MARINE TECHNOLOGY REPORTER

January/February 2016

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Autonomous Vehicles
The New Workhorse

SUPSALV & the search for
El Faro

Volume 59 Number 1


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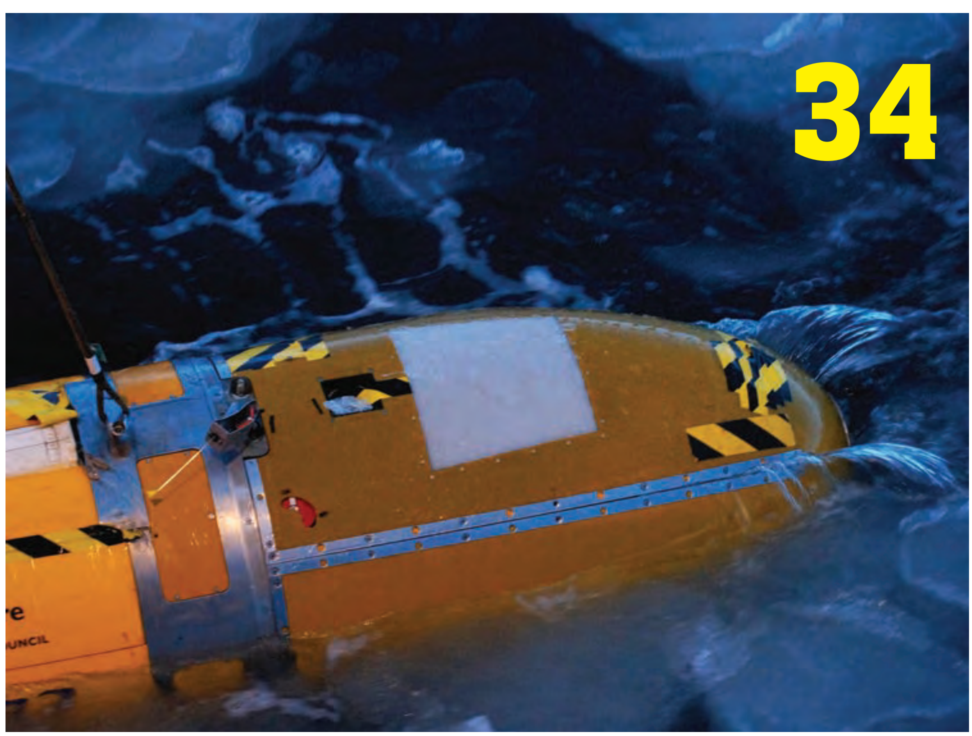
(Courtesy of U.S. Navy)

On the Cover

NTSB

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DRAGON: New Class of Personal Subs

The Authors

Kira Coley

Kira Coley graduated with a BSc. (Hons) Marine Biology degree from University of Portsmouth and has extensive experience as a Field Scientist in various locations. *p. 30*

(Courtesy of U.S. Navy)

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2016 has started with a decided thud, as many in the industry around the world hold their collective breath and watch closely as the price per barrel for oil sinks ever lower. While the angst is real and the immediate future is unclear, I see that some – inside and outside of this industry – starting to enter a surreal zone, calling oil a 'sunset' industry and rationalizing that offshore oil and gas may never bounce back. I certainly have been wrong in the past and I'm not a gambling man, but if I had the money and the interest I'd be more than willing to bet that the oil and gas industry will bounce back with a vengeance, and the hunt for energy resources around and under the waters of our planet will be a substantial and vital industry for generations to come. It's not even close to a matter of "if," rather a white-knuckle ride of "when."

This month I am honored to share with our readers insights from **Captain Gregg Baumann**, U.S. Navy, Supervisor of Salvage & Diving; Director of Ocean Engineering. I met Capt. Baumann last year at the American Salvage Association annual meeting in Stamford, Connecticut, before he and his team embarked on its mission to find the sunken U.S. flag ship El Faro. While El Faro steals many headlines, including an early January 2016 feature on CBS investigative news show "60 Minutes," the good works of Capt. Baumann and SUPSALV far transcends material that makes 15-minute clips in mainstream media. His team are salvage masters, and I invite you to turn to page 18 for the story on SUPSALV and its contribution to working safely and efficiently under the water.

As with every edition of MTR, uncovering next-gen advances and emerging technology is the foundation, and I am pleased to share with you two features in this edition that fit the bill. Starting on page 30 Kira Coley goes in-depth, as she usually does, on the Ocean Aero Submaran vehicle, or as we humbly call it in our headline the "Next Generation of Ocean Observation." Immediately following this story, starting on page 34, is Tom Mulligan's insightful report on investment at NOCS, specifically the opening of a new cutting-edge research and technology facility, the National Oceanography Center's Marine Robotics Innovation Center in Southampton, England.

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NOAA Case Study

Remains of 1800s Whaling Fleet Found

NOAA archaeologists have discovered the battered hulls of two 1800s whaling ships nearly 144 years after they and 31 others sank off the Arctic coast of Alaska in one of the planet's most unexplored ocean regions.

The shipwrecks, and parts of other ships, that were found are most likely the remains of 33 ships trapped by pack ice close to the Alaskan Arctic shore in September 1871. The whaling captains had counted on a wind shift from the east to drive the ice out to sea as it had always done in years past.

The ships were destroyed in a matter of weeks, leaving more than 1,200 whalers stranded at the top of the world until they could be rescued by seven ships of the fleet standing by about 80 miles to the south in open water off Icy Cape. No one died in the incident but it is cited as one of the major causes of the demise of commercial whaling in the United States.

With less ice in the Arctic as a result of climate change, archaeologists now have more access to potential shipwreck sites than ever before. In September, a team of archaeologists from the Maritime Heritage Program in NOAA's Office of National Marine Sanctuaries scoured a 30-mile stretch of coastline in

Abandonment of the whalers in the Arctic Ocean, September 1871, including the George, Gayhead, and Concordia. **This illustation originally ran in Harper's Weekly in 1871.**

(Credit: Robert Schwemmer Maritime Library) the nearshore waters of the Chukchi Sea, near Wainwright, Alaska. Previous searches for the ships had found traces of gear salvaged from the wrecks by the local Inupiat people, as well as scattered timbers stranded high on the isolated beaches that stretch from Wainwright to Point Franklin.

Using state-of-the-art sonar and sensing technology, the NOAA team was able to plot the "magnetic signature" of the two wrecks, including the outline of their flattened hulls. The wreck site also revealed anchors, fasteners, ballast and brick-lined pots used to render whale blubber into oil.

"Earlier research by a number of scholars suggested that some of the ships that were crushed and sunk might still be on the seabed," said Brad Barr, NOAA archaeologist and project co-director. "But until now, no one had found definitive proof of any of the lost fleet beneath the water. This exploration provides an opportunity to write the last chapter of this important story of American maritime heritage and also bear witness to some of the impacts of a warming climate on the region's environmental and cultural landscape, including diminishing sea ice and melting permafrost."

James Delgado, maritime heritage director for NOAA's Office of National Marine Sanctuaries, said he believes the wrecks were pressed against a submerged sand bar that rests about 100 yards from shore. Working from first-hand accounts of the loss of the fleet, he said the ice opened the hulls to the sea and tore away the upper portions of the ships, scattering their timbers on the beach, while the lower hulls, weighted down with ballast, and in some cases still anchored, stayed in place against the sand bar. On Sept. 12, 1871, the captains of the 33 whaling ships caught in the ice convened aboard the Champion to consider their options for saving the 1,219 officers, crew, and in some cases, families, from their fate. Although, their situation was dire, there was some small glimmer of hope for rescue by seven nearby ships.

However, to save such a large party, the rescuing whale ships had to jettison their precious cargoes of whale oil, bone and their expensive whaling gear to make room for the survivors. The rescue ships were able to sail safely out of the Arctic and back to Honolulu, where hundreds of native Hawaiian whalers aboard the stranded vessels lived, while others sailed on to San Francisco, New Bedford and other cities.

The search for the abandoned whaling fleet was funded by NOAA's Office of Exploration and Research, in collaboration with the NOAA Office of Coast Survey and the Alaska Region of the Bureau of Ocean Energy Management. Additional support and expertise was provided by technology partners Edgetech and Hypack.

www.noaa.gov

Bill Kikendall, Teledyne RDI

Marine Technology Reporter recently had the opportunity to visit with Bill Kikendall, president of Teledyne RDI and Group Manager of Teledyne Marine's Instruments Group, for his 'view from the top.'

By Greg Trauthwein

Please provide a brief overview of the company.

Teledyne has recently aligned our many individual marine focused business units into a single group that we call Teledyne Marine. This group includes: 23 individual brands and 2,400 employees operating from 41 global manufacturing and service centers. The Teledyne Marine Group of companies provide marine imaging, marine instruments, marine interconnect, marine seismic, and marine vehicle products and solutions. These products serve the Oceanographic Research, Security and Defense, Energy, Biological, Water Resources and Transportation markets.

Looking back, from the time you started your career to today: What technology do you attribute with having the greatest influence on the ability to explore and work underneath the water more efficiently and effectively, and why?

Remote and Autonomous Underwater Vehicles. These vehicles are providing ever expanding ways to conduct sophisticated work under extreme operating conditions as well as significantly expanding the sampling of the ocean environment at an ever decreasing cost point relative to traditional means of acquiring the data.

We often discuss "Industry Voice," or in the case of the Subsea and Maritime Communities, lack thereof, and the "need" to raise the stature, profile and visibility of this industry to foster further growth. From where you sit, and looking at the industry as a whole, do you agree on the need for a stronger industry voice?

In a word, yes. The maritime environment has a profound impact on society and society has an impact on that environment. Given the scale of the ocean environment, the effort and expense for understanding how to mitigate the negative consequences and enhance the positive consequences are such that they must be addressed by society at large (fundamentally at a regional, national and international level). At this level, there is profound competition for funds to address the collective needs of society. Effectively messaging the maritime need to those who will make the decisions on the allocation of those funds is best supported by a collective voice of experts. That voice is most credible when it is the voice of industry, academia and relevant government organizations working together.

When you look at your industry as a whole, and looking at the myriad of serious issues that we face as citizens of this planet, what do you see as the burning issues of the day that will put the work that you do in the world's oceans front and center for the next generation?

The serious issues are very broad and impact individuals in very different ways depending on whether the individual

Photo by John Mickett and Sonya Legg

ADCP deployment (part of T-Tide Experiment) in the Southern Ocean just east of Tasmania.

lives in an area where the ocean influences their safety and welfare, they derive their livelihood directly from ocean related activities, or less directly when their standard of living relates to the international commerce on the ocean. Underlying the impact is the ability to understand cause and effect relationship in the ocean environment as well as more precisely determine storm impact and impact mitigation. Ultimately, in many cases, decisions will be made on how to deploy assets to reduce the negative consequences of an activity or event (or enhance positive consequences). As an industry we will continue to develop vehicles and instruments that facilitate the collection of better data, understand the relationship of that data to a future event, process the information in a time relevant manner and provide that data to decision makers. We will do this in collaboration with academia and government organizations.

Nearly everyone I have ever interviewed universally loathes the "crystal ball" question, but the context of this talk requires it: If you

had a crystal ball and could envision how this industry will look and operate in the year 2025, what would you see?

During the past decade there has been considerable consolidation in the industry. Companies such as Teledyne, Danaher, Xylem, Fugro and Kongsberg have acquired smaller, successful businesses and in doing so combine the innovation of the small businesses with the resources, market access and processes of the larger enterprises in turn facilitating growth. This is likely to continue while at the same time there will be new small businesses that develop based on focused innovation. Autonomous surface and subsurface vehicles will expand significantly. This growth will be facilitated by advances in vehicle technology, power technology and underwater navigation as well as communications. Instruments will be developed that facilitate broader sampling technologies and data/information will be available in much shorter times relative to when the data is sampled. Scientists will be able to devote more of the budgets to science rather than to developing vehicles and sensors to conduct the science.

What emerging technology do you see today that you believe will have the greatest impact on your business, your industry, in the coming 10 years, and why?

Autonomous vehicles (surface and sub-surface). These vehicles provide the virtual platforms that allow us to significantly expand sampling of the ocean environment at a significantly reduced cost. Companies such as Ocean Aero and Liquid Robotics are examples of companies developing entirely

Teledyne RDI CTD recovery of the coast of Spain.

Photo by FERNANDO LÓPEZ MELIÁN

new and unique vehicles for ocean observing. The growth in application of autonomous marine vehicles will be supported by advances in navigation (MEMS and chip scale solutions), power sources, communications and new sensing technologies.

Every business, every industry has its challenges. What do you consider to be the greatest challenge to your business today, and how are you investing to overcome that challenge.

In the marine industry it is managing through the business cycles. To sustain in the soft markets and grow in the strong markets organizations must continue to innovate and to collaborate with our customers to help them differentiate in their markets. For Teledyne it is to continue to invest in innovation, collaborate across our broad group and with our customers to innovate more efficiently and utilize the resources of the corporation to differentiate in the market. These resources include the Teledyne Science Center, Teledyne Dalsa and Teledyne Brown Engineering.

Bill Kidendall's Career Path

Bill Kikendall is the President of Teledyne RD Instruments and serves as a Group Manager in Teledyne Marine's Instrument Group with responsibility for RD Instruments, Oceanscience and Teledyne's minority share in Ocean Aero. Mr. Kikendall received a BSEE from Iowa State University in 1980 and a MBA from the University of Dallas in 1986. His career began in 1980 with Geophysical Service Incorporated (a division of Texas Instruments) which conducted offshore seismic exploration for oil and gas. He joined Teledyne Geotech in 1983 and for more than 30 years, he has been an employee of Teledyne Technologies, Inc. At Teledyne, his role began as an instrumentation design engineer and progressed through various levels of management including business unit management and leading to his current responsibility in group management. More than 25 years of his career have been in the marine industry.

