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MARITIME REPORTER AND ENGINEERING NEWS

SINCE 1939

May 2019

IMO 2020 & the

EXHAUST 'SNIFFERS'

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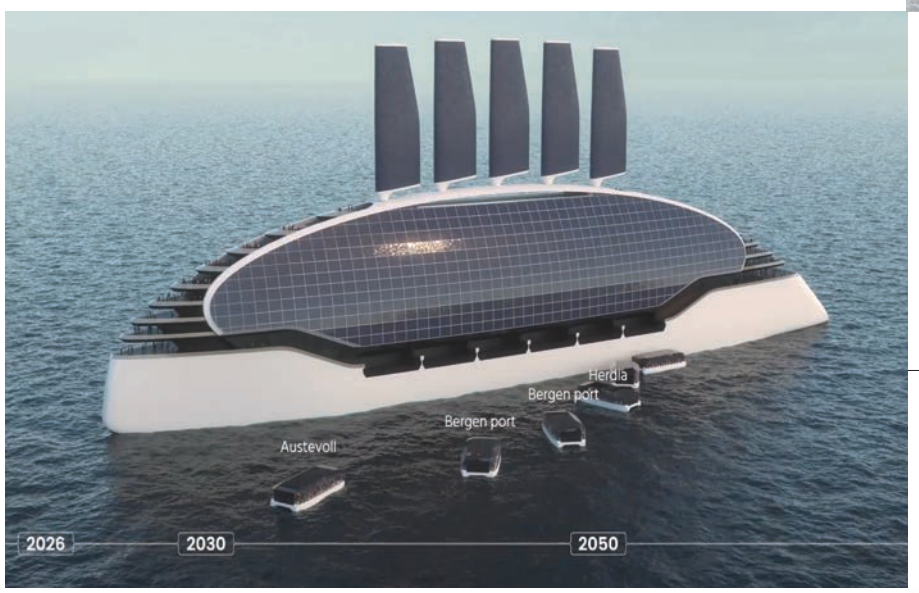

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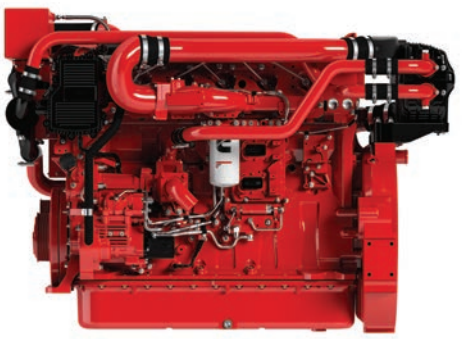

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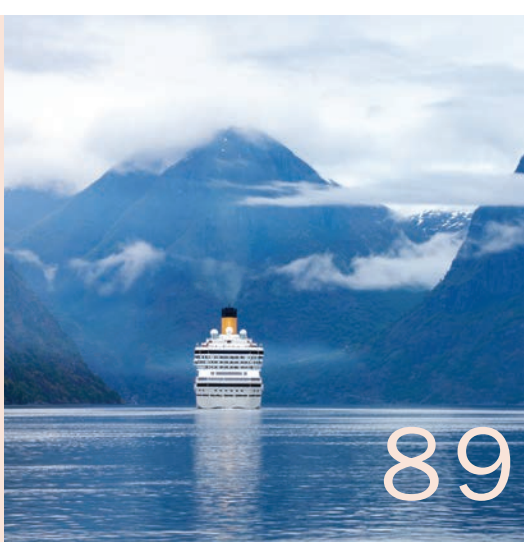

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Editorial

John E. O'Malley: 1930-2019

The drive for January 1, 2020 and meeting the new IMO2020 fuel rules has been, in a word, manic. I've covered many new regulations in my 27 years in this job, and never before have I seen so much confusion and uncertainty in the market. (OK, to be fair, the Ballast Water Technology rules and systems caused its own considerable ruckus, but to be fair having seen it drag on for more than 15 years, the time lost effectively dulled my senses!).

There remains real and justifiable concern that when the clock strikes midnight on 2019, there will be problems, big problems in efficient operation of ships globally. I am the polar opposite of a gloom-and-doom' sort, but the rapidity of this rule from announcement to implementation is unprecedented. In regards to fuel, the availability, quality and most importantly, price of a ship's fuel to meet the new regulation is foggy at best. In the end, the optimist in me suggests that problems will arise, solutions will be offered and vessels will keep schedules traversing the world's shipping lanes. The big question: ***At what cost?*** From this seat no one seems to have an exact answer, and if you do, please call.

This month's 'Green Marine' coverage focuses on a myriad of connected issues to this main theme. Norway, soon to host the year's biggest maritime event in the form of NorShipping 2019, has never been one to shy from aggressively pushing environmental mandate. So while everyone gnashes their teeth looking at 2020, consider that Norway has set a January 1, 2026 deadline for *"Zero Emission Fjord Cruising,"* as William Stoichevski reports starting on page 40. As with any new emission rule, this will require an ample quantity of research and investment, bringing new thinking, new solutions to the maritime space. Looking closer in at the IMO2020 fuel rule, Stoichevski delivers another insightful article starting on page 28 discussing how Norwegian authorities are amassing a fleet of flying drones to efficiently hover over and sample arriving ship's stacks – emission sniffers you can call them – to ensure that each and everyone is in compliance with the new emission rules. The 'Green' coverage is rounded out with Peter Pospeich's report, starting on page 32, from Germany where boxship major Hapag Lloyd is embarking on a world-first, the conversion of a 15,000 TEU containership to methane fuel.

RIP: John E. O'Malley

Last month **John Edward O'Malley** passed away at the age of 88 at his home in Glen Head, NY. Born in 1930, O'Malley was the son of John J. O'Malley, founder of Maritime Activity Reports in 1939. He proudly served in the U.S. Navy during the Korean War, which is where he discovered his passion for flying. An avid pilot throughout his life, he could often be found at the Bayport, NY Aerodrome preparing his PT-26 WWII army trainer for a flight. When not barnstorming over Long Island John enjoyed horseback riding and classic cars. On March 6, 1952 John joined the publishing firm his father founded in New York City, where he rose to the position of Publisher of *Maritime Reporter & Engineering News*, leading the firm and growing the publication to become the world's largest circulation magazine serving the global maritime Industry. During his career he was an outspoken and tireless supporter of the American maritime industry and for decades he was a member of The Society of Naval Architects and Marine Engineers.

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INFRASTRUCTURE '101' Part II

"… U.S. Infrastructure Needs More Impactful Money, Not Just More of It." – Fitch Ratings' Cherian George.

It wasn't too long ago – okay it was at least three Marad Administrators ago – that a Marad staffer confided in me about a U.S. DOT meeting that he had attended; one which was supposed to give government personnel a sense of the progress that DOT was making when it came to developing the nation's infrastructure. One by one, the modes were discussed and benchmarked; rail, trucking and air. Notably absent from the discussion was the waterfront. Our staffer had the temerity to raise his hand and ask why. This was reportedly not well received.

A number of years later, I attended a logistics conference in Hong Kong, where, after I had recovered from the trauma of a 16.5 hour flight (they are still buffing my fingernail marks from the inside of the fuselage), I attended a panel session on logistics. The Canadian delegation gave an excellent talk. One by one, they got up in sequence – representatives from trucking, marine terminals, rail, port executives, etc. – and every one of them said the exact same thing: any transport mode is only as good as the one that immediately follows or precedes it the supply chain.

Progress

It isn't all bad news here in America. In fact, closer to home, and when it comes to domestic infrastructure, the hits (lately) just keep on comin.' Last year, and after more than 30 years, the ribbon cutting to officially open the Olmsted Locks and Dam took place on August 30. Sure, it came with cost overruns that would make even the most experienced Washington politician blush, but at the same time, and in many ways, the Olmsted project was remarkable; arguably the civil engineering equivalent to the Manhattan project.

The Corps estimates that Olmsted will produce average annual national economic benefits of more than $640 million. Operation and maintenance costs will be reduced. New locks mean fewer delays. Olmsted's two 1200 x 110-foot locks will eliminate transit double-locking. Whatever it cost, that was money well spent.

Fast forward to a few weeks ago, and *the Trump Administration, in concert with Senate Democrats, agreed that they would spend $2 trillion on roads, bridges, water, broadband and power grids.* How they will pay for that is less clear, and the course line to reconciling legislation to make it all possible will no doubt be choppy. Maybe it is best that we don't watch them stuff the sausage casing. On the other hand, someone has to.

Separately, and no less important, Washington, DC-based CG/LA Infrastructure Inc. released its list of Top 50 strategic projects. Among these important tasks, thankfully, were maritime projects such as the Soo Locks Upgrade, the Corpus Christi Channel Improvement project, a Rail Support Facility at the Port of Long Beach, California and the Calcasieu Ship Channel project at Port of Lake Charles, Louisiana. In total, the four projects totaled about $3.2 billion in spend.

That Top 50 Strategic U.S. Infrastructure Projects Report will be presented at CG/LA's Blueprint 2025 2X Leadership Forum. That the waterfront was mentioned in just 4 of 50 projects is disappointing, and, that this combined cost is a mere drop in the bucket in comparison of what is proposed ($286+ billion) for other modes of transport and infrastructure, is even more depressing.

According to CG/LA, the U.S. infrastructure industry is at a moment of transition, and President Trump is again talking infrastructure with Capitol Hill, tabling a $2 trillion investment number. Norman Anderson, CEO & Chairman of CG/LA Infrastructure, says, "Following years of underinvestment one of the report's key conclusions is that we have a massive opportunity to leapfrog into the future." I couldn't agree more. On the other hand, where we (might) differ is where and on what that money is spent.

Real Progress

The recent U.S. Department of Transportation's Maritime Administration (MARAD) decision to award $6,790,000 in grants to three Marine Highway projects is a sign that the federal government finally understands where infrastructure money should be spent – and more importantly, why. The funding, provided by MARAD's Marine Highway Program, will ultimately enhance existing shortsea services in Louisiana and Virginia, and support the development of a new project in New York. Maritime Administrator Mark Buzby said it best, perhaps, when he explained, "America's Marine Highway Program is dedicated to expanding freight movement on the water and this round of grant funding will go a long way towards ensuring that our nation's waterways continue to be utilized as effectively as possible." In other words, it isn't necessary that you sit in traffic behind scores of 53' trailer trucks on long haul assignments, when that cargo can be on the water, utilizing only drayage for that "last mile" delivery.

Notably, the Harbor Harvest Long Island Sound Service was awarded $1,812,285. Shortsea shipping subject matter expert Bob Kunkel's dream of providing a greener and more efficient transport service for Long Island Sound farmers and their eager customers is the perfect manifestation of this type of federal assistance. And, we need more of this. In a nutshell, the project, also sponsored by the Connecticut Port Authority, involves the development of the Harbor Harvest "Farm-to-Harbor-to-Market" service. The goal of the service is to provide a viable source of waterborne transportation for Connecticut and Long Island farmers and manufacturers by connecting neighboring communities in addition to creating produce markets in both Connecticut and New York. The service will support a more sustainable and marketable transportation option, drastically reducing highway congestion while moving commodities from more than 3,000 farms.

In addition to expanding the use of Jones Act-supported vessels in the region, the project will also reduce shipping costs and increase economic opportunities. It will also take countless trucks off the road, reduce pollution (Kunkel's first vessel boasts groundbreaking hybrid propulsion), and make the morning commute just a little easier for local residents. The so-called Baton Rouge – New Orleans Shuttle on the M-55 was awarded $3,155,622. This project, sponsored by the Port of New Orleans, will support the Ports of Baton Rouge and New Orleans Container on Barge Service, allowing them to purchase purpose-built vessels that will increase the viability of the service. As Louisiana's chemical industry continues to grow, the demand for more inland transportation has increased; the barges are essential to increasing the capacity of the shuttle, intermodal efficiency and reducing costs. According to Marad, the existing container on barge service currently moves approximately 16,800 FEUs between Memphis/Baton Rouge and New Orleans, operating twice weekly to deliver export cargo that will be loaded on deep-

draft container ships.

In addition, the James River Expansion Project on the M-64 was awarded $1,822,093 by Marad. Sponsored by James River Barge Lines, the grant funds will be used for the construction of a third barge to expand the existing service in order to accommodate an estimated 27% annual growth on the M-64 corridor. Since its inception in 2008, the 64-Express barge service has seen substantial year-over-year cargo growth, transporting a total of 27,626 containers in fiscal year 2018, an increase of 23% from fiscal year 2017. In case you missed the point, that's 27,626 trucks that you didn't have sit behind in traffic in 2018. The addition of a third barge would capitalize on previous Marine Highway Program investments by increasing the number of weekly trips to seven days and carrying an average of 170 containers per trip.

(Hopefully) More Progress to Come

The reality is that regardless of what happens with the economy – long or short term – the shipment of freight in North America will explode over the next three decades. It's not that there isn't enough cargo to go around for all the freight modes; instead, there's too much. Our Canadian friends have it right. They all know that they need each other. The truckers (apparently) aren't worried about losing market share to rail, who isn't worried about losing market share to the waterfront, etc. What they are worried about is just how much freight they can win from U.S. West Coast ports in a post-Panama Canal expansion era, with their on-dock rail connections to a very fast class one railway heading east. That's how you run a supply chain.

In North America, the trucking crisis is just around the corner. Stakeholders predict a nationwide shortage of as many as 50,000 drivers within ten years. The reasons for that are many, but one way to attack the problem is to let these professionals go home at night. In an intermodal equation that only employs drayage as the link that makes that final mile delivery, trucking outfits can handle multiple deliveries daily with one local driver, who, at the end of his shift, can go home and see his (or her) son's little league game. Before that can happen, however, the ports and inland waterways have to be made ready to make that final handoff a seamless one.

Last month's Marad shortsea shipping grants are a very good start. So, too, is talk of $2 trillion in infrastructure funding on the Hill. But, we have to get it right, and we need to get our priorities in order. To that end, Fitch's Cherian George insists, "This is a job for independent, non-partisan infrastructure commissions with experts, not a job for politicians. Elected officials need to accept that fact and that for this to work, accepting the commission's recommendations should be treated as mandatory not optional." Let's hope that vision becomes our reality.

Dennis L. Bryant
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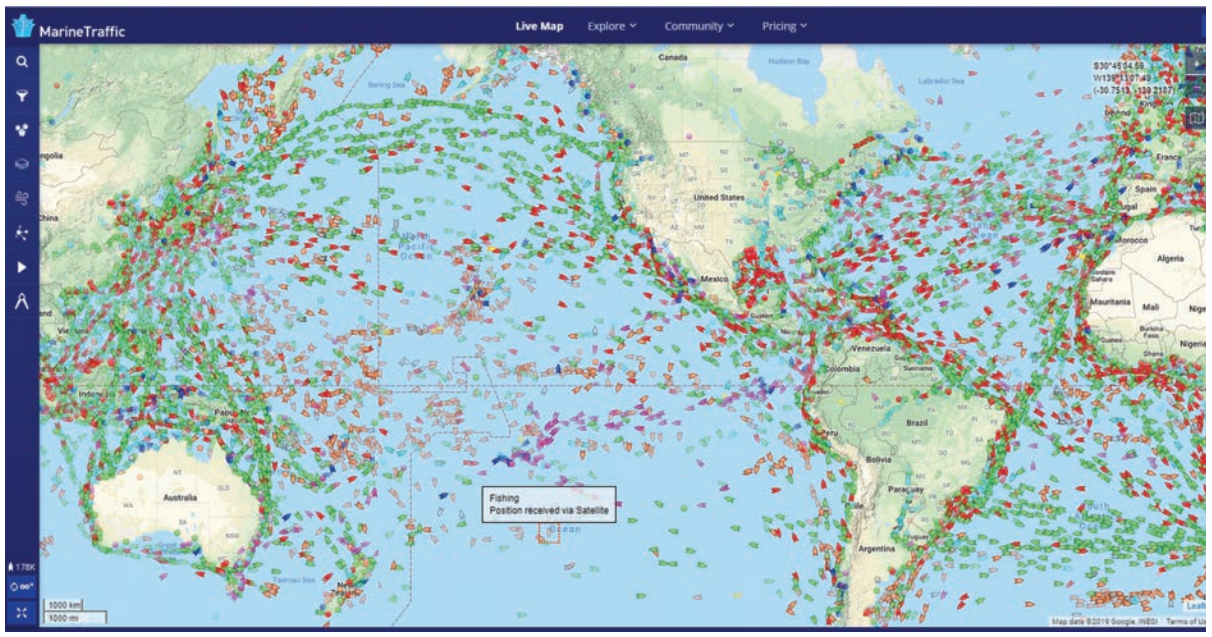
AIS Data

The Automatic Identification System (AIS) was developed with the sole goal of improving maritime safety by allowing ships in proximity to one another to automatically exchange information regarding their name, course, speed, type, cargo, etc. The exchange of this information would allow conning officers on each ship to make better decisions regarding the possibility of close encounters and the need to change course and/or speed. It would also make it easier for one ship to contact the other by radio-telephone to hopefully remove any doubt. To that extent, AIS has largely worked as intended, although collisions continue to occur.

It did not take long, though, for governments to get involved. They started installing shore-based receivers to monitor AIS transmissions from approaching ships, out to a point just beyond the horizon. Those governments could also monitor ships in harbors and transiting off the coast or on inland waterways. The United States incorporated this data into its maritime security or maritime domain awareness programs. Governments also utilize the data to analyze marine casualties and to determine waterway usage. A large amount of AIS data is collected by governments around the world, which share much of that data amongst themselves. There are also commercial companies that collect AIS data, including several that utilize satellites to collect this data from ships on the high seas outside the range of land-based AIS receivers.

Governments are now using AIS in an innovative manner by creating virtual aids-to-navigation that provide an AIS signal to mark hazards to navigation in locations where a physical aid-to-navigation does not exist. The virtual aid appears on the electronic chart display and information system (ECDIS) of ships within range and they know (or should know) to avoid the location. By combining AIS data with other information, such as photos from surveillance aircraft or satellites, correlations can be made between individual vessels and pollution incidents. Use of AIS data from commercial services can allow traders and others to track vessels (and their cargoes) worldwide, making it difficult for vessels to arrive unexpectedly and influence a market.

As we learned in a recent report of the U.S. Committee on the Marine Transportation System (CMTS), three federal agencies generate terrestrial AIS-derived



Source: MarineTraffic.com

information. The U.S. Coast Guard focuses primarily on coastal areas, ports, and harbors. The U.S. Army Corps of Engineers (USACE) focuses on AIS products for inland waterways. The Saint Lawrence Seaway Development Corporation (SLSDC) focuses on the St. Lawrence Seaway and associated waters.

Numerous other federal agencies utilize AIS data in furtherance of their missions. The National Oceanic and Atmospheric Administration (NOAA) utilizes AIS data to monitor and analyze fishing activity; improve marine mammal protection; and prioritize charting and surveying based on measured traffic volumes. The Bureau of Ocean Energy Management (BOEM) uses AIS data to support its marine planning needs associated with offshore energy development.

The Maritime Safety and Security Information System (MSSIS) is a government-to-government data sharing network operated by the Department of Transportation. It combines AIS data from 74 participating nations into a single raw-AIS data stream that collects over 150 million vessel position reports per day from approximately 60,000 vessels. The combined data is available in several different formats to participating governments and federal agencies.

NOAA and BOEM jointly manage MarineCadastre.gov, a Geographic Information System (GIS)-based marine data viewer and repository that provides decision support tools for siting of offshore energy development, aquaculture, and other activities.

Because AIS data is stored on the Electronic Chart Display and Information System (ECIS) devices carried on most vessels engaged in international commerce, it has become the go-to location for marine casualty investigators and, in the event of litigation, for legal counsel.

Almost every marine casualty report published by flag state or port state includes AIS data and an analysis of the movements of all vessels involved in the casualty based on that data. Interviews of crew members are still important, but actual ship movements as recorded in the AIS data tends to be the dominating factor in the analysis – and always prevails in the event of conflicts between different sources of information. The AIS data does not reveal why particular actions were taken, but it is almost always given full weight in determining what actions were.

