbit Systems UK was one of a shortlist of U.K. companies selected to take part in the second phase of the project. In the Progeny trials, Seagull was equipped with the L3Harris Helicopter Long-Range Active Sonar (HELRAS) and successfully conducted its autonomous ASW operation in a cold and very windy environment.

"We are proud of our ongoing work with the Royal Navy as we work together to maintain its operational advantage," said Martin Fausset, CEO of Elbit Systems UK.

TRAPS-USV

Under its ASW toolbox roadmap, Elbit Systems has integrated different sensors on the Seagull, enabling the USV a level of operational agility unmatched by larger, manned platforms. Seagull changes the dynamics of anti-submarine operations by creating a threat to submarines using a cost-effective and available asset, replacing and augmenting manned assets with minimal threat from submarines. It empowers a surface vessel or naval base commander with offboard, available and rapidly deployable ASW capabilities to protect critical sea areas and high-value assets from both submarine and sea-mine threats.

Adapting the TRAPS sonar for operation on USV was handled by Elbit Systems' Canadian subsidiary GeoSpectrum, the original manufacturer of the low-frequency sonar intended for detection, classification, localization and tracking of submarines. TRAPS is used on vessels of different sizes, as a permanent installation or containerized package. To meet this requirement, the company redesigned the TRAPS-USV variant to be lighter and compact. In April 2020, the system successfully passed a series of sea trials in Haifa, Israel, demonstrating the capability of the system to operate autonomously on a USV at sea, deploying and recovering the towed system at different speeds and transmission at various power levels.

"We understand that unmanned systems can and will play a significant role in modern ASW operations," Paul Yeatman, president of GeoSpectrum, said. "We are confident that TRAPS-USV is a significant game-changer in this respect."

TRAPS-USV maintains all-acoustic active sonar capabilities of the regular TRAPS and enables the Seagull to perform ASW on the move, substantially increasing operational range and flexibility.

The integration of the TRAPS-USV on the Seagull followed the conversion of the HELRAS dipping sonar for the USV. Produced by L3Harris, HELRAS is a popular dipping sonar employed on ASW helicopters worldwide. The Israeli Navy considered using HELRAS as an interim solution for the ASW mission, using the Seagull as a platform. In February 2019, Elbit Systems completed the integration and passed the Navy's acceptance tests. Operating the dipping sonar on board a USV significantly increases acoustic detection capabilities and enhances mission endurance, compared to heliborne operations. Since entering service, the Israeli Navy has committed this new ASW asset in several naval exercises, with the

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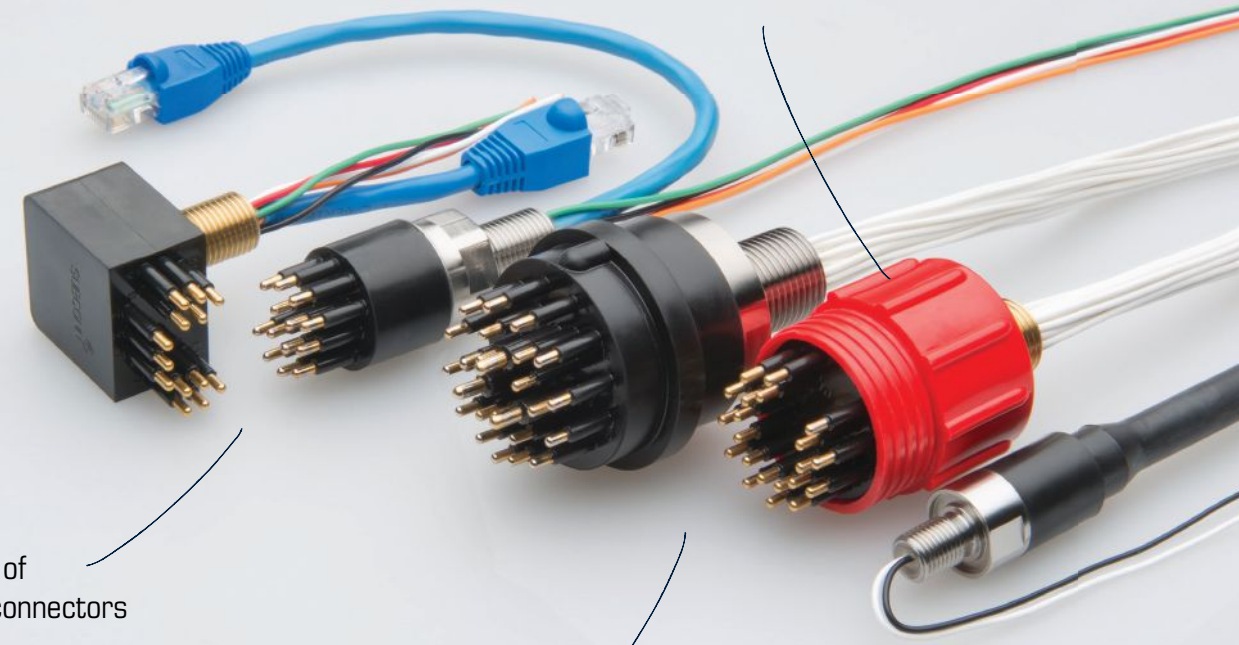

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Hellenic, Spanish and British Royal navies, demonstrating the increased effectiveness of UAS in ASW missions.

Deployment of fixed-wing UAS was another milestone for the Seagull. Elbit Systems has recently explored the integration and operation of its Skylark-C on board the unmanned vessel to enable launch and control of the UAS from the boat, further enhancing its intelligence-gathering capabilities. The visual feed generated by the drone can be transmitted via the Seagull's communications link to the land-based control unit or the mission control system on other vessels.

Seagull Grows 'Teeth'

To maintain effective deterrent, ASW operations require "teeth." The Seagull demonstrated the capability to launch an Mk-46 anti-submarine lightweight torpedo (LWT) in 2016, being the first in the world to launch such a weapon from an unmanned boat. The design enables the launch of any LWT from the Seagull.

In 2018, Elbit Systems and Leonardo group entered further cooperation to integrate Leonardo's torpedoes on the unmanned boat and demonstrate the capability to launch LWT and mini torpedoes from the Seagull. This solution is based on the same architecture used for airborne torpedo launching systems. The torpedoes Leonardo offers for such missions are the MU90, designed to combat submarines of all types, in the open sea and shallow littoral water. The MU90 employs a powerful propulsion battery enabling a top speed of up to 38 kt. and increased endurance over 13,500 m. Leonardo also develops the Black Scorpion, a mini torpedo designed to engage small targets, including mini-submarines and UUVs in shallow waters.

These torpedoes enable the Seagull to hold at-risk submarines detected by the unmanned boat, employing ASW techniques, tactics and procedures similar to those performed by helicopters and large surface vessels.

Assuming a growing range of missions, Elbit Systems' Seagull USV is introducing exciting and transformative naval warfare capabilities, paving the way for future maritime warfare techniques. Seagull offers navies a real force-multiplier, delivering enhanced performance to naval operations, reducing risk to human life, and dramatically cutting procurement and operating costs. Mine countermeasures and anti-submarine warfare are two applications already supported by the Seagull, employing the comprehensive toolbox concept. **ST**

RAdm. (retired) Yaron Levi is the vice president of naval systems at Elbit Systems. He served more than 30 years in the Israeli Navy.

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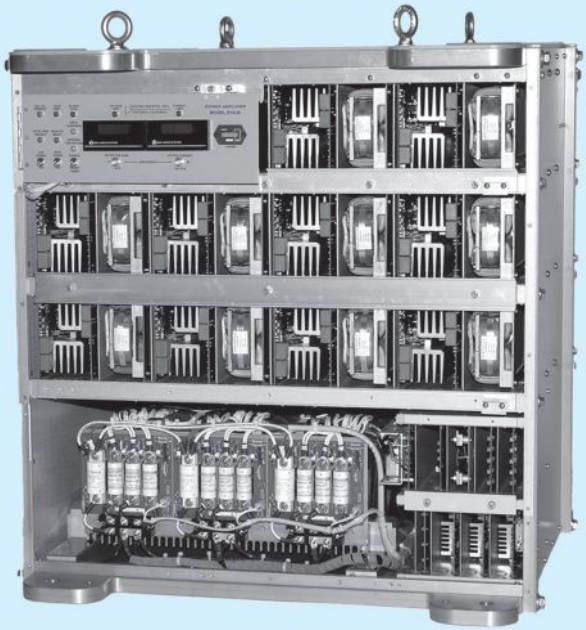

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Contactless Mine Recovery

UXO-LSDS Remotely Retrieves Unexploded Ordnance

By Wilbert Beilsma

As environmental sustainability is becoming one of the highest priorities on the business agenda, the energy industry is currently facing a challenge of having to balance a growing demand with the need for reduced emissions.

In order to combat the consequences of fossil fuel usage, scientists and governments are working to identify alternative technologies that will generate enough energy to meet the increasing demand while reducing the emissions of greenhouse gases to the atmosphere. In other words, across the world, we are engaged in the implementation of an "energy transition."

Within the transition trend, there is a wide portfolio of alternative energy sources available, from a large-scale development of hydrogen as a clean fuel to renewable energy such as wind or solar power.

Growth of Offshore Wind Market And the Growing UXO Threat

Offshore wind is considered one of the fastest growing energy industries, with 2019 being the biggest growth year to date. As offshore wind continues to thrive despite the impacts of COVID-19, the Global Wind Energy Council (GWEC), an industry body, has not only predicted a substantial growth in 2020 but also identified emerging markets, which will offer further opportunities in the sector.

The rapid growth of the number of offshore wind projects raises concerns about the suitability and safety of the offshore marine environment. It is predicted that as a result of the 20th century World Wars, an estimated 1.6 million metric tonnes of conventional and 220,000 metric tonnes of chemical warfare agents have been decomposing at the bottom of the North and the Baltic Seas. The risk is also prevalent in U.S. waters, where the unexploded ordnance (UXO) "hot spots" include munitions dump locations and sites of historic or modern military training.