Prior to Teledyne beginning its series of marine business acquisitions he was responsible for Teledyne Geophysical Instruments, a business unit that provided instrumentation for the offshore seismic exploration market for oil and gas exploration. At the time, this was Teledyne's only marine business. With the 2005 acquisition of Teledyne RD Instruments, Kikendall relocated to California to assume management for its first acquisition in the marine industry. He has been involved in acquisitions and group management within the marine businesses since that time.

Fiber Fundamentals

Multimode vs. Single Mode

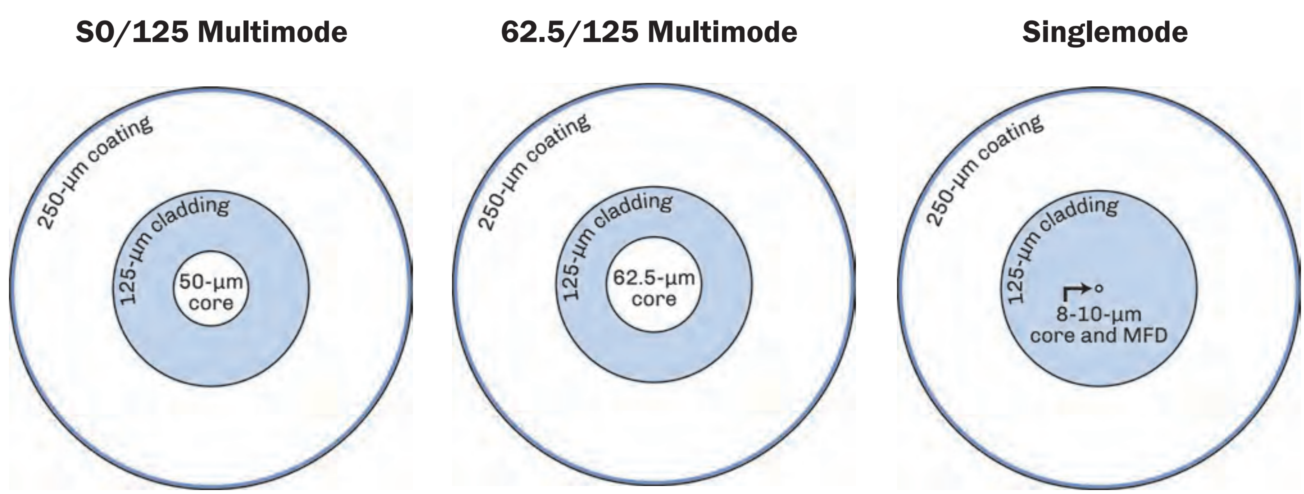
By Ed Miskovic

This article provides some of the basic information on optical fiber (both single-mode and multimode) and discusses how they can be used in the subsea environment. We will also discuss some of the fundamental differences between multimode (MM) and single-mode (SM) fiber. Specific attention will be given to how they can impact the quantity, distance, and speed of the transported signals between the subsea and topside locations. Of all the differences between MM & SM fibers, the most fundamental differences are the size of the fiber's core and the associated attenuation or loss and bandwidth of the fiber. The fiber itself consists of 3 basic elements – the core, cladding and buffer or coating. The core is the most central portion of the fiber through which the light propagates. While there are a wide variety of fibers in use for various applications & markets, there are 3 basic fiber core diameter sizes for fibers used in subsea applications. Single-mode fiber has a nominal core diameter of 9µm while the most common multimode fibers have either a 50µm or 62.5µm core diameter. For the fibers we use, the cladding is always 125µm while the protective coating has a diameter of 250µm for loose tube fibers. Other buffers and jacketing materials are used to build the fiber up to more practical and rugged cable structures.

As the below diagram illustrates, the two types of common multimode fiber have either a 50µm or 62.5µm core diameter. Single-mode fiber, on the other hand has a core diameter of only 9µm.

The basic rule of thumb is that the smaller the core diameter, the higher the fiber's bandwidth and the lower the attenuation (loss in dB per kilometer). These fiber parameters are also dependent on wavelength. Table 1 (next page, top) illustrates the approximate attenuation (loss) of both multimode & single-mode fibers.

Systems using these fibers will be either loss or bandwidth limited. The fiber and associated optical components such as connectors, splices and splitters can attenuate the optical signal to such a point where the receiver cannot reliably recover the information. The bandwidth of the fiber can also introduce significant dispersion of the signal to where it cannot be recov-



Fiber Cross-Sectional Diagram

(Courtesy: The Light Brigade)

Table 1

Fiber Type	Wavelength	Multimode	Multimode	Single-mode
Core diameter		50µm	62.5µm	8 – 10µm
Attenuation (dB/km)	850nm	2.5	3.5	N/A
	1300/1310nm	0.8	1.4	0.35
	1550nm	N/A	N/A	0.25

ered even though there is adequate optical signal strength at the receiver (quantity vs. quality).

Fiber systems employed in the subsea market typically use single-mode fiber. While there may be some older, legacy systems for shallow-depth applications that use multimode fiber, the great majority of these systems now incorporate single-mode fiber. This fiber type change affords larger sea depths and more high bandwidth signals using wavelength multiplexing (CWDM).

In general, the loss budget or allowable attenuation between the output of the transmitter and the minimum required input to the receiver is on the order of 15-20dB, depending on the type of signal, data rate, etc. By referring to the data in the fiber attenuation table (Table 2, found on the top of page 16), and assuming that the system loss budge is 20dB, the maximum distance (from an attenuation point of view) can be ap-

Table 2

Fiber Type	Wavelength	Multimode	Multimode	Single-mode
Core diameter		50µm	62.5µm	8 – 10µm
Maximum distance (km) (based on loss budget)	850nm	8	5.7	N/A
	1300/1310nm	25	14	57
	1550nm	N/A	N/A	80

proximated as follows (see table above):

If you just consider the attenuation of the fiber as the transmission-distance limiting factor, it would appear that even the 62.5µm multimode fiber operating at 850nm would satisfy all operating depths. Fiber attenuation is one of the basic characteristics of fiber that needs to be understood and taken into consideration when designing any fiber transmission system. However, in order to accurately calculate and predict the maximum operating distance of any fiber system, particularly on multimode fiber, you must take into account the fiber's bandwidth or, in single-mode fiber, its chromatic dispersion. In most cases, the multimode fiber's bandwidth will determine the maximum distance over which the signals can be transported reliably.

There is a general misconception that once you transmit signals on fiber, the distance is almost unlimited because the fiber's bandwidth is, for all practical purposes, infinite and attenuation is low. The reality is that, while single-mode fiber has an extremely high bandwidth, multimode fiber has limited bandwidth characteristics that significantly influences the maximum distance that you can transmit high resolution/definition video signals.

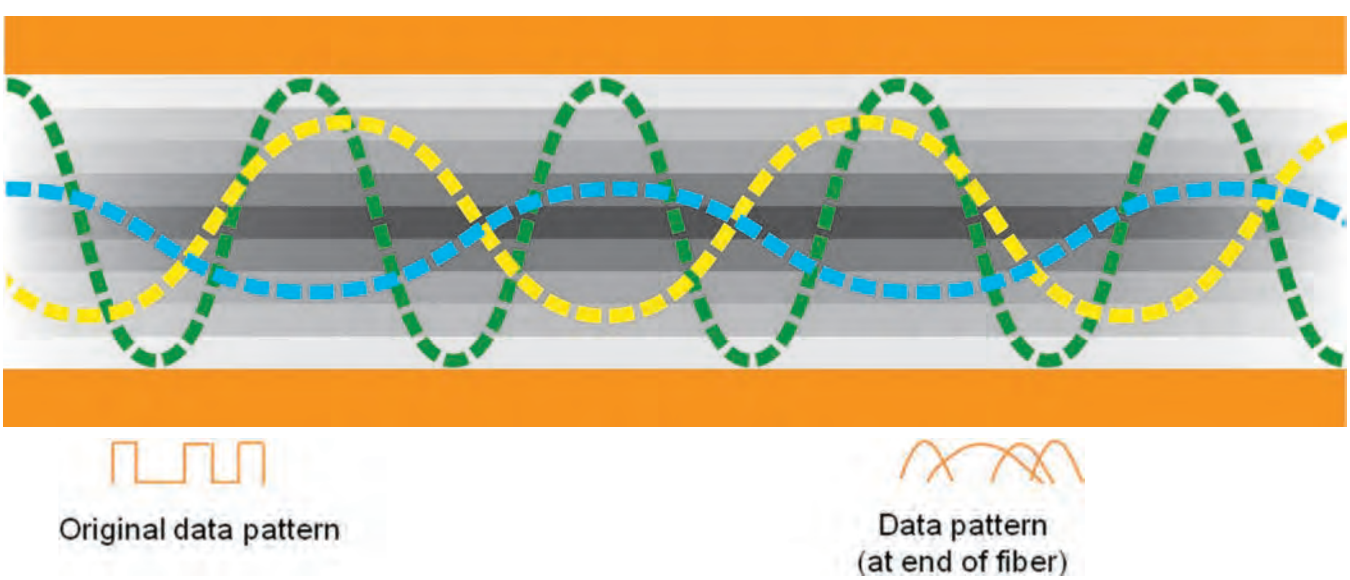
Multimode fiber suffers from a physical characteristic termed modal dispersion or differential mode delay (DMD). The term multimode fiber is derived from the fact that the core of the fiber will support hundreds of different optical paths for the light to traverse from one end of the fiber to the other, each with its own overall propagation time. The figure below illustrates this principle.

As the light travels down the fiber the difference between the times the various 'modes' or paths of light reach the end of the fiber will continue to increase. This graphic shows several modes taking different paths and how the time differential between these paths results in the optical pulse being spread over time.

This phenomenon is referred to as modal dispersion and is generally the limiting factor in transmitting high speed data over multimode fiber. Contrary to some beliefs, the many modes in a multimode fiber are not used to transmit individual wavelengths or signals but simply refer to the different paths the SAME signal's pulse of light traverses down the fiber. The number of different optical paths is related to the core diameter of the fiber, the wavelength and spectral or wavelength spread of the light source.

There are 4 basic types of multimode fiber applicable to the undersea market. These are labeled as OM1, OM2, OM3 and OM4. The bandwidth characteristics of each are shown in Table 3 on the top of page 17.

The fiber's bandwidth is inversely proportional to the distance. Therefore, OM1 fiber's bandwidth at 850nm is 160MHz at 1km but only 80MHz at a distance of 2km. It becomes increasingly difficult to transmit high bandwidth signals such as GigE and real-time HD video over this and other multimode fiber types. Note that the bandwidth of these different fibers



(Courtesy: The Light Brigade)

Table 3

Multimode Fiber Type		Legacy (62.5/125μm)	Laser Optimized (50/125μm)	Legacy (50/125μm)	Laser Optimized (50/125μm)
	Wavelength	(OM1)	(OM2)	(OM3)	(OM4)
Bandwidth (MHz-km)	850nm	160	500	2,000	4,700
	1300nm	500	500	600	600

is about the same (500-600 MHz-km) at 1300nm while it increases significantly at 850nm as you transition from OM1 to OM4 fiber. The OM3 & OM4 fibers are known as laser-optimized. As the table indicates, the wavelength range for which they are optimized is 850nm. Therefore, when you want to take advantage of the increased bandwidth of these laser-optimized fibers, it's important to use lasers that emit in the 850nm range.

Single-mode fiber is really the only choice when transmitting high bandwidth signals over long, undersea distances. In addition to the lower attenuation, single-mode fiber has significantly higher bandwidth. This allows the fiber to transmit high bandwidth signals over very long distances. Single-mode fiber can also be easily used for various types of wavelength multiplexing. The undersea market commonly uses both WDM (2 wavelengths) and CWDM (16-18 wavelengths). This technology allows for the long distance transmission of many different types of signals over one, single-mode fiber. These include all types of video, GigE & 10GigE, data, audio, etc.

This first article is intended to provide some of the basics of fiber and fundamental differences between multimode and single-mode fiber. Future articles will deal with CWDM (Coarse Division Wavelength Multiplexing), optical connectors and active devices, test equipment and system performance testing. If you have any questions or if you have any particular fiber topic you would like to know more about, please send an email to me at **emiskovic@nc.rr.com**.

Captain Gregg W. Baumann

U.S. Navy, Director of Ocean Engineering, Supervisor of Salvage and Diving

Captain Gregg W. Baumann, U.S. Navy, Director of Ocean Engineering, Supervisor of Salvage and Diving. shares with MTR insights on the long and proud history regarding difficult missions accomplished, including most recently the location and filming of the lost TOTE containership El Faro.

By Greg Trauthwein

What, specifically, is the scope of the responsibility of the Supervisor of Salvage & Diving; Director of Ocean Engineering?

The responsibilities of the Supervisor of Salvage & Diving; Director of Ocean Engineering (SUPSALV) include being the Center of Excellence for diving for the Department of Defense (DoD), the system safety certification authority for DoD diving and manned hyperbaric equipment, the technical authority for military diving equipment, the technical authority for underwater ship's husbandry repairs & inspections, and salvage; By authority of the "Salvage Facilities Act" (10 U.S.C. 7361-7364) SUPSALV provides salvage facilities for public and private vessels and provides Admiralty legal support to settle claims for salvage services rendered by the Navy. Within the context of this authority, SUPSALV provides for the equipping and maintenance of a national salvage capability for use in peacetime, war, or national emergency.

To put your office into scale and scope. Can you please give an overview of the personnel and physical assets under your guidance.