AIS has expanded far beyond its original purpose and it is hard to imagine maritime operations in today's complex environment without it. It is not, though, a panacea. The Automatic Identification System is clearly an important tool, but must continue to be used with caution, recognizing its inherent limits, as well as future possibilities, including the increased prevalence of automated ships.

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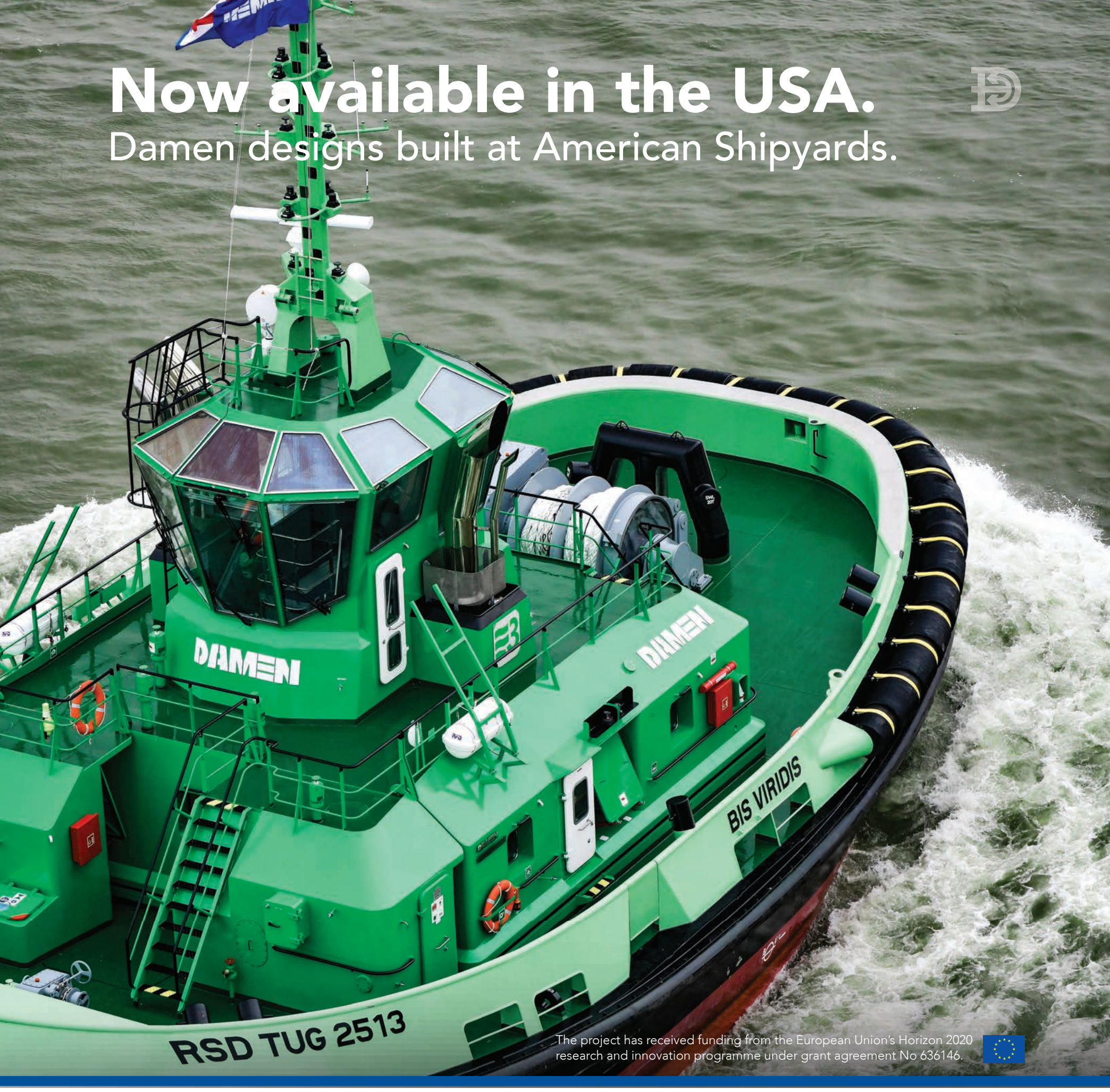

The project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 636146.

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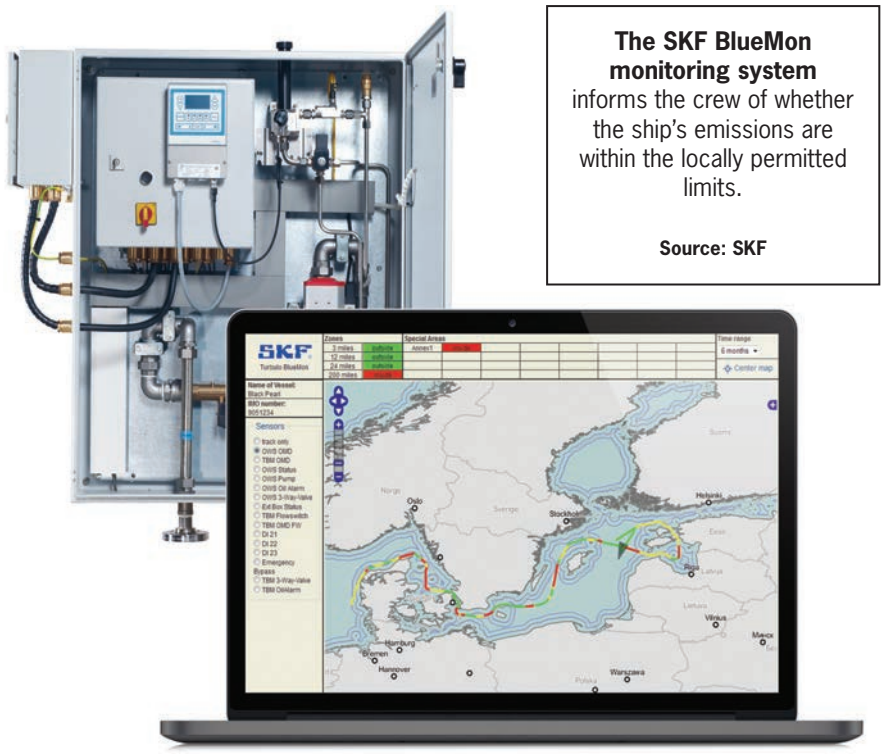
Mathias Rusch
Mathias Rusch, Director of the Marine business unit at SKF explains what trends are currently shaping the industry, what future challenges are emerging and how operators can manage the flood of data that is coming out of the digitalization revolution.

Managing the digital data flood

Two major trends that shipowners and operators are currently dealing with are persistently low freight rates, which have been significantly depressing shipowners' earnings for a number of years and the requirements concerning emissions into both air and water that continue to grow. With new regulations introduced to reduce such emissions, ship operators must perform expensive retrofits to their fleets, increasing competitive pressure and ship operator running costs.

Minimizing operating costs is the order of the day. To achieve this, the industry has been seeing consolidations among shipowners and ship operators for a number of years. Although this has allowed costs to be reduced, it has also increased the pressure on smaller ship operators. While such consolidations have helped reduce costs in some areas, operating a fleet of ships is primarily about availability, service, spare parts and finding the right time to replace them. With this in mind, SKF has been working with ship owners and operators, both large and small, to make this process smooth and cost-efficient.



The SKF BlueMon monitoring system informs the crew of whether the ship's emissions are within the locally permitted limits.

Source: SKF

The SKF approach

SKF has supported customers with fleet contracts to help improve their planning security with regard to the availability of spare parts. In addition to this, SKF condition monitoring and condition-based maintenance solutions have been used to great effect. SKF has developed resource-saving products such as Simplex BlueRun, SKF EcoMode and SKF Dynamic Stabilizer Cover, which are intended to reduce ship fuel consumption and make their operation more environmentally friendly. In addition, SKF's BlueMon monitoring system informs the crew if the ship's emissions are within the permitted limits per its locale. This also provides the crew with certainty during inspections, because the system continually tracks the ship's position and time, the emissions values it has had and whether countermeasures were taken when limits were exceeded.

Digitalization

At SMM 2018, the show's tagline was 'SMMart Shipping'. This reflected one of the most potentially game-changing trends that is beginning to gain traction within the industry - digitalization. At present cruise ship operators are leading the way and they are exchanging a large number of operating parameters with central control rooms. One example of this is the Costa Group's Fleet Operation Center (FOC), which has been running since 2015. Data from different ships is pooled centrally in the FOC. Digitalization has, indeed, already taken a big step here, but other commercial owners of container ships, tankers or general cargo vessels have also done a lot in moving towards digitalization and condition monitoring. For the majority, however, the topic is still in its infancy.

Although digitalization in ship operations is only just beginning to really get off the ground, it has the potential to provide a range of advantages to ship owners and operators. For example, condition monitoring solutions and digitalization can enable the remaining service life of components to be more accurately determined. This, in turn, allows for the prompt planning of servicing and avoids machine failures.

The trend in digitalization is towards cloud solutions, which connect ships and onshore offices together and make a fast and straightforward exchange of data possible. As a result of this, the crew on board no longer has to make decisions alone, but can draw on the help of experts onshore. In addition, the operating parameters of sister ships are already being compared in order to identify increased fuel consumption, for example, and to define corrective measures. Depending on the data transmission rates that are possible, this can already be done in real-time. Intelligent systems such as the SKF EcoMode software can also help the crew to make the right decisions based on extensive and timely data evaluation.

The digital data flood

Thanks to falling costs for sensor systems, an enormous number of operating parameters can be monitored and large volumes of data generated. This however means that operators are suddenly having to process a flood of digital information and draw the right conclusions from it.

To help overcome such challenges,

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The new EcoMode software optimizes the use of fin stabilizers, helping to improve a ships' energy footprint. The SKF Dynamic Stabilizer Cover (for the aerodynamically advantageous covering of the stabilizer 'parking bay' in the hull) also contributes to this.

Source: SKF

SKF has developed targeted assistance via simple dashboards. These have been achieved by defining what the end user actually wants to know and for what benefit, to be able to both prepare the data on board and then to evaluate it onshore. However, a great deal of expertise in the areas of data analysis and guidance is required if the benefits of digitalization are to be maximized moving forwards. The challenge for ship owners and operators will be whether to build this up internally, or turn to specialized service providers.

The future of shipping

Digitalization's progression will mean that job profiles within the maritime industry are set to change and internet connections will need to continue to become more stable. Alongside the established providers, start-ups will also increasingly push into the maritime market with new, innovative ideas. Today, for example, increasing numbers of drones and unmanned aircraft are being used for inspection tasks.

Although autonomous shipping is often discussed, operating a completely unmanned ship is still a long way off. However, the number of crew members who travel with the ship will continue to fall and there will be ever more onshore control centers. This is because even today it is becoming more difficult for operators to find trained crew, and this is where digitalization can help, too. Ship operations will become significantly simplified, supported or even taken over by remote control technologies and digitalization will help enormously in intelligently analyzing information from on board and providing instruction.

3D printing & repairs

The 3D printing of spare parts will also have a greater influence in the years ahead and will entail a great deal of change. In fact, a number of companies are already looking at how spare parts can be manufactured on-site using this method, depending on the spare part, different raw materials are required for printing. With this in mind, there will need to be central locations for 3D printing around the world. For example, 3D printers located in a repair port such as Singapore, which, upon request, would produce spare parts for ships due to call at the port. With this type of technology to hand, all of the spare part strategies that manufacturers and ship operators use today will be replaced – maybe not in the next five years, but in the not too distant future.

For SKF, its no longer a matter of pursuing the optimization of a seal or bearing in shipping applications, but at looking at the system as a whole. Alongside

bearings, seals and lubrication systems, the team is working on enhanced components for condition monitoring, in order to facilitate on-board operations, the monitoring of systems and emissions and to support the crew.

These are exciting times and with so many challenges and opportunities being faced by ship owners and operators.

The trend in digital condition monitoring solutions is towards cloud solutions, which connect ships and onshore offices with one another. As a result of this, the crew on board no longer has to make decisions alone, but can draw on the help of experts onshore.

Source: SKF

Tom Ewing
Tom Ewing is a freelance writer specializing in energy and environmental topics. He has been a regular contributor to MarineLink publications for the past two years. He has extensive experience working on legislative and public policy issues, both at the state and federal levels.

California Dreamin'

IN CALIFORNIA, OFFSHORE WIND HAS UNLIMITED POTENTIAL

When it comes to states promoting renewable, non-fossil electricity generation, California surely leads the list, from utility-scale regional grids to individual rooftop solar panels.

In fact, a December 2018 update from the California Energy Commission (CEC) estimates the state may already have exceeded an initial renewable generation goal of 33% by 2020. CEC estimates that in 2018 that generation number was already 34%. You can note (below) that wind accounted for 29% of the almost 100,000 GWh of renewable electric generation in 2018.

None of those 27,838 GWh comes from offshore wind – yet. As in other states, CA's offshore wind is still to come, still on the horizon; or more likely, just over the horizon, keeping wind towers out of sight from CA's postcard shorelines.

It's important to note that unlike some Atlantic coast states, e.g., New York, California has not set a specific demand for offshore wind. In CA, offshore wind will result from merchant projects, not utility policies. But, of course, this is California, with an almost insatiable demand for electricity – especially as electric vehicles are mainstreamed. If you have renewable energy to sell, CA's buying.

CA's offshore wind could be an energy gusher. In 2016 DOE's National Renewable Energy Laboratory (NREL) published a study: "Potential Offshore Wind Energy Areas in California: An Assessment of Locations, Technology, and Costs." One conclusion: CA's offshore wind resource potential "corresponds to about 1.5 times the state's electric energy consumption based on 2014 EIA figures" (italics added, EIA = the US Energy Information Administration). The NREL study is based on six likely Pacific wind energy areas, from Crescent City, in the north, near Oregon, to Port Hueneme, just north of LA.

CA's offshore process started in earnest three years ago when a wind energy company then called Trident Wind – now Castle Wind – submitted an unsolicited request to BOEM (Bureau of Ocean Energy Management) to lease a site in the Pacific near Morro Bay (about half-way between LA and San Francisco).

Castle's filing started a federal-state effort to determine best ways to move forward. Officials from the California Energy Commission teamed up with BOEM to form the California Intergovernmental Renewable Energy Task Force (Task Force) which first met in October 2016.

After Trident's "nomination" – that's BOEM's term for when a company suggests or proposes a project – BOEM issued a request for comments (referred to by BOEM as a "Call") on the merits of the Morro Bay site and to check competitive interests, i.e., to check for "nominations" from other wind energy companies.

Indeed, Equinor responded with interest in Morro Bay – an important signal regarding markets and project viability, not just for CA ratepayers but also for US taxpayers since Uncle Sam collects rent from the leased sites. In September 2018, BOEM received another unsolicited nomination from the Redwood Coast Energy Authority (RCEA) for a possible project in the Humboldt Bay area (near Eureka, CA).

Last October BOEM issued a Call with a broader scope, focusing on three Outer Continental Shelf sites (which were within the NREL study referenced above): the Humboldt Call Area off the north coast and the Morro Bay and Diablo Canyon Call Areas, both off the central coast. These areas cover approximately 1,073 square statute miles (687,823 acres). Comments – and nominations – were due January 28, 2019.

Indeed, there is strong demand for Pacific wind energy areas (WEAs)! BOEM received nominations from 14 companies expressing interest in all three proposed areas.

Concurrent to BOEM's Calls, the BOEM/CA Task Force has been in a developmental mode – meeting with stakeholders, creating a new California Offshore Wind Energy Gateway to facilitate development and documenting and presenting how wind energy could impact coastal, fishing and tribal communities.

This outreach is important. Offshore wind in California is much more difficult than the "average" ocean-based wind project. The Pacific Ocean slopes off more suddenly from the shore compared to the Atlantic coast, getting deep very quickly.

Pacific projects will require wind turbines built within or on floating platforms, cabled to the ocean floor, possibly in waters 800-1000 meters deep. An area with dozens or hundreds of floating platforms becomes a very different seascape, laced with underwater cabling, both for infrastructure stability and power transmission. Some of that submerged cabling infrastructure will extend for miles, from offshore platforms to landside connections.

This demands a close look at marine and maritime impacts. The Pacific Merchant Shipping Association, for example, recommends that BOEM, upfront, eliminate WEAs that overlap with shipping lanes. PMSA Vice President John Berge advises that this would "avoid wasting unnecessary time and resources pursuing projects that conflict with maritime traffic routes."

Floating platforms are not yet in widespread use. However, wind energy companies believe these platforms, in various configurations, are on the cusp of being market ready.

There is one project – called Hywind, built by Equinor – in Scotland using platforms; it's small, just five turbines. Equinor is one of the companies which responded to BOEM's Call. Equinor writes that it will utilize the "competence, lessons learned, and experiences gained from these Hywind projects in the development of larger scale floating projects in California."

Some companies are working together to build an offshore project. In the Humboldt Call Area, for example, the Redwood Coast Energy Authority (RCEA), a consortium of local governments, has been working to develop a wind project since 2017. Humboldt Bay has some of the best Pacific wind resources, although that is offset by challenges with land-based connections.

RCEA selected an energy team that includes Principle Power Inc. (PPI), founded in 2007 in Emeryville, CA. PPI has developed the WindFloat, a floating

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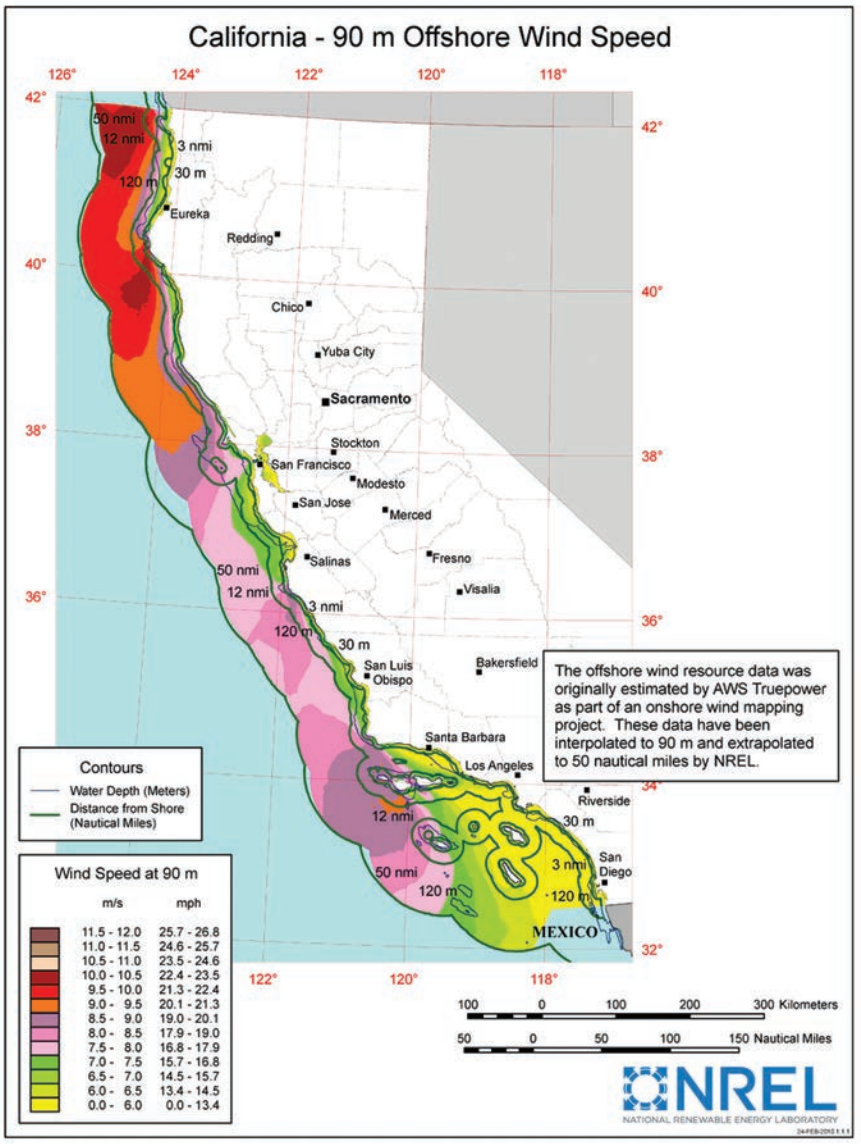

Above:
Ila Weinstein, CEO, Castle Wind, a joint venture with EnBW North America.