UXO poses a tangible risk to any activity taking place within the marine environment around the world. Offshore wind and oil and gas platforms are equally exposed to UXO-related hazards. It is vital for the offshore wind developers, operators and EPC (engineering, procurement, construction) contractors involved in marine development projects to understand the threats that UXO presents in the marine environment, where any high disturbance to the seabed is capable of causing unintended

The Unexploded Ordnance Lifting & Safe Disposal System (UXO-LSDS).

The UXO-LSDS during testing.

detonation of surface or buried ordnance. The ramifications carry major HSE (health, safety, environmental), financial, and construction risks.

The Importance of Safety

In order to avoid any potential obstacles that would jeopardize the safe and timely completion of a project, all marine developments, whether it is a wind farm, a drilling site or an oil platform, should employ safety measures that would mitigate UXO risks.

Managing the risks in the planning process, rather than after the commencement of a project, prevents unexpected UXO discoveries, of which disposal may considerably inflate the costs and have a significant impact on the project time lines and, most importantly, safety.

Accidental detonation of marine UXOs under uncontrolled conditions may result in loss of life, injury or property damage. However, even controlled underwater detonation of unexploded ordnance can often cause a series of shock waves, which not only present a great hazard to any vessel or construction in proximity but also pose a great danger to the UXO-clearance divers.

With the divers' safety being one of the key drivers, Unique Group has pooled its expertise in survey and buoyancy technology with Dutch UXO experts Bodac to develop an Unexploded Ordnance Lifting & Safe Disposal System (UXO-LSDS), which paves the way for contactless mine recovery.

Innovative System

UXO-LSDS is a one-stop-shop concept supported by Unique Group's unrivaled knowledge and skill set in the areas of diving, buoyancy and survey, combined with Bodac's experience in UXO risk mitigation and explosive engineering services in the deep sea.

One of the most challenging factors of working within the marine environment is its unpredictability; constantly changing nature where water currents, natural marine processes or even the fishing industry may cause a disturbance and potential movement or migration of the unexploded munition. The ability to adapt to these constantly shifting conditions by using a fit-for-purpose technology allows us to safely and efficiently resolve specific issues faced by the operators and/or contractors.

The technology is based upon Unique Group's robust Seaflex Mono Buoyancy Unit (MBU) design, which has a proven track record of over 20 years and has been used by several navies and commercial diving companies as a lifting device.

Unique Group and Bodac have also addressed the clients' need for a quick and easy-to-use product by designing UXO-LSDS to be an easy and efficient technology that is compact and lightweight, as well as easy to transport and handle.

Considering the potential financial, safety and environmental threats posed by the landfill of abandoned warfare on the seabed, it is crucial to choose an appropriate approach when mitigating those risks. With its unique design consisting of a housing for two 9-L, 300-bar composite cylinders and a Sonardyne acoustic Lightweight Release Transponder (LRT), the UXO-LSDS offers complete support in explosive ordnance relocation, recovery and neutralization with full safety.

Process

There are several mine recovery systems available on the market that, should there be an unexpected explosion, can put divers' lives at risk. Bearing that in mind, Unique Group has created technology that allows a swift and cost-efficient contactless disposal of explosive ordnance while ensuring the safety of the divers involved with the recovery of the unexploded bombs.

After attaching the UXO-LSDS onto an unexploded ordnance either by an ROV or a mine recovery diver, and securing it via a long lifting sling to maintain a safe distance, the sensor is remotely activated, releasing the flow of air from the composite cylinders and filling the lifting bags (Seaflex MBUs), with the precise amount of air required to commence the lift. The unexploded ordnance is then safely towed away or disposed of while assuring that the diver is removed from the life-threatening blast vicinity.

Working with known UXO weights and water depths, the UXO-LSDS is fitted with multiple pressure-relief valves and pressure maintenance valves, which serve as additional safety and control mechanisms.

Testing and Validation

The UXO-LSDS has been subjected to multiple practical tests, both in-house and external, which then have been evaluated and improved on in order to generate the most comprehensive assessment of the technology's design and validity.

Unique Group has carried out numerous tests in its new facility in Werkendam in the Netherlands, which, with a direct access to the waterfront, provides ideal testing conditions of each development stage, from the manufacturing process to the trial itself.

In addition to the in-house examination, the remote mine recovery system has been tried and tested in an external facility. By utilizing a specialist diver training facility with a 9-m-deep test tower located in the Netherlands, Unique Group has been able to simulate a real-time scenario test in order to evaluate the reach of the acoustic alarm when there is interference by various objects, such as vessels, pontoons and quay sides.

The 9-m-deep test tower has also been utilized in order to evaluate the functionality of the first prototype, as well as the product's ergonomics. The examination has been carried out by descending a heavy, metal object with the LSDS system attached to it to the bottom of the basin, where its conduct has been evaluated based on the time and speed of its ascend as well as the performance of the safety valves on the lifting bags.

The wide range of tests, both in-house and external, have also proven that the Sonardyne acoustic alarm, which has been built into the UXO-LSDS, shows excellent capabilities when setup in challenging conditions with external interferences.

Accreditation

The works have been conducted within a regulatory system that fully complies with the ISO 9001-2009 Quality Management Standard, as audited by Lloyd's Register Quality Assurance for full traceability.

In addition to several other accreditations, including ISO 14001 and ISO 18001, the Seaflex products have been built in accordance with the International Marine Contractors Association's regulations, and each model has been awarded the 5:1 safety factor certificate.

Future Capabilities

Having safety and practicality at the forefront of its technology, Unique Group is dedicated to the further development of its product, which in the future would offer not only automatic ascend but also descend, allowing remote and safe deposit of the UXO in a detonation place.

With the ability to design bespoke systems to support complex projects and solve specific problems, Unique Group is leading the way in remote mine recovery, revolutionizing the way in which unexploded ordnance is recovered and disposed. **ST**

Wilbert Beilsma is the general manager of Unique Group's Netherlands office. Beilsma holds a B.A. in international business and is trained in international project management. With 17 years' experience in the maritime industry and extensive knowledge of commercial, military and medical diving equipment, he is specialized in managing customer relationships and executing complex projects.

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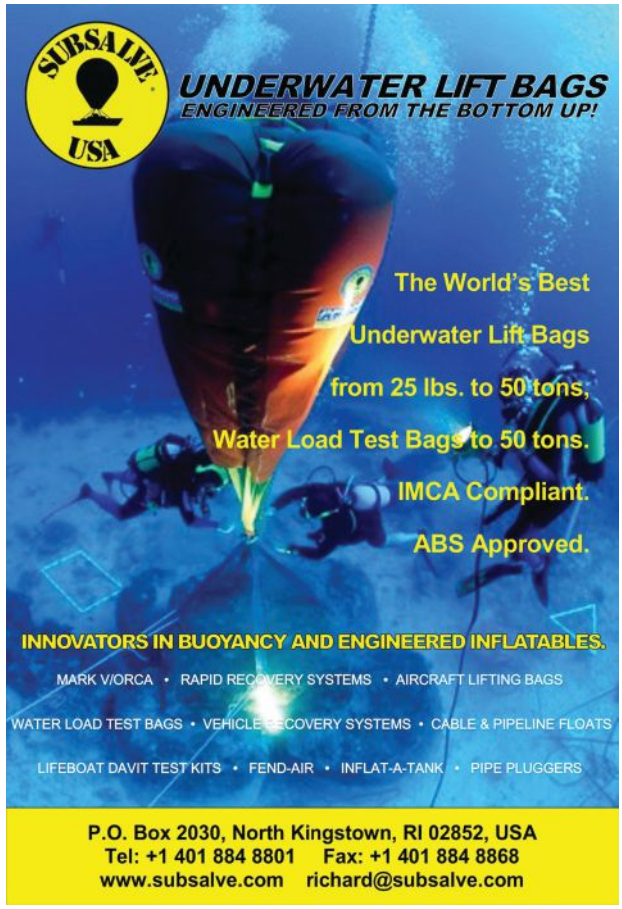


Q&A: Career Possibilities

A recent Bankrate study ranked the most and least valuable college majors and discovered that two niche and little known majors top the list of 162 fields of study: naval architecture and marine engineering. They are followed closely by nuclear and electrical engineering.

Many students may have little to no exposure to these career options and may dismiss them out of hand. But experts at Huntington Ingalls Industries (HII), the largest military shipbuilder in the U.S. and regular employer of all four of these top professions, want students to take a closer look.

Ingalls Shipbuilding designer Alexandra Dupuis with a wireframe diagram of a U.S. national security cutter. (Credit: Huntington Ingalls Industries)

Brian Blanchette, the director of technical and design engineering at Ingalls Shipbuilding, a division of Huntington Ingalls Industries, aims to share his love for naval architecture and marine engineering with young people. He shared his thoughts on the profession and its possibilities with *Sea Technology*.

What do you think prevents college students from studying naval architecture and marine engineering?

Naval architecture and marine engineering is a relatively small field, and only a few schools offer it as a major. Students may head off to college knowing they are interested in engineering but not yet decided upon which discipline. Unless they are at a school that offers NA&ME, they are effectively locked out of the field at that point.

And there is not enough awareness about these areas. Many students are familiar with aerospace engineering but may not know about the nautical side of things. One of the great aspects of these careers is not only do you get to live near the water, but every ship is unique and brings new challenges with it, so that may differ from some engineering careers that are more production-line focused.

How do you propose stoking interest in these fields?

The first step is education and information, ensuring students understand that naval architecture and marine engineering is an option and that it's an incredibly exciting time to be involved in this area.