SUPSALV has more than 565 military, civil servants, and full time contracted employees supporting our Washington, District of Columbia headquarters office, our Naval Experimental Dive Unit research laboratory in Panama City, Florida, our deep ocean search and recovery equipment program, our Emergency Ship Salvage Material (ESSM) warehouse system, diving engineering services, and our world-wide, underwater hull cleaning services for fleet vessels. Our facilities include a headquarters office, eight ESSM warehouses and support centers around the world, a Deep Ocean Search and Recovery warehouse and engineering facility in Maryland, and diving services support offices in Virginia, California, Hawaii, Japan, and Bahrain. Our inventory of search equipment, diving support material, oil spill recovery equipment, and spares total more than 30,000 items, more than 500,000 sq. ft. of facilities, and a world class diving and equipment research facility. SUPSALV maintains national mission assets of search and recovery systems with capabilities ranging from shallow water to 20,000 ft. that include the Towed Pinger

Locators, towed Side Scan Sonars, and Remotely Operated Vehicles. Additionally, we maintain three worldwide commercial salvage services contracts for which we can immediately surge in personnel and equipment. Our annual average operating budget is approximately $110-120M, but increases significantly when we conduct large reimbursable salvage and oil spill operations. The value of our non-facility related inventory is in excess of $110M.

We understand that you assumed this post in October 2014. To date, what do you find most rewarding? What do you find most challenging?

What is most rewarding and most challenging is one in the same. Specifically, SUPSALV is the backbone for providing the U.S. Navy fleet with diving support and salvage capabilities as a national level first responder. Providing all of these services on a daily basis so that the Navy fleet can maintain its strong military presence at sea and keeping our sailors, airmen, soldiers, marines, and guardsmen safe is what drives me each and every day. However, meeting all of these challenges with limited budgets and resources, requires making difficult decisions to keep the warfighter prepared and safe while still operating in a difficult fiscal environment. Helping our forces accomplish their missions safely and effectively is the reward for our team's hard work and diligent efforts.

For the context of this interview, we are most interested to focus on salvage and diving safety. Given that scope, could you share with our readers a 'case study' or two which you feel best exemplifies the capability of your office?

First, I'd site two recent marine incidents. The first is the M/V El Faro which went missing on or about Oct. 1 in the Bahamas. The National Transportation Safety Board (NTSB) in the conduct of their safety investigation deemed they needed SUPALV's experience and resources. With our long standing working relationship, we quickly partnered and developed plans to search for, locate, conduct a Side Scan Sonar survey of the accident area, video document the ship, and retrieve the ship's Voyage Data Recorder (VDR). Utilizing our 20,000 ft. Side Scan Sonar "ORION", our 20,000 ft. Remotely Operated Vehicle "CURV", and the Military Sealift Command's ocean

(Courtesy of U.S. Navy/CBS '60 Minutes')

Captain Baumann discusses with CBS '60 Minutes' anchor Scott Pelley the technology to be deployed in the search for El Faro. The feature El Faro spot aired on CBS on Sunday, January 3, 2016.

If you missed it, view the 60 Minutes video here:
http://www.cbsnews.com/live/video/60-minutes-goes-on-the-hunt-for-el-faro/

going tug USNS Apache (T-ATF 172) we mobilized and satisfied three of the four objectives within just a few weeks. Unfortunately, we have yet to be able to locate the VDR. The accident is still under investigation with the NTSB and United States Coast Guard.

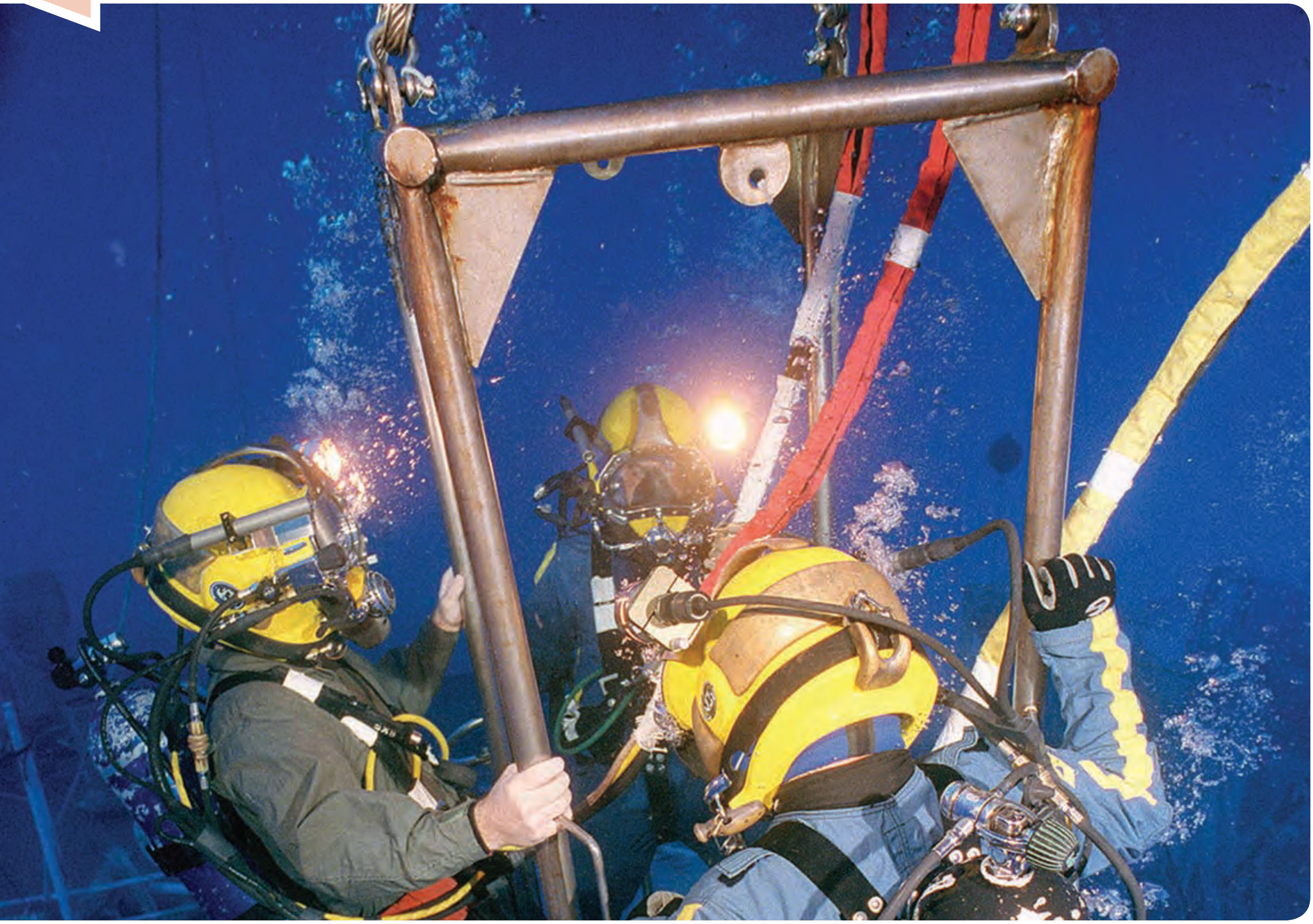
A second salvage example would be the successful removal of USS Guardian (MCM 5) in 2013. The ship unfortunately ran hard aground on Tubbataha Reef in the Sulu Sea in the Philippines. Due to the sensitive reef environment, the inability to access the vessel with large removal equipment, monsoon weather and seas, SUPSALV brought together a team of navy divers, a navy salvage ship, salvage engineers, and commercial salvors to safely remove the ship from the reef by cutting it up. Balancing environmental concerns, effective salvage plans, and political sensitivities, SUPSALV safely sectioned the ship into four 250-400 ton lifts, and removed the ship without causing any further damage to the reef or allowing the release of pollution or hazardous substances into the environment.

Your job by its inherent nature is a dangerous one. Put the emphasis on safety in perspective.

On diving safety, personnel safety is always the primary consideration. This involves ensuring safety is paramount in both the design of Divers Life Support Systems (DLSS) as well as diving operations themselves. We ensure safety is designed into, tested for and eventually certified in all of our DLSS. Tragically though, we lost four sailors in

(Courtesy of U.S. Navy)

Captain Baumann said that the salvage of the Japanese high school training fishing vessel F/V Ehime Maru – and recovering eight of the nine souls lost off the coast of Hawaii in 2000 ft. – was one of the most technically challenging and personally difficult of his career.

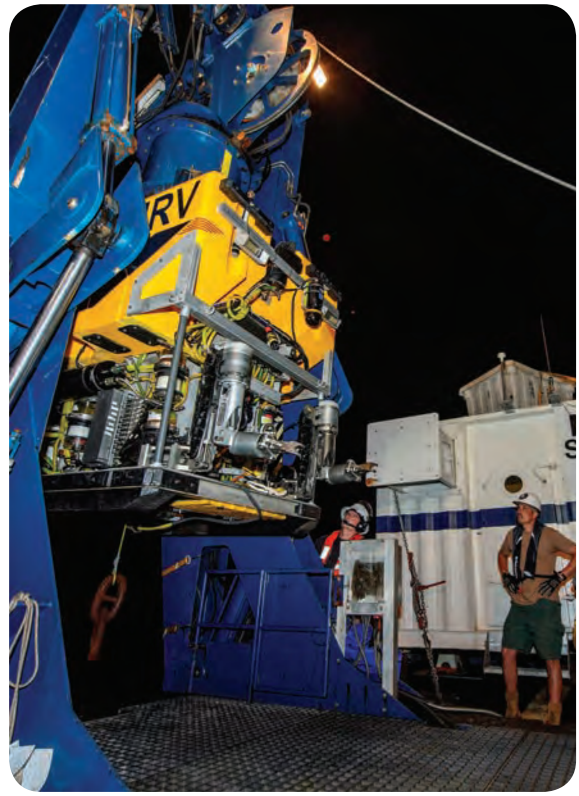


diving accidents in 2013. As a result, we conducted a strategic assessment of the safety of diving operations throughout the Navy. SUPSALV co-chaired a Diving Operational Assessment Integrated Project Team that conducted a holistic review of Navy Diving Program compliance with requirements with particular focus on supervisor accountability. Integral to this effort was an assessment of the culture within the diving community, as it affects our ability to adequately assess operational readiness, effectively plan missions, accurately apply operational risk management, safely execute dives, and apply lessons learned. The findings of the review found: Navy diving continues to meet Combatant Commander requirements and supervisory accountability, and that navy diving is effective. However, there were specific areas that were deemed to need improvement: improve supervisor decision making, development, qualification, and proficiency; build effectiveness in command level diving assessments; become a self-learning organization; establish better diving mishap reporting and trend analysis; and update the Navy's diving program instruction.

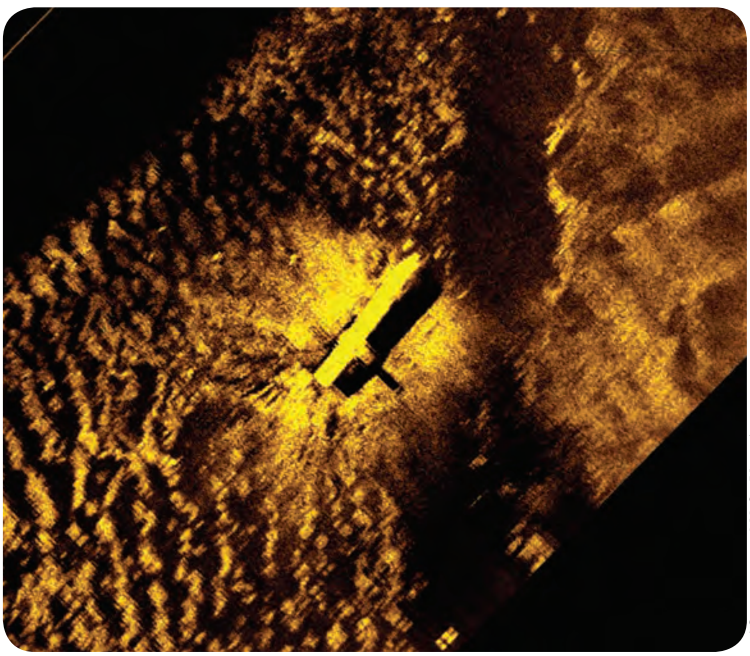
Marine Salvage is an intriguing business, literally an engineered solution as no two wrecks are the same. In your career, what one technology do you count as having the greatest impact on allowing salvage to be conducted more efficiently and safely?

Unequivocally, it's the improvements in the area of information technology that have had the greatest impact in our response capability. In most cases the physical rigors of salvage are basic, rudimentary, and don't have huge strides to make with the increase in technology. However, the software


(Courtesy of U.S. Navy)



(Courtesy of U.S. Navy)


(Courtesy of U.S. Navy)

(Courtesy of NTSB)

(Courtesy of NTSB)

(Courtesy of NTSB)

The Quest to find the sunken M/V El Faro, which went missing in the Bahamas, required SUPALV's experience and resources. Utilizing its 20,000 ft. Side Scan Sonar ORION, its 20,000 ft. Remotely Operated Vehicle CURV, and the Military Sealift Command's ocean going tug USNS Apache (T-ATF 172) SUPSALV mobilized and satisfied three of the four objectives within just a few weeks. At press time, the VDR was not yet found.

tools now immediately available to the salvor are game changers. The software packages available today have the capability to rapidly perform very detailed and complex analyses of vessel loading, stability, and structural characteristics for intact, damaged, and grounded vessels and evaluate these properties over the full range of salvage operations. Within SUPSALV, we use a Navy unique software package, Program of Ship Salvage Engineering or "POSSE" for short. As IT systems continued to grow, SUPSALV teamed with a commercial vendor to jointly fund and develop POSSE. It has given us the ability to fully model every ship in the Navy inventory. As a result, when a salvage incident does arise, within minutes we have our engineers conducting risk assessments, developing salvage plans, and providing understandable engineering solutions to complex, and multi-variable problems.