Left:
The California offshore 90-m height wind map and wind resource potential estimates are provided. Areas with annual average wind speeds of 7 m/s and greater at 90-m height are generally considered to be suitable for offshore development. The National Renewable Energy Laboratory has produced these estimates of the gross (not reduced by environmental or human use considerations) offshore wind potential expressed in "installed capacity." This is the potential megawatts (MW) of rated capacity that could be installed at offshore areas with mean annual wind speeds of 7 m/s and greater at a 90-m height, assuming 5 MW of installed capacity per square kilometer of water. The offshore wind potential tables PDF present the resource broken down by annual wind speed, water depth, and distance from shore.

Sources: Castle Wind & NREL

foundation for offshore wind turbines, being readied for operation in Europe in 2021. RCEA also selected Aker Solutions, the Norwegian company expert in oil and gas platforms. RCEA's third partner is EDPR, Portugal's largest generator, distributor and electric supplier and the fourth largest operator of wind energy based on net installed capacity in the US.

BOEM and CA Task Force officials were to update their activities since the December Task Force meeting and the close of the comment period, January 28, for BOEM's October Call.

John Romero, a BOEM public affairs officer, said BOEM has reviewed 118 public comments, which cover a range of opinions about offshore wind: strongly supportive, supportive but cautionary, and, of course, some in opposition.

A CA Task Force spokesperson said staff continues to work on "outreach, data collection and working with state and federal agencies." Regarding development of a wind energy supply chain, like in NY and Virginia, the spokesperson said, "it's too early in the process" to focus on that.

The BOEM/Task Force work, of course, is preparatory. In reality, all of this background work positions BOEM to officially start its prescribed wind energy evaluation process. BOEM's next task is "area identification," likely taking about six months, then come decisions about specific areas, taking another 18 months. BOEM anticipates conducting a lease sale in 2020.

Site assessments and surveys and technical reviews, taking 6 – 7 years, would follow a lease sale. Project work could start after that.

Six or seven years, of course, is a long time for a business to have to keep the faith among investors, employees and suppliers that a good idea will – eventually – come to fruition.

John Romero was asked whether his team senses impatience about a schedule that, after three years, is just now at the starting point. Romero concurred that this is not a quick process, but he added that people in energy businesses know that BOEM has to work equitably and transparently among all parties. He said that President Trump's recent Executive Order on regulatory streamlining is causing a fresh look at ways to work faster.

Alla Weinstein is CEO of Castle Wind, a joint venture with EnBW North America. Recall it was Weinstein's WEA lease request, in 2016, that started BOEM's CA activities. Weinstein was asked for her perspective on BOEM's timeline and timeliness.

"We believe BOEM is moving as fast as they can, realizing that the creation of an offshore wind industry in California requires significant time and investment," she said, noting the "unprecedented number of agencies and stakeholders" involved. She pointed out that wind farms will be installed in federal waters, but interconnection and affiliated activities are under state and even local jurisdictions.

Weinstein was asked about alignment between regulatory timelines and private sector challenges regarding financing, project planning and a business plan. "Of course, we'd like for the process to move as quickly as possible," she said. "The sooner we can begin development and truly launch the offshore wind industry, the sooner we can help contribute to California's clean energy mix and begin to bring costs down. Not to mention the local and regional economic benefits that these new projects will drive." She would like to see an auction in early 2020, a date that lines up with BOEM's schedule.

Still a lot of work ahead. But now the focus starts to change: it's no longer whether there should be offshore California wind energy. Rather, it's figuring out the best ways to make it work. Remember, things happen first in California.

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Advancing Digitization

CMA CGM BECOMES THE FIRST OCEAN CARRIER LISTED ON FREIGHTOS. GLOBAL FREIGHT MOVES TOWARDS THE 'ONE-STOP SHOPPING' STANDARD.

By Tom Mulligan

CMA CGM Group and global online freight marketplace company Freightos have established an ambitious pilot agreement whereby CMA CGM has become the first ocean carrier listed on Freightos. Online bookings, guaranteed pricing, and secured capacity on CMA CGM China-US trade lanes are available on the platform, with further extension to additional lanes planned in the near future.

For its part, CMA CGM says that it has reinforced its position as a digital leader within the industry and taken yet another step towards its customer-centric strategy, offering importers and exporters of all sizes direct access to instant pricing, routing, and concrete sailing information in seconds, as well as guaranteed capacity. CMA CGM rates can now be found free of charge on the Freightos website, www.freightos.com.

Real Change for Industry

"This development represents a real change for the industry because, for the first time, global shipping on key trade lanes functions like passenger travel or e-commerce, where customers can obtain guaranteed prices within seconds," said Mathieu Friedberg, Senior Vice President – Commercial Agencies Network at CMA CGM Group. "This initiative demonstrates our commitment to customer centricity. We've been on a journey to provide our customers with innovative offerings to ensure them the best shipping experience. This partnership raises the bar for ourselves, and the

Source: CMA CGM

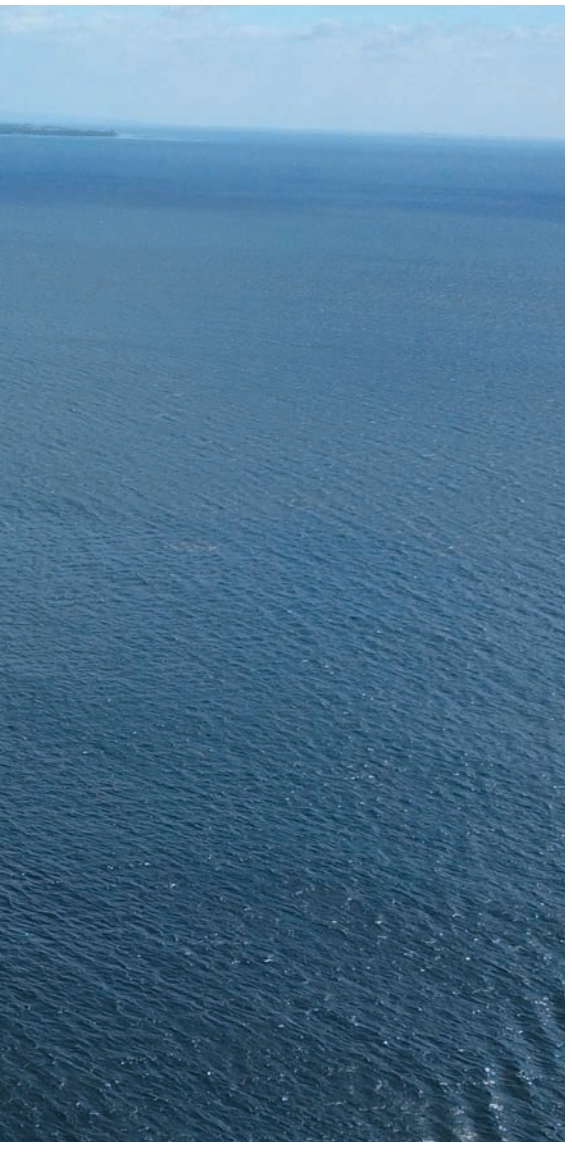
industry, with this important step into the digital era, selling directly to shippers on Freightos."

Zvi Schreiber, CEO and founder of Freightos, added, "This is a true win-win for the industry and a major step toward improving the customer experience. With CMA CGM selling on Freightos, smaller shippers now have direct access to a major carrier with competitive pricing. Additionally, shippers of all sizes will have access to guaranteed prices and capacity. This aligns with our goal to help logistics providers drive more value for customers, enabling smoother global trade, and ensuring more reliable and affordable supply of goods to end consumers."

CMA CGM is a worldwide shipping group with 506 vessels calling at more than 420 ports on five continents and in 2017 the company carried almost 19 million TEUs. The company has a presence in 160 countries and, through its 755 agencies network, the Group employs 34,000 people worldwide, including 2,400 in its headquarters in Marseilles, France.

Freightos' mission is to make global trade frictionless with the world's online marketplace for the trillion dollar international shipping industry. The Freightos Marketplace is designed to help importers and exporters reduce logistics spend and save time with instant comparison, booking and management of air, ocean and land shipments from top logistics providers to book international shipping as smoothly as booking a flight online.

Freightos also provides patent-pending technology that empowers carriers and logistics providers around the world to automate freight sales. With Freightos AcceleRate and Freightos WebCargo power rate management, automated



"FREIGHTOS RESEARCH SHOWS IT TAKES AN AVERAGE OF THREE DAYS FOR A SHIPPER TO RECEIVE A SIMPLE PRICE QUOTE EVEN ON A MAJOR TRADE LANE. **TWENTY-FIVE PERCENT OF CONTAINERS DON'T MAKE IT ON TO THE SHIP YOU EXPECT THEM TO GO ON.** EIGHTY-THREE PERCENT OF SHIPMENTS DON'T HAVE PROPER TRACK AND TRACE VISIBILITY DOOR TO DOOR."

ZVI SCHREIBER,
CEO AND FOUNDER,
FREIGHTOS

pricing and online freight sales are made available for more than 1,000 logistics service providers and carriers, including multi-billion dollar companies such as Panalpina and Nippon Express. Freightos has accumulated the world's largest global database of multimodal freight rates, providing industry transparency with its Freightos Baltic Index.

An 'Expedia' for Freight

Freightos was founded in 2012 by Schreiber, a serial entrepreneur who has sold companies to General Electric, IBM and others. At his previous company, Schreiber shipped regularly from China to the United States and was "shocked" at the inefficiency he experienced as a shipper every time he needed to ship goods.

He said his experience wasn't unique: "Freightos research shows it takes an average of three days for a shipper to receive a simple price quote even on a major trade lane. Twenty-five percent of containers don't make it on to the ship you expect them to go on. Eighty-three percent of shipments don't have proper track and trace visibility door to door." And so he decided to create an 'Expedia' for freight.

Between 2012 and 2015, Freightos focused on digitizing the supply via a solution for logistics service providers to use internally. This platform, Freightos AcceleRate, does rate management, instant freight quoting, business intelligence and tender management. Additionally, Freightos acquired Freightos WebCargo with the world's largest database of air cargo rates.

Instant, door-to-door international air & ocean freight quotes

Once the company reached the milestone where dozens of forwarders such as Hellmann Logistics, CH Robinson and CEVA Logistics, to name a few, were managing their rates in Freightos, it began building the supply side. Freightos Marketplace launched in the summer of 2016 for small and mid-size shippers on a few trade lanes. On a weekly basis, more than a thousand shippers use the platform, and it is growing rapidly. The service offers instant, door-to-door international air and ocean freight quotes and small and mid-size businesses can log in to ship.freightos.com, search and compare freight quotes from forwarders, and now also direct from CMA CGM, the third-largest ocean carrier in the world, which is offering its rates on the marketplace, enabling shippers to compare freight quotes and book online.

Once booked, Freightos also helps manage the shipments. Documents, tracking and payments are all managed digitally on the Freightos

Source: Freightos

website, while logistics service providers can use the Freightos Marketplace as a sales channel. Large providers are also happy to receive new orders from new shippers with a very low cost of sale, an easy quoting process and a low customer acquisition cost.

One benefit of the system is that Freightos is partnering with incumbent carriers, forwarders and shippers to bring digitization.

"The benefits are lower cost, better transparency and a superior modern customer experience," said Schreiber. "Our independent research shows that 86 percent of forwarders see technology as their biggest lever for growth – this is way above the other tactics they've discussed in the past, such as mergers and acquisitions.

"Freightos has been talking about online freight forwarding for years," he added. "A shipper should be able to get his/her freight quote automatically online, self-service, just like you can book a hotel online. And for years it has been just talk; but today you now have several big logistics providers offering price quotes on major trade lanes on their websites. This is a big change, all within the span of one to two years, and proof the big players understand the freight experience must be online.

"Containers probably won't be changing in the next 20 years; but everything around how the industry manages them has started to change and needs to continue changing in a big way."

Expanding user base

Schreiber also added that as Freightos evolves, a broader range of importers and exporters tend to use the system "The initial user base centered around the long tail of smaller importers and exporters," he said." E-commerce stood out as a key market, belaying a rapidly growing market of first-time importers that were graduating from local sourcing to international sourcing and, with time, Freightos has expanded to significantly larger volumes. While ease of use and education was a hallmark value for smaller shippers, we now attract larger shippers who now benefit not only from a digital experience but also from more aggressive pricing. The introduction of CMA CGM's secured capacity is a game-changer; reliability is often more important than pricing for larger importers and exporters and marrying public reviews with guaranteed capacity and competitive pricing means increased interest from top-tier companies, albeit centered on their spot shipment volume.

"A good digital platform is never complete," he continued. "For our roadmap, we're guided by the need to provide an exceptional customer

experience, while remembering that as a two-sided marketplace, we also need to provide an outstanding, secure environment for our sellers.

"We're continuing to make headway on creating a better shipment management experience, with more direct integrations into seller TMS systems and other data resources, facilitating better proactive exception management and user life cycle operations."

Schreiber also knows that reliability is also a key parameter when selecting providers. He adds, "As we increase the number and quality of the Freightos sellers, we are also putting systems in place to track reliability and customer service levels, and then feed those back into rate selection. Expanding the types of sellers on the marketplace to include even more carriers, as well as ancillary services that drive value for importers in a one-stop platform is also an exciting direction that we're pursuing."

Improving global digital infrastructure

Schrieber stated that Freightos is working on improving its underlying global digital infrastructure. "While we've already automated freight pricing and sales for over 1,200 logistics providers globally, this internal automation must be augmented with increased agility. Nearly every major global industry leverages dynamic pricing based on real-time metrics to make smarter, automated decisions."

To that end, Freightos, in partnership with the Baltic Exchange, provides indexes of container shipping prices, the Freightos Baltic Index (FBX). "We are working on a number of solutions, including derivatives, to help reduce pricing risks and improve stability. This isn't just talk either; we're in the process of exploring implementation with major multinational corporations," he concluded.

Source: CMA CGM

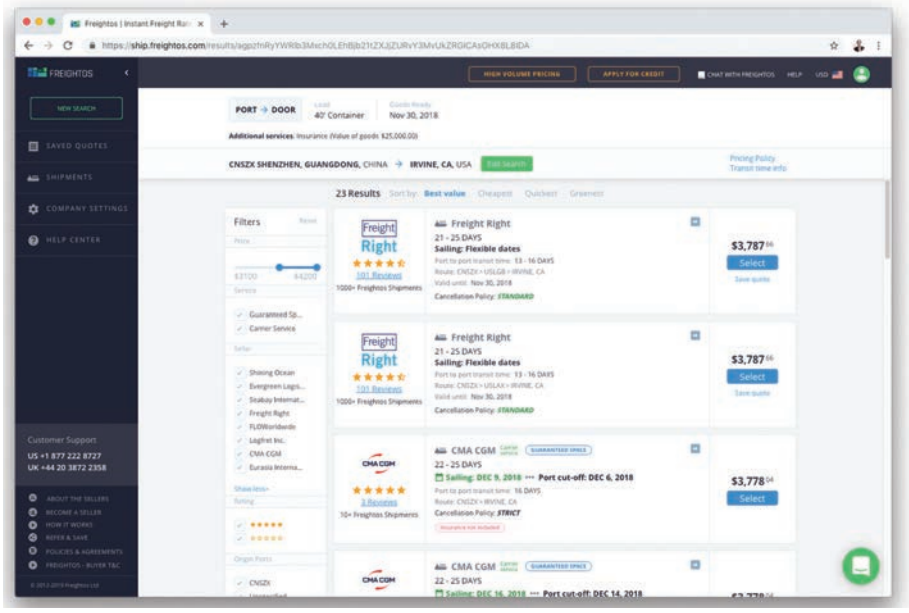


Image: Freightos

“A SHIPPER SHOULD BE ABLE TO GET HIS/HER FREIGHT QUOTE AUTOMATICALLY ONLINE, SELF-SERVICE, JUST LIKE YOU CAN BOOK A HOTEL ONLINE. AND FOR YEARS IT HAS BEEN JUST TALK; BUT TODAY YOU NOW HAVE SEVERAL BIG LOGISTICS PROVIDERS OFFERING PRICE QUOTES ON MAJOR TRADE LANES ON THEIR WEBSITES. THIS IS A BIG CHANGE, ALL WITHIN THE SPAN OF ONE TO TWO YEARS.”

ZVI SCHREIBER,
CEO AND FOUNDER,
FREIGHTOS

Dirk Balthasar

President, Thermamax, Inc.

What is the Thermamax offering to the maritime industry?

Thermamax is a specialist in the design and manufacture of thermal and acoustic insulation solutions for diesel engines, spark ignited engines, exhaust aftertreatment systems and electric storage systems. Our markets include automotive, on- and off-highway sectors, power sports vehicles, stationary power generation, ships, and oil platforms, both on land and at sea. For the marine industry, Thermamax is a solution provider for SOLAS-compliant insulation solutions for engine rooms. We supply highly effective insulation claddings for most of the leading engine and turbocharger OEMs. In addition, Thermamax is able to design, manufacture and install SOLAS- compliant retrofitting insulations also for engines that are already in service for a longer period of time and that eventually do not meet latest safety standards. This is relevant for cruise ships and offshore vessels, but really for any commercial ship.

What percentage is to the maritime and offshore segment?

About 20% in 2018.

When you look at your range of products to the maritime sector, what is the top driver?

The number one driver certainly is safety. According to IMO SOLAS the surface temperature of modern marine engines must not exceed 200°C. In addition, engine builders are striving for better fuel efficiency, mainly by increasing the engine`s power density what typically leads to higher exhaust gas temperatures. Due to higher charge air pressures even the area of the compressor outlet of the turbocharger becomes a concern in terms of surface temperatures. Consequently, every new engine has to be equipped with a highly efficient insulation system. But as already mentioned, higher levels of safety are also important for older engines that do not meet latest SOLAS requirement. For these engines, Thermamax is able to design

custom made retrofit solutions and to install them on board.

Do Thermamax products have a role in helping vessel owners achieve reduced emissions?

Thermamax insulation systems are often used for exhaust after treatment systems. Let it be the pipes between the turbocharger outlet and the SCR, or the SCR itself. Our insulations keep the heat in the system and temperatures at a level that is required to ensure proper catalytic reaction in the SCR.

We understand that Thermamax is also investing in product development to support increased electrification and batteries on ships.

Recently Thermamax developed housings for battery modules to support electrification, beside others, for marine application. Also, on board ships electrification is becoming more and more important. Thermamax battery housings can be used for on-board energy storage systems, replacing conventional Diesel generators. Our battery housings ensure effective fire protection and extend the battery range by balanced thermal management.

Tmax-Retrofit

In the engine room temperatures are highest and reliable fire prevention is vital. As 3D details are often not available for older engines, retrofitting with SOLAS-compliant high-performance insulation systems has only been possible to a limited extent until now.

With Tmax-Retrofit, older marine engines can now also be upgraded with high-temperature insulation systems which exceed SOLAS guidelines. The all-in-one package provides all services – from the preparation of the engine's 3D profile to the thermography of the developed and installed insulation system – all from one source.

1. A 3D-Scan of the engine to ensure the best fit of the exhaust gas and turbocharger cladding. Results of the scan are used as the basis for preparing digital 3D models.