There's a digital transformation underway in shipbuilding, which promises revolutionary advances in quality, safety and efficiency. To be on the forefront of all these technological advancements is a unique and rare opportunity. Enhanced digital technologies such as 3D printing, artificial intelligence, augmented and virtual reality, and data analytics are forever changing the way we design and build these ships and aircraft carriers and

"There is a great breadth of options available to NA&ME graduates, whether in support of commercial or military shipbuilding, in design or construction, in the government or private industry."

submarines, which are the nation's most complex and sophisticated naval military vessels.

Another key component in raising awareness about these professions is through the companies that rely upon and employ naval architects and marine engineers. At HII's Ingalls Shipyard, for example, we invite high-school students to visit us and to learn about these areas of expertise. In addition, our Employee Resource Groups conduct competitions and other fun activities to encourage student interest in these STEM fields. Promoting these professions in the media helps spread the word as well!

What can those who major in these fields expect when they enter the job market? How easy/hard is it to get a job, what kinds of jobs are available, what are starting salaries like?

There is a great breadth of options available to NA&ME graduates, whether in support of commercial or military shipbuilding, in design or construction, in the government or private industry. Starting salaries are usually equal to or greater than other engineering majors. Graduate school is also an option, but you can get a good-paying, rewarding job with a four-year degree.

What career trajectory can these students expect?

One of the best aspects of a degree in naval architecture and marine engineering is that you focus on the total system. As a result, it fosters a big-picture mindset. In my opinion, that prepares students to accept more breadth of responsibility, which opens doors to technical and project management career tracks.

The field is also sufficiently rich that, if you are technically focused, you can specialize in very specific areas and pursue a purely technical or even research-focused career track. The fundamentals of the degree allow you to make those choices after you get into your career, so it offers a lot of potential options.

How did you become interested in naval architecture and marine engineering?

I grew up in Rhode Island, so I spent a lot of time near the water.

When I was in school, Australia defeated the United States in the America's Cup, and I thought at the time I wanted to design sailboats and bring the cup back to the States.

Somebody beat me to that before I had a chance to go to college, but when I found out that naval architecture was an option, it seemed like the perfect fit. I knew I wanted something involving science and math, and the opportunity to apply that to designing boats and ships really appealed to me.

What has your career been like?

I have been at Ingalls Shipbuilding since graduating from the University of Michigan over 25 years ago. I have had one incredible opportunity after another, working in multiple departments. I've been a part of new ship design efforts, worked collaboratively with the Navy in Washington, D.C., been in the production environment, and even traveled the globe working in business development.

At every step, I have been able to apply the combination of problem-solving skills of an engineering curriculum with the total system approach of a naval architecture and marine engineering degree.

What is most interesting about your current and previous jobs?

Working for a military shipbuilder is extremely fulfilling. Our facility itself could be the subject of a documentary special, and the ships we build are even more impressive.

But, even more exciting than what we do is why we do it. We all contribute to defending America's freedom and freedom around the globe by giving our Navy and Coast Guard capable and survivable warships. We build them as though our own son or daughter could one day sail on that ship. It's incredible to be a part of something bigger than yourself. And, of course, it's thrilling to host presidents and first ladies and other well-known dignitaries when ships are christened.

What advice would you give students still seeking a major?

I highly recommend looking at a degree like naval architecture or any engineering field that is marketable right out of school. Problem solving is a skill that's applicable to every aspect of life, no matter the person or the profession, and that's a key component to engineering.

Also, it's important to note that majoring in engineering does not preclude an appreciation for liberal arts. I had a boss tell me once that more great works of literature have been written, more beautiful works of art painted, and more amazing musical pieces composed by engineers than there have been engineering marvels developed by literature, art or music majors. That's not to diminish any of those other majors but simply to point out that engineering offers a great deal of flexibility and unique opportunities. **ST**

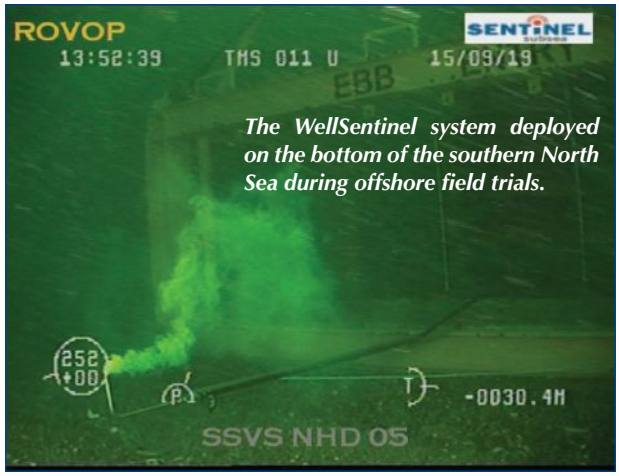
Monitoring Well Integrity

WellSentinel Supports Effective Carbon Capture and Storage

By Jim Gordon

Fossil fuels are the backbone of many global economies; however, extensive carbon dioxide (CO_2) emissions released by burning fossil fuels are widely believed to be the main cause of global warming.

Despite progress in exploring renewable energy sources, including wind and solar power, the increasing demand for fossil fuels means that they will continue to supply a significant part of the energy landscape in years to come. Nevertheless, in order to meet the legislative goals of the European Climate Foundation's Net-Zero 2050 and the UN Paris Climate Agreement, the reduction of carbon emissions to the atmosphere is vital.



The WellSentinel system deployed on the bottom of the southern North Sea during offshore field trials.

One of the most widely thought ways to facilitate the energy transition and reduction of greenhouse gas emissions is carbon capture and storage (CCS); a process of capturing carbon dioxide at the production source and transporting it to an isolated destination, preventing the CO_2 from entering the atmosphere.

The Importance of Wells in the Low-Carbon Future

CCS is a technique that can reduce millions of tonnes of carbon dioxide emissions that otherwise would have been released to the atmosphere. It is critical for a cost-effective transition to the low-carbon economy and is believed to be one of the few methods that will help governments across the globe meet their decarbonization targets. The process can capture up to 90 percent of CO_2, allowing us to continue using available fossil fuels by decarbonizing heavy industries and power generation.

Shut-in, suspended and abandoned wells have a potential to play a key role in capturing and storing carbon in depleted oil and gas fields, acting as transportation routes and allowing the injected carbon dioxide to be moved into the deep sandstone reservoir within a sufficient time frame.

Well Integrity in a Net-Zero Emissions Energy Industry

With the transition toward greener energy, many regions of the world are entering a period of intense activity around the decommissioning of oil and gas wells (which can be utilized as CCS infrastructure). Recent studies estimate that the U.K. has 78 GT (78 million tonnes) of potential carbon capture storage space, and since only 15 percent of this would serve the U.K.'s purposes for 100 years, it's a hugely viable option in terms of emissions reduction. In order to unlock this storage capacity there must be complete confidence that interconnected, suspended or abandoned wells will retain their integrity as the reservoir is repressurized.

At the present time, there are varying levels of legislation in place to track shut-in, suspended or abandoned wells, meaning a loss of zonal isolation could potentially go undetected for a period of time, with varying degrees of environmental ramifications.

It is predicted that well operators spend $500 million per annum on subsea inspections in order to maintain compliance with regulations. With aging assets and an increasing number of wells reaching the end of production, without innovation, the operating costs of inspections will only increase.

(From top to bottom) Sentinel Subsea's CTO Dr. Andrew Jaffrey with the alert beacon. The WellSentinel test rig before being lowered to the seabed off the Noble Hans Deul. The WellSentinel Coral design showing the alert beacon being released to the surface.

Sentinel Subsea's passive monitoring systems not only address the critical need to lower the costs of well inspection and monitoring but can also play a huge part in ensuring the integrity of CCS, and therefore contribute to meeting and maintaining ongoing emission reduction targets in the long term.

The Aberdeen-based company's innovative technology reduces the need to repeatedly schedule manual inspection and is set to have a significant impact on how integrity monitoring is conducted, holding the key to de-risking and preparing wells for a low-carbon future while reducing current subsea monitoring costs.

WellSentinel System

Sentinel Subsea was founded in 2018 with the goal to develop a well-monitoring technology that does not rely on an active power source or repeated flyovers and associated vessel time. The Sentinel Subsea method focuses on capturing material from the well, mechanically releasing an alert in the scenario of unwanted loss of containment (LoC).

The WellSentinel system is a remote integrity and emissions monitoring system for subsea infrastructure such as wellheads and Xmas trees. Operating without power while providing continuous monitoring, Sentinel Subsea's range of remote well-tracking technologies adopts a unique method for achieving vital integrity management activities while offering a low-cost, easy-to-deploy and environmentally friendly system, that can be applied to any well phase, from exploration to abandonment.

In addition to de-risking assets, when installed onto CCS subsea infrastructure, WellSentinel not only significantly reduces the need for costly manual inspections, but the in-situ passive nature of the Sentinel Subsea's technology makes it ideal for the long-term requirements associated with CCS, where monitoring can be expected up to 25 years. The system has been designed with longevity in mind.

The WellSentinel detection system can be easily and quickly installed onto, or near, key subsea infrastructure and areas of importance. It is designed to collect and direct any material toward Sentinel Subsea's specialized trigger mechanism, which is configured to react with a number of specific materials, including CO_2. This trigger mechanism holds an alert beacon within it. Once exposed to CO_2, the trigger mechanism mechanically degrades, releasing the individually coded alert beacon to the surface. Once at the surface, the alert beacon battery is activated, allowing the system to initiate and send an alert via the Iridium satellite network to the well owner.

The CO_2 triggers have been created following the development of the Sentinel Subsea's gas hydrocarbon (C1 to C5) and tracer-sensitive triggers. By arming the system

with CO_2-sensitive triggers, the alert sequence is only initiated when the CO_2 is present in the benthic environment.

WellSentinel is the company's overarching technology that delivers continuous asset monitoring, regardless of the remoteness of field or asset location. This passive type of monitoring allows for an extended on-well period without system checks and/or battery replacement.