When I speak to commercial salvors, most cite the increasing size of ships as one of their top challenges today, as quite simply ships and cargo capacity are growing larger, faster, than the salvage capability to assist them in time of need. With that as a backdrop, how is the market changing to present challenges to your office?

As it relates to SUPSALV's participation in the salvaging of commercial vessels, the increased size of ships is certainly at the top of the list of challenges. However, as it relates to SUPSALV's overall salvage operations, it's the increased focus on minimizing damage to the environment and pollution discharges while conducting the salvage. As a result SUPSALV regularly conducts spill exercises with the fleet, provides on-going hands on and table top training, and maintains one of the largest oil spill equipment repositories around the world in our ESSM system.

We cover Navy and Government vessels in our pages regularly, and to say current government spending is "challenged" at the moment is an understatement. From where you sit, what are your funding issues, if any, and how has this had a material impact on your service.

The center focus of the Navy budget every year is shipbuilding and the 30 year shipbuilding plan. Since the Cold War ended, the Navy's inventory of ships has dwindled and replacement with more complex technologies has become more expensive for the same size of vessel. As a result, finding the right balance of ships in the 30 year shipbuilding plan has become increasingly challenging. Our current inventory of four tugs and four salvage ships is aging and will require replacement in the not too distant future. How the Navy will replace this capability to meet the fleet mission requirements is still being discussed.

Looking at your career, please explain in as much detail as possible the most difficult or challenging dive or salvage operation, explaining why.

The operation that clearly stands out the most to me is the salvaging of the Japanese high school training fishing vessel, F/V Ehime Maru, and recovering eight of the nine souls lost off the coast of Hawaii in 2000 ft. In 2001, one of our submarines tragically hit and sunk the Ehime Maru during a routine training exercise. Showing true sorrow and good will to the Japanese families who lost loved ones in the incident, President Bush promised to do everything possible to recover those who were lost. In looking at the possible solutions at this depth, we came up with few alternatives. At 2000 feet, we couldn't find anyone certified to conduct saturation dives to this depth. We then looked at the idea of penetrating the ship with ROV's. This option was ruled out due to the high probability of ROV entanglement and inability to access the entire interior of the vessel. The solution we eventually arrived at was to place two straps beneath the ship, lift and suspend the ship beneath a ship on the surface, then carry it to shallow water where we could safely and effectively dive on it. A salvage of this nature had never been accomplished before so we were developing innovative solutions as the operation progressed. To obtain expertise conducting complex operations at this depth, we turned to the deep ocean oil field support companies.

Teaming with a handful of these companies and a commercial salvor, we successfully placed two straps underneath the ship and brought the ship into a depth where we could dive on it. This operation was by far the most difficult in my career due to the depth of recovering the ship and use of ROV's to do so, the political sensitivities involved between the two governments, the cultural sensitivities involved, the Sept. 11, 2001 terrorist attacks taking place while recovering the ship, and most importantly the human compassion involved in trying to help the nine families. In the end we were only successful in locating and recovering eight of those lost. In the 29 years I've served in the Navy, the memory that has etched itself the deepest in me was notifying the family of the 9th victim that we were unable to locate their teenage son.

(Photo: SAL)

Working Among Volcanoes & Strong Currents

SAL Heavy Lift completed one of its most challenging projects when the crew of MV Svenja installed an offshore development platform over a subsea gas well conductor in Alaska's Cook Inlet. It is the largest exploitation area in Alaska's Cook Inlet – surrounded by active volcanoes and strong currents.

"Kitchen Lights Unit # 3" is exposed to a tidal range of 25 ft. which provokes currents in excess of five knots. Here is where SAL Heavy Lift faced one of its most challenging missions in its 35 years of history.

In March 2015 MV Svenja was chartered for the installation of the offshore development platform within the petroleum and gas exploitation area operated by Deutsche Oel & Gas AG on 337 sq. km. The area posed major technical and operational challenges for SAL Heavy Lift within the installation. Plan

"A very short preparation time for the project between sig-

"Kitchen Lights Unit # 3" is exposed to a tidal range of 25 ft. which provokes currents in excess of five knots. **Here is where SAL Heavy Lift faced one of its most challenging missions in its 35 years of history.**

nature and start of installation of approximately three months was very challenging," said Holger Krenz, SAL Project Manager. "We managed the work across at least three time zones and with a maximum time difference of 17 hours. Fifteen specialists of SAL planned the construction and installation of the platform, designed a special mooring arrangement for the vessel, drafted the temporary living quarters onboard the MV Svenja and accompanied the project steps in detail – from scheduling over cost-controlling to vessel stability calculations, rigging design and lifting procedures. Twenty-five SAL colleagues and a team of 58 experts from Crowley and subcontractors were reliant on the most accurate preparations for the later installation onboard the vessel.

After mobilization in Singapore MV Svenja set off to Alaska. Fourteen days of sea passage later, the ship had to get secured on-site by a two and a half days operation. Ten pre-installed anchors on the seabed corresponding with 10 additional winches onboard were needed to ensure solid posi-

(Photo: SAL)

tioning in choppy sea with strong currents at the Cook Inlet.

This was needed also to comply with the Jones Act, which rigidly restricts the usage of foreign vessels within U.S. territorial waters.

In addition, all tasks within the installation were restricted by a tight time schedule, as during high tide, installation windows were open for about four hours. Precisely moored, the installation crew first had to drive the King Pile into the seabed - close to the wellhead, a connection piece standing four meters out of the ground in a water depth of more than 30 meters. The King Pile worked as a guide to lower the Monopod safely onto the wellhead, which was a high precision operation with an 80 tons heavy hydro hammer.

In the next step, the 1100-ton Monopod was transported to MV Svenja by a barge and lifted onto her deck for additional preparation. Subsequently the two 1,000 tons cranes of the MV Svenja lifted the Monopod off the vessel and lowered it down to the seabed.

This was a challenging task, as the crew had to "thread" the Monopod, a 45-m high steel base, exactly over the wellhead – without underwater visibility and by a complex lifting arrangement. Once the Monopod reached under the waterline the crane commander lost visibility of the unit. So the crew had to fully rely on a subsea 3-D-sonar-system, displayed on separate monitors in a special survey container. "There was a lot of team play necessary between the survey crew and

“We managed the work across at least three time zones and with a maximum time difference of 17 hours. Fifteen specialists of SAL planned the construction and installation of the platform, designed a special mooring arrangement for the vessel, drafted the temporary living quarters onboard the MV Svenja and accompanied the project steps in detail – from scheduling over cost-controlling to vessel stability calculations, rigging design and lifting procedures.”

Holger Krenz, SAL Project Manager

our lift supervisors. And I would like to highlight that the team was the main aspect that made the whole project successful,” said Sebastian Westphal, Master of MV Svenja.

Once the Monopod was landed and the cranes freed, eight piles were driven through guides on the Monopod securing into the seabed. Subsequently the eight piles were to be filled with concrete. Moreover, the piles were compiled in parts, as the required total length of 90m could not be lifted with the cranes.

Therefore a special setup was created where the first part of a pile was driven into the seabed and the second part was welded on top of the first part and so forth.

In early August the engineers installed the 671 tons Topside onto the Monopod with a 700 tons single hook lift. “The Topside installation was an extremely tight lift with very small tolerances,” said Rüdiger Bauer, Captain.

During the high tide there was only an installation window of about four hours for lift piling sequence including welding operations. Careful planning, exact execution and a lot of teamwork was necessary.

For the installation, a very large barge carrying Topside and Helideck lay alongside MV Svenja with only 2.5 meters clearance to the Monopod. Due to the crane out- reach it had to be moored that close – with the additional challenge not to touch any of the many mooring lines, that kept MV Svenja in position. The Topside was lifted from the barge onto the Monopod. Limited access within the installation and the short time frame made the insertion of the Topside into the guides even more challenging. “We installed the Topside within two hours from lift off from the barge until set-down on the Monopod,” said Bauer. The crew completed the platform installation by installing the 40 tons Helideck. Although they carried out this part by a rather simple lift, it still demanded proper planning due to the lifting height and the placement of the unit’s balance point.

At the end of August, after 90 days on site, the installation was completed and MV Svenja headed back to Singapore for two weeks of demobilization.

“SAL was our primary heavy lift contractor for the highly technical and environmentally challenging job,” siad Michael Johnson, Statement Project Manager, Crowley. “SAL’s technical calculations and engineering constructions, their vessel and the team’s operational experience on land as well as onboard led to a very successful installation.”

The Ocean Aero Submaran

Next Generation of Ocean Observation

By Kira Coley

As the demand for coastal and open-ocean observation increases throughout the world, the need of information in real-time has never been more important. The prohibitive costs of manned research ships often result in fewer ocean surveys as well as compromises towards scientific objectives. Unmanned research vessels, such as autonomous underwater and surface vehicles, are hailed as the solution at a time of reduced government budgets and heightened importance of oceanic studies. In a bid to solve the ocean observation challenges for the military, scientific and oil and gas communities, Ocean Aero has designed the "Submaran": a new affordable class of Unmanned Underwater, Surface Vessel (UUSV), that combines the best of both surface and sub-surface technology into a completely new transformable body, capable of missions in extreme conditions.

The last several years has seen the rise of the Unmanned Surface Vessel (USV) and the classification of various forms of autonomous vessels. Now a new generation in unmanned ocean systems, the "Submaran", has entered the market as an autonomous, renewable powered unmanned vessel packaged in a small, man-portable configuration. As well as its affordability, the Submaran is a revolutionary AUV, possessing capabilities as the first ever Hybrid vehicle.

The Submaran ability to submerge allows it to navigate storms and avoid traffic while performing sub-surface data collection tasks. The combined capabilities of the Submaran represents a new level of ocean autonomy, survivability and self-sufficiency.

"In our eyes, autonomy has four levels: remote control; directed autonomy; supervised autonomy and what we call, 'terminator' autonomy" explains Eric Patten, CEO of Ocean Aero, "It is difficult to control unmanned vessels for long periods with remote control. With directed autonomy, the operator provides waypoints and the vessel automatically adjusts the rudders, flaps and sail accordingly. 'Terminator' autonomy is when they


OCEAN AERO
SUBMARAN S10

are sentinels in their own right with the ability to go off to do their own thing. Supervised autonomy is what we are after for the Submaran."

By defining a set of waypoints and trigger actions, the Submaran can travel between locations. If conditions are beyond predetermined parameters, the wingsail folds and retracts allowing the vessel to quickly submerge. The added versatility underwater means that the vessel can also avoid detection for long periods - trigger actions can be assigned if the operator wants the vessel to automatically submerge if it senses other vessels in the same area.

"From an application perspective we see it being used all over, but science is where we see the biggest opportunities. The science community have the largest need in unmanned systems to be able to collect data and information about our oceans, usually with the lowest budgets" explains Patten, "Which is why systems such as the Submaran is so good because we don't even need a boat to support us, you can launch it straight off a pier or ramp: if you have the time it can sail to wherever it needs to start the surveys. This gives us some great flexibility."

The Submaran is the first renewable energy powered hybrid vessel designed for extended autonomous ocean observation and data collection. Being wind powered essentially allows the vessel to move around the ocean infinitely. The solar power permits the vessel to be operated on the surface and underwater while powering the payload with solar rechargeable lithium batteries. The size and weight of the Submaran allows it to carry payloads up to 23kg. The combination of wind and solar power results in speeds up to 5 knots with the navigating agility for lengthy station keeping and prolonged monitoring.

"We carry around 1.2KW of rechargeable power on the vessel now via batteries and our hotel load of under 20 watts means you can actually power a lot. Really we are offering a platform flexible enough for the payload packages of the customers choosing, as every customer has different needs" says Patten, "As we are looking across the board when it comes to market, everything from scientific to government, being payload agnostic allows us to serve those customers better."

Ocean observations are required throughout the marine sectors from science and industry to government and defence. Regular monitoring of ocean currents and environmental data such as salinity, biologics and pollutants, must be collected over long periods of time to aid in the engineering, construction and maintenance of offshore platforms.

Due to the cost of manned observation platforms, sometimes up to $50,000 per day, the oil and gas industry spends on average $20,000 per square nautical mile for hydrographic and other necessary surveys performed by expensive ships with high operational overheads. The Submaran helps reduce the expense of survey equipment and operational costs as well as offering an efficient, adaptable solution for any number of surveys.

Ocean Aero also offer the Submaran as a 'communications gateway': with an acoustic modem on the vehicle it can signal devices on or under the water and transmits the data via any communication platform of the customers choosing. This capability in combination with its ability to avoid detection also makes the Submaran well suited for the defence and intelligence sector.

The 'Surface to 10 meter (S10)" is the first product released by Ocean Aero. Already the company plans to release a 'Surface to 200 metre (S200)' version of the Submaran by next summer. The S200 will also be a buoyancy glider, powerfully efficient underwater advancing the vessels hybrid capabilities. In late 2017, Ocean Aero also plans to launch a 40ft vehicle with a 900kgs payload.

"We are a company that is quickly growing. We have transitioned to a production company from one that has spent the last three years in development of our product. We just announced that we are our taking orders for the vessels for delivery in Q1 2016. This means that for us 2016 will be a year of growth, adding a production capability to our already outstanding development team." Says Patten, "Already we have had great interest from not only the United States but all over the world. The feedback we have received on the vehicle has been phenomenal and we are very excited about the coming years."

Autonomous Vehicles

The new workhorse of the sea

Unmanned vehicles are having a major impact on how oceanographic research and industrial work at sea is carried out and nothing demonstrates this more than the recent opening of a new cutting-edge research and technology facility in the UK, the National Oceanography Center's Marine Robotics Innovation Center in Southampton, England. Tom Mulligan reports.