2. Reverse Engineering: Based on the scanned 3D profile, Thermamax develops a CAD model of the engine. For this it first generates a polygon network in STL format from the available data. This is converted into standard geometries and free-form surfaces. From these attributed surface models and own on-site photos, we can then create a CAD model in the STEP or IGES format.

3. Design and Simulation: Now starts the classic design process. On the basis of a 0D/1D thermal calculation Thermamax defines material and thickness of the insulation. The detailled constrution is made in Creo, a specialized software. The result is a durable exhaust gas/turbocharger cladding which reliably lowers the maximum surface temperature below 220 °C and even below 100 °C, depending on requirements.

4. Manufacture: First, Thermamax produces a prototype. In its own test lab, it performs various tests on all materials and components to ensure high quality in practical applications.

The individual Tmax-Insulation Cladding is now ready to use and can be installed.

5. Installation: Thermamax installs the exhaust gas/turbocharger cladding – first the prototype – on your engine.

6. Thermography: To ensure that the new insulation system performs as required, Thermamax performs a thermography test.

Norway prepares to 'send in the drones' as maritime

Emission 'Sniffers'

Norway is growing its arsenal of military grade drones for missions that will take them into the exhaust stream of ship's funnels.

With the IMO now supporting the 0.05 percent sulfur cap on marine fuel from Jan. 2020, and with southern Norway below the 62nd parallel officially a European Emissions Control Area, or ECA, the Norwegian Maritime Authority, the NMA, is cracking down on illegal sulfur emissions.

By William Stoichevski

Oslo's NMA and its domestic enforcement allies — the Norwegian Coast Guard (Kystvakten), the Norwegian Coastal Administration and the police — will share the burden of making shipping to and from Norway compliant with EU, IMO and new Norwegian rules on emissions of sulfur, or rather sulfur-oxide. Checking for illegal levels of SOx is the job of NMA principal surveyor, Svein Erik Enge, who we meet in Haugesund, a sleepy town in Western Norway being transformed into Norway's "clean-tech" cluster.

Enge in June of 2018 coordinated and supervised the NMA's test drone project at the entrance to Bergen Harbor. For a week, a sensor-laden drone operated from the bridge of Kystvakten's KV Tor was flown into the vapor stream of several ships to take samples of SOx. The exhaust's electronic sulfur count was instantly transmitted to the KV Tor's computer screens. Though the drone had kept its safe distance of 50 meters from the vessels, illegal levels of sulfur were detected. The Kystvakten contacted the NMA ashore, and a ship inspection was planned. "We use it like a police breathalyzer test," Enge says, adding, "But we still go onboard." Still, the test inspections were a total success. The drone was "impressive." It took five minutes for the drone to analyze samples using the leased chemical sensors it carried. The possibilities were endless: "You can notify the next port. You can issue a fee, or you can ask for a (fee payment) guarantee." The highest fee issues to date has been to the tune of 650,000 kroner, or $75,000. It is understood to have gone to a cruise ship operator. Since that fateful 2018 test, the Kystvakten has grown its fleet of drones from one to three and is reportedly ready to buy five new ones each year: or five sensors. The information we get from different sources seems contradictory. Enge says, "We only buy the sensors (not the drones)," while another source says the sensors are rented out from commercial players and Norway's research institutes, like AMOS, who have developed their own "chemical-sniffing" spectral cameras.

Emission inspection: The old way (bottom left inset), and the new way, via drone.

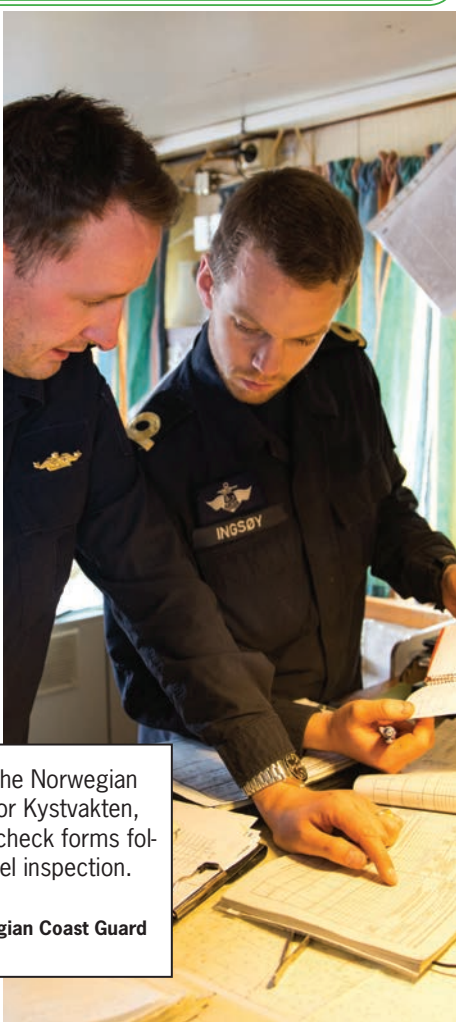
Image: Norwegian Maritime Authority/Nordic Unmanned

Zero-emissions

The Kystvakten was ideal for the job of inspection because it already had the vessels and could look after the drones. The coastal guard already inspects "50 to 100" ships each year inside the ECA, although that number is expected to rise sharply, and in 2018, ship inspections in all regions reached over 200. The IMO is now in on the sulfur cap, and from the beginning of 2026, Oslo begins enforcing a zero-emissions regime for cruise ships in the fjords. Until then, the IMO-recognized sulfur cap rules apply below 62 degrees North latitude, and after January 1, 2026, the area above will be subject to the sulfur cap. In 2030, the entire Norwegian littoral — an area as long as the West Coast of the United States — will be "emissions free."

So, Enge and the Kystvakten's new R-70 Sky Ranger drone are law enforcement pioneers at the dawn of a new low-emissions age. Like other trailblazers before them, they'll build on existing experience. The Kystvakten is understood to have already used a Lockheed Martin Indago drone equipped with infrared and 30x200 cameras to spot and chart oil spills during the day and at night. The new R-70s are from FLIR company Aeryon will also rely on fitted sulfur sensors, for now, while other sensors for other environmental elements are developed and procured in anticipation of further environmental tightening. "With IR for the first time, we could see how deep the oil was in the sea. You could locate the oil spill on a chart. It made it much, much easier," Enge says. Now, ease was also being cited in that first sulfur inspection of a ship's funnel exhaust: "You could see the drone lift off from the deck and follow the ship. It was better than a toy," Enge says, an apparent reference to Aeryon's vessel-tracker. Other stately first responders wanted one, too, so in 2018, five new R 70's were ordered, their sensors unique to services that included the Norwegian Radiation Protection Authority; the Coastal Administration; the NMA and the Kystvakten.

In April 2019, Norse Asset Solutions, or NAS, delivered the Sky Rangers' sulfur sensors and GIS, and the drones with sniffers became a 14 million kroner contract in March 2019. Canadian company Aeryon Labs (owned and now called Oregon-based FLIR) built the drones and supplied Aeryon Mission Control Systems originally made for the military market. The R-70's are man-portable at 80 centimeters wide; fly at speeds of up to 50



Inspection: The Norwegian Coast Guard, or Kystvakten, disembark and check forms following a vessel inspection.

Image: The Norwegian Coast Guard

Complete sulfur-sniffer package: A NAS emissions inspection drone made from a modified Aeryon Labs R70 drone; below the original R70. Image: NAS/The Norwegian Coastal Administration

Image: NAS/The Norwegian Coastal Admin

km/h for 50 minutes to five kilometres away. They can handle 70 km/h winds and, during sulfur inspections, will "ideally" be followed by a support craft, autonomous or not.

But as with all drones, it's payload, payload, payload. The 2.5 kilogram drone can carry a 2.5 kg camera and sensor payload. The NAS sulfur sniffer is tiny, but only needs to suck in a miniscule air sample to replicate the analysis trained surveyors have always done in NMA labs.

"We can change out the sensor, and you can check for other gaseous elements as well," said Enge, who admits, "We're still working on the software for this one." Indeed, the new drones the NMA will procure come with Aeryon Labs secure Application Development Kit and Payload Development Kit "to enable rapid third-party software integrations and payload developments", and that's exactly what happened.

When the Sky Ranger was introduced in 2015, TrellisWare Technologies, Datron, Aeryon Labs and Black Diamond Advanced Technologies reportedly presented the SkyRanger to the US Marine Corp with a TSM radio that enabled real-time streaming and thermal imaging over a mobile ad-hoc network, or MANET. It's not known whether any of this technology is being used in Norway.

Super drones

Drone sales for maritime applications have been a big hit in Norway, although structure integrity missions have been the main draw. Since 2015, Stavanger-area outfit, Nordic Unmanned, struck a distribution deal with Lockheed Martin for their Indago VTOL drones.

Since then, Nordic Unmanned has earned contracts pulling hydro power pilot lines and dropping objects for electric grid operators as well as surveys for the national railroad. Kongsberg Maritime Broadband Radio, a satellite-independent system, is at least aboard the Indago drones, one of two types tested, since a deal exists between Nordic Unmanned and Kongsberg. The MBR also streams real-time surveillance video in real-time between ground, air and marine assets.

The new NMA orders of Sky Ranger drones are understood to be R70's that can operate from -30 degrees Celsius to 50 C. They're intuitive enough that the surveyor need not be an engineer, although they will receive training from NAS and, or Nordic Unmanned and FLIR.

"This drone is the first of its kind that's being combined and integrated as a finished package," NAS operations leader, Joachim Hovland, was quoted by stately chroniclers as saying. "Before this, we did not have the opportunity to inspect vessels that are sailing, but now we're the first in the world to systematically use drones for this type of work. The drone will therefore ensure that we make more effective the way we inspect sulfur emissions from vessels."

One thing is certain: Enge was "extremely pleased" with the navigation and flight control of the Sky Rangers from the KV Tor's deck, with its camera controls. "The touch screen system allows the execution of dynamic flight plans," a manufacturer's note says. And Enge and the NMA will also use a point-and-click XRF pistol that scans fuel and can determine sulfur content within 30 seconds — or about as long as the Sky Ranger has to remain in the exhaust stream of a ship's funnel.

From coal to oil to natural gas

MV Sajir Moves to Methane

By Peter Pospeich

In its more than 170 years of existence, the Hamburg-based Hapag Lloyd has used all kinds of solid and liquid fuels to generate energy for the propulsion of its ships. And now the shipping company has announced that it intends to convert the propulsion system of its 15,000 TEU container vessel MV SAJIR to use natural gas (methane), a world-first.

The contract for the conversion was signed with Hudong Hondhoa Shipbuilding (Group) Co, Ltd., a contract which also includes the conversion of the auxiliary diesel engines to natural gas. The conversion of the five-year-old ship will be carried out by Huarun Dadong Dockyard Co., LTD, Shanghai, in 2020.

The conversion of the main engine to natural gas operation will be carried out by MAN Energy Solutions based on a contract recently signed with the company.

The pilot project, which is unique to date, provides for the conversion of an existing MAN B&W 9S90ME-C engine, which was previously operated with heavy fuel oil, to a MAN 9S90ME-GI dual fuel engine with gas injection.

"With the conversion of SAJIR, we are the first shipping company worldwide to convert a container vessel of this size to natural gas propulsion," said Richard

The 15,000 TEU megaboxer MV SAJIR to be converted to methane for operation.

Image: © Hapag-Lloyd

von Berlepsch, Managing Director Fleet Management at Hapag-Lloyd. “It is a unique pilot project from which we hope to learn for the future and pave the way for the conversion of large ships to this alternative fuel.”

SAJIR is one of 17 “LNG-ready” vessels in Hapag-Lloyd’s fleet already designed during the newbuilding phase. With the conversion of the SAJIR, Hapag-Lloyd is implementing a technical option for reducing the exhaust emissions of large ships. The company is thus reacting to the tightened sulfur limits in fuel which will come into force next year and lead to considerable additional costs for all shipping companies.

The conversion of two-stroke engines for the use of natural gas enables considerable emission reductions. According to MAN ES, the CO2 emission reductions are between 25 and 30% compared to HFO and MDO. NOx reductions are around 30% (far below the TIER II limits). The most significant reductions are in sulfur dioxide and particulate emissions, at more than 90%.

The shipping company thus sees good opportunities to convert part of its fleet for the use of natural gas. There is talk of a further 16 container ships that have already been built “LNG-ready.” With conversion costs of around 25 to 30 million dollars per ship, this would result in a total investment of around 400 million dollars.

The new propulsion system

The 368 x 51 m SAJIR, which was put into service in 2014 and comes from the fleet of the Arab shipping company

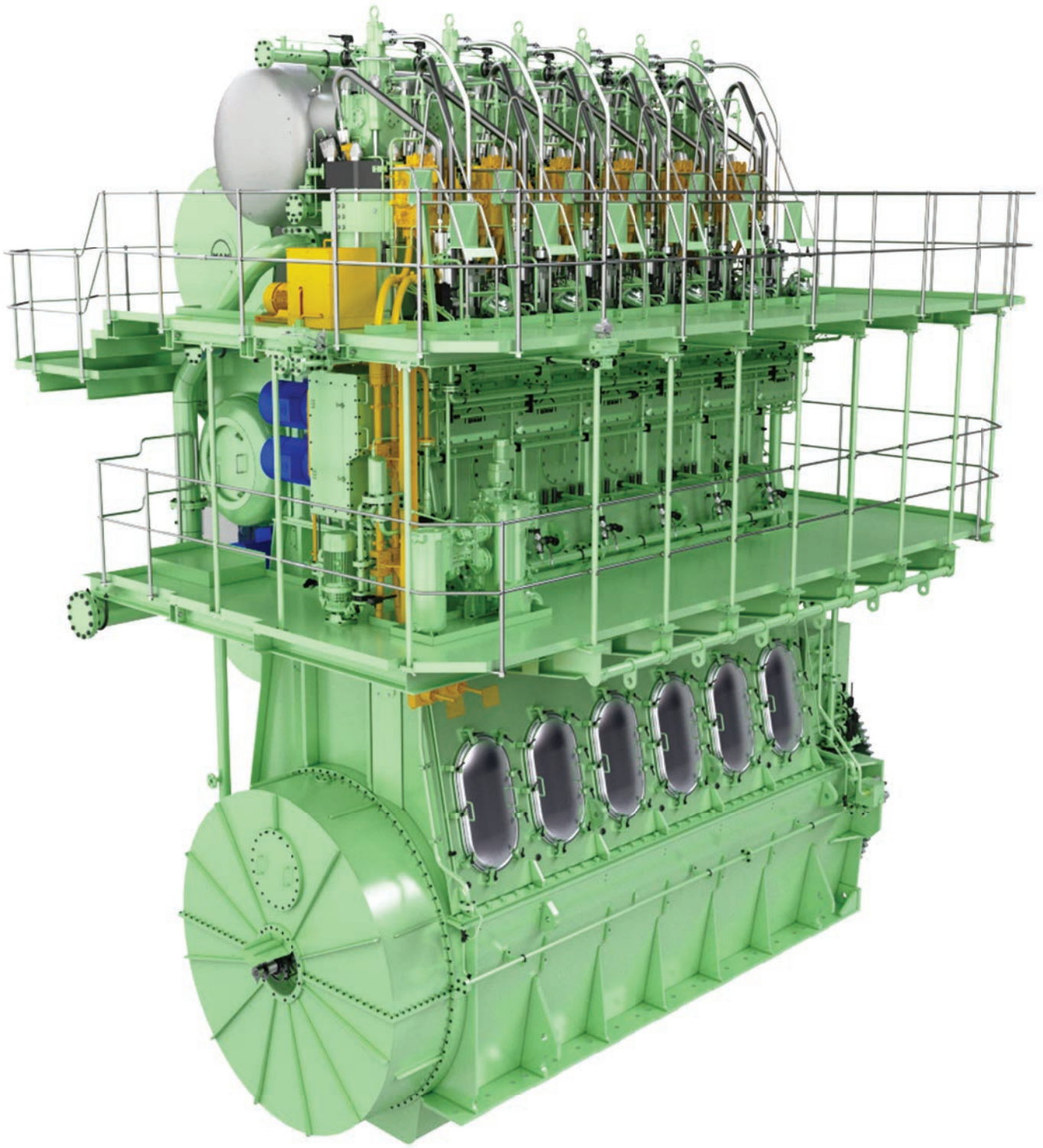
UASC (United Arab Shipping Company), still has a slot capacity of 14,993 TEU. The ship is currently powered by a MAN 9S90 ME-C 10.2 engine with an output of 37,630 kW at 72 rpm. This engine is to be converted into a 9S90 ME-C 10.5-GI dual-fuel engine with the same power and speed.

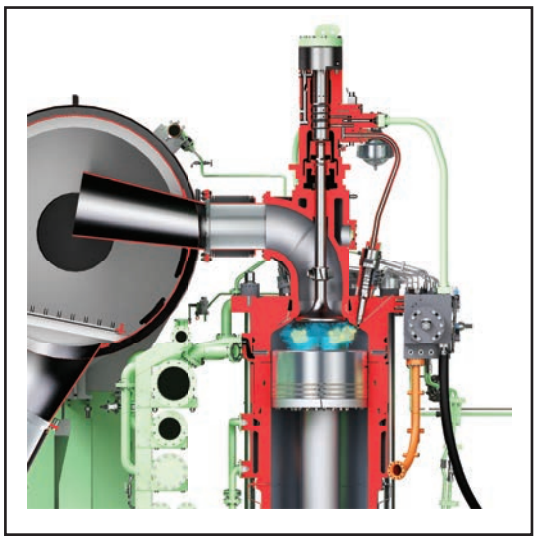
MAN SE has already been able to present several engine conversions from its portfolio (see MV WES AMELIE and others) as a reference, but the Hapag-Lloyd project is nevertheless the first ship-side retrofit project for the Augsburg engine manufacturer. The conversion of a ship to methane operation is highly complex. Even though the nine-cylinder in-line diesel engine of the SAJIR to be converted is the "progenitor" of the DF engine 9S90 ME-GI, the two variants differ in essential components and systems. For example, the cylinder head of the ME-GI engine is equipped with two valves for gas injection and two conventional valves for the pilot fuel oil. The two engine types, ME-C and ME-GI, are largely the same and have the same efficiency, the same power and the same main dimensions. In comparison to the ME-C engine, the ME-GI engine has a modified exhaust system, a modified cylinder head with the necessary gas supply lines and attached gas control devices.

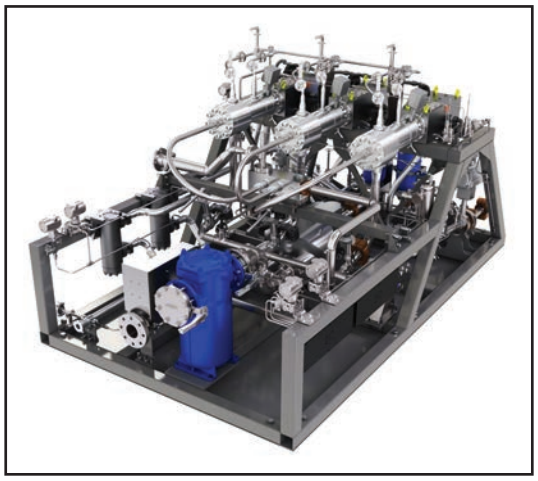
On the gas supply side, space must be found for the LNG tank and vaporization

"WITH THE CONVERSION OF SAJIR, **WE ARE THE FIRST SHIPPING COMPANY WORLDWIDE** TO CONVERT A CONTAINER VESSEL OF THIS SIZE TO NATURAL GAS PROPULSION."

RICHARD VON BERLEPSCH, MANAGING DIRECTOR FLEET MANAGEMENT, HAPAG-LLOYD







Images: Starting left:

The MAN B&W engine type ME-GI.

Sectional view gas injection of ME-GI.