Current Portfolio

Depending on the subsea application, Sentinel Subsea's range of systems is designed to be installed onto a variety of infrastructure. When developing these, Sentinel Subsea's key requirement was to keep the installation as simple and seamless as possible, without compromising overtrawlability and dropped-object protection.

Currently, there are three detailed designs of the WellSentinel system: the Oyster, the Coral and the Frond, all of which can be armed with the CO_2-sensitive trigger mechanism.

The WellSentinel Oyster is easily attached and locked onto a subsea structure directly above the area requiring monitoring. As the system application demands integration onto the protective structure or subsea tree, the installation of the WellSentinel Oyster is either pre-planned and attached prior to the subsea installation or retrofitted to existing infrastructure.

The WellSentinel Coral is a replacement of the standard debris cap commonly applied when a well is temporarily suspended. The monitoring technology is housed in the modified cap. Installation is straightforward with minimal time over the well.

The WellSentinel Frond offers larger coverage than the first two systems. This technology is installed on the seabed around the key infrastructure, collecting materials from the well as they drift on subsea currents.

Potential Application

When applied to potential CCS storage sites, Sentinel Subsea's technology provides long-term monitoring to remote legacy assets contained within the field, as well as infrastructure directly associated with the capture and storage.

With no demand for ongoing communication, the WellSentinel systems are designed to fit multiple marine (CCS) scenarios where monitoring is required. Due to the system not requiring an active power source, such as umbilical or power banks, there is a greater amount of flexibility for its use in the subsea environment.

With the Sentinel Subsea's technology being a cost-effective tool to identify CO_2 leaks from critical locations within the field, CCS field operators can have peace of mind and mitigate any potential risks associated with undetected leaks in advance.

Field Trials and Technical Validation

The development of the WellSentinel system involved onshore system testing, followed by both nearshore and offshore field trials. The objective of these tests was to validate the system's ability to gather material and trigger the alert sequence in various subsea scenarios and environments.

Buckie Harbour in the northeast of Scotland was utilized for the initial testing in October 2019. The first build and deployment of a WellSentinel system in a real marine environment was proven successful, meeting the test objectives and confirming the readiness of the system to progress to the next phase of the trials.

The Buckie Harbour tests were followed by offshore trials November 2019. Over a two-week period, a test skid was deployed multiple times from the Noble Hans Deul jack-up rig on station in the southern North Sea. In order to test the system's capabilities, a tank of material on the rig was used to simulate a loss of containment by pumping known volumes directly to the seabed. Multiple successful deployments showed the system's ability to capture sufficient material to start the alert process from 5 m from the well center.

The conducted field trials, both onshore and offshore, were further validated by function testing in Edinburgh's Heriot-Watt University labs, as well as at Sentinel Subsea's Aberdeen facility.

Vital Environmental Stewardship

As global climate change and air quality have become increasingly important environmental concerns, oil and gas companies are obligated to address the emissions occurring within their boundaries, setting targets for the low-carbon future.

Drilling contractors and operators through all phases of oil and gas production can play an important role in environmental stewardship, adapting to changes and utilizing their skills, expertise and infrastructure to contribute to decarbonization of the oil and gas sector.

With global energy needs expected to grow, CCS could be a relevant solution that would allow significant reduction of CO_2 emissions while producing a sufficient amount of energy to meet the increasing demand.

The oil and gas sector has a chance to potentially utilize entire fields and interconnected wells as storage, delivering cost-effective transition to the low-carbon economy and helping governments to meet their decarbonization targets.

Sentinel Subsea's remote monitoring systems are not only a very real signal to the wider stakeholder community that environmental stewardship is vital to oil and gas operators' ethos, they also offer a low-cost and easy-to-deploy solution that can be applied to any well phase, potentially revolutionizing how wells are monitored, reassuring that harmful emissions are locked away. **ST**

Jim Gordon has spent the last two years in Sentinel Subsea's business development department. He holds an M.S. in international business management from the University of Aberdeen. With particular expertise in market research and analytics, he identifies markets, growth areas and trends, and relishes the fast-paced start-up environment of Sentinel Subsea.

international

Launch of NI Foundation

The Nautical Institute (NI) has launched the Nautical Institute Foundation, a new charitable initiative that aims to improve standards in maritime safety and marine environmental protection.

"We identified the benefits that could arise from a separate charity focusing on maritime safety initiatives that would attract potential donors keen to support such projects but only via a separate charity," explained NIF Chief Executive Jonathan Stoneley.

ESAIL Microsat Launched for Testing

exactEarth Ltd. has successfully launched the ESAIL microsatellite.

Developed under ESA's (European Space Agency) ARTES Partnership Project for global ship tracking, the ESAIL satellite was launched in September on board the Arianespace Vega (VV16) flight, from Europe's spaceport in Kourou, French Guiana.

The satellite will undergo commissioning testing over the next few months and then be brought into service to provide advanced vessel detection and tracking capability as part of exactEarth's global constellation of more than 70 high-performance AIS satellites providing real-time monitoring of the global shipping fleet.

Emissions Monitoring, Earth Observation Microsats Now Operating

Space Flight Laboratory (SFL), a developer of 52 distinct microspace missions, has successfully launched and deployed the GHGSat-C1 greenhouse gas monitoring microsatellite and the Slovenian NEMO-HD Earth observation microsatellite. SFL developed the small satellites at its facility in Toronto. Both satellites were in contact with ground control within hours of their launch in September aboard an Arianespace Vega rocket from French Guiana. They are healthy and operating as planned.

Fugro Tests Hydrographic Mapping System

Fugro has successfully trialed a major upgrade to the Fugro LADS airborne LiDAR bathymetry (ALB) system. The enhanced LADS HD+ technology was developed in Fugro's laser laboratory in Adelaide, Australia, and is a hydrographic mapping system that accurately measures water depth over marine and coastal zone environments. It is designed for safe, high-speed, cost-effective surveys of clean, shallow coastal areas in depths up to 80 m. ALB can be integrated with traditional hydrographic survey methods using acoustics, such as multibeam echosounders. It will complement Fugro's lightweight Rapid Airborne Multibeam Mapping System (RAMMS).

USCG Authorizes IRClass

Indian Register of Shipping (IRClass) has received authorization as a recognized organization from the U.S.

flag administration, indicating that IRClass meets the stringent safety and quality requirements of the U.S. Coast Guard (USCG).

Review of Tariffs for Netherlands CCUS Project

International energy consultancy Xodus Group has delivered a review of tariffs for a landmark carbon capture utilization and storage (CCUS) project in the Netherlands. The review for the Dutch Ministry of Economic Affairs and Climate Policy analyzed proposed fees for the transport and storage requirements of the Porthos project, a joint venture between the Port of Rotterdam Authority, Gasunie and EBN, which seeks to transport CO_2 from industry in the Port of Rotterdam to empty gas fields beneath the North Sea.

The study involved a top-down benchmarking analysis, where the project was compared to other planned CCUS developments globally, with a focus on similar CCUS backbone suppliers. Xodus also recreated the Porthos design in its cost-estimating software and database to arrive at an independent tariff estimate and range. The two approaches yielded similar transport and storage best estimates of around 50 euros per tonne, encouragingly close to the figures calculated by Porthos.

Xodus believes that more momentum is required around enabling CCUS projects if countries are to meet net-zero targets.

MM&C Pivots to Marina of the Future

Designing sustainable projects for maritime shorelines and nautical spaces that serve multiple purposes is becoming a priority for communities around the world. Poralu Marine, a constructor of aluminum marinas, is making a significant shift and launching Marina Management & Consulting (MM&C), with a new vision of tomorrow's marina, shattering traditional business models, which focus solely on the leisure aspects of a marina. By moving from manufacturer to manager, operator and investor, MM&C is responding to strong market demand and revolutionizing its core business. The company claims to be the first in the world to offer a complete and tailor-made solution while mastering the entire value chain.

Ammonia-Fueled Tanker Design Approved

Lloyd's Register (LR) has granted approval in principle (AiP) to Samsung Heavy Industries (SHI) for its ammonia-fueled tanker design, a milestone in the joint development project LR and SHI announced with MISC Berhad and MAN Energy Solutions in January 2020.

To meet the International Maritime Organization's 2050 ambitions on halving greenhouse gas emissions from 2008 levels, zero-carbon vessels need to enter the world fleet by 2030. Ammonia is among the zero-carbon fuels being considered by maritime stakeholders.

SHI aims to commercialize development of a relevant fuel gas supply system and detailed ship design by 2024.

Canada Supports Kraken

Kraken Robotics Inc. is receiving advisory services and up to $2,909,891 in research and development funding from the National Research Council of Canada Industrial Research Assistance Program to support the development of Kraken's seabed resident ThunderFish XL AUV (TFXL AUV). Building on ThunderFish Alpha AUV, TFXL AUV will be larger, with an increased depth rating and payload capacity, and longer mission endurance.

LNG Bunkering Milestone in US

Fure Ven, a dual-fuel vessel owned and operated by Furetank of Donsö, Sweden, has become the first non-U.S.-flagged vessel to bunker LNG in a U.S. port. Eagle LNG Partners is the first company to deliver LNG bunker fuel to a foreign-flagged vessel. This milestone paves the way for more international trading vessels to bunker at Jacksonville Port Authority.

AZFP Early-Career Scientist Award Winner

ASL Environmental Sciences has chosen Dannielle Eager as the winner of the fifth annual Acoustic Zooplankton Fish Profiler (AZFP) early-career scientist award contest. She is a postgraduate student at the University of Plymouth at Devon, U.K., in the school of Biological and Marine Science. Her research will focus on the influence of dynamic seamount oceanography on pelagic biota in the tropical Indian Ocean.

Ocean Sonics Pacific Opens

Ocean Sonics Pacific has launched, with headquarters for real-time underwater listening on Canada's West Coast. The goal of Ocean Sonics Pacific is to support new and existing users of icListen products. Ken Brough, Pacific product specialist, heads the office.