A new $5 million center to develop technology for the emerging marine robotics sector has been opened at the National Oceanography Center in Southampton, England. The UK's Minister of State for Science and Universities, Jo Johnson MP, performed the official opening of the Marine Robotics Innovation Center (MRIC) in November 2015. The Center will be a hub for businesses developing autonomous platforms with novel sensors that will be used to cost-effectively capture data from the world's oceans.

Autonomous measurement systems for the ocean have

by Tom Mulligan

Autosub6000 being recovered from a mission in Antarctic waters.

(Photo: NOC)

grown out of demands for frontier science in extreme environments. These autonomous systems have the potential to transform research work across many sectors, for example, they will improve data collection for weather and climate prediction, for defense, and for the emerging needs of offshore energy and other industries, as well as in environmental monitoring.

Funded through the UK Natural Environment Research Council (NERC) from the Science and Universities Minister's 'Eight Great Technologies' initiative, the MRIC has been operational since the summer of 2015. Several companies, including marine scientific instruments specialist Planet Ocean Ltd, unmanned vehicles manufacturer ASV, and sensor software developer SeeByte Ltd, have already taken space within the Center, which provides office and testing facilities along with access to specialist instrumentation. The National Oceanography Center (NOC) has been working with industrial and academic specialists on the development of unmanned vehicles, battery design and operational procedures, and recently announced the provision of advanced training programs for PhD engineers in these areas.

Kevin Forshaw, Associate Director, Innovation and Enterprise at the NOC, stated: "We believe that truly great innovation happens when great minds meet and ideas can be brought to life. The Marine Robotics Innovation Center is the place for that to happen. We recently saw two fantastic new autonomous vehicles built out of our collaboration with businesses, and we're at the start of several exciting new projects that look set to repeat this success."

Commenting on Planet Ocean's take-up of space at the Center, Forshaw stated: "This really is just the beginning. We have already seen the effect working with the NOC can have on small marine technology businesses, so we're confident we have an offering that works. The Center provides a true hub for marine technology development and we believe that it will attract business from all over the world."

He added: "It is really good to be welcoming SeeByte to the Marine Robotics Innovation Center, being a leading player in the control of autonomous assets, and a partner to many of the companies we engage with. We ourselves have collaborated with SeeByte on several R&D projects to date, and having them on site will stimulate further collaboration in the future. Both organisations have key areas of expertise, that when combined, will help to bring about exciting new innovations for the sector.

"We are also very pleased to welcome ASV into the Innovation Center here - a company at the leading edge of autonomous surface vehicle development for an emerging global market. We are already collaborating with ASV, looking to develop highly innovative platforms and systems for use by a variety of end-users in science and survey, oil and gas, defense and other offshore industries. Having representatives from the company on-site will only increase the opportunity for further collaboration in the future, and we welcome this wholeheartedly."

Developed by ASV, the C-Enduro is a long-endurance autonomous surface vehicle (ASV) used to safely and cost-effectively collect data at sea. The vehicle is shown here on a sea trial off Oban, Scotland.

(Photo: ASV)

A NOC glider mechanical engineer trims a glider in the saltwater ballast tank, one of the facilities available in the new Marine Robotics Innovation Center at the National Oceanography Center.

The innovative companies based at the MRIC developing technology for the next generation of autonomous and robotics systems share specialist facilities with the NOC's Marine Autonomous and Robotics Systems unit which has broad experience of marine autonomous platforms in highly challenging environments, including extensive missions under ice and in the depths of the Cayman Trough.

One example of the NOC's activity in marine autonomy technology development is its Long Endurance Marine Unmanned Surface Vehicle competition, held in 2012, in which competitors were briefed to develop a USV with a 90-day endurance capability and the ability to sprint if required at 10 knots over 100 nautical miles. As a direct result of holding the competition, five $80,000 concept studies were awarded. These were later down-selected to platforms designed by ASV and MOST (AV) Ltd, each leading to the production of vehicles that now compete in the global market.

The MRIC

The MRIC provides the NOC with additional resources and capabilities for working collaboratively with innovative companies that are developing technology for marine autonomous systems. The Center encourages early-stage developments and enables the growth of a cluster of autonomous systems companies able to answer international challenges. Specifically, it aims to encourage and support development of technologies and systems that create a step change in systems capability, as well as to provide an exchange of ideas and information to facilitate wider adoption of these systems. It supports collaborative projects that respond to national and international challenges more effectively and ensures the effective use of public funding in specific research and development areas, and also supports the development and demonstration of new technology via access to the additional research facilities and equipment available at the NOC. In addition, the MRIC pro-


(Photo: NOC)

A NOC glider software engineer prepares a customized Slocum Glider for its next mission.


(Photo: Dan Wilson Photography / NOC)

The UK Minister of State for Science and Universities, Jo Johnson MP, hears from Dr. Maaten Furlong, Head of the National Oceanography Center's Marine Autonomous Robotics Systems Group, about the NOC's fleet of gliders.


(Photo: Dan Wilson Photography / NOC)

L to R: Dr Maaten Furlong, Head of the National Oceanography Center's Marine Autonomous Robotic Systems Group; **Dave White**, Marine Autonomous Robotic Systems Glider Manager; **Jo Johnson** MP, UK Minister of State for Science and Universities; **Kevin Forshaw**, the National Oceanography Center's Associate Director, Innovation and Development; and **Professor Ed Hill**, Executive Director of the National Oceanography Center, view the saltwater ballasting tank for glider ballasting.

Autosub6000 being deployed into light sea ice in the Antarctic.

The AutoNaut on a mission sampling an ocean front off the coast of Scilly, UK.

vides information about regulation and legislation, risk and reliability, communication, and control relating to marine autonomous systems. The MRIC's partners will work on novel projects, not currently market-ready, with the long-term aim of advancing marine autonomous systems technology.

Marine Unmanned Vehicles: Capabilities

The oceanographic research capabilities of unmanned vessels and their potential impact on marine exploration were amply demonstrated when the largest deployment of marine autonomous vehicles in British waters took place in October 2014. In a broad-ranging research effort, a fleet of seven USVs and AUVs undertook a 300-mile mission across an area of the Atlantic Ocean off the southwest of the UK to test new technologies and to map marine life in a key fishing ground. Two of the craft were innovative British devices designed to operate for months using renewable sources of power including wind and wave energy. This 'Exploring Ocean Fronts' project, led by the NOC, involved a large number of partners, including university research departments, the UK Meterological Office, the Royal Navy, and specialist commercial companies.

The second phase of the project reached its conclusion in December 2014 and phase three commenced last August, with the NOC working in partnership with the World Wildlife Fund (WWF) to measure marine wildlife in the Celtic Sea. A submarine glider and a USV were deployed into the Celtic Deep area of the Celtic Sea and over a three-week period worked together to investigate why this area is particularly attractive to marine predators such as dolphins and seabirds.

In addition to the WWF, the deployment was supported by a range of industry, government and academic partners working in collaboration with the NOC to test new sensors on the Slocum Glider and C-Enduro vehicles employed in the project, and to assess how other data sources such as satellite imagery and tidal predictions can improve operational efficiency. Many of these partners were also involved in phases one and two of the project.

Vehicle Capabilities: The future

As a result of a competition to develop novel Adaptive Autonomous Ocean Sampling Network (AAOSN) management systems for the NOC, two UK consortia are developing systems capable of co-ordinating a suite of marine autonomous vehicles gathering data from the ocean over periods of months, and tracking and sampling dynamic features.

The two-phase competition was launched in September 2014 by the UK Natural Environment Research Council (NERC) in partnership with the Defence Science and Technology Laboratory (DSTL) and Innovate UK, with $2.3 million being made available for the project. Phase one saw nine consortia submit feasibility studies, and two consortia were invited to apply for phase two for the development of prototypes, which would be capable of undertaking demonstration missions at sea.

In addition, last October the NOC announced its partnership in NEXUSS, (NEXt generation Unmanned Systems Science), a new $4 million Center for Doctoral Training in the use of robotic systems for environmental sciences. It will provide training to more than 30 science and engineering PhD students, with the first intake due to start in the fall of 2016.

www.noc.ac.uk/innovationCenter
www.planet-ocean.co.uk
www.asvglobal.com
www.seebyte.com
www.autonautusv.com

Autonomous Vehicle Development

The NOC and its predecessor organization, the Institute of Oceanographic Sciences Deacon Laboratory (IOSDL), have pioneered the development of marine autonomous systems. The origins of its 'Autosub' family of vehicles goes back to the latter part of the Cold War years, when there was a need for affordable, sustained observations in areas to detect Soviet submarines and to obtain near-real-time oceanographic data, without having to permanently deploy oceanographic research ships. Early Autosub concepts directly addressed this need, but with the end of the Cold War in the early 1990s, civilian applications came to the fore. The NOC and the IOSDL displayed concept drawings and models of marine autonomous systems at Oceanography International from 1992 onwards and in 1997 the NERC Thematic Research Program 'Autosub Science Missions' was approved to deliver the first tranche of real-world deployments of the original Autosub 1 vehicle. Powered by lead-acid car batteries, the Autosub quickly evolved into the Autosub 1a with several thousand 'D'-cells housed in carbon-fiber tubes, providing 1000 km range or up to 8 days endurance, which was quite an achievement for the time. The first science missions included deployments in the North Sea, as well as around the west coast of Scotland and off the Scilly Isles. The first under-ice missions were undertaken at this time and new discoveries were made in all of the missions. A private-sector version of Autosub 1a was built by Subsea 7 under license, and was exhibited at the first London-based Oceanology International in 2002.

In the next NOC mission, 'Autosub Under Ice', the vehicle was upgraded to Autosub 2 standard, and, following this, the need for rechargeable batteries and 6000-meter diving capability were met by the next member of the family, Autosub6000. Still in regular use, this vehicle introduced lithium-ion pressure balanced battery packs, and is considerably shorter than the Autosub 1 to 3 series. It also has stubby 'wings', and was the first vehicle to replace the original multi-bladed propeller with a two-blade design.

Next in the family was the latest version, Autosub LR (for Long Range). Using a completely new design, this vehicle mixes design elements from autonomous gliders and the earlier Autosubs and is designed to eventually achieve a range of 6000 km as well as being able to dive to 6000 m. The Autosub LR is the first of the family not to require a specialized launch-and-recovery gantry, and is much more compact than the earlier machines.

Commercially Developed Machines

Four different types of commercially produced marine autonomous vehicle were deployed in the NOC-led Exploring Ocean Fronts project:

- **AutoNaut:** Powered by wave action and solar panels, the AutoNaut USV resembles a canoe and provides a platform for instruments. The vehicle was designed and built by Chichester, UK based autonomous vehicle specialist MOST (AV) Ltd.
- **C-Enduro:** This ASV has an in-built wind turbine giving it a structure reminiscent of an airboat. The C-Enduro is designed to operate on its own for up to three months and back-up power is provided by a diesel motor. Instruments record water and weather data, and a winch can lower sensors below the surface. The C-Enduro is designed and built by ASV , a company based in Portchester, UK.
- **Wave Glider:** The Wave Glider has twin elements, one floating on the surface, the other a system of miniature blades dangling underwater and absorbing energy. Designed to operate at sea for periods spanning years with no fuel, emissions or crew, more than 100 units have been produced by US company Liquid Robotics, which is headquartered in Sunnyvale, California.
- **Slocum Glider:** Named after Joshua Slocum, the first solo round-the-world sailor, this autonomous vehicle developed and manufactured by North Falmouth, Massachusetts based Teledyne Webb Research resembles a torpedo. It dives and rises through the water with a system of variable buoyancy. When it surfaces, the glider can relay information by satellite and pick up new instructions.

A glider on the surface before diving.

(Photo: NOC)

Photo: Keoki Flagg

Dragon: A New Class of Personal Subs

Latest personal submarine from DeepFlight is a $1.5 million model that's easier for users to operate and maneuver, with the capability to fly and hover underwater

Founded by renowned ocean engineer Graham Hawkes, submersible manufacturer DeepFlight has been in the business of producing top-of-the-line personal underwater craft since 1996, over the years developing a number of recreational vehicles to push the boundaries of undersea adventure and exploration.

The company recently debuted its sixth generation personal sub, the Dragon, a more compact vehicle targeting a wider range of users via safer and easier operation. First introduced at the Monaco Yacht Show in 2014, and then launched at the same show in 2015, the two-person Dragon only requires minimal instruction before pilots can take the helm, cruise at speeds up to four knots and dive down to depths of 120 meters.

Helping to make this a safe reality, DeepFlight designed a system called DeepFlight Dive Manager, which automatically monitors and adjusts oxygen flow, battery life, depth and altitude control. And like all DeepFlight submarines, the Dragon is positively buoyant, meaning it floats itself to the surface should an emergency occur.

Also unique to the Dragon, the sub is DeepFlight's first craft to offer underwater "flying" and "hovering" capabilities, allowing pilots to cruise alongside sea life or stop and hover over objects such as shipwrecks and canyons. Quad brushless DC thrusters and a lithium-iron-phosphate battery pack enable quiet operation for up to six hours between charges, and a 40V system voltage and low electric signature ensure the Dragon can be piloted safely near swimmers and marine animals, the manufacturer said.

At 1,800 kg and five meters in length, the Dragon is more compact than its predecessors, enabling the sub to be launched, recovered and stored on yachts like a tender, with little or no retrofit. The Dragon can even be operated from shore via a beach or boat ramp, similar to a small boat.

Dragon Specifications

Length:	5 m (16ft 5in)
Width:	1.9 m (6ft 3in)
Height:	1.1 m (3ft 7in)
Weight:	1,800 kg (4000 lbs)
Operating Depth:	120 m (400 ft)
Payload:	250 kg (550 lbs)
Cruising Speed:	4 knots
Operating Depth:	120 m
Crew:	2

Durval Tavares, President & CEO, Aquabotix

Last month MTR spent some time with Durval Tavares, President and CEO or Aquabotix, for insights on his company's push to increase penetration of its innovative HV PRO further, faster into the commercial ROV market.