The 300-bar high-pressure pump vaporator unit (VPU system) from MAN SE to be installed at the SAJIR.

equipment in the ship without losing too much container capacity. As Hapag-Lloyd reports, with the additional gas storage system certified by DNV-GL, around 350 container sites will theoretically be lost in the space provided during the construction of the ship.

The engine technology

The vessel normally serves the Far East route from Asia to Northern Europe through the Suez Canal. The LNG tank capacity will be 6,500 cu. m. A membrane tank (GTT design) will be installed at the designated location in one of the holds, just in front of the engine room. Membrane tanks allow an optimal adaptation to the existing ship shape. From today's point of view, the range with one LNG tank filling cannot yet be specified precisely. According to statements, the SAJIR will re-bunker LNG twice - the locations will depend on the availability of the fuel and the price.

The ME-GI (Gas Injection) engine has already established a new industry standard for two-stroke propulsion engines with well over 200 machines ordered and delivered and is used on LNG carriers, container ships and bulk carriers. According to the company, the two-stroke technology also solves the problem of the unwanted methane slip. The engine combines the ad-vantages of multi-component combustion with the reliability of the established ME engine.

MAN Energy Solutions supplies the necessary engineering as well as all necessary engine and selected system components for the conversion in order to adapt the engine, which is currently still suitable for heavy fuel oil, for operation with liquid and gaseous fuels.

"We offer a fully integrated complete solution. In addition to the conversion of the engine, this also includes the entire gas treatment system for supplying gas to the main engine, including the pilot oil module, and the auxiliary engines from MAN Cryo and a 300 bar high-pressure pump vaporator unit (VPU system) from MAN SE," said Wayne Jones, Chief Sales Officer MAN SE.

The ME-GI PVU is designed to pressurize and vaporize the LNG fuel to the exact pressure and temperature required by ME-GI engines. Gas pressure is controlled via control of hydraulic oil flow to the pump, ensuring a very quick and precise control of the LNG supply to the engine. Separate control of each pump head provides full redundancy.

Operation with low-sulfur fuel (LSFO) is also possible as back-up.

On the engine side, as far as possible all components of the combustion chamber and their attachments are replaced. In addition, the injection components for gas injection are re-placed or added. In particular, the pilot oil system required for gas operation will be completely rebuilt. The control of the ME-GI engine is more complex than the original control of the heavy fuel oil engine. This requires a conversion of the engine sensors or a new instrumentation.

Hurtigruten's CEO Dan Skjeldam: "bullish" about the expedition cruise sector's prospects.

Image: Hurtigruten

Dan Skjeldam

Smaller, Greener, More Specialized:

Hurtigruten drives the future of the cruise travel sector

Building on its 125-year heritage, Norwegian shipowner Hurtigruten has become a leader in exploration travel offering voyages to more than 200 unique destinations in more than 30 countries ranging across the globe from the Arctic to the Antarctic and including cruises in Norway, Greenland, Svalbard, Iceland, Western Europe, and the Americas. In an exclusive interview with Maritime Reporter and Engineering News, Dan Skjeldam, the company's CEO, emphasizes the need for the cruise industry sector to be more environmentally aware and to operate responsibly in order to take advantage of the new business opportunities represented by consumer demand for new travel experiences.

By Tom Mulligan

Norwegian cruise operator Hurtigruten has a mission to offer on- and off-ship experiences that enable its guests to "connect with their inner explorers." When asked how he felt about prospects for the cruise industry market, Dan Skjeldam, the company's CEO, said, "extremely bullish". And when asked about expedition cruises in particular, he stated: "It's currently a small part of the total sector but I expect to see a lot more growth." However, he added that there were some caveats to these statements: "We need to tackle the effects of the cruise industry 'dumping' people into cities – this practice could have a negative effect on the industry's reputation. The other major issue is that pollution from cruise ships needs to be dealt with: HFO is no longer an acceptable fuel and scrubber technology isn't the answer. Hurtigruten has placed itself at the forefront in dealing with these issues by refusing to engage in 'over-tourism' and by tackling pollution through the use of green technologies and hybrid power systems."

Headhunted

Skjeldam became CEO of Hurtigruten after being personally headhunted to the position by the company's largest shareholder, Trygve Hegnar, in 2012. At the time Skjeldam stated that "Hurtigruten remains the real thing in a world that is increasingly dominated by big white cruise ships and will regain Scandinavia and Asia, as well as extend the season for British tourists chasing the Northern Lights", immediately making major changes to the company: its headquarters moved to Tromsø and non-strategic assets were sold off. These and other structural changes enabled Hurtigruten to make an annual saving of more than $10 million, with the result that in May 2013 the company was able to announce its first positive earnings in nine years. It has traded successfully since.

Skjeldam holds or has held directorships on several company boards including those of Spitsbergen Travel AS, the oldest travel and tour operator in Svalbard, where he has been Chairman of the Board since 2012; Norwegian Finans Holding ASA; Call Norwegian AS, a Norwegian VoIP phone service provider; and Tereda Holding AS. He has previously been on the board of ferry companies Fjord1 MRF and Fjord1 Fylkesbaatane.

He holds an MBA from the Norwegian School of Economics.

Above: An impression of the MS Roald Amundsen cruising in the fjords of Norway.The ship is due for delivery later this year.
Image: Hurtigruten

Inset: Hurtigruten's new cruise ships are hybrid-powered by four main engines backed by two 627 kWh batteries that charge and discharge at 1750 kW each.
Image: Tom Mulligan

Experienced operator

Hurtigruten was established by in 1893 by government contract to improve communications along the coast of Norway, the first round-trip journey taking place from Trondheim to Hammerfest in the summer of that year. This was a difficult trip to make in the then poorly-charted waters, especially in winter, and the advent of Hurtigruten was a major development for the isolated communities along the route. It now took only seven days to deliver mail from central Norway to Hammerfest, as opposed to the previous three weeks in summer and five months in winter. From the 1980s, partly due to the introduction of a local airport network and an improved road system, the role of Hurtigruten changed and the company began to concentrate more on tourism, although it still caters to routine passenger and cargo needs. Following the merger of Ofotens og Vesteraalens Dampskibsselskab (OVDS) and Troms Fylkes Dampskibsselskap (TFDS) in 2006, the company became the Hurtigruten Group, and shortly afterwards Hurtigruten ASA. It was delisted from the Oslo stock exchange in 2015 following its acquisition by private equity group TDR Capital and now operates expedition cruises to Greenland, Iceland, Svalbard, the Americas, the Arctic and Antarctica in addition to its cruise and other services in Norway.

Fleet expansion

The current Hurtigruten fleet consists of a number of 12 coastal vessels and four expedition ships, the MS Fram, MS Nordstjernen, MS Midnatsol and MS Spitsbergen, and three expedition ships on order: the MS Roald Amundsen, due for delivery this year; the MS Fridtjof Nansen, being delivered in 2020; and an as-yet-unnamed vessel, due for delivery in 2021.

Being constructed by Norwegian shipbuilder Kleven Verft and classified by DNV GL, the new ships are based on the most advanced and greenest cruise ship technology available today, being hybrid-powered by four main Bergen B33:45 engines running on MGO fuel backed by two 627 kWh batteries charging and discharging at 1750 kW each. The engines have an output of 3600 kW each, powering two azimuth propulsion motors with a propulsion power of 3000 W, enabling a service speed of 15 knots. The ships are also equipped with two bow thrusters with 1500 kW output each and have two fin-type stabilizers. They are capable of carrying 681 people: these comprise 530 passengers and 151 crew.

Big plans

This isn't all, however: "We've big plans for the future," said Skjeldam. "Based on our assessment of the potential of the industry and its room for growth. There will be a lot more ships added to the Hurtigruten fleet in the next 10 years, we'll be operating in new areas of the world, and there will be a lot more newer, greener technology on board," he asserted. "We can deliver on these ideas through our 125 years of acquired operational experience and our experience in operating in ecologically pristine areas. We have seen the effects of pollution elsewhere on the planet and, as the CEO of the world's greenest cruise line, I have to express my concern about the way some companies operate, especially those with larger vessels carrying large numbers of passengers. Hurtigruten believes in keeping its operations small: smaller cruise vessels and lower numbers of passengers per ship – the maximum number of passengers we carry on a ship is around 500."

Evolving business

Because of the new demands being placed on the cruise industry sector, and in particular on the expedition cruise market, Skjeldam expects to see considerable consolidation in the sector over the next decade: "At present, overall there are a lot of smaller operators, " he said. "However, technological pressures, driven mainly by ecological and environmental factors, will result in there being a lot of consolidation in this currently fragmented industry – companies need to be of a certain size to operate effectively and I am quite sure that there will, sadly, be some bankruptcies in the cruise industry simply because the smaller operators cannot afford to purchase the modern vessels required to serve the market. The older ships, dating from the 1960s, are now so out of date that they are simply not up to the job and are not suitable for use in today's business and natural environment – the cruise industry has moved on, it's a much more professional business than it was 10 or 15 years ago and there will be even more advances in the future," he concluded.

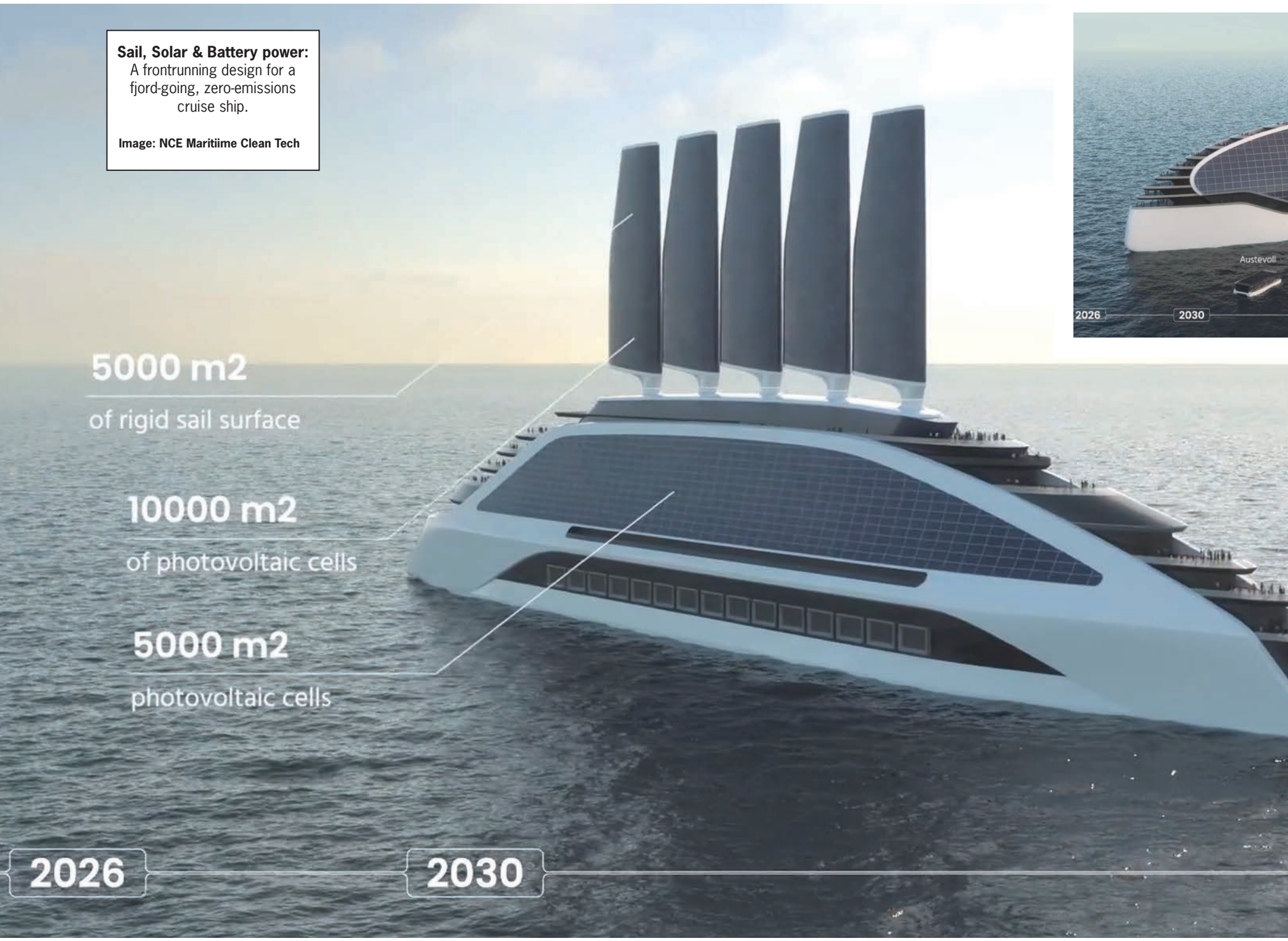
Zero Emission Fjord Cruising

Norway on January 1, 2026, will begin a ban on cruise ships powering through the Unesco-listed heritage fjords on anything but zero-emissions propulsion. For now, that means battery power, but few of the 190 cruise ship calls to these fjords are made with that kind of electro-chemical fuel on board. From now until 2026, you can still cruise the fjords on a closed-loop, or in-line, scrubber system, but few cruise ships have these installed. The new rules mean cruising elsewhere, finding suppliers of energy storage systems or accepting novel zero-emissions solutions.

By William Stoichevski

Sail, Solar & Battery power: A frontrunning design for a fjord-going, zero-emissions cruise ship.

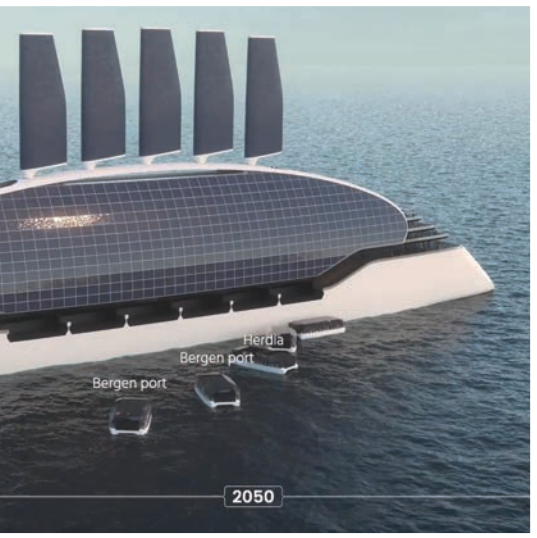
Image: NCE Maritiime Clean Tech

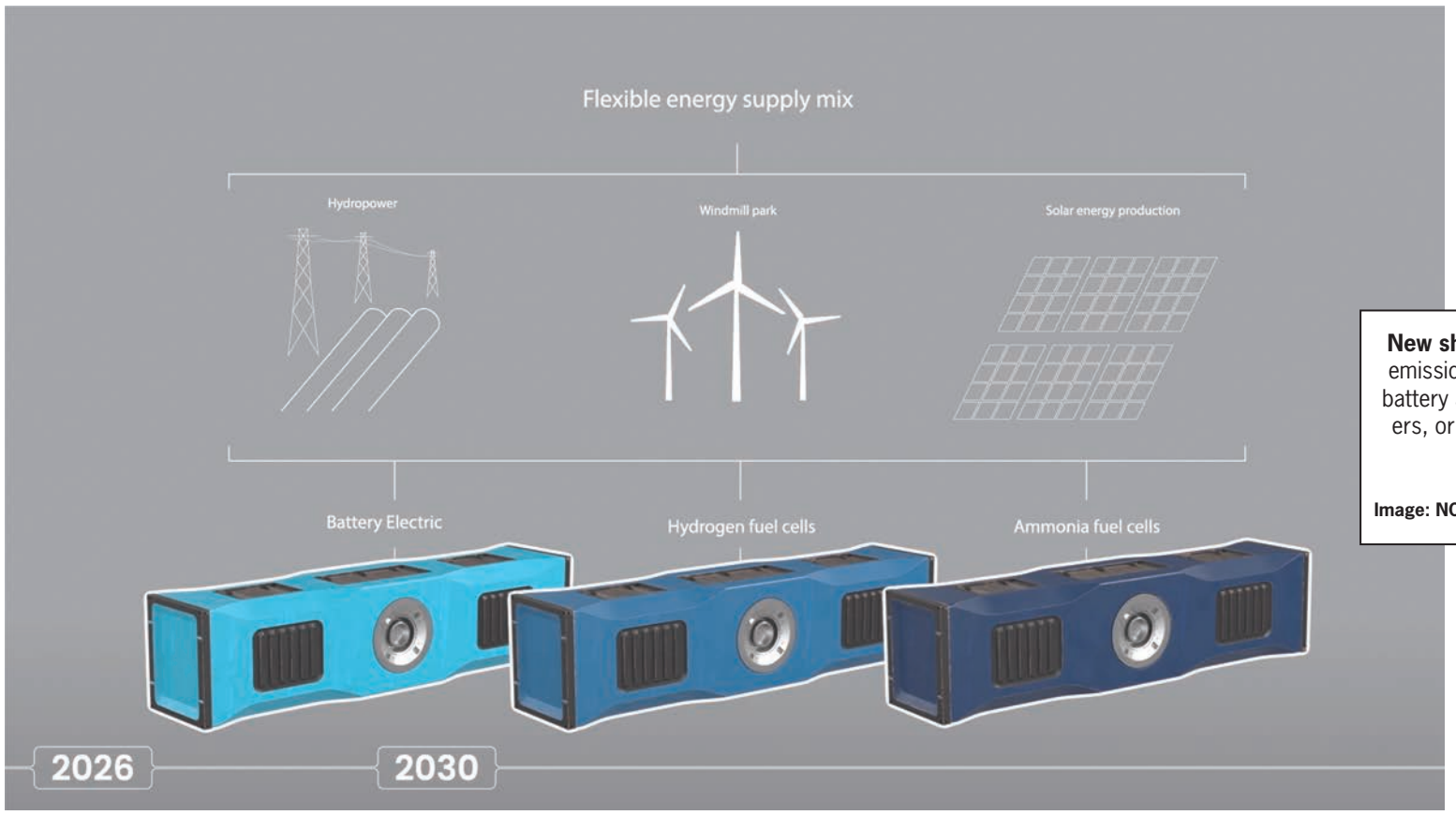


Western Norway's UNESCO-designated Geiranger and Naeroy fjords start at the sea and terminate in picturesque villages, where a cloud of exhaust from visiting cruise ships tends to hang. The plumes of visible emissions of particulate matter, carbon-dioxide, sulfur dioxide, nitrogen oxide and water vapor have been studied at length, and now the Norwegian government has had enough: The polluting ends Jan. 1st, 2026, and by 2030, the remaining Norwegian fjords will be made emissions-free zones.

The studies by DNV GL, Marinetek and Sintef reveal that just 25 percent of cruise ships entering the fjords are running low-SOx and low-NOx systems aboard, including scrubbers. Most are on cleaner, low-sulfur distillate fuels for main and auxiliary engines, and about 10 percent run on bunker; 70 percent of cruise ships entering the protected fjords were built, on average, 20 years ago and lack the newer, greener tech.

It was a 2018 Norwegian government debate on the embarrassing fjord clouds that led to the new zero-emissions ban on fossil fuels in passenger ships over 1,000 GT. The Norwegian Maritime Au-





New shore routine: zero-emissions planning covers battery and service containers, or backs, exchanged quayside.

Image: NCE Maritime CleanTech

thority in coastal town Haugesund that will enforce the requirement that cruise calls in the fjords are electric-only. The NMA will also enforce the use of closed-loop exhaust scrubbers until 2016. Until then, too, European Emissions Control Areas rules for NOx and SOx will apply above Norway's 62nd parallel of latitude (including the half of Geiranger fjord nearest the sea).

"It'll definitely impact the (cruise industry)," says the NMA's head of delegation to the IMO, Lars Christian Espenes. "It could be difficult for cruise ships, as only a handful are compliant." He confirms that it'll be battery power only or hybrid from 2026 on, admitting that "few are prepared" for the changes. That's great news for Norway-based power-system in-tegrators like Siemens, ABB, Kongsberg Maritime (formerly Rolls-Royce Marine) and a range of others with containerized or compartmentalized energy storage systems, or ESS, a battery or hybrid ships power and propulsion solution. Integrating battery power is also great for Canada-rooted battery outfit, Corvus Energy, a newly integral part of western Norway's maritime clusters.