Washington Maritime Blue Investment Infusion

Washington Maritime Blue, a nonprofit alliance to accelerate innovation and sustainability in the maritime and ocean industries, has been awarded a $600,000 "Build to Scale" Industry Challenge grant from the U.S. Economic Development Administration in cooperation with the U.S. Department of Energy, as well as matching investments of $600,000 from the Washington State Department of Commerce, Port of Seattle, City of Tacoma Office of Community and Economic Development and Tacoma Power. New investment in Washington's blue economy totals $1.2 million over the next three years.

BMA Offers Online Access to Services

The Bahamas Maritime Authority (BMA) has enhanced its digital platform, the Bahamas Online Registration Information System (BORIS): https://public.bahamasmaritime.com/account. Companies registering for this service will be able to digitally access many of the services offered by BMA.

New Unmanned Center of Excellence

Huntington Ingalls Industries' new manufacturing campus will be located at Hampton Roads Center North, a 20-acre site in Virginia. It will serve as a center of excellence to develop, test and manufacture marine unmanned systems and will create over 250 new jobs. **ST**

navycurrents

GE Powers Canadian Navy's First Arctic and Offshore Patrol Ship

The Royal Canadian Navy has taken delivery of HMCS *Harry DeWolf*, its first full-electric power and propulsion ice-class patrol vessel with combat package. GE's Power Conversion business was the designer and provider of the high-voltage electric power system (HV) and electric propulsion drive trains, with specialist capability for operations in multi-year ice, for the Arctic Offshore Patrol Ship (AOPS) class of six vessels.

General Atomics Contracted for Naval Propulsor Hardware

General Atomics Electromagnetic Systems (GA-EMS) has been awarded a developmental contract by Naval Surface Warfare Center Carderock Division (NSWCCD) to provide manufacturing design drawings, engineering, fabrication, inspection, and assembly of prototype propulsor, shafting and bearing components, as well as the equipment needed to support propulsor research and development, testing and evaluation. GA-EMS will work with NSWCCD to develop new propulsor components for both surface ships and submarines.

Kraken Mine-Hunting Sonar for Danish Navy

Kraken Robotics Inc. has signed a contract with the Danish Ministry of Defence, Acquisition and Logistics Organization (DALO) to supply mine-hunting sonar equipment to the Royal Danish Navy.

Kraken will deliver its KATFISH towed synthetic aperture sonar, Tentacle winch and autonomous launch and recovery system (ALARS). Kraken's mine-hunting system will be integrated on board the Royal Danish Navy's optionally unmanned surface vessels.

ROV Package to Target Underwater Threats

Greensea, creator of OPENSEA, the open-architecture robotics platform for the marine industry, is providing EOD Workspace software systems for another order of VideoRay Defender ROVs headed to the U.S. Navy.

The Defender, with Greensea EOD Workspace, has been selected as a next-generation EOD Underwater Response Vehicle by the U.S. Navy.

NOAA Improves Marine Navigation Near Georgia and New Hampshire Naval Bases

Two new Physical Oceanographic Real-Time Systems (PORTS) are improving maritime safety near Kings Bay, Georgia, and Portsmouth, New Hampshire, near two U.S. Navy installations. NOAA and the U.S. Navy partnered to install the first new PORTS in two years, the 34th and 35th in the nationwide network.

The system near Naval Submarine Base Kings Bay, the East Coast home to U.S. *Ohio*-class submarines, is an integrated series of sensors that will provide critical real-time information on oceanographic and meteorological conditions. The second site is near the Portsmouth Naval Shipyard for the Navy's nuclear-powered attack submarine fleet; a new tide station on Seavey Island will help protect shipyard personnel, critical facilities and U.S. Navy submarines.

Successful Collaboration at ANTX

MIND Technology Inc. and its Klein Marine Systems subsidiary successfully completed a live Advanced Naval Technology Exercise (ANTX) in a collaborative effort with the Naval Surface Warfare Center Panama City Division (NSWC PCD); Commander, Naval Meteorology and Oceanography Command (CNMOC), and in coordination with the Naval Oceanographic Office's Fleet Survey Team (FST), at NSWC PCD.

Klein and a group from NSWC Panama City partnered to integrate the Klein UUV 600 and μMAX technologies into an L3Harris OceanServer Iver3 AUV. Klein also partnered with Seafloor Systems Inc. to integrate the Klein MAX View 600 gap-filling side scan sonar system with the large-format, wave-adaptive HydroCat-180 USV.

JFD Diving Services for UK Navy

JFD has been contracted for the management and availability of the U.K. Royal Navy's in-service life-support diving equipment to help safeguard divers worldwide. JFD will service its Shadow rebreather and provide support for recompression chambers, enclosed mine lifting bags, parachute lift bags and surface-supplied diving equipment. **ST**

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Oyster Aquaculture Could Improve Potomac River Estuary

Oyster aquaculture in the Potomac River estuary could result in significant improvements to water quality, according to a new NOAA and U.S. Geological Survey study published in Aquatic Geochemistry. All of the nitrogen currently polluting the Potomac River estuary could be removed if 40 percent of its riverbed were used for shellfish cultivation, according to the joint study. >> Read more

Navy's Laser Weapon Ready For Summer Deployment

Navy engineers are making final adjustments to a laser weapon prototype that will be the first of its kind to deploy aboard a ship late this summer. The prototype, an improved version of the laser weapon system, will be installed on USS Ponce for at-sea testing in the Persian Gulf. Navy leaders have made directed-energy weapons a top priority to counter what they call asymmetric threats, including unmanned and light aircraft and small attack boats that could be used to deny U.S. forces access to certain areas. >> Read more

Ferry Sinks Off Coast of South Korea

With 462 passengers onboard, a ferry sailing from Incheon, South Korea, to the island Jeju sank near the southern tip of South Korea Wednesday, reported Associated Press. Most of the more than 460 people on the ship were high school students headed for a school trip to the tourist island. In the rescue effort, more than 80 vessels and at least 18 aircraft swept in to pull passengers from the water to safety. >> Read more

Pay Increase for Sailors Soon to Come

Sailors working for the U.S. Navy could see a fatter paycheck in the coming weeks, reported the Virginia Pilot. On May 1, sailors serving onboard ships will receive a pay raise. The increase in pay comes as an effort by the Navy to incentivize thousands of unfilled seafaring jobs. The bonus is a part of sea pay, a perk to those who work in jobs involving long deployments. Currently, this stipend is between $50 and $700 dollars. >> Read more

US Senate Reviews DOE Budget Request

For fiscal year 2015, the Department of Energy (DOE) requested $27.9 billion. The U.S. Senate Appropriations Committee, Subcommittee on Energy and Water Development, held a hearing last week to review the funding request and discuss financial priorities. According to Lamar Alexander (R-Tenn.), research should be a focus of spending. >> Read more

US Technology Helps in Search for Flight 370

More than a month after Malaysia Airlines Flight 370 went missing, crews are hard at work trying to uncover what happened to the plane's black box, which houses records from the flight, provide a lead to the location of the plane, and eight countries are participating in the effort to scan the waters off the coast of Northwest Australia. Chris Johnson from Naval Sea Systems Command told Sea Technology how the U.S. Navy is helping in the search. >> Read more

2014 Sea Technology Buyers Guide Now Available

Published annually by Compass Publications, the 2014 edition of the Sea Technology Buyers Guide/Directory is now available. The Buyers Guide/Directory features a market analysis and seven sub-directories, including industrial firms, services, federal government organizations, educational institutions, oceanographic research vessels and geophysical survey vessels.

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RF Over Fiber Link

Mil-Aero 10 MHz to 6 GHz suits navy applications and multi-service military electronic warfare systems where fiber is an essential replacement to coax. It covers bands from HF, VHF and UHF through to telemetry and satcom bands P, L, S and C. It is ideal for high-bandwidth applications, or where the application has a large range of RF signal powers. ViaLite Communications.

Inertial Sensors Firmware Upgrade

Ekinox, Apogee, Navsight and Quanta have the following new features: autonomous trucks motion profiles; real-time heave behavior and accuracy improved in shallow water; data logger with clearer file layout and blackbox mode of operation; Qinertia PPK workflow simplified with INS settings automatically read; and algorithms refined for performance in harsh environments. SBG Systems S.A.S.

Cloud-Based Fleet Management

FUELNET GEN-6 features: new dashboards showing entire fleet performance; new interactive charts, graphs, plots and map views to expose fuel waste and eradicate pilferage attempts; and significantly improved system performance and processing. FUELTRAX.

Multimetal Corrosion Protection

VpCI devices protect metals by conditioning enclosed environments with corrosion-inhibiting vapor molecules. Molecules are attracted to and adsorb onto metallic surfaces, resulting in the formation of nanofilms, very thin microscopic molecular layers of corrosion protection. Cortec Corp.

Hydrographic Survey Tech

SPAN GNSS+INS technology provides heading, attitude and heave measurements on the open water. This 3D solution powers hydrographic survey applications through extended GNSS outages. It is scalable with multiple different IMUs, the VERIPOS LD900 receiver and Quantum visualization software. NovAtel Inc.

Washwater Filtration

The Oberlin Filtration System is now offered for worldwide marine applications exclusively through CR Ocean Engineering. It will integrate seamlessly with any hybrid/closed-loop scrubber system supplied by CROE. CR Ocean Engineering LLC and Oberlin Filter Co.

DVL for Micro-Vehicles

Wayfinder provides Doppler navigation capability for micro-vehicles, which are often constrained by stringent size, weight and budget limitations. Measuring just 10 x 10 x 7 cm and weighing 0.51 kg, it suits the industry's proliferation of increasingly smaller subsea vehicles. Teledyne RD Instruments Inc.