Please provide a brief personal and professional background.

I graduated from UMass with a degree in Electrical Engineering, and worked at the Naval Undersea Warfare Center in Newport, RI for 20 years, followed by 10 years with Fidelity Investments. I founded Aquabotix in March of 2011.

Looking back, how did you come to be interested in and involved in the subsea technology business?

I've always had a passion for the ocean. After I graduated from engineering school and went to work for the naval laboratories my passion was ignited and I have continued professional and personal exploration of the ocean since then.

From the time you started the company, what were your goals for the company and the brand?

I want Aquabotix to be globally recognized as an innovator of accessible underwater technology

Correct me if I'm wrong, but I believe your products are more widely used in the recreational market. Can you talk specifically to the decision – when & why – that was taken to broaden your presence in the commercial sector.

Our intent was always to have a full product offering which included the commercial sector. We started selling in the recreational market to begin building brand awareness and to test the product which was followed by hardening the vehicles for the commercial sector.

What we've done is be innovative by taking emerging technology from the land and transforming it for the underwater space. Our vehicles operate on a completely digital platform that is fully scalable to grow as the missions grow.

What attributes of the vehicle do you consider particularly attractive to the professional?

Accessibility: our vehicles are easy to operate and simple to deploy with only one operator

Hybrid: The Hybrid ARV offers dual functionality in one vehicle. It has the flexibility to be used as an autonomous underwater vehicle for wide range searches then with the attachment of the tether it can be used as a remote operated vehicle for detailed inspection.

The HydroView Pro ROV is available with five to eight motors, a host of tether and sensor options, grabber arm and two pounds of payload capability.

Geographically, where do you see opportunity?

We see opportunity across the world - more than half of our business is international. We are especially excited about some emerging markets including South America and Asia Pacific.

The continued low price of energy affects all businesses. How is it affecting yours?

This affects our business in a few ways. Companies are looking for more affordable products. Low price are also forcing companies to look at new ways of operating to lower costs.

If you had to pinpoint a single (non-vehicle specific) technology that will have the greatest positive impact on AUV efficiency and performance in the coming year(s), what would that technology be and why?

Increased Battery Power: many of the AUVs today use Lithium technology for batteries. The industry needs more power in a smaller form factor. Increased battery power will result in improved efficiency, performance and increased mission time.

DOE Debuts Phantom T5 ROV

Deep Ocean Engineering (DOE) revealed the newest addition to its family of underwater drones, the Phantom T5 ROV, which is designed to be a powerful, rugged, reliable, portable and easily expandable system. According to DOE, applications for the Phantom T5 span a broad spectrum:

- *Homeland Security: Defense, Military, Customs, Police*
- *Hydroelectric System Monitoring*
- *Infrastructure Inspections: Bridges, Tunnels, Pipelines, Ships*
- *Scientific Research: Geology, Biology, Archeology*
- *Exploration: Oil and Gas, Salvage, S&R*
- *Cinematography: Videos, Photos, Film*

"The Phantom T5 open-frame architecture makes mechanical integrations a breeze, while the dedicated expansion bulkhead connectors, used for both power and telemetry, are provided as standard," said John Bergman, Deep Ocean Engineering, Vice President of Engineering. "In addition, an optional tool skid allows the customer to "bolt on" their sensors or tools by plugging into the expansion bulkhead connectors for nearly limitless, task-specific, expansion possibilities."

Ben Kinnaman, President and CEO of Greensea Systems, Inc., said "Their (Deep Ocean Engineering) engineers are top-tier, and we were happy to work with such a strong, resilient, and rugged vehicle. We know that integrating any of our navigation, control, and autonomy packages on their ROVs will result in high performance and increased capabilities."

Standard Phantom T5 features:

- Full HD video (1080i & 0.35 lux) with 20X optical zoom, on-screen videographic overlay mounted on a tilt platform with angle feedback
- 300m depth rating (500m optional), LED Lights, and two person portability (39 kg / 86 lbs. dry weight)
- User accessible power/telemetry bulkheads and open frame architecture for facilitated expansion
- Minimal topside footprint for rapid deployment
- high performance, magnetically coupled thrusters (highest thrust to weight ratio and reliability of any ROV in its class
- Resilient, non-corroding polypropylene chassis
- Maintenance-free auto-functions available (including auto-heading, auto-depth, auto-stabilize and auto-altitude)

Cathx Ocean Aims to Help You See

Subsea 20/20

The Cathx Ocean mission is as simple as it is complex: to change how subsea video and imaging are captured, stored and viewed. Leading the way is Michael Flynn, Chief Technology Officer and Co-Founder of Cathx Ocean, who spent some time with Marine Technology Reporter recently at Oceans '15 to explain the rationale behind its latest subsea imaging system.

By Greg Trauthwein

Cathx Ocean was founded in 2009 by Adrian Boyle and Michael Flynn and it has grown steadily at its design and manufacturing facility based in Kildare, Ireland.

Cathx Ocean first entered the subsea market with its range of professional dive lights which are highly regarded by navy and law enforcement, subsea construction and oceanographic research divers worldwide. At the time, LED lighting was just starting to make headway into the subsea space, "so to start the company, we designed and launched a high quality LED lighting system," said Flynn.

In 2012, the Cathx LED lighting range for subsea vehicles was introduced to the market. Following the success of these lighting products and recognizing the need for improvements in subsea imaging and measurement, the company began designing a subsea machine vision camera and laser system. Successful trials of this system were completed in the North Sea in 2014.

In short, today, Cathx Ocean has designed from the ground up a subsea camera integrated with a laser system with the goal of providing superior underwater imaging. Equally critical to the quality of the lighting, camera and laser system is the integration of all into a comprehensive, automated package designed to automate manual tasks.

Built from the Ground Up

The job to design, engineer and build a highly automated subsea imaging system is not one to be taken lightly, particularly when built from the ground up. "We set about to build a system, taking the best of sensors, electronics, lens systems and onboard storage and processing," said Flynn. "Personally I looked long and hard at the options available and found the whole package wasn't available off the shelf."

The mission: Build a smart subsea imaging solution that could be tailored for different uses

"One of the key aspects of the (camera system) is something that we call sequential imaging," said Flynn. Essentially, as a unit, the camera system, lights and lasers work in concert to adjust to the ever changing conditions at varying depths, with the aim of providing the clearest images, the best data.

Flynn noted that the system has been particularly of interest for the larger, faster moving AUVs, such as MMT's Surveyor as well as Hugins and Bluefins.

The Cathx Ocean System has been installed on an MMT Surveyor for more than a year.

With all of the technology and enhanced capability, Flynn notes that the premise of Cathx Ocean's high-tech offering is really pretty simple … to provide a more efficient, cost-effective means to survey underwater assets.

The System

The L1000 Laser Profiling System includes the Cathx Ocean M12 A1000 Stills camera and Green Line Laser. The Green Line Laser is a 520nm long range laser that produces a straight line with uniform intensity over a long range. The system can capture UHD Still images and laser profiles in a rapid sequence providing laser xyz data and co-registered still images.

A laser system for range and scale can easily be set up using the M12 Camera facing cownwards with a Green Line Laser in parallel.

A pre-calibrated laser system can be configured for high density 3D point cloud data capture using a Green Line Laser facing downward and an M12 A 1000 Camera at a suitable angle for optimum measurement and within the physical limits of the vehicle.

www.cathxocean.com

"We were looking for new opportunities in optical-based automation and **we saw a green field opportunity** in the subsea area"

Cathx Ocean CTO and co-founder

Michael Flynn

Photo: Greg Trauthwein

TRAPS

New Lightweight Sonar System

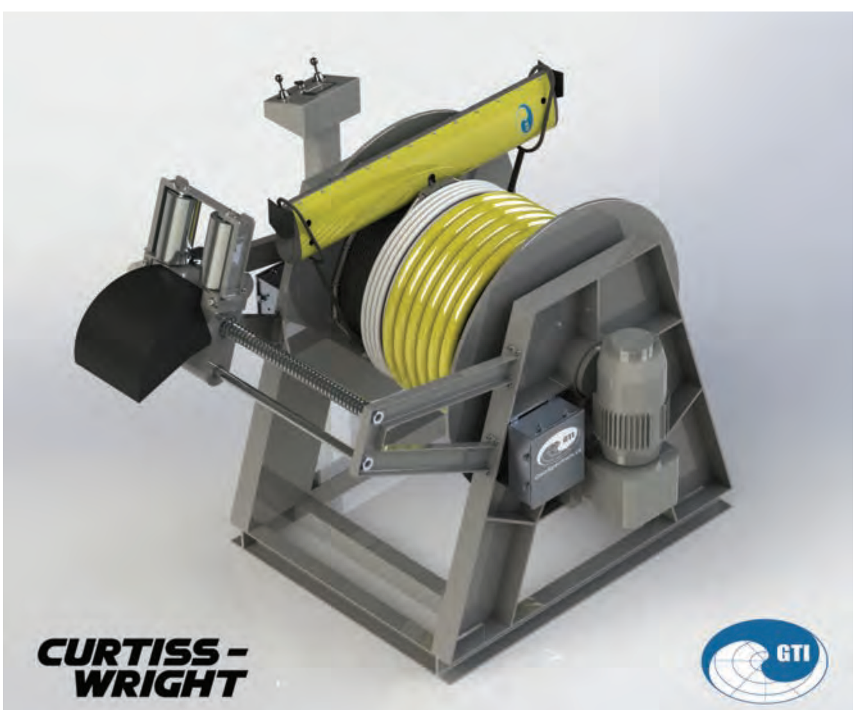
The TRAPS (Towed Reelable Active Passive Sonar) system is an innovative Antisubmarine Warfare solution designed specifically for smaller surface ships and USVs

Curtiss-Wright's Defense Solutions has announced that its INDAL business unit is collaborating with GeoSpectrum Technologies (http://geospectrum.ca) to develop a new compact and lightweight sonar system designed for the smaller surface ship and Unmanned Surface Vehicle (USV) markets. The TRAPS (Towed Reelable Active Passive Sonar) system is designed to deliver a unique, high-performance Antisubmarine Warfare (ASW) solution to the undersea warfare marketplace. Based on its reduced size and weight, TRAPS will reportedly be the first towed active/passive sonar system to enable smaller navies, such as those operating frigates, corvettes, coastal patrol vessels, and ships of opportunity, to perform effective ASW operations. Unlike towed sonar systems, the developers position TRAPS as the first reelable towed system that features a vertical active source combined with a high performance passive towed array, all handled "in-line" on a lightweight and easy to use winch system.

The TRAPS system is touted as ideal for use in a variety of critical applications, including submarine detection for smaller surface combatants in a containerized package (mission configurable) that can be deployed on both existing vessels and new builds. It can be deployed as a permanent installed ASW system for new ship construction (especially smaller combatants) or as a permanent installed ASW system retrofit on existing ships with minimal impact and cost.

www.curtisswrightds.com

The TRAPS (Towed Reelable Active Passive Sonar)



MacArtney-GreenLink inline termination is designed to make offshore medium voltage termination jobs faster, easier and more efficient.

Photo: MacArtney)

Tidal Turbine Connected
with Onshore Electricity Grid

French marine renewable energy pioneer SABELLA has completed a cable operation connecting a tidal turbine to an onshore grid. The operation was carried out in the Fromveur Passage, off the island of Ushant, France, and the future outcome of connecting the two halves is a coverage of 15 to 20 percent of the Ushant island's electricity consumption needs. Completed with the help of a MacArtney connectivity solution, the 'Sabella D10' tidal stream turbine project includes two drymate GreenLink connectors, one linked with the turbine, the other one connected to the export cable. They are eventually lifted out of the water and connected to one another.

Over the past years, Sabella has developed an original concept for a screen of tidal turbines being positioned on the seafloor. In accordance with a permit issued by the French government, Sabella therefore plans to keep the D10 tidal turbine submerged for one year to conduct various trials.

Following the gradual increase in the speed of the Fromveur Passage currents, Sabella's D10 tidal energy turbine has produced 10 MW/h of electricity under real operating conditions. Having been deployed last June, the turbine started delivering limited quantities of power to Ushant island in November 2015.

For transmitting the harnessed tidal power to the onshore grid, the 'Sabella D10' relies on a purpose-built subsea connectivity solution from MacArtney. Based on MacArtney's GreenLink Inline Termination technology the power is transmitted back to the onshore grid via the dynamic subsea export cable. The solution also comprises a couple of hang-off stress terminations, a customized flange including various medium- and low-voltage fiber-optic connectors for the turbine nacelle, a junction box jumper cable, and various test cables.

Pre-orientated in the direction of natural tidal currents and empowered by symmetrical rotor blades, the turbines effectively capture the energy generated by the shift between ebb and flow. The rotor is activated even by modest current motion and powers a generator, which exports the electricity produced to the onshore grid via a submarine cable anchored and embedded at its landfall.

MacArtney GreenLink Inline Termination solutions are often used to connect dynamic cables from offshore renewable wind-, tidal- and wave-energy converters to export cables. In addition, they are widely used to interconnect subsea units and can be combined with the GreenLink Hub to support more devices in an array.

www.macartney.com

Final fixation of GreenLink connector to its plate.

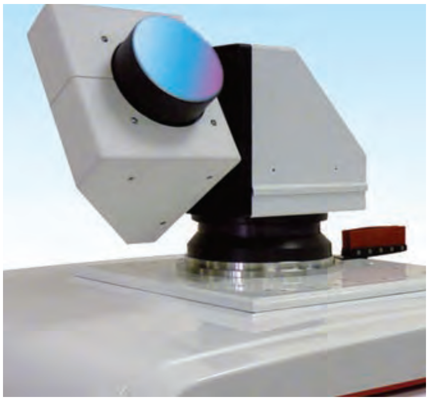
(Photo: SABELLA)

(Photo: Fugro)

1GW of Offshore Wind Data

Oldbaum Services has deployed two 3D WINDCUBE 400S Scanning LiDARs as part of the wind resource assessment campaigns the company is currently conducting at two French offshore wind sites. It is the first time that such long range scanning systems are deployed for operational campaigns, after having successfully completed third party validation tests with DTU and DNV GL. Oldbaum's work will contribute significantly to making best use of the wind resource available at both locations to reduce the costs associated with offshore wind development.