One of those industrial fora is NCE Maritime Cleantech, proponent of local zero-emissions designs that including two key frontrunners: a sail-rigged cruise ship and a temporary cruise-ship-in-tow solution.

Business boost

The second of these envisions fitting rows of batteries stacked aboard an out-of-work, off-shore oil-and-gas, anchor-handling, tug-supply vessel, or AHTS, that'll tow a retrofitted cruise ship as it pulses through the eastern and southern ends of the heritage fjords.

Visuals presented at the Miami trade show in April suggest the battery-laden "fjord pilot" could be the interim solution for fjord-going cruise vessels: batteries aboard the AHTS ship by 2026 ahead of new battery and other designs for cruise by 2030. The aim is to have the cruise ship in hotel mode, with hotel power streamed over from the AHTS. Technology now used to charge batteries at harbor would effect the power transfer under new harbour systems, now on the drawing board, are developed.

The sail-equipped cruise ship would be ready by 2030. It's designer, understood to be industrial designers, Eker Design, have developed the concept in cooperation with cruise heavyweights, Carnival and Royal Caribbean. Other Maritime Cleantech suppliers have also got-ten onboard. The key to these "sale-and-solar" designs is ESS, with batteries this time charged by photovoltaic cells imbedded in 5,000 square meters of sails. All passengers are envisioned having their own balconies surfaced with solar-filmed glass.

Clean sailing

While we've seen and walked around the containerized ESS from three different suppliers and power-system integrators, the sail, solar and battery cruise concept envisages a novel exchange of power and service containers for each onboard process: "packs" for energy (batteries); kitchen waste; potable water; passenger waste; recycling and luggage. All would be emptied or exchanged shoreside and replaced with fresh packs — energy or service. The energy packs are key, as battery, hydrogen and ammonia fuel cells are envisaged. It is hoped the energy "cycle" of containerized ESS, solar and sail power provide 14 days of "clean sailing" through the fjords.

In the six-and-a-half years before the zero-emissions deadline, cruise vessels will only be allowed into the inner fjords if they're running closed scrubber technology, or tech that doesn't dip or release into sea water or surrounding air to do the job. Norway-based exhaust scrubber makers offer open and closed scrubber systems in the run-up to the Heritage Fjords deadline.

Last year saw a ramp-up of systems production that failed to meet demand, as it surges ahead of the IMO's Jan. 1st, 2020 deadlines for getting the SOx in emissions down to 0.5 parts per million.

"As far as we know, the regulation concerns the so-called Heritage Fjords, where a zero-emission policy will be implemented from 2026," says a maker of scrubbers for ocean-going tankers, cargo vessels and cruise ships. "This means no fossil fuels can be used by any vessel inside these fjords … (cruise vessels) all use fossil fuels (so) they simply cannot enter these fjords from 2026". Another scrubber maker says their systems are too large for cruise, "because you'd have to remove a casino or a pool".

So, the Fjords clean-up may be strictly about marine batteries. Retrofits of these, at least for AHTSs, can seem as simple or as configurable as a Kongsberg Maritime battery "container" connected to a hub. The no-emissions rule (which includes "grey water" and waste), will turn an ugly problem into a unique opportunity for the local shipping cluster and allied in-ternational partners to take a market lead.

The NMA affirms this: "We take a very strong role in creating international regulations," says NMA spokesperson, Caroline Stensland. The 350-strong agency headquartered in Haugesund works with industry on new tech much like DNV GL does, and their own engi-neers and scientists work alongside maritime cluster participants.

"That sets us apart from other national maritime authorities," she says. "We see ourselves as partners for technology development."

Key to that development are the system integrators, "clustered" and incubated by Maritime CleanTech and government.

As we went to press, the NCE was showing the Cluster's zero-emissions concepts to conferencegoers at SeaTrade Cruise Global in Miami.

"The world's first zero-emissions zone (Norway's heritage fjords)" and the heavyweights of cruise will have their first zero-emissions, solar-sail-ESS between by 2030. Until then, it's cruise ships in-tow.

Corvus' Cruise Offering

Corvus Energy's batteries are understood to be at the heart of the solar-sail cruise concept and a temporary plan to use retired anchor handlers packed with batteries to tow passenger vessels through Norway's fjords. Halvard Hauso, executive VP at Corvus Energy, confirms the ESS outfit is ramping up for the cruise segment. "We're launching a battery system for each vessel type," he says, confirming that batteries let owners shrink engine sizes. Hauso's comment is timely — a cruise vessel recently thundered through the nearby fjords on main engines packing 120 megawatts of power.

Already, Corvus Energy's ESS is slated to be aboard vessels of the cruise ship operator, Havila Kystruten. The liners will operate from Bergen in Western Norway to Kirkenes in the near arctic. That success, the largest marine battery order ever, is being followed up with a new series of battery packs expected to launch at Norway's Nor-Shipping expo in June 2019.

With 200 MWh of installed power, Corvus may already have half the market for marine battery power. Now, moving operations from Canada to Scandinavia and securing a network of Norwegian owners has proved prescient. Competitors have fallen away. It was the logistical costs and bans on air-lifting tenable chemicals that had padded the logic of setting up in Norway.

New Corvus product launches for specific shipping segments are being rolled out named for ocean mammals that denote scale: cruise is understood to be called the Blue Whale package. Orca is understood to be for adventure cruise or yachts. "We decided on the (blue) whale format of ESS because it was too big for yachts and too small for rigs," Hauso says, admitting that quietly, Corvus has had 190 energy storage projects on the go, including 13 in the cruise and yacht segment.

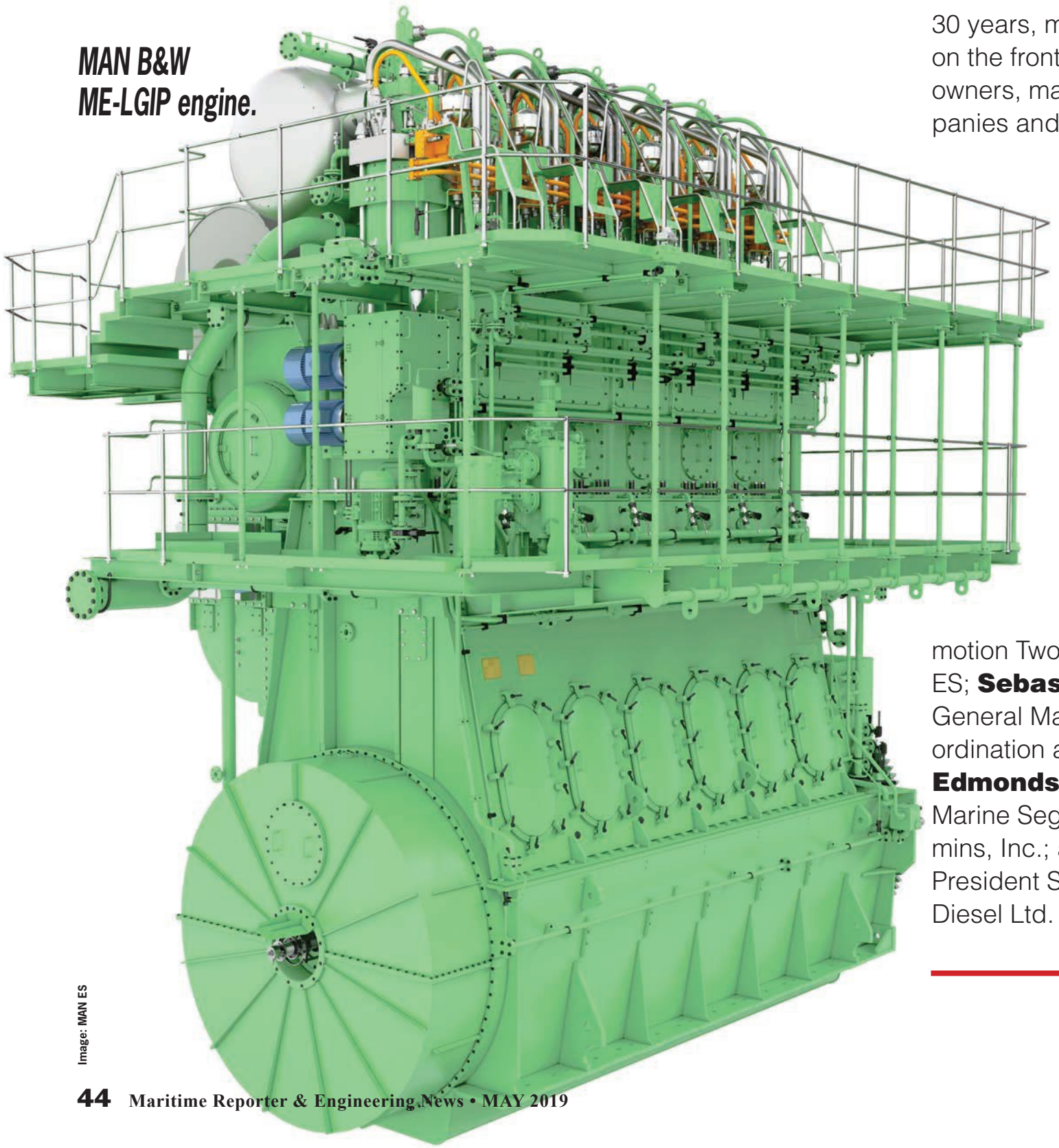
The newest Corvus ESS are solid-state rather than gelatinous, and that has reduced the size of the company's new Orca system for ferries by half. The Blue Whale system, which will have power and coms controls moved to the cabinet, are being offered to the cruise market with unique chemistry made by different suppliers.

Corvus Energy EVP Halvard Hauso.

Blue Whale marine ESS will roll out to the cruise market in earnest by 2021, or just in time for Norway's 2026 Fjords rules and a year after MARPOL emissions rules kick in. As Hauso says, power configurations for cruise will mean ESS becomes "as a fuel, with more batteries."

Power Players

By Greg Trauthwein



MAN B&W ME-LGIP engine.

Image: MAN ES

With new fuel rules courtesy of IMO2020 quickly approaching and emissions reduction and elimination on the agenda for the next 30 years, marine engine OEMs are on the front line, working with ship owners, marine fuel and lube companies and research institutions to deliver machinery to meet ever stricter environmental mandate. We recently were able to visit with a number of leaders in marine power field for their insights on the 'next chapter' in marine propulsion. This month 'thought leadership' participants are **Kjeld Aabo**, Director New Technologies, Sales and Promotion Two Stroke Marine, MAN ES; **Sebastiaan Bleuanus**, General Manager of Research Coordination and Funding, Wärtsilä; **Edmonds Brown**, Commercial Marine Segment Leader, Cummins, Inc.; and **Rolf Stiefel**, Vice President Sales, Winterthur Gas & Diesel Ltd.

"I think it is very early to project what will be the fuel of the future.
I think that it will be much more clear in January 2020 (when the new IMO fuel rules enter force) and we see the direction of fuel costs."

Kjeld Aabo,
Director New Technologies,
Sales and Promotion Two Stroke Marine,
MAN ES

Image: MAN ES

To start, put in perspective the current pressure to reduce emissions in the maritime industry.

Aabo, MAN ES It all really started at the beginning of the 1990s when the world started discussing that something needed to be done on exhaust gas emissions from marine vessels. We stayed in contact with various regulatory authorities, as we tried to be a part of the conversation in the creation of rules. Today the path to making exhaust gas cleaner is going much more smoothly. From an operator's perspective, the biggest issue is when rules are made and enforced locally, not internationally. Today, overall, we have much more efficient vessels, much more efficient propulsion systems.

Stiefel , WinGD When I started in the marine industry (coming from the power generation markets) back in the early 2000's, the main focus was to achieve higher outputs at affordable capex. Fuel consumption slowly gained importance with increasing energy prices over the years, which became even more important after the 2008 financial crisis. Emissions where not as relevant, they were just required to be IMO compliant. Today we are facing a totally different situation. Besides the rules and regulations around NOx, SOx, we are now also very aware of CO2, GHG, Black Carbon and particulates, well ahead of the regulations! The awareness of this industry on our impact on the environment has dramatically grown.

Brown, Cummins When I started in the marine industry, my primary focus was working to achieve certification of Cummins' marine engines for U.S. Environmental Protection Agency (EPA) Tier 1 and International Marine Organization (IMO) Tier I standards. Back then, there was a single solution to meet all the regulations. This was not only easier on engine manufacturers, it was easier on the fleet owners, too, providing them with only one system to implement and maintain.

Since then, not only have emissions regulations gotten more stringent, but they are also increasingly siloed, making it difficult to scale research and development across platforms. On the surface, today's emissions regulations appear to have similarities. But in reality, they are very different. At the same time, the landscape is continuing to diverge, with more regulations, such as China stage 1 and 2, taking effect. Each regulation is distinct and challenging, which, from a solutions perspective, means each requires a lot of work.

We have also seen the cycle between regulations decreasing, meaning that once you meet current regulations, you already need to focus on developing solutions to meet the next standards.

This isn't unique to engine manufacturers. Fleet owners and operators also feel the challenge. As regulations change, ship designs must also be adapted. This means the fleet isn't standardized and it's difficult to consider lessons on emissions from previous generations of vessels.

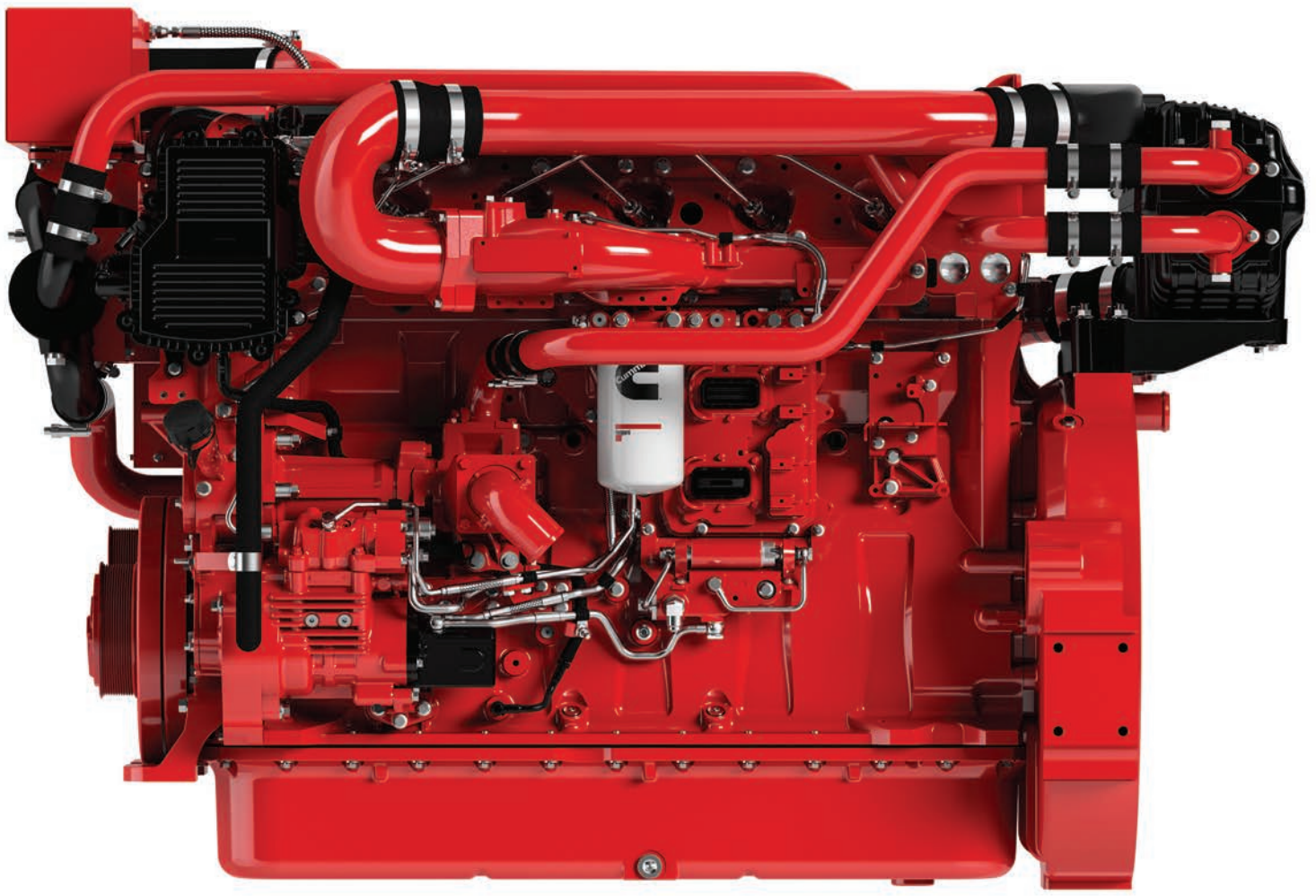
Bleuanus, Wärtsilä The last 15 years have seen a shift in legislative focus in two main areas; a tightening of the air quality related emission limits first near densely populated areas (the Emission Control Areas) and now also globally through the introduction of the sulfur cap. The second area is of course the limitation of the impact of shipping on global climate change, and we have seen many measures put in place for the newbuild of vessels (EEDI) but also for vessel operation (SEEMP). And of course last year, the IMO initial strategy on greenhouse gas emissions was approved, setting ambitious goals for reducing the impact of shipping on climate change.

What technologies or 'lessons learned' from other industries are you applying to maritime solutions?

Stiefel , WinGD In the power generator industry we had already introduced the lean burn Otto cycle Wärtsilä four- stroke engines back in the late 90`s. There, through regulation like TA-Luft and so on, the limitations especially on NOx and SOx where already in place and were more stringent than the IMO rules we have now for 2020 onwards. The introduction of the LNG burning engines to the marine market was, from that perspective, absolutely no surprise. Basically, we are applying technologies which have existed for quite a long time to a new market. And of course, the engines have been marinized and made fit for application on

"The traditional definition of an autonomous vessel piloting itself across the ocean ***means very little to the engine. But when you look at the broader need for less human interaction for maintenance, diagnostics and repairs, this is where Cummins has been working with customers to adapt, develop, and implement technology.***

Edmonds Brown
Commercial Marine Segment Leader, Cummins, Inc.



Cummins Marine X15

Image: Cummins MArine

board of a ship.

Aabo, MAN ES The marine industry is quite unique because of the breadth of the vessels and the ownership. Overall, it is definitely not more simple to operate vessels today. In the last few years there has been increasing (environmental regulation) pressure, and the choice has largely focused on fuel choice. What we have done is we have kept the diesel principle for the engine itself, meaning that we can run on almost anything. It is only dependent on the fuel injection system.

In tandem with the change the company's R&D efforts have changed and grown, particularly in the study of different fuels and NOx reduction systems, which takes a lot of testing.

Bleuanus, Wärtsilä In all our business areas we see and support a strive for achieving the lowest possible impact of operations. One great example is the utilization of gas as a fuel. Already a workhorse in on-shore power generation, LNG is now also rapidly gaining traction in marine transportation and with good reason.

Brown, Cummins Cummins is a diversified business that participates in many market segments. This allows us to leverage significant investments across numerous segments and platforms and benefit from knowledge and experience gained over thousands of product launches. Being involved in so many diverse segments on a global scale is a strength when looking at how we can adapt solutions for use in the maritime industry. For example, Cummins has been involved in meeting complex on-highway emissions for more than 20 years. Our early adaptation of aftertreatment solutions for the on-highway market, whose strict emissions regulations are ahead of most, has carried over to our marine solutions.

In addition, our Cummins Emission Solutions business delivers products not just for Cummins' engines, but for engines built by other companies, too. The technology they develop really distinguishes us. Even some of our competitors use these products in different segments.