IHM Maintenance Dashboard

This "3-Way Plug & Play" dashboard ensures efficient and continuous maintenance of inventory of hazardous materials (IHM) reports. The digital system ensures the IHM can be updated accurately, effectively and in real time to comply with the EU Ship Recycling Regu-

lation (EU SRR) deadline of December 31, 2020, as well as ongoing maintenance requirements. Verifavia Shipping.

Facilitating Data Transfer

GTReplicate is a cyber-secure solution that automates synchronization of files and data relating to vessel operation with next to no intervention. This cloud-based tool relieves seafarers and shore teams of a growing manual file replication burden. GTMaritime.

Starters and Alternators

Validation testing for all products includes endurance, humidity, power thermal cycling, vibration, salt spray and thermal shock. Every starter and alternator comes with extensive coverage and a warranty rate reduction through extended field life of new units. WAI Global.

Subsea Survey Sensors

Ideal for ROVs and AUVs, the miniIPS2 and uvSVX each have a field-swappable sensor head, so users can select the pressure range for increased accuracy at any depth. This eliminates the need for different instruments for shallow- and deepwater. Valeport Ltd.

Underwater Welding Electrode

Low carbon steel ProTouch offers all-position welding capabilities. It is available in 1/8-in.-diameter, 14-in.-long electrodes and sold in 8-lb. tubes; approximately 95 per tube. Broco Rankin.

Underwater Hull Inspection

A new ROV-based service provides complete hull-coating inspections while a vessel is at port or anchorage. The service is being rolled out at key ports across Asia-Pacific and will be extended to key maritime hubs worldwide in the near future. Hempel A/S.

Determining Commercial Viability

CHASMAI is a tool that provides a clear indication of the potential commercial viability of early-stage technology in the subsea industry for both innovators and investors. It helps identify exactly where pioneering companies should focus their efforts. National Subsea Research Institute.

Microgrid in a Box

CanPower can add energy storage to virtually any vessel, without the need for complex design and build times, with the highest energy density currently available. Energy storage reduces greenhouse and other polluting emissions. Sterling PBES Energy Solutions Ltd.

Digitizing Trade Finance

CargoDocs has been integrated with Temenos Transact banking software to enable the digitization of shipping and trade documents, including electronic signing and transfer of original title documents, such as bills of lading. essDOCS and Temenos AG.

Rugged Laptop

Durabook Z14I can handle data-intensive tasks at speed. It has been built to withstand the harshest of environments, with military-grade rugged connectors. Users can customize the laptop to their needs. Durabook Americas.

Web-Based Fleet Management

FleetManager 4.0 offers visibility and comparison of recommended route(s) against the master's intended route(s). It also provides 17 new types of weather forecast data ("layers") that can be overlaid on the display. C-MAP.

Catamaran-Style USV with GPS

H-1750 features stability and endurance for surveys, harbor inspections and port security. The 1.75-m USV is autonomous mission-ready. Deep Ocean Engineering Inc. **ST**

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BOEM Releases Citizen's Guide to MMP Leasing

The U.S. Bureau of Ocean Energy Management (BOEM) has made available a Citizen's Guide to BOEM's Marine Minerals Program (MMP) federal leasing process for sand, gravel and other mineral resources on the U.S. Outer Continental Shelf (OCS). The user-friendly guide features informational graphics and flowcharts to outline resource use, process milestones and opportunities for public involvement. The guide is available for viewing and download at: www.boem.gov/mmp-citizens-guide.

BOEM authorizes OCS mineral leasing, primarily of sand and gravel, for coastal resilience projects including beach nourishment and habitat restoration, and commercial leasing of hard minerals such as cobalt and manganese. While BOEM has not seen commercial leasing activity for hard mineral resources, the bureau has experienced a significant increase in recent years in both the number of requests to use OCS sand resources and the volume requested. This trend is most likely due to a diminishing supply of available material in state waters, benefits of using OCS sand supplies, and increased coastal erosion from recent intense storms.

OCS sediment may be used to protect critical infrastructure from coastal erosion, rebuild areas following storm events, or improve habitat used by a variety of wildlife. OCS sediment has been used for about five-dozen coastal restoration projects in Florida, Louisiana, Maryland, Mississippi, New Jersey, North Carolina, South Carolina, and Virginia. Sand assessment surveys are also being completed from Maine to Florida, throughout the Gulf of Mexico, and offshore California.

DHS Funds Research to Model Compound Flood Events

The U.S. Department of Homeland Security (DHS) Science and Technology Directorate (S&T) has awarded $950,000 to Deltares USA and Deltares to develop a community-oriented, flood hazard modeling process using open-source data, models and software. This effort supports the Federal Emergency Management Agency's (FEMA's) goal to build a culture of preparedness, and to reduce fatalities and property losses from flood disasters.

Based in the Netherlands, Deltares is an independent institute for applied research in water and soil.

This project will develop and demonstrate a process and prototype configuration using Deltares open-source software that will help communities develop planning strategies to improve resilience to compound flood events. With this improved information on flood risks, this project provides the potential to increase the number of people buying flood insurance and drive additional mitigation investments needed to lower risk.

Compound flood events result when rain-driven inland flooding combines with storm surge flooding. These types of flood events are particularly devastating. The complex and unpredictable nature of severe weather is a challenge to developing a plan to protect a community from this type of flooding. Deltares USA will build upon flood resilience collaborations already occurring between S&T's Flood Apex program and Deltares. The project's work will begin with a workshop for community and DHS stakeholders to examine and define needs, capabilities and desired outcomes. Information gathered at the workshop will inform development of the process model. The model will be validated against historical events and hypothetical storm scenarios and tested against a prototype configuration.

The process model and prototype configuration will be fine-tuned to ensure that they operate and produce outcomes consistent with the intended project goals. The project will continue through fiscal year 2021.

New IUU Fishing Strategy by USCG

The U.S. Coast Guard (USCG) released a new strategy to enhance global safety, security and stewardship of the maritime domain by combating illegal, unreported and unregulated (IUU) fishing: www.uscg.mil/IUUFishing.

IUU fishing is a collection of dishonest practices, both on the high seas and in areas within national jurisdiction, that threatens global geopolitical security and prosperity and weakens rules-based order; especially as the worldwide demand for fish as a protein source continues to grow. This IUU Fishing Strategic Outlook announces the Coast Guard's commitment to leading an international effort to combat illegal exploitation of the ocean's fish stocks and protect our national interests.

The Coast Guard has been the lead agency for at-sea enforcement of living marine resource laws for more than 150 years. Working with partners at NOAA, the Department of State and the Department of Defense, the Coast Guard will advance a whole-of-government effort to promote economic prosperity and drive stability, legitimacy and order in the maritime domain.

US House Passes Bill to Address Climate Change

The U.S. House of Representatives has passed H.R. 4447, the Clean Economy Jobs and Innovation Act. It includes programs to develop and deploy clean energy resources; improve the efficiency of homes and businesses; electrify the transportation sector; modernize the grid and enhance its resiliency; prioritize the needs of environmental justice communities; reduce carbon pollution from industrial and traditional sources; develop advanced nuclear energy technologies; and much more. This landmark bill contains over a dozen bipartisan pieces of legislation introduced by members of the Science, Space, and Technology Committee this Congress.

"It is long past time for us to make significant investments in policies to address climate change," Chairwoman Eddie Bernice Johnson (D-Texas) said in a statement. "By prioritizing clean energy R&D, we can combat climate change while creating jobs that put Americans back to work. This legislation provides robust support and direction for comprehensive clean energy research, development, demonstration, and commercialization activities that will be key to achieving meaningful carbon pollution reduction targets as quickly as possible." **ST**

Expanding the Range Of Remote Operation

Forum Energy Technologies has developed and demonstrated the ability to remotely operate the work-and observation-class Perry and Sub-Atlantic ROV systems between an offshore vessel and a remote location. This new capability brings major opportunities to adapt operational practices in response to the latest industry drives as cost savings and reductions in HSE (health, safety, environmental) risks can be realized through reducing offshore crew sizes.

The concept of remote piloting was proven by Forum in 2010 when the company successfully operated its TXLX work-class ROV in its test pool at Kirkbymoorside, U.K., from a TXLX Console located in Florida. Internet speeds were much slower then, resulting in high-latency telemetry, but continued development in software efficiencies and increased availability and reliability of the global 4G network has now allowed Forum to offer remote operations on its full range of ROV systems. Forum's ICE and subCAN remote operations suites provide a robust means of piloting vessel or platform-based systems from an onshore control facility via a wired, 4G or satellite connection. The ICE and subCAN control software apply enhanced position control when a compatible DVL and gyro are fitted to the ROV.

Fully Remote Inspection in UK

Fugro has delivered the first fully remote inspection of an oil and gas platform in U.K. waters, 250 km east of Scotland, using an ROV and Fugro's state-of-the art remote operations center (ROC) in Aberdeen. In a first for the U.K. sector, the platform's entire jacket structure was inspected remotely.

Fugro originally intended to trial the remote inspection provision during the campaign. However, when only one offshore inspection engineer was able to mobilize to the platform due to COVID-19, inspection engineers based at Fugro's ROC in Aberdeen stepped in and delivered the whole project remotely to stay on schedule. The ROV was mobilized with dedicated remote systems for visual inspection, cathodic protection and flooded member detection, and all systems were base-checked to confirm communications links with the ROC. Fugro also transacted a COABIS database across the onshore and offshore locations; this allowed the client and ROC personnel to access data acquired by the ROV in near real time.

Home for USCG OPCs

The U.S. Coast Guard (USCG) announced that Naval Station Newport, Rhode Island, will be home to future offshore patrol cutters (OPCs), the Coast Guard's top acquisition priority. OPCs will provide the majority of the Coast Guard's offshore presence, bridging the capabilities of the 418-ft. national security cutters and the 154-ft. fast response cutters.

OPCs will conduct missions including law enforcement, drug and migrant interdiction, search and rescue, homeland security, and defense operations. Each OPC will be capable of deploying independently or as part of a task group, and be capable of serving as a mobile command and control (C2) platform for surge operations such as hurricane, mass migration or other contingency response operations.