Oldbaum provides wind data interpretation and consultancy services that efficiently complement Leosphere's scanning LiDAR, allowing Oldbaum to design and implement cost effective wind resource assessment campaigns to establish the offshore wind regime from onshore for future wind farms as well as optimise their layout design. The instrumentation Oldbaum selected for the job includes the 3D WINDCUBE 400S Scanning LiDAR from Leosphere, which is able to scan hemispherically up to a distance of 10 km. It scans the wind out to sea, providing Oldbaum with a comprehensive picture of the wind resource available at both sites, returning data using low risk cost effective measurements.



Fugro's Seafloor Drill 2 Completes Site Investigation

Fugro's Seafloor Drill 2 (SFD2) has completed a multisite investigation across the North West Shelf of Australia, encountering variable calcareous sediments and delivering results to support a jack-up drilling campaign.

The work was performed in water depths up to 112m and required in situ testing and sampling to a total length of 323m. The SFD2 proved effective in sampling some of the world's most difficult seabed sediments, from ultra-soft carbonate muds to highly weathered limestone. According to Fugro, its success can be attributed to a number of factors including the flexibility provided by the proprietary wireline system, the innovative approach to mud supply and a 'hands-on' approach by the geotechnical drillers. An additional advantage was the ability to airfreight the SFD2 to Australia.

Ian Finnie, Fugro's Integrated Geosciences' Lead, helped scope the investigations and interpret the seabed conditions for the client. "Seafloor Drill 2 has proved to be ideally suited to the calcareous sediments that we have around Australia and is a game changer in Fugro's ability to support the offshore industry in Western Australia and South East Asia. This drilling technology significantly enhances Fugro's fully integrated geoscience service, from optimally scoping data acquisition, through successful execution, and then into engineering design and construction support."

www.fugro.com

Fugro's SFD2 completes a multi-site investigation offshore NW Australia.

Photo: CMRE

CMRE, NOAA Partner for

Atlantic Ocean Monitoring

There is a continual need for improved prediction of climate variability and its impact on the countries surrounding the tropical Atlantic basin. In 1997 the U.S. Department of Commerce - National Oceanic and Atmospheric Administration (NOAA) initiated the PIRATA (Prediction and Research Moored Array in the Tropical Atlantic) multinational observation network, established to enhance knowledge and understanding of ocean-atmosphere variability in that area. PIRATA is a three-party project between Brazil, France and the United States that seeks to monitor the upper ocean and near surface atmosphere of the Tropical Atlantic via the deployment and maintenance of an array of moored buoys and automatic meteorological stations and via ancillary observations collected during annual servicing cruises. The network includes array of backbone moored buoys in key regions such as the climate-critical Tropical North Atlantic where the U.S.-led PIRATA Northeast Extension (PNE) is present.

The program requires global class research vessel support to accomplish studies, monitoring and maintenance. The NATO Research Vessel Alliance, operated by the NATO Center for Maritime Research and Experimentation (CMRE), has proved to be particularly well-suited to this mission. In this context, **NOAA Vice Admiral Michael S. Devany,** Deputy Under Secretary for Operations at NOAA, and **Rear Admiral (Rtd.) Hank Ort**, CMRE Director, signed a five-year framework agreement to facilitate research vessel support from NRV Alliance in particular, with monitoring of meteorological, hydrological, and oceanographic processes, bathymetry and climate.

Lane

Seebyte

West

Sonardyne

Lloyd's Register

SeeByte Founder Professor Lane Honored

SeeByte founding member Professor David Lane has been appointed Commander of the Order of the British Empire (CBE) for services to Engineering in the 2016 New Year's Honors list. Professor Lane is Professor of Autonomous Systems Engineering at Heriot-Watt University and a founding Director of both SeeByte and the Edinburgh Center for Robotics. In 2001 Professor Lane formed the founding team of SeeByte, and as CEO until 2010 he led the company from a start-up to a multi-million dollar award winning organization, with offices in Edinburgh and San Diego. Bob Black, CEO at SeeByte said "On behalf of all of us at SeeByte, I would like to congratulate Dave on receiving his CBE. SeeByte continues to benefit from the hard work that Dave put into the company and we wish him all the best for his future endeavors".

Professor Lane remained involved with SeeByte as a Board member until 2013 when SeeByte was acquired by Battelle.

Bazin Joins SBG Systems

France based motion sensing solutions provider SBG Systems has hired Ludovic Bazin as its new Technical Support Manager. Bazin has a Master degree in Surveying technology and Positioning. He has been working for the past 19 years in the Geophysical Industry as Surveyor / Navigator, Support Engineer and Navigation, and Positioning Technical Manager. The company recently moved its U.S team from Chicago to Huntington Beach, Calif. With an additional 10,000 square feet, the new office enables SBG Systems to keep expanding the local SBG team, to reduce delivery time as well as to welcome clients in more convenient meeting facilities, the company said. SBG Systems said it also plans to hire a Field Application Engineer to join its new U.S office.

Sonardyne Appoints West

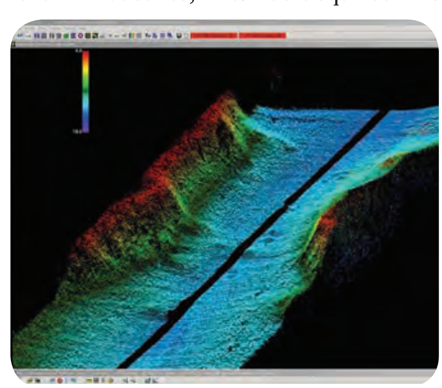
Sonardyne International appointed Geraint West as its new Global Business Manager for Oceanography. West joins Sonardyne with immediate effect and brings with him extensive experience gained over 32 years with the Royal Navy, Fugro and most recently, the National Oceanography Center (NOC).

West's early career as a hydrographic surveyor included a posting to the U.S. Naval Oceanography Office, and culminated as Charge Surveyor in the ice patrol ship, HMS Endurance. He then moved to Fugro as Project Manager for the U.S. Army Corps of Engineers airborne laser hydrographic survey system. At NOC, Geraint held a variety of positions, initially managing operational and technical support to the seagoing research program, and then as Director of National Marine Facilities, with strategic leadership for the U.K. marine science community's large research infrastructure, specialist facilities and data center.

During his 14 years with NOC, Geraint oversaw the introduction of the UK's new multi-purpose oceanographic research ships, RRS Discovery and RRS James Cook, as well as the establishment of its Marine Autonomous and Robotics Systems group. He has also worked extensively with the international oceanographic community, including two years as Chair of the International Research Ship Operators group.

Mitcham Acquires L-3's Klein Associates

Geophysical equipment supplier Mitcham Industries, Inc. has acquired L-3



Klein

Klein S5500 V2 Bathy QC Display 3D.

Aker Solutions, LR Partner on Subsea O&G Engineering

Lloyd's Register (LR) and Aker Solutions collaborate under a new global framework agreement to drive efficiency in engineering and subsea O&G developments. The contract gives Aker Solutions access to all relevant services from the Lloyd's Register Group, including inspection, compliance, certification and advisory/consulting services in areas like risk management/HSEQ, engineering dynamics, asset integrity, drilling, wells and reservoirs. The first call off from the contract is already in place: a global project for international quality management system standard ISO 9001 and ISO 14001 (environmental) certification of Aker Solution's Subsea division.

The project will be carried out by LRQA – a division of the Lloyd's Register Group.

(L) Inge Alme from Lloyd's Register Energy and (R) Gaute Fardal, Lead Group Category Manager at Aker Solutions.

Communications Klein Associates, Inc., a designer, manufacturer and worldwide distributor of sonar and waterside security systems to military and commercial customers, effective January 1, 2016. Klein, now renamed Klein Marine Systems, Inc., was a wholly-owned subsidiary of L-3 Communications Corporation, a provider of a broad range of communication and electronic systems and products used on military and commercial platforms, and a prime contractor in aerospace systems.

www.l-3klein.com
www.mitchamindustries.com

Nautilus to Wet Test Seafloor Production Equipment

Nautilus Minerals signed agreements with United Engineering Services to provide support services associated with wet testing the company's Seafloor Production Equipment and storing the equipment as it is delivered from various suppliers prior to integration onto the company's Production Support Vessel. The first of the equipment to be tested will be the three Seafloor Production Tools (SPTs). The SPTs are due for delivery from the Soil Machine Dynamics facility in Newcastle upon Tyne early in 2016. On completion of the wet testing, the SPTs will be stored at UES facilities in Duqm, Oman for preservation and maintenance until integration on the PSV which is expected to occur in 2017.

C-Innovation Chooses Kongsberg AUV

C-Innovation (C-I) ordered four AUVs from Kongsberg Maritime, adding AUV capabilities to C-I's ROV fleet, integrated with parent company Edison Chouest's worldwide vessel fleet for a full-spectrum IMR solution for clients. The two HUGIN AUVs under order are depth rated to 4,500m, while the two MUNIN AUVs are rated to 1,500m.

EchoBoat-RCV Integrates with Norbit iWBMSc

Seafloor Systems has integrated and tested the Norbit iWBMSc (Integrated Wideband Multibeam Sonar, Compact) multibeam echosounder system with the EchoBoat-RCV remotely controlled survey vehicle.In addition to its ultra compact form factor, the Norbit system features an integrated INS and Sound Velocity sensors—eliminating the need to install separate devices while greatly reducing calibration and offset measurements. The EchoBoat-RCV is Seafloor Systems' multi-payload, remotely controlled survey platform, which features portability, improved thrust, and large payload capacity.

www.seafloorsystems.com

Seafloor Systmes

Rapp Marine Wins China Deal

Rapp Marine was chosen as the supplier of equipment packages for two new oceanographic research vessels for the Guangzhou Marine Geological Survey, GMGS, and Polar Research Institute of China, PRIC. The deliveries are developed in Bodø, where most of the detail engineering will also take place, with production from the company's new factory in Serbia.

Rapp Marine is currently delivering systems for eight similar vessels.

The RV

Guangzhou Marine Geological Survey

Rapp Marine

(GMGS) ordered an oceanographic research vessel to engage in surveillance, research and advisory services. Onboard are laboratories and workstations used to collect the data that is analyzed by researchers and scientific advisors. GMGS employs a staff of 800 people, and it partners with other research institutes, both nationally and internationally, including projects with USA, Germany and Russia.

The Icebreaker

Polar Research Institute of China (PRIC) ordered an icebreaker that is 122.5m overall, significant as it will be the first ice-breaker to be built in China. PRIC is also the only organization in China that has specialized in polar expeditions. Today it operates the Xue Long, a vessel that will work together with the new ice-breaker to supply and assist researchers at the Antarctic Zhongshan Station. PRIC has 124 employees, 41 are research staff, 34 are the maritime crew.

Teledyne BlueView Partners with Measutronics

Teledyne BlueView has selected Measutronics Corporation as a strategic marine partner for distribution in the Americas, adding expertise in marine positioning, guidance, mapping and underwater imaging to the Teledyne Marine portfolio. "We've been watching the evolution of the BlueView product line since their acquisition by Teledyne a few years back," said Lou Nash, President of Measutronics. "Their ability to provide a complete solution of hardware, user interface and final deliverables has allowed us to offer more advanced solutions to our customers."

Teledyne BlueView noted it has timed the new partnership with Measutronics to introduce BlueView's most recent system offering, MotionScan. MotionScan allows the BV5000 Multibeam Scanning Sonar user to collect motion corrected 3D point clouds from a moving platform.

Ted Germann, Chief Sales & Marketing Executive at Teledyne BlueView, said "We're excited to have the Measutronics organization as part of our team – their technicians bring a wealth of additional experience and industry knowledge to our organization. We'll be relying on their inputs and feedback for future product enhancements and development. In addition, we look to utilize Measutronics' capabilities to provide on-water system demonstrations, as well as class room training, in supporting our customer base."

www.blueview.com

First Subsea Completes Heidelberg Spar Mooring

Deepwater mooring specialist, First Subsea Ltd, has completed the installation of subsea mooring connectors for Anadarko Petroleum Corp's Heidelberg truss spar platform moored in 5,310ft (1,620 m) of water in field development in the Gulf of Mexico. The 23,000-ton spar has been moored by nine Series III Ballgrab ball and taper mooring connectors attached to polyester mooring lines. The connector's male mandrels are manufactured in compliance with American Bureau of Shipping (ABS) 2009 Approval for specialist subsea mooring connectors.

First Subsea

www.firstsubsea.com

DOF Wins IMR, Subsea Installation Work

DOF and DOF Subsea have been awarded several IMR and subsea installation

Seatronics, Inuktun Enter Robotics Collaboration

Seatronics is collaborating with Inuktun Services Ltd. to supply the Inuktun ROV Manipulator as a standardized option for the Seatronics Predator ROV Elite System. The Elite System was established and manufactured by Seatronics as a Bomb Squad Capable Improvized Explosive Device (IED) ROV specifically designed to operate within the military and defense industry. The Inuktun ROV Manipulator is a compact and powerful addition to the Predator Elite System with flexible interchangeable jaw sets and pressure compensated housing.

www.seatronics-group.com

Seatronics

DOF Group

contracts in the Asia Pacific and Atlantic regions, with a total contract value of about $23.8 million. The contracts will secure utilization of the subsea project fleet in the regions. In Asia Pacific, OMV New Zealand has awarded DOF Subsea an IMR contract, where the scope of work includes inspection and work on eight mooring lines on the Maari field's FPSO, Raroa, offshore New Zealand. The offshore phase of the project will be carried out during 1the first half of 2016, and the vessel Skandi Hercules will be utilized under the contract.