While I'm certain that your organization's investment in R&D is broad and continuous, can you point to an area where you are investing most heavily, explaining why?

Stiefel , WinGD The major area of our investments is in three new engine testing facilities in Winterthur and in China. Focus of the development is to further increase engine efficiency and to further reduce the emissions of our X Series Diesel engines and our X-DF Series LNG burning engines. These testing platforms will also be used to research alternative future fuels like Hydrogen, Ammonia, Methanol and Bio fuels. Another focus area is around the digitization n of our engines and preparing them to be able to operate in "unmanned ships" of the future. These are the significant areas of development not only for WinGD but for our industry as a whole.

"The next big thing on fuels is LNG.
We are a long way from identifying a fuel which offers the same viability, in terms of infrastructure, beyond LNG at the moment. LNG is the necessary bridge which is getting us closer to a carbon neutral future.
Already today about 30% of all new engines ordered to propel deep sea vessels are using LNG as fuel."

Rolf Stiefel
Vice President Sales,
Winterthur Gas & Diesel Ltd.

Brown, Cummins Emissions control, across our business, is an area where Cummins is investing time, energy, and money. Four to five unique regulations drive work on our marine engine platforms alone. When you look at how many engine platforms Cummins has across all its business segments, and multiply that by the unique emissions regulations that we need to meet, you begin to see how expansive and all-encompassing meeting emissions regulations can be.

Bleuanus, Wärtsilä Efficiency (and thus emissions) and also flexibility. Even if the future of shipping sometimes seems less clear today than it did 10 years ago, operational and fuel flexibility remains one of the key elements to reduce investment risks in cutting edge technology. We need to ensure that our solutions work as well in the future as they do today. Flexibility is key in meeting that promise.

There is (justifiably) vibrant discussion surrounding fuel choice. From your discussions with your clients, do you see one fuel emerging today as the 'next big thing?'

Aabo, MAN ES I think it is very early to project what will be the fuel of the future. I think that it will be much more clear in January 2020 (when the new IMO fuel rules enter force) and we see the direction of fuel costs

Bleuanus, Wärtsilä LNG. It brings large air quality benefits today which improves people's health. And there is a significant reduction in climate impact as well. Not enough to meet the IMO strategy by itself, but the beauty of LNG is that it is the perfect transition fuel. Fossil LNG can be seamlessly mixed and replaced by Bio-LNG and in the future also Synthetic LNG made from renewable hydrogen. A key aspect in this is that the supply chain for LNG is rapidly maturing. There are of course other options, but for a large scale implementation a supply chain, mature fuel storage technology, safety rules and experience and also economical aspects play a vital role. What is not to like about large benefits today and a clear path towards near-zero climate change impact?

Stiefel, WinGD The next big thing on fuels is LNG. We are a long way from identifying a fuel which offers the same viability, in terms of infrastructure, beyond LNG at the moment. LNG is the necessary bridge which is getting us closer to a carbon neutral future. Already today about 30% of all new engines ordered to propel deep sea vessels are using LNG as fuel. The reasons are compelling: lower emissions, less CO2 and offered at a very attractive price compared to 0.5% igitiz fuels. As an entire industry, we need significant collaboration in order to bring the next future fuel to the same level of availability. The uptake of alternate fuels such as hydrogen and ammonia in short-distance routes are exciting, progress is happening. But the viability as a fuel for ocean-going vessels is just not there yet. That's why LNG is the right choice now.

Brown, Cummins Diesel continues to be the most viable fuel right now and probably in the foreseeable future for our marine customers. While there are ongoing discussions around alternative fuel sources, such as natural gas, LNG, methane, and electric, there is no one standout among them. For the industry to switch, mariners will want to see that a new fuel is a viable and dependable option, and that the global infrastructure exists to support it. If diesel prices were to increase, it could possibly open the market to wider adaptation alternatives such as LNG. But it would require a massive updating in infrastructure within the shipping industry for alternatives to be used on a wide scale.

Put in perspective 'Autonomous Marine Operations'. What is your definition, and is it a real conversation with your clients today, or a topic far in the future?

Aabo, MAN ES It is difficult to say; to me it seems quite unrealistic to have completely unmanned ships for the safety factor alone.

Today we from time-to-time see issues happens with the electronic and mechanical equipment on board have to fixed on the spot … is it realistic to think that everything can be fixed remotely?

Stiefel, WinGD The WiDE (WinGD Digital Expert) system we offer improves the way operational data on a day to day basis is analyxed to improve operations and predict maintenance. Nevertheless, such

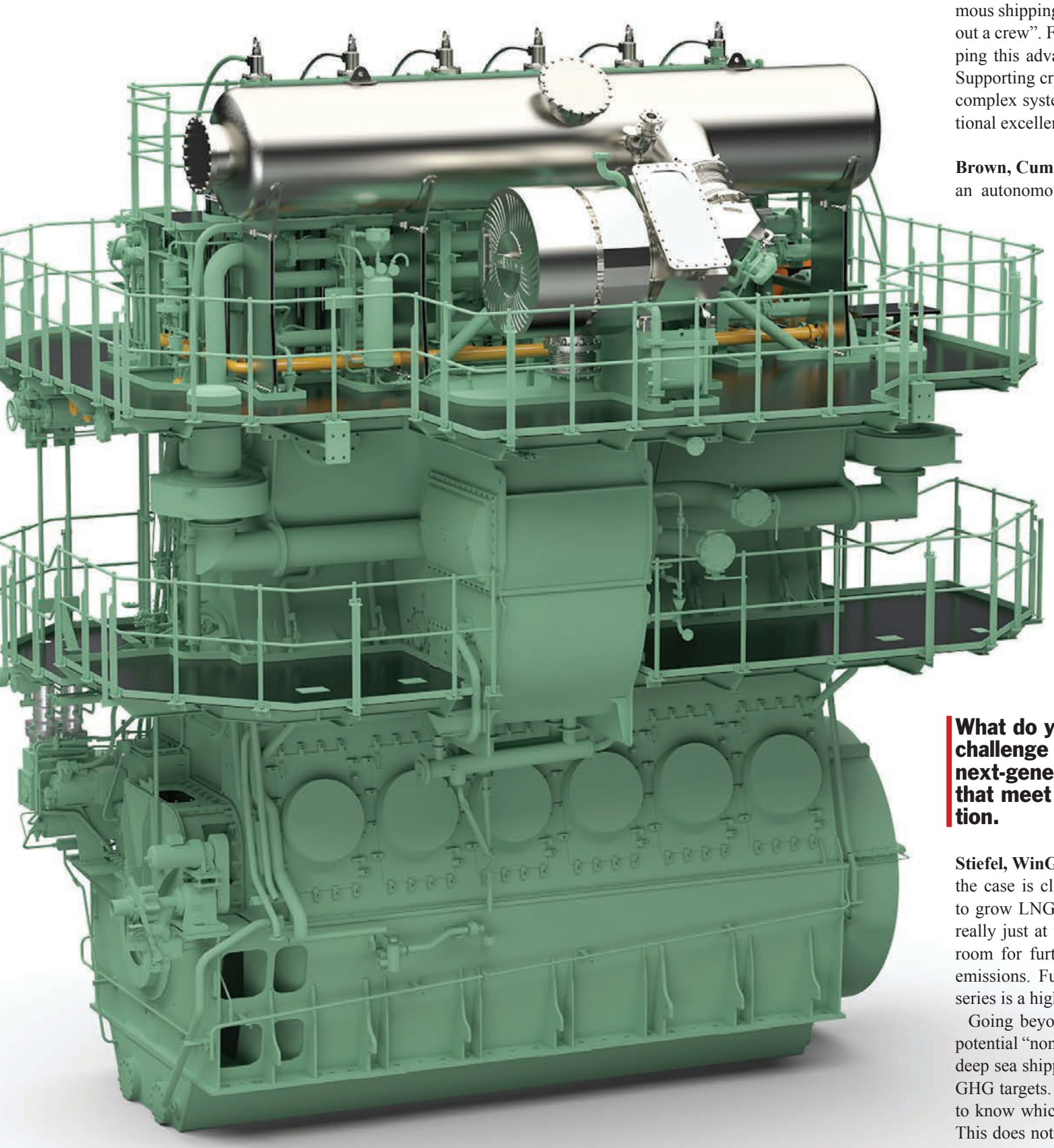


Image: Winterthur Gas & Diesel Ltd

WinGD X92DF Engines Power CMA CGM's Largest Containerships

a system is still far away of enabling an "autonomous shipping" if this should mean a vessel "without a crew". For the moment for the deep sea shipping this advancement looks to be still far away. Supporting crews to be better able to deal with the complex systems on board and to improve operational excellence is our primary target.

Brown, Cummins The traditional definition of an autonomous vessel piloting itself across the ocean means very little to the engine. But when you look at the broader need for less human interaction for maintenance, diagnostics and repairs, this is where Cummins has been working with customers to adapt, develop, and implement technology.

An engine controlled remotely, running longer between service intervals, performing standard maintenance on itself and diagnosing its own problems. Cummins is already deploying this kind of technology across various platforms.

I think there are pockets where autonomous marine operations make sense today, but as far as widespread adoption in the marine industry goes, there are still many factors to consider.

What do you count as the biggest challenge to produce innovative, next-generation propulsion plants that meet or beat emission regulation.

Stiefel, WinGD For the next decade or so the case is clear: There is still so much capacity to grow LNG as fuel across our industry. We are really just at the beginning with LNG so there is room for further improvement of efficiency and emissions. Further developing our X-DF engine series is a high priority.

Going beyond 2030 there needs to be a strong potential "non fossil" fuel which can be applied for deep sea shipping in order to reach the IMO 2050 GHG targets. The biggest challenge for us here is to know which fuel will be the one to be chosen. This does not only depend on what we (as engine designers) consider to be the best choice but what will be "left over" for shipping considering the needs of Power markets, road transportation, and air traffic, all facing the same challenges. We can't all compete for the same clean fuel – there needs to be an increased capacity across the board.

"Even if the future of shipping sometimes seems less clear today than it did 10 years ago, ***operational and fuel flexibility remains one of the key elements to reduce investment risks in cutting edge technology. We need to ensure that our solutions work as well in the future as they do today. Flexibility is key in meeting that promise."***

Sebastiaan Bleuanus
General Manager of Research Coordination and Funding, Wärtsilä

Brown, Cummins We believe tough but fair regulations can be a key factor in driving innovation. Regulations can create clear goals and a level playing field for companies to innovate. But the regulations must be enforced. If enforcement is inconsistent, the only loser is the one who complies.

As the potential impacts of emissions on our environment becomes increasingly clear, more countries are embracing tougher standards. In areas other than marine, we're seeing more consistency and that bodes well for innovation and the future. But even more consistency would make it easier for companies in our industry to innovate.

Bleuanus,, Wärtsilä System integration. Besides using low net-carbon emission fuels, we need to increase ship efficiency in any way we can. Not just during seatrials, but even more in actual operation. This calls for greater system integration, system flexibility, robustness and intelligence.

Aabo, MAN ES When you operate on low sulfur fuel oil you need a low BN lube oil, and it can be difficult to get a lube oil with the needed detergency. For engines operating on low Sulphur Fuels , including, gaseous gases LNG, Ethane and liquid gases as LPG, Methanol, NH3 LVOC lube oil detergency is quite important.

As emission regulations get stricter, in regards to Particulate Matter (PM) and Nox, really the biggest challenge when we talk about the marine industry is that marine is everywhere. Differing, local and national regulations make it a challenge.

The IMO last year dropped the gauntlet to reduce maritime emissions 50% by 2050. Is that target achievable, and if so, which fuels or technologies will be key to success?

Stiefel, WinGD Yes, the target is achievable. It will need broad collaboration in the industry looking at the entire ship and the full logistic chain. To some extent, non-fossil fuels will be needed in this equation.

Brown, Cummins Cummins is working on its own environmental sustainability plan right now tied to 2050 that will be announced later this year. So, it's a topic getting a lot of attention at every level of our company. In addition, technical innovation is happening faster now than maybe at any time in our company's 100-year history. So, it's hard to predict what technology we'll use or the fuels that will get us where we want to go.

Bleuanus,, Wärtsilä These targets are definitely achievable. Efficiency measures and technologies on a vessel level are key to reduce the fuel consumption. It looks like such technologies can take us roughly to the 2030 target of 40% less emissions per average vessel compared to 2008. Beyond that, low net-carbon emission fuels are absolutely needed and we believe bio- and synthetic LNG, utilized in the same supply chain and vessels as today's fossil LNG is one of the key fuels for this and also the one that meets all targets in the most economically feasible way.

Same Question as above, but comment on the prospects of zero carbon emissions?

Bleuanus, Wärtsilä Same answer; in practice we believe that on an average vessel level, an 80% cut in emissions is actually needed to meet the -50% on a fleet level. This is because the fleet is set to grow significantly out to 2050, and it also means that a certain amount of ships already need to be zero emission to compensate for (older) vessels that cannot economically make such deep cuts. Moving to net zero for the entire fleet then simply means removing these (older) vessels from the fleet, which will happen as and when newbuilt replacements are made.

Aabo, MAN ES We can reach it if we had "white" Ammonia or hydrogen produced by sustainable sources available but if using the more traditional carbon fuels we can reach some in that direction. But it is important to realize that It is not just the engine, it is the shape of the hull, it is the speed that the ship operates. In the lates 1980s AP Moeller adopted a Waste Heat Recovery system, a move that resulted in a 10% efficiency boost just by using waste heat. But the installation cost is high..

Stiefel, WinGD Quite a challenge and raising the bar. I believe a "carbon neutral" future is more realistic for shipping. That in and of itself will be a great achievement.

Please discuss a recent product (or service) introduction(s) that you see as truly transformational for owner/operators of commercial ships and boats.

Aabo, MAN ES Last year we launched the LPG engine and we already have a number of orders and retrofits for LPG carriers.

Stiefel, WinGD The introduction of the WinGD X-DF low pressure gas engine has been transformational for shipping. Launched in November 2013 we have secured more than 200 engine orders to date and have achieved almost 100% of the market share when two-stroke DF engines are selected. We understand the pressures faced by today's shipping industry and simple solutions are key. Our X-DF engines offer ship owners a proven, reliable way to improve their environmental footprint while at the same time, increase efficiency while maintaining simple, and safe operations.

Brown, Cummins Earlier we mentioned Enhydra, the large excursion boat now based in San Francisco. Some are calling the 600-seat vessel one of the "greenest" boats in America. It has a lithium-ion battery-electric hybrid propulsion system that can complete extended cruises completely on electricity. Each of the vessel's two screws are connected to generators powered by 410-horsepower Cummins QSL9 diesel engines.

Also, in March of 2018, Cummins announced that Azam Marine had selected two QSK95 engines to power its next passenger ferry, the Kilimanjaro VII, which will operate between the islands of Zanzibar, Pemba and mainland Tanzania. The QSK95 is the largest engine diesel engine Cummins makes.

The high-speed diesel engine offers a power output previously exclusive to much larger medium-speed marine engines with power ratings from 3,200 to 4,200 horsepower for propulsion, auxiliary, generator and diesel electric applications. The QSK95 has a lower capital cost, more compact installation and exceptional fuel efficiency when compared to other engines in its class, which translates into lower greenhouse gases.

Also in 2018, Cummins announced that a version of its popular X15 engine was available for commercial marine markets including inland waterways, commercial fishing and passenger transport. The marine X15 is designed to withstand high hour, continuous duty operation, offering variable speed and fixed speed ratings between 450 horsepower (336 kW) and 600 horsepower (447 kW), while meeting EPA Tier 3 and IMO Tier II emission standards.

Workboats

A deep dive into the trends driving the U.S. Workboat Market.

By Barry Parker

The towing and tug business, with 5,500 boats and more than 31,000 barges, is an economic juggernaut. A 2017 study commissioned jointly by the U.S. Maritime Administration (MARAD) and the American Waterway Operators (AWO) by consultant PriceWaterhouseCoopers (PWC) estimated a total impact on U.S. GDP of $33.8 billion, using 2014 data. Cargo statistics reflect vast quantities of materials moving. U.S. Army Corps of Engineers (USACE) data for 2017 shows domestic commerce on the water of 873 million short tons (s.t.), which includes 164 million s.t. coastwise, 535 s.t. million internal (on the rivers and ICW), and 91 million s.t. intra-port. The business, often mischaracterized as traditional and slow-to-change (perhaps because of its reticence for publicity), is moving briskly on a forward course, responding to regulatory mandates, technological innovation and to broader economic challenges.

The Major Players

Along the coasts, Articulated Tug Barges (ATBs) continue to gather share. Vane Brothers, long a mainstay in the bunkering trades and in clean and dirty fuels transportation along the U.S. East Coast- what the USACE would call coastwise and intraport, provides an example of the industry's direction. With a fleet of more than 50 tugs and 75 barges, including three new ATB units, the company has recently expanded to the West Coast with bunkering in Puget Sound, and cargo transfers with one of the new ATBs in California ports.

The movement to the West Coast saw a Panama Canal transit for its ATB Assateague (4,400 horsepower, paired with the 80,000 bbl barge DS-801), working in Los Angeles, the first of three units built at the Conrad yards in the U.S. Gulf. The third unit, ATB Wachapreague, working in the fuel trades from the U.S. Gulf refineries into the East Coast, was delivered in early 2019.

Reinauer Transporation, well known

Inland pushboat and barge.

Image: Kirby Corp.

The U.S. towing and tug business is 5,500 boats, more than 31,000 barges with an estimated total impact on U.S. GDP of $33.8 billion (using 2014 data).

in the Northeast, recently completed its 8,400 hp Bert Reinauer at its owned yard, Senesco, paired with a 160,000 bbl barge. Bouchard Transportation, another stalwart along the East and Gulf Coasts, has also added ATBs to its fleet. In March, 2019, the New York area based company linked together its 4,000 hp Evening Breeze/B. No. 252 (55,000 bbl) from the VT Halter yard (tug) and Bollinger (barge). The 50,000 bbl size is an important niche for movements along the East Coast. Vane has fitted two tugs (Jacksonville – already working around New York, and the soon to be delivered Charleston, built at St. Johns) with coupling systems to handle barges in this size class.

The figurative 800-pound gorilla in the room is Kirby Corporation (NYSE: KEX), which is also active in this sector on all coasts, with a deep sea fleet of 50 boats and 53 barges (with more than 1/3 in the 80 kbbl- 90 kbbl sizes) at end 2018. Crowley Maritime, also a major ATB owner, is also a big participant in the coastwise. Its 18 ATB fleet includes a trio with barge capacity of 330,000 barrels.

On inland river system Kirby is the leader in the liquid segment (with approximately 26% of total inland capacity), Q4 2018 results indicated a firming marketplace. With a fleet of more than 1000 tank barges barges (total capacity on the order of 23 million barrels) and more than 300 inland towboats projected at the end of 2019, fleet growth has been fueled by consolidation (rather than through newbuilds). Early in 2018, Kirby acquired Higman Marine Inc. with 159 inland tank barges and 75 boats. Also, 27 additional barges joined the KEX fleet in late 2018 in a deal with CGBM, and in January 2019 announced a $244 million acquisition of Cenac Marine Services and its 63 barges (30,000 bbl) and 36 boats.

Other carriers in this segment include privately owned Canal Barge Company (also active in dry), Magnolia Marine, Florida Marine Transporters (also active in dry) and Southern Towing. The dry sector, where privately held Ingram Barge, based in Nashville, has the largest fleet, has seen restraint on new ordering in recent years. Other large players include American Commercial Barge Line, and American River Transportation (linked to agribusiness

Ardmore Seamaster & RTC 102

Image: Karatzas Maritime

Crowley response tug.

Image: Crowley Maritime

giant ADM). Grain major Bunge Corp, through an arrangement with Seacor Holdings Inc. (Seacor), controls a large dry barge fleet and Marquette Marine (also active in grain trades).