Island Offshore Switches to Hybrid Battery Solution

Kongsberg Maritime has been contracted by Island Offshore to supply turnkey hybrid battery solutions for three of the firm's UT 776 CD-design platform supply vessels.

The conversion of all three into hybrid craft not only represents a firm commitment on the part of Island Offshore to the principles of environmental responsibility, but also unlocks a wealth of potential for increased operational efficiency and a marked reduction in maintenance requirements. This in turn translates to significant cost savings for the company.

KONGSBERG's SAVe Energy battery system,which has been validated by DNV GL, allows for fewer engines to be running, thus improving efficiency by increasing the load on the remaining engines while also instantly delivering power on demand: ideal in the context of low-load operations such as dynamic positioning. Fuel consumption and running costs will also be reduced through conversion of the vessels to closed bus-tie operation.

New Majority Shareholder For Principia

Artelia has become a majority shareholder in Principia, specializing in consulting engineering for marine activities in the offshore, nuclear, and naval and civil defense sectors.

In acquiring 66 percent of the company's shares, Artelia demonstrates its intention to develop its offshore activities (oil and gas and wind power) by joining forces with shareholder NPCC (National Petroleum Construction Co.), based in the United Arab Emirates, whose holding remains at 33 percent. Artelia also intends to reinforce its naval defense activities, including alongside Naval Group, which has historically been a shareholder of Principia and remains a strategic partner. This merger also targets industry expectations for marine renewable energy development.

C-Innovation Acquires Controlling Interest in Caltex

C-Innovation LLC (C-I), an affiliate of Edison Chouest Offshore (ECO) and its family of companies, has acquired the controlling interest in Caltex Oil Tools, a company that provides equipment rentals, services and customized engineering capabilities to the offshore industry.

Headquartered in Houston, the Caltex team will enable C-I to further expand its engineering and subsea service capabilities.

This acquisition underscores C-I's core mission to serve as a single-source solution for the subsea and offshore industries. **ST**

The New Normal for Surveys

With COVID-19 severely disrupting traditional manned surveys in the marine and offshore industry, Bureau Veritas (BV) in Singapore, in collaboration with Nokia and Sembcorp Marine, has successfully completed remote surveys that pave the way for establishing a new class procedure for the remote inspection of vessels under construction. Such remote service delivery will likely become the new normal in vessel surveys.

At the pilot trial, BV, Nokia and Sembcorp Marine testbedded remote surveys on a newbuild vessel construction at Sembcorp Marine's Tuas Boulevard Yard. Various checks were carried out to assess the integrity of the hull components, which were in various stages of construction. The checks included material verification, panel fit-up, as well as visual inspections of the subassembly block.

Using Nokia's cloud-based collaboration platform and FastMile 4G Customer Premises Equipment (CPE), the remote monitoring center at Tuas Boulevard Yard communicated effectively with Sembcorp Marine's quality control (QC) inspectors located at the vessel's fabrication and assembly sites. The QC inspectors were equipped with rugged head-mounted cameras with high-definition video streaming and voice communication functionalities that enabled the BV surveyor stationed at the remote monitoring center to verify production quality and spot defects.

Teledyne CARIS Part of 22-Day Ocean Mapping Mission

Teledyne CARIS, a Teledyne Technologies company, was an integral part of the team involved in a groundbreaking uncrewed offshore survey mission in the Atlantic Ocean. Teledyne CARIS's Mira AI and CARIS Onboard software enabled autonomous survey and real-time processing operations on a USV built by SEA-KIT that mapped over 1,000 sq. km of the ocean floor in 22 days while being continuously monitored via satellite communications at its remote operations center in Essex, U.K. The GEBCO-Nippon Foundation Alumni Team operated the survey equipment and provided quality control of the data from various "work-from-home" locations around the world.

The SEA-KIT USV surveyed in the southwestern edge of the U.K. Continental Shelf. Final image processing is being completed using CARIS HIPS software to produce the final deliverable for the survey.

This work is part of the Nippon Foundation-GEBCO Seabed 2030 project to map the global ocean floor in the next 10 years.

LR Awards Digital Twin Ready AiP to HHI

Lloyd's Register (LR) has awarded approval in principle (AiP) to Hyundai Heavy Industries (HHI) for its digital health management (DHM) system for a Type B gas containment tank, following a joint development project between the two parties launched in November 2019.

The system, Hyundai Prismatic Independent IMO Type B Tank eXcellence (HiPIX), has been assessed by LR's digital experts against LR's ShipRight Procedure for Digital Compliance, resulting in HiPIX receiving Digital Twin Ready AiP.

This approval sets HHI on the path to become a DHM provider to the maritime industry, offering customers the possibility to operate and maintain their ships' Type B gas containment tanks in an optimal cost-effective way while complying with classification and statutory requirements.

Abu Dhabi Maritime Academy Enhances e-Training

Wärtsilä has successfully delivered its brand-new Cloud Simulation solution to Abu Dhabi Maritime Academy. With a combination of cloud-based solutions, including navigational, engine room and liquid cargo handling simulators, Wärtsilä says it is the first company to offer class-approved, cloud-based simulation technology to the maritime industry.

The online installation has enabled the academy to continue providing training despite COVID-19 pandemic-related restrictions.

Pioneer Class Notation For LPG Carrier

The Korean Register (KR) has presented Hyundai Heavy Industries (HHI) with the world's first Cyber Security (CS Ready) class notation for a very large liquefied petroleum gas (LPG) carrier.

The notation is issued to newbuilds that have successfully passed 49 inspection items in a total of 12 categories, including risk and asset management and cyber incident response and recovery.

Norway Awards Funds to Kongsberg Digital

Innovation Norway has given Kongsberg Digital a funding award of NOK 24 million, to be dedicated to developing cloud-based simulation solutions for teaching and practicing navigation.

Kongsberg Digital develops cloud-based simulation technology to support advanced operational studies, research and education in the maritime industry. This technology is now in use by several international projects to develop digital twins and autonomous vessels. The company continues to develop its simulation technology in support of new competence requirements.

Drones, Digital Tech For Subsea Pipeline Inspection

Vallourec is working with Forssea Robotics and iXblue to develop a pipeline inspection solution combining subsea drones and visual markers directly integrated on subsea pipelines to enable vessel-free subsea navigation.

These markers would be navigation aids for subsea drones equipped with Forssea cameras and iXblue's inertial navigation systems that would relay the pipelines' locations to the operators, thus removing the need for acoustic positioning systems and costly mother vessels. **ST**

Climate Change Drives Expanding Tropics

Earth's tropics are expanding poleward, and that expansion is driven by human-caused changes to the ocean, according to new research. The tropics wrap around Earth's middle like a warm, wet belt. This part of the globe gets the most direct sunlight throughout the year and is characterized by high average temperatures and heavy rainfall. In contrast to the tropics' lush interior, however, this region's edges are hot and parched.

Scientists have noticed for the past 15 years that these arid bands are expanding toward the poles into regions like the Mediterranean, southern Australia and southern California. Interestingly, these dry areas have expanded more in the Southern Hemisphere than the Northern Hemisphere, and researchers have struggled to pinpoint exactly what is driving the trend.

A new study in AGU's *Journal of Geophysical Research: Atmospheres* argues that the failure to agree on an exact mechanism has been, in part, because most researchers have been looking in the wrong place. The new study found tropical expansion is driven primarily by ocean warming caused by climate change rather than direct changes to the atmosphere. A bigger shift is happening in the Southern Hemisphere because it has more ocean surface area, according to the new study.

Tropical expansion could have profound economic and social implications: The process could shift storm paths and cause more severe wildfires and droughts in places like California and Australia that are already water-stressed.

The new findings provide clear evidence that tropical expansion is primarily driven by climate change, according to the study authors. While natural long-term climate fluctuations contribute to the observed trends, these variations alone cannot explain the extent to which expansion has already occurred.

Less Growth for Eastern Arctic Ocean Winter Ice

The eastern Arctic Ocean's winter ice grew less than half as much as normal during the past decade, due to the growing influence of heat from the ocean's interior, researchers have found.

The finding came from an international study led by the University of Alaska Fairbanks (UAF) and Finnish Meteorological Institute (FMI). The study, published in the *Journal of Climate*, used data collected by ocean moorings in the Eurasian Basin of the Arctic Ocean from 2003 to 2018.

The moorings measured the heat released from the ocean interior to the upper ocean and sea ice during winter. In 2016 to 2018, the estimated heat flux was about 10 watts per square meter, which is enough to prevent 80 to 90 cm (almost 3 ft.) of sea ice from forming each year. Previous heat flux measurements were about half of that.

"In the past, when weighing the contribution of atmosphere and ocean to melting sea ice in the Eurasian Basin, the atmosphere led," said Igor Polyakov, an oceanographer at UAF's International Arctic Research Center and FMI. "Now, for the first time, ocean leads. That's a big change."

Indonesia Tackles Marine Plastic Pollution

Indonesia is among the biggest contributors to marine plastic pollution. In response, the Indonesian government's national marine pollution plan aims to reduce plastic waste by 75 percent between now and 2025.

To this end, the Ministry of Marine Affairs and Fisheries (KKP) has turned to CLS, a subsidiary of CNES and CNP, and to the IRD development research institute to get a clearer picture of where this waste is going in Indonesia's maritime territories. The program is supported by the French development agency AFD and the World Bank. Its objective is to gain new insight into how marine plastic and other waste from rivers and large cities drifts, accumulates and washes ashore in order to prioritize and optimize collection at sea and on land.

KKP and CLS teams are pursuing two complementary approaches, one on the ground and one based on modeling. The field approach deploys 70 Argos transmitters from the mouths of the Cisadane in Jakarta, the Bengawan Solo (central Java) and the Musi in Palembang (Sumatra).