Forum AMC Awarded Contracts for Bucking Unit

Forum Energy Technologies, Inc. (FET) said that its AMC Engineering product line has been awarded multimillion dollars worth of significant new orders within one month. The multiple orders are for the manufacture and supply of its fully rotational torque (RT) bucking unit with the first delivery scheduled for the first quarter of 2016. They have been purchased by three of the largest multinational oil service companies and will enable improved and increased tool make up capabilities at locations in the Middle East, South America and Caspian regions.

The RT bucking machine (RT) is a self-contained, free-standing hydraulically powered unit designed for fast and accurate make up and break out of premium and regular threaded connections for tubular equipment up to a maximum torque of 200,000 foot-pounds (ft. lbs.). Forum also announced that from January, 2016, the manufacture of the company's PQuip Mud Bucket product will be transferred to the Forum AMC facility. This joins the Tautwire product line that was moved to the Aberdeen location earlier in 2015.

Alaska Awards Fugro for Ice Management

Alaska Governor Bill Walker announced Fugro as winner of the 2015 Governor's North Star Award for International Excellence in the category of scientific exchange. The accolade follows the 'Spotlight on Arctic Technology' award announced during the annual Arctic Technology Conference last year. Fugro was honored for its development of an airborne sea-ice management capability that enables ice thickness mapping, characterization and monitoring over large geographic areas. Utilizing a unique radar mapping system known as GeoSAR, the ice management capability is designed to reduce risk in Arctic operations. Fugro's Alaska Division Manager Rada Khadjinova accepted the award, saying, "It is an honor to be recognized by Governor Walker for this important work. This is truly an Alaska-born discovery, made during our early work on the Alaska Statewide Digital Mapping Initiative (SDMI), and now being utilized in other Arctic regions." Originally designed as a regional-scale topographic mapping solution, Fugro deployed the GeoSAR system to Alaska in 2010 to help update the state's baseline mapping data. It was during this project that Fugro realized the depths to which its GeoSAR system could penetrate snow and ice. Efforts to exploit this capability began in 2012 and have continued every summer since then. In 2016, Fugro anticipates bringing the capability into commercial operations.

James Fisher Subsea Excavation Expands

Three key appointments have been made to the business development team at mass flow excavation (MFE) provider James Fisher Subsea Excavation. The company welcomes business development manager Jorge Anez and business development executives Steve Kaub and Stuart Porteous to build its presence worldwide. Anez has an in-depth knowledge of Latin America and its business culture, having previously held similar roles in the marine trenching sector where he has a track record of increasing revenues and client portfolios. He said: "It's an exciting and challenging time in the South American market and I'm looking forward to promoting James Fisher Subsea Excavation's proven capabilities as a leading operator in the field of subsea excavation."

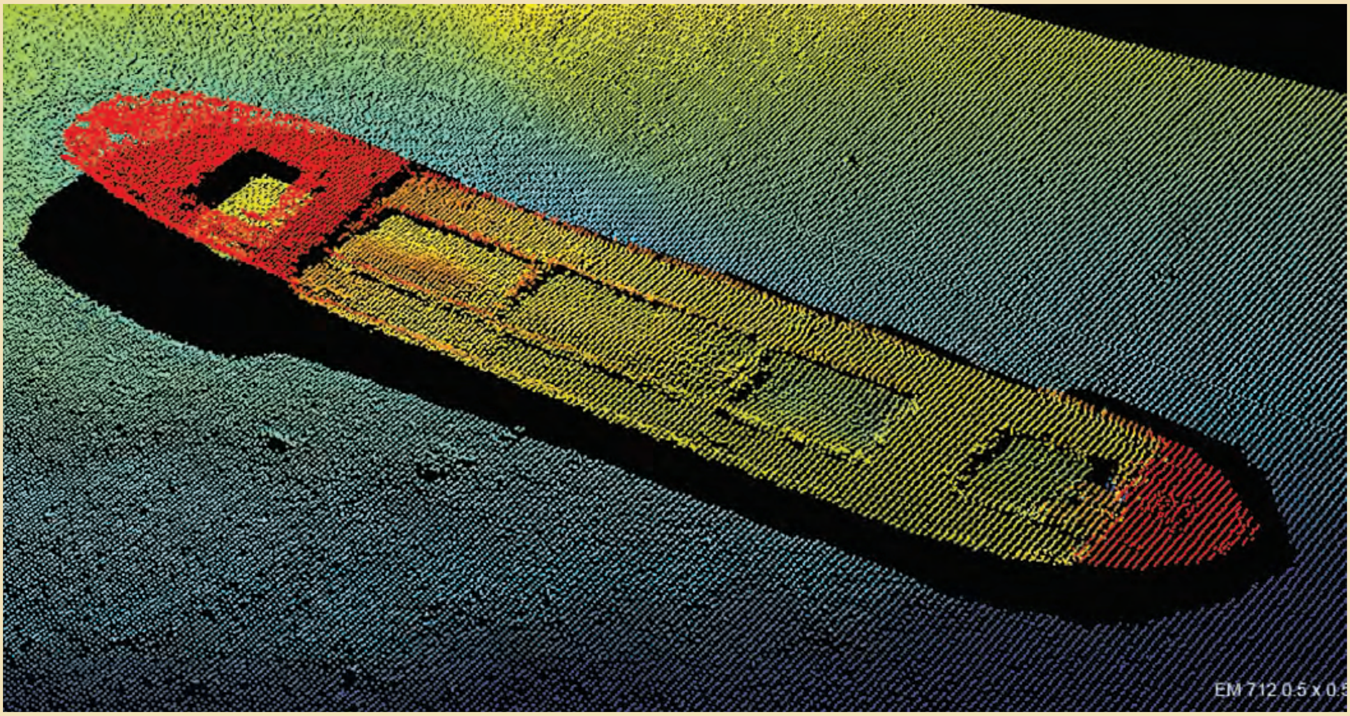
Porteous will be targeting new opportunities for the company in the UK, Europe and West Africa and has experience across a range of disciplines in the energy industry. Kaub has a strong understanding of subsea excavation having been involved in diverse roles within the industry will be developing client relationships in U.S.

Anez

New Shallow-Medium Depth Multibeam Echo Sounder

Kongsberg Maritime introduced a new multibeam echo sounder designed for survey and inspection operations in shallow and medium water depths. The new Kongsberg EM 712 multibeam echo sounder is the second generation of wideband multibeam for these water depths. The EM 712 supersedes the EM 710, which is well established for shallow to medium surveys. All users of the EM 710 will be offered an upgrade path, making it easy to integrate the EM 712 into their operations. One of the key benefits that the re-engineered system introduces is increased range performance, which is close to double that of the EM 710, resulting in a maximum range of 3600m and a swath coverage of close to 4000m. Ensuring that the EM 712 can support the same wide range of applications as the system it replaces, it is offered in multiple versions, including a 0.25 x 0.5 degree system for the best range and resolution and a smaller, portable 2 x 2 degree system ideal for use on vessels of opportunity. All models are available as full versions for maximum range performance, or as a shallow range version without FM chirp enabled. Kongsberg Maritime has also developed an 'entry level' model, with reduced depth performance.

www.km.kongsberg.com

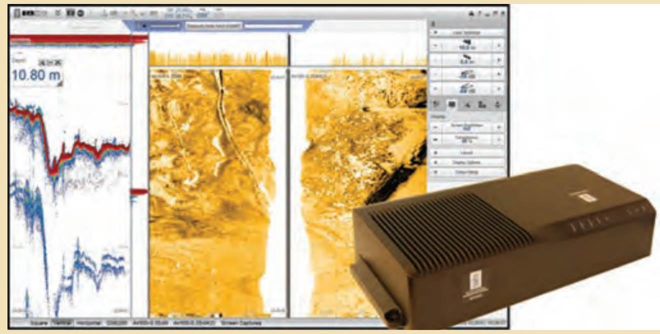


EDITORIAL CALENDAR

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

MTR Special Reports: Unmanned Marine & Subsea Vehicles November 2016 Bonus Electronic Edition
Publication Date: November 7, 2016

Kongsberg Singlebeam Echo Sounder



Kongsberg Maritime released its fifth generation of single-beam echo sounder designed for shallow to medium depth waters and for hull mounted side scan systems. The new EA 440 supersedes the established EA 400 single beam platform with the addition of a new Wideband Transceiver (WBT), which provides for much more flexible installation and operation. All users of the EA 400 will be offered an upgrade path to this new enhanced version.

The new WBT unit in the EA 440 covers all frequencies and comes with a complete new topside software with a number of new and improved features. The system now uses FM Chirp as the transmit pulse, which offers longer range from less power, resulting in a much higher range resolution.

The EA 440 hardware is designed for using up to four channels at the same time in a small and ruggedized transceiver unit, which makes for easier and more flexible installation. The WBT can be set up to use any frequency between 30 kHz and 500 kHz, which means it can be connected to any transducers on the market.

www.km.kongsberg.com

Rowe Releases The SeaSEVEN

RoweTech presents its new innovation in ADCP's, the SeaSEVEN, a Research Grade Doppler Profiler. According to the company this is the first coordinated seven-beam profiler on the market, and it is designed with maximum performance and flexibility for advanced research, featuring: dual frequency, high ping rate/resolution/accuracy, and long range performance with ultimate controllability. To best serve today's data-rich environment, the SeaSEVEN features a high capacity data recorder, multi-mission capability, external sensor integration and ultra-fast Ethernet data download. It also offers a low aperture splayed beam array and modern electronics. The SeaSEVEN is designed to solve difficult application requirements. Data can be used in turbulence, waves, sediment transport, renewable energy, Reynold's Stress and Bottom Boundary layer research.

www.rowetechinc.com

Image: Global Marine Systems Limited

Augmented Reality App

Global Marine Systems Limited GMSL APP brings Global Marine's images to 3D life. The technology shows digital information, in this case 3D models, overlaying static images in real-time via the camera view of either a smartphone or tablet. Users can take a 3D tour of installation vessel C.S. Sovereign or the Q1000 ROV – key assets for Global Marine in the power market. Alternatively, switch to X-Ray View to read more information about each key feature of the two by pressing the hotspots shown in the 3D image. The app is available for free download from the App Store or Google play by searching 'GMSL'.

www.globalmarinesystems.com

Flat Cables for Sub-Zero Temperatures

Rated for operational temperatures as low as -65°C, Cicoil's flexible flat cables have been designed to provide non-stop reliability in Punishing Weather, Polar Climates, Cryogenic Equipment and Space Applications. The deep freeze resistant Flexx-Sil Rubber Jacket needs no external conduit for protection, retains flexibility and will not deform, crack or wear due to long-term exposure to intense cold temperatures. In addition, the ultra-durable jacketing material is "self-healing" from small punctures and cable jacket damage can easily be repaired in the field. Cicoil's Flexx-Sil rubber jacketed cables are unaffected when exposed to ice, snow, sea ice, vibration, salt water submersion, permafrost, physical shock, operational stress, high levels of UV rays & ozone, de-icing fluids, most chemicals and even high heat (+260C) too. Cicoil's Arctic Grade Cables are UL Recognized, CE Conforming, RoHS & REACH Compliant and are manufactured in an automated, climate controlled environment. In addition, the cables are 100% contaminant-free and exceed the outgassing requirements of ASTM E-595.

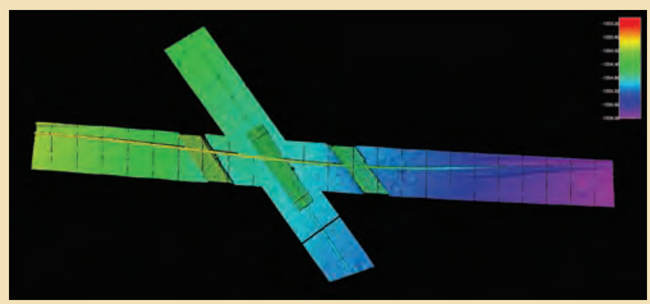
www.cicoil.com

Palfinger Package for Kreuz Subsea's New RV

Palfinger Marine won the contract to deliver lifesaving equipment and a winch package for Kreuz Subsea's newbuild vessel, a Vard 317 design. The vessel for the Singapore-based integrated offshore subsea service provider Kreuz Subsea is designed and constructed by Vard. The DP2 class vessel, with a total length of 91.2 meters a beam of 21.5 meters, is prepared for remote operating vehicles (ROVs) and will be used to for diving support and subsea construction duties. Palfinger Marine's newly acquired Norwegian Deck Machinery (NDM), is to supply the winch package, including two combined windlass/mooring winches, two chain stoppers, two capstans, four 60-ton mooring winches (four-point mooring system) inclusive bridge mounted remote control system as well as two HPUs.

www.palfinger.com

Image: Palfinger Marine



2G Robotics Delivers to Oceaneering

2G Robotics delivered two deep-rated ULS-500 subsea laser systems to Oceaneering Survey Services (C&C Technologies), a provider of deepwater seafloor mapping services, subsea surveys and satellite positioning. Including these two ULS-500 systems, Oceaneering now uses six of the ULS-500 systems with its AUVs as part of its advanced survey and inspection services for assessing pipeline and flowline integrity. Oceaneering has been using the ULS-500 since 2013 to perform dynamic flowline and pipeline inspections with its AUVs. The ULS-500 can be used to perform high-quality stationary scans, but the system delivers even greater operational value when integrated with subsea vehicles to perform dynamic scanning. The ULS-500 is specifically designed for dynamic scanning with development focused on subsea vehicle integration, high sample rates, and timing synchronization for efficient and accurate data acquisition.

www.2grobotics.com

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