"Our inland marine transportation business experienced robust levels of activity, which resulted in tight market conditions and barge utilization levels for our fleet in the low to mid-90% range," KEX President and CEO David Grzebinski told investors, on its conference call detailing 2018 Q4 results. "With these tight market conditions spot market rates increased in the mid to high single digit range compared to the third quarter."

KEX says that roughly 65% of business is tied to "term" contracts.

The Role of Regulation

Much like all maritime sectors, regulatory mandates are driving some of the changes underway in the towing sphere. Subchapter M rules, enacted in 2016 with a compliance date of July, 2018, have mandated inspections (by the U.S. Coast Guard, by third parties such as American Bureau of Shipping or other recognized auditors, through AWO's "Responsible Carriers Program" or "RCP"). According to AWO, which worked on the program with the USCG since 2003, "Subchapter M is the most important rulemaking ever to affect the tugboat and towboat industry."

The initial issuance of actual Certificates of Inspection (COIs) for towing vessels will be phased in through 2022 (where a phase-in schedule requires 25% of fleets should be inspected by July 2019, one year into the program). Some of the first COI's issued were issued to well-known names; Endeavor, in the fleet of Dann Marine Towing, based in Tampa, and Vane Brothers 6,000 hp vessel Brandywine (built 2006 for ATB service, coupled with a 140,000 barrel barge) were early COI recipients. Subchapter M also impacts equipment serving the inland waterways; the towboat Sacred Heart (built 2007) owned by Marquette Transportation gained its COI around the same time.

The industry is now on a path to Subchapter M compliance. USCG spokesperson, Lt. Amy Midgett, told Maritime Reporter & Engineering News: "In accordance with Subchapter M regulations, owners and operators of more than one towing vessel are responsible for ensuring that 25 percent of their fleet has received a COI before July 22, 2019. Owners of a single towing vessel have until July 2020 to obtain a COI."

A Foss Tug.

Image: Jensen Maritime, a unit of Crowley Maritime.

The sidebar (see related story on page XX) provides further detail on COIs issued thru late April, 2019.

The changes wrought by Subchapter M were evolutionary not revolutionary for many larger veterans of the business that had already implemented safety programs, including the RCP. Consider remarks by Bruce Reed, Vice President/Chief Operating Officer at Tidewater Barge Lines who explained in an AWO webinar regarding Subchapter M implementation: "… we used the RCP as our playbook…" for developing requisite Safety Management System (SMS), working with ABS. Rick Iolucci, General Manager at Vane Brothers, where operations extend to the blue water, explained that SMS were drawn from both the RCP, but also from the International Safety Management (ISM) code, also using ABS as a third-party organization.

Environmental regulations also loom large, with newbuild tugs now transitioning to EPA Tier 4 emission standards. ATB newbuilds Bert Reinauer and Bouchard's Evening Breeze both meet the EPA restrictions on NOx and particulates. Bouchard has another ATB, Evening Stroll, due to be delivered later this year from VT Halter. Early on, in advance of the Tier 4 requirements for mid-sized engines, inland powerhouse Ingram Barge retrofitted three of its boats with kit provided by GE Marine Solutions (using exhaust gas recirculation), which were also the vendor to Reinauer.

"At a macro level, ***the bigger ships are causing downward pressure on the ship assist business*** because there are fewer ship calls given the increased capacity of these vessels. ***However, certain ports have seen tremendous growth,*** based on strategic location and infrastructure investments that have attracted these larger ships and been a net plus for these areas."
Kate Fuhrman, Crowley Marine Services

Bigger Ships Demand Bigger Workboats

The increasing sizes of deep sea vessels are dictating the need for highly maneuverable but more powerful harbor boats. Kate Fuhrman, Director, Business Development, ship assist and escort services, Crowley Marine Services, told Maritime Reporter, "At a macro level, the bigger ships are causing downward pressure on the ship assist business because there are fewer ship calls given the increased capacity of these vessels. However, certain ports have seen tremendous growth, based on strategic location and infrastructure investments that have attracted these larger ships and been a net plus for these areas." She explained further: "When these bigger ships do reach their destination, they generally either need a tug with higher bollard pull than usual or an additional tug to help maneuver to berth. Crowley is active all along the West Coast (which has seen calls by containerships handling as many as 18,000 TEUs).

McAllister Towing, active in ship assist and docking all up and down the East Coast, has recently seen upgrades to its fleet, built to Tier 4 specifications

Image: Karatzas Maritime

Moran Tugs with NYC's World Trade Center in the background.

with Caterpillar engines. Two 6,700 hp tractor tugs have already been delivered and are now stationed in New York and Norfolk.

Another two, Ava M. McAllister and Capt. Jim McAllister, are set for delivery from Eastern Shipbuilding, later in 2019. In early 2019, Moran Towing, based in southern Connecticut and active on the East and Gulf coasts, announced that it had ordered a design contract (to Jensen Maritime, a unit within Crowley Corporation) for Tier 4 tugs with Rolls Royce Z drives, to be equipped with Caterpillar engines, that would be used for ship assist and escort work.

On the West Coast, Foss Maritime (which closed its own West Coast yard in late 2018) has placed a four vessel order (with options for six additional vessels) for tractor tugs to be built at Nicholls Brothers, also using a Jensen Z-drive design. The boats, which would be used, similarly, for harbor towing work, will be equipped with MTU engines.

Monitoring the Energy Markets

Developments in the energy markets are set to impact the tug business in the harbors, in addition to the increasing Jones Act ATB moves along the coasts. Crowley's Fuhrman said "we are certainly seeing more activity and interest in terminal tug agreements as midstream/downstream players are attempting to build out dedicated export terminals on the Gulf Coast. While only a handful of those announced will likely make it to market, those that do will require dedicated tug resources ensure timely loading and departures and will create a new, niche market for tug providers in this region."

Still another trend worth watching is the role of Americas Marine Highways (AMH), an effort spearheaded by the U.S. Maritime Administration to shift surface transportation onto the waterways. The latest round of America's Marine Highway grants, announced in April 2019, included $3.2 million for a container on barge service, operated by Seacor AMH (part of Seacor), between New Orleans and Baton Rouge, with the two ports receiving the grants.

Coast Guard: Stay Ahead of Inspections

"If you have not already done so, the Coast Guard highly encourages you to make contact now with the local OCMI that will be conducting the vessel's initial COI and schedule an inspection date," said Lt. Amy Midgett. "While we understand the dates may shift due to operational obligations, a tentative date will help the Coast Guard manage resources to ensure a marine inspector is available. When scheduling an inspection, indicate whether the vessel will be using the Coast Guard or TSMS option. Total COIs issued as of April 22, are 534-sorted by Coast Guard district, follow. In addition, there are 371 COI applications currently being processed."

1st District:	36
5th District:	27
7th District:	29
8th District:	377
9th District:	17
11th District:	5
13th District:	32
14th District:	5
17th District:	6
Total COIs issued:	**534**

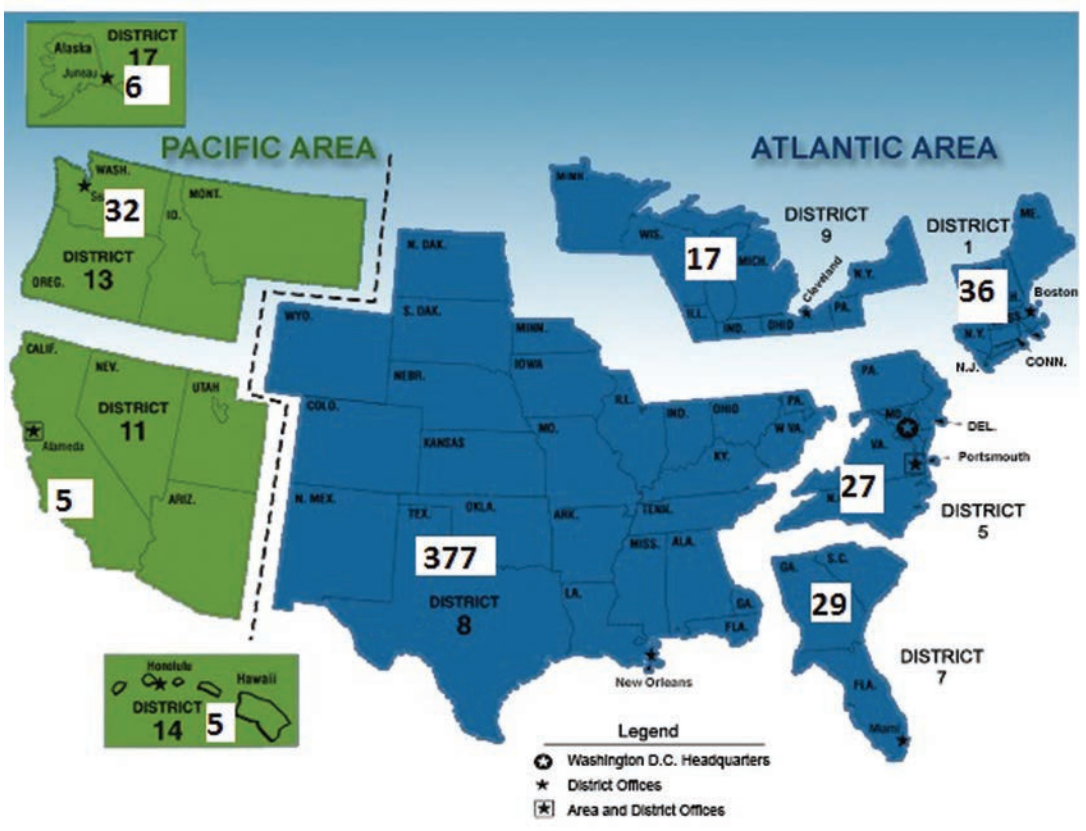


Image: USCG

Ferries

A look inside the fragmented ferry industry, which recently held a Ferry Safety & Security event in Bangkok.

Alan Haig-Brown reports from Thailand

"Death Toll in Phoenix Boat Accident Rises to 44" ... "Deadly Fire Aboard Ferry Norman Atlantic" ... ***"Lake Victoria, Tanzania: Dozens drown in ferry capsize"*** ... "Ferry Capsizes in Mosul, 80 Feared Dead"

Such headlines have become all too familiar in the world of marine ferries from small passenger only boats to large RoPax vessels. They occur from Asia to the Americas and Africa to Europe. A significant number of experts are working to reduce the headlines while increasing the safety of ferries.

Dr. Roberta Weisbrod, Executive Director and founder of the New York-based Worldwide Ferry Safety Association has long been a leading activist in the cause. This past February she spearheaded a conference on Ferry Safety and Security held in Bangkok Thailand.

It was sponsored by Bangkok's Chao Phrya Express Boat Company, Manila-based Archipelago Ferries, Vesseltracker.com, along with the Damen Group, FRS, EA Mechanics and McLaren Engineering. With a tight agenda over a day and a half the conference limited official introductions and got down to work with a panel of presenters titled "Good News About Ferry Systems".

Two presenters went to the heart of ferry safety for Indian and Bangladesh. World Bank Transport Specialist Rajesh Rohatgi explained how the inland waterways offer potential for economic integration of Bangladesh, Bhutan, India, and Nepal. However, he explained there is a huge need for the further development of public and private ferry fleets, terminal infrastructure with "last-mile" connections, as well as navigational aides and infrastructure. The World Bank is currently working on a project to promote this for the area.

Without making excuses for the poor safety record of Bangladeshi ferries, the country's Director-General of Shipping, Commodore Syed Ariful Islam, explained some of the challenges. For those who have not read Amitav Gosh's great novel The Hungry Tide, set in the Indian Sundarbans, the mangrove forested area extending from India into Bangladesh, Islam catalogued the challenges of maintaining an infrastructure for ferries. This is an area of incessant tidal and weather changes to the mud banks of the islands that make up much of southern Bangladesh along the Bay of Bengal.

The causes of 3,633 ferry related deaths between 1991 and 2018 have been investigated. Among them are, collision, overloading, inclement weather, fire and explosion and bottom damage all contributing to the total. It has been ascertained that the most important preventive actions will include training and education of the ship's crew and improved aides to navigation.

Photo Courtesy Alain Haig-Brown

Dr. Roberta Weisbrod, Executive Director of the Worldwide Ferry Safety Association, was did much to spearhead the Ferry Safety Conference in Bangkok.

A Different Approach

A very different, albeit more focused, approach to ferry safety for developing nations, was explained by Seattle based naval architect John W. Waterhouse, of Elliott Bay Design Group. Waterhouse and some associates were looking for an African project. Noting the lack of a maritime navigation culture around the huge Lake Victoria, they researched the needs of an offshoot, the Winam Gulf. Entirely in Kenya, this body of water is about 35 miles long and 15 miles wide.

Road conditions in the area are bad in the dry season and virtually impassable in the rainy season. A ferry crossing of the Gulf will take 60 minutes. By road to go around the Gulf, even in the dry season, will take 155 minutes. The key to a successful operation will be control of as many variables as possible. Beginning with a main depot and waiting room, toilets and fueling, the company will ini-

Photo Courtesy Alain Haig-Brown

One of the fleet of Archipelago's Australian-designed FastCat ferries.

tially have only one secondary terminal with a third to be added.

The first of two 23.8 by 6.25-meter boats capable of operating at 23 to 24 knots with a pair of 339 kW engines and jet drives, to avoid the lake's water hyacinth, will be ordered from an Australian builder in March of 2019. Delivery of the first two ferries is planned for the fourth quarter of 2019 with the start of service in the first quarter of 2020. Additional boats and up to five routes are planned. Safety of operations is built in with crew training and certification handled by the company. Similarly operating and maintenance procedures will be designed and managed in house.

Another naval architect presenting to the conference was Anders Ørgård of the Danish firm OSK-ShipTech A/S. Ørgård's interest was in the development of the world's largest battery-operated ferry for Scandlines. But he had a number of other interesting observations: a designer should know an owner at least two years prior to embarking on a major design-build project; diesel-electric ferries can be designed to take advantage of energy saving when going downstream, that can them be used when going upstream; given currents and other vessel traffic, ferries do not travel in a straight line between ports A and B; diesel-electric propulsion can be an important asset in meeting the Paris Accords on global warming.

Tech Focus

AIS, the automatic identification system for marine vessels, received extensive attention at the conference. The system is mandated by the IMO for all ships of 300 gross tonnage and upwards engaged on international voyages, cargo ships of 500 gross tonnage and upwards not engaged on international voyages and all passenger ships irrespective of size. These requirements have been in effect since 2004.

US Coast Guard Captain Kevin Kiefer explained how the addition of weather and navigation information via enhanced AIS messaging had been beneficial on the Ohio River. The Coast Guard maintains 129 towers on the inland waterways. These each have a range of about 24 nautical miles. In this manner it has been possible to cover the entire river and to deliver, not only locational data, but also weather and navigational information such as high and low water notes to towboats and other vessels using the waterway. A similar system is being developed for coastal Alaska.

Karsten Pedersen, CEO of Aerial Maritime, explained that his firm's proposed satellites will dramatically improve the current system of offshore coverage. Utilizing nano-satellite technology they will make global coverage affordable and, unlike present systems, rapid and accurate. Using a combination of satellite and ground stations he promised a 1.5 second latency and an eight second update rate.

David Hewson from Vessel Tracker together with IMO expert Nurur Rahman explained that AIS, in combination with Vessel Tracker's antenna system, is already making a contribution to ferry safety worldwide and specifically in Bangladesh. Rahman, who is also on the board of the Worldwide Ferry Safety Association, said that, "through our growing collaboration over the last three years, we have come to believe that AIS technology is one of the most powerful and cost-effective tools available to im-

Photo Courtesy Alain Haig-Brown

One of the new Hop-On-Hop-Off Tourist boats approaches a pier on the Chao Phraya River while one of the wooden Express Boats departs.

Photo Courtesy Alain Haig-Brown

Ralf Lange, Director of Safety and Security for the international ferry firm FRS, explained some of the faults that he finds behind apparently benign surface appearances when he inspects ferries.

John Waterhouse of Elliott Bay Design Group was conference MC and presented on a ferry project that he is involved with for Lake Victoria.

Photo Courtesy Alain Haig-Brown

prove worldwide ferry safety, especially in developing countries."

Hewson added that of the five top causes of ferry accidents, three; human error, weather, and navigational issues can be corrected by use of enhanced AIS. With regard to human error, he pointed out that monitoring of the AIS encourages safe and responsible behavior, and helps shore-based operations teams support vessel crews. Weather information can be gathered from tracking other vessels, or the AIS is used to transmit real time weather reports. Real-time awareness of navigational issues helps avoid collisions, and grounding. Long–term analysis helps identify risks in busy waterway as has already been done in the Bosporus, New York Harbor, and Jacksonville, Florida.

In recent years Thailand has been troubled by drowning of passengers traveling to the islands in overloaded tourist boats. Khun Thanatip of the Thai Marine Department pointed out that a series of conditions caused one such accident. The vessel Phoenix was returning to Phuket when it rolled and sank in heavy weather. Resulting in 47 people drowning of a total of 89 onboard.

Four measures have been taken to reduce the chance of such disasters in the future. Vessel Traffic Management will issue twice daily weather forecasts, the Marine Department and related agencies will promulgate navigation and weather warnings, vessel owners and operators will be required to set up a safety management system, a training syllabus for domestic ferry passengers will be developed, and ship survey regulation relating to structure, damage stability, ballasting, and crowd management will be revised. Policing and enforcement of the improved regulations remains a challenge.

RoPax vessels, routinely carry trucks loaded with unknown cargos as well as cars with dubious electrical systems. Indonesia and the EU continue to review fires aboard such vessels in their waters. In a comprehensive presentation, Aleik Nurwahyudy, of the Indonesian National Transportation Safety Committee, showed a graph of RoPax accidents in Indonesian waters between 2007 and 2018. Of 32 investigations carried out 17 involved fires.

While not all fires originated on the car deck, it was those that caused the most damage and loss of life. He cited failure to identify the source or type of fire, limited access to the fire origin site, tight vehicle stowage, ineffective suppression systems and unskilled crew as some of the contributing factors to fatal fires. Aleik's analysis and recommendations were

Photo Courtesy Alain Haig-Brown

Adam Schwetz of the Australian firm Schwetz Design explains the finer points onboard the new Chao Phraya Tourist boat.

The causes of 3,633 ferry related deaths between 1991 and 2018 have been investigated. ***Among them are, collision, overloading, inclement weather, fire and explosion and bottom damage all contributing to the total. It has been ascertained that*** **the most important preventive actions will include training and education of the ship's crew** ***and improved aides to navigation.***

comprehensive and detailed.

In a similar vein, Gianluca de Rosa, of the Italian Ministry of Infrastructure and Transport, gave a breakdown of two RoPax fires. The M/V Norman Atlantic caught fire in Otranto Strait on December 28, 2014. There were 18 fatalities. Just 88 passengers and crewmembers escaped the burning ship by lifeboat. The open sides on the car deck fed oxygen and caused the fire to spread rapidly.

The M/V Sobrrento caught fire of Palma di Majorca on April 28, 2015. There were no fatalities or injuries and all crew and 196 passengers escaped the burning vessel by lifeboat. The cause of the fire was traced to a faulty plug in on a reefer truck. Lessons learned from both fires are included in a report to IMO and are being included in new regulations for RoPax vessels.

On the second and final day of the conference a presentation by the IMO's Irfan Rahim explained the his organization is currently surveying domestic ferry operators for examples of best practices. He stressed the limitation of IMO in regulating domestic ferries that are not governed by SOLAS or MARPOL regulations. Rahim has been tasked with collating feedback and presenting a set of guidelines for domestic ferry operations by June of 2020. He can be contacted at the London IMO offices,

Mary Ann Pastrana of the Archipelago Philippine Ferries gave a delightfully enthusiastic description of the fleet of FastCats that she and her husband have created. They currently have 12 of the Australian-designed, China-built RoPax vessels in