Satellite Data Reveal Suspicious Vessel Activity

HawkEye 360 announced the discovery of a vast fleet of Chinese fishing vessels just outside the Galapagos Island's Exclusive Economic Zone (EEZ). Effectively patrolling this massive region, which is larger than Spain and Portugal combined, using traditional coast guard and airplane observation is nearly impossible, making it easy for fishing vessels to "go dark" and cross into the EEZ.

HawkEye 360, which specializes in radio frequency (RF) geoanalytics, has published new data that reveal the Chinese vessels deactivated their AIS tracking system hundreds of times to go dark. HawkEye 360 discovered multiple instances of dark vessels within the EEZ boundary that didn't correlate with AIS records—raising suspicion of illegal fishing without notice.

HawkEye 360 also conducted a joint RF and SAR (synthetic aperture radar) collection with partner Airbus Defence and Space Intelligence. By fusing multiple forms of intelligence, they found many dark vessels and a better understanding of fleet activity. Airbus's automatic vessel detection extracted 58 vessels' locations from a SAR image and provided estimated size and heading for each vessel. Comparing these locations against +/- 60 min. of AIS data matched only 16 vessels to AIS tracking, reinforcing the many gaps in the AIS record.

HawkEye 360 plans to launch its second cluster of satellites aboard a SpaceX ride-share mission in December at the earliest. **ST**

contracts

Jotun, Sandefjord, Norway, has signed the first commercial contract for container vessels with its Jotun Hull Skating Solutions (HSS). The Jotun HullSkater robot for proactive cleaning and the SeaQuantum Skate anti-fouling will be installed on a 14,000-TEU vessel later this year. MSC Mediterranean Shipping Company SA.

CONTROP Precision Technologies Ltd., Hod Hasharon, Israel, has been selected to supply iSea-25HD observation systems for installation on new ships under construction in India and vessels being built for the Vietnamese Border Guard. The systems will be delivered in 2020 and 2021. L&T and Hong Ha.

Kongsberg Maritime, Kongsberg, Norway, has been contracted to design and equip an innovative vessel for a Norwegian krill processing firm. The 120-m ship is expected to begin operations in 2022. Rimfrost.

Oil and Natural Gas Corp. Ltd. (ONGC), Mumbai, India, has awarded a three-year contract to provide integrated survey services for the fourth consecutive time. Geo-data results from the engineering surveys will provide ONGC with the seabed and subseabed insights to develop key offshore infrastructure. Fugro.

iXblue's, Denver, Colorado, Octans attitude and heading reference system (AHRS) has been selected to provide accurate navigation capability to the *Mayflower Autonomous Ship* (*MAS*), which is scheduled to cross the Atlantic in April 2021 to commemorate the fourth centenary of the original *Mayflower* voyage. ProMare.

Interventek Subsea Engineering, Aberdeen, Scotland, will supply multiple API-17G qualified 7.375-in. 10,000-psi in-riser landing strings, including the shear-seal Revolution safety valve, for subsea systems. Baker Hughes.

ABB, Zurich, Switzerland, will supply a hybrid propulsion solution using electric power from 8.8-MWh batteries and diesel generators that will cut fuel consumption on P&O Ferries' Dover-Calais route by 40 percent. Guangzhou Shipyard International Ltd.

BIO UV Group, Lunel, France, has extended a partnership agreement, formalizing a five-year relationship between the two companies, to support the ballast water treatment system installation and integration projects carried out at PIRIOU Group drydocks. PIRIOU Group. **ST**

meetings

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

DECEMBER

December 1-4—Oi Connect, Virtual. +44(0)1202 669244, j.riegal@saltwater-stone.com or www.oceanologyinternational.com.

December 1-17—American Geophysical Union Fall Meeting, Virtual. 202-777-7396 or www.agu.org/fall-meeting.

December 9-11—Sustainable Ocean Summit, Virtual. summit@oceancouncil.org or www.oceancouncil.org.

December 14-16—Seatrade Maritime Middle East, Virtual. www.seatrademaritimeevents.com/stmme/en/home.html.

December 16-17—West Coast Defense Contracting Summit, San Diego, California. 202-552-0179 or marketing@defenseleadershipforum.org.

2021

JANUARY

January 5-9—NCSE & Drawdown: Research to Action Conference, Virtual. https://tinyurl.com/yygpo6o8.

January 19-20—Floating Wind Solutions Conference & Exhibition, Houston, Texas. 832-862-3390 or https://floatingwindsolutions.com.

January 19-21—The Coastal Futures – REACH 2021: Ocean Recovery, Virtual. bob.earll@coastms.co.uk.

FEBRUARY

February 2-5—SMM (Shipbuilding, Machinery & Marine Technology), Hamburg, Germany. +49 40 3569 2445, nora.hirschfeld@hamburg-messe.de or www.smm-hamburg.com.

February 23-25—Subsea Expo, Aberdeen, Scotland. www.subseaexpo.com.

February 25-26—Floating Wind Solutions, Houston, Texas. https://floatingwindsolutions.com.

MARCH

March 2-4—World Ocean Summit & Expo, Lisbon, Portugal. https://events.economist.com/events-conferences/emea/world-ocean-summit.

MAY

May 3-6—Offshore Technology Conference, Houston, Texas. www.otcnet.org.

May 18-20—Aquaculture UK, Aviemore, Scotland. www.aquacultureuk.com.

JUNE

June 1-4—Nor-Shipping, Oslo, Norway. www.nor-shipping.com.

June 15-17—Seawork and Marine & Coastal Civil Engineering Expo, Southampton, England. www.seawork.com and www.mcceexpo.com.

SEPTEMBER

September 13-17—London International Shipping Week, London, England. https://londoninternationalshippingweek.com.

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

Climate Change and Anti-Submarine Warfare—*Giovanni Sembenini and Sandro Carniel*

Giovanni Sembenini is the deputy director of the North Atlantic Treaty Organization Science and Technology Organization Centre for Maritime Research and Experimentation (NATO STO CMRE). Sandro Carniel (pictured) is the head of the Research Division of NATO STO CMRE. He also retains his position as director of research at the Institute of Polar Sciences at the National Research Council of Italy (CNR).

Since World War II, the primary way to conduct anti-submarine warfare (ASW) activities has been through the use of acoustic waves, via SOund Navigation And Ranging techniques (sonar), used in passive or active configurations.

The propagation of acoustic waves in seawater is affected by oceanographic parameters that strongly influence sonar performance. The speed of sound in seawater depends on temperature, depth and salinity, as stated more than a century ago, suggesting the existence of a deep sound channel (heavily exploited for ASW after WWII). Some years later, the so-called "afternoon effect" was explained: The solar radiation warming the surface waters generates an upper layer sound duct that does not allow the sound pulses emitted by hull-mounted sonar to propagate in depth, therefore producing dramatic changes in detection ranges.

In the sonar equation, two terms are more significantly affected by seawater's physical properties: transmission or propagation loss (TL) and noise level at the receiver (NL). Hence, an assessment of the climate change (CC) related impacts on oceans on potential ASW capabilities would be extremely useful.

Global warming has contributed significantly to generate CC consequences that heavily impact the oceans. The current trends show generally warmer waters (approximately +0.1° C per decade in the last 50 years in the upper oceans), locally affected by huge freshwater discharges due to ice and permafrost melting (+290 gigatons per year from Greenland alone). We can expect some direct impacts related to CC on TL and NL, and therefore on sonar performance.

Let's considers two geographical areas where CC is expected to have great impact on ASW capabilities: the Arctic Ocean regions and the shallow-water areas (SW).

Arctic ASW is difficult because of the complications of the surrounding environment. The ice canopy prevents both submarine and ASW operations conducted by ships, aircraft and helicopters. Ice cover also scatters sound, limiting detection and torpedo performance. CC dramatically increases sea ice summer melting, reducing sea ice cover. Thus, ice cracking, the major source of noise in ice-covered areas, especially in the Marginal Ice Zone (hundreds of kilometers wide), is widely changing its areal effect.

Because of the new marine areas now directly exposed to solar radiation and interaction with the atmosphere, large modifications of oceanographic and acoustic properties are foreseen. The speed of sound in seawater increases with increasing temperature and increasing salinity.

Even more than the absolute values, the spatial and temporal variations of temperature and salinity should be measured since they substantially influence how sound propagates in water. For example, in the western Arctic, the "Beaufort Lens" sound duct has recently appeared, formed by a warm water layer at 100- to 200-m depth not previously present. Mid- to high-frequency underwater sound waves can propagate for hundreds of kilometers inside the duct without interacting with the sea surface and seabed. Overall, CC could therefore facilitate, at least in summer, ASW operations in the Arctic.

Shallow waters (SW) are also a fast-changing environment showing relevant effects from CC and challenges for sonar detection. The propagating sound can have multiple interactions with both the seafloor and the sea surface, causing high TL. In SW, the NL is usually much higher than in deep waters because of the ambient noise generated by human and marine animal activity. Intense tides and significant internal waves modify sound propagation both in space and time, making SW environmental variability higher than in deepwater.

Likely, the main CC-related general effect on SW could be a lowering of the NL resulting from a sensible reduction of snapping shrimps' crackles (the most common biological feature of marine coastal soundscapes, often dominating background abiotic noise), expected as a consequence of increasing CO_2 levels in seawater.

On the other hand, the predicted increase in marine storms' intensity would occasionally increase NL and TL in new regions.

In general, CC would impact SW environments in ways that vary greatly in space and time; hence, regional assessments must be conducted locally.

In conclusion, while global warming is producing some very well identified tendencies, it is clear how specific studies are needed to quantify with a good degree of accuracy CC's impacts on ASW activities in different regions.

In the meantime, sonar performance predictions based on obsolete data are rapidly losing their value. Near-real-time ocean data and forecasts are available and can provide useful updates for several deepwater areas, but improvements are needed for shallow-water areas and for the Arctic regions. **ST**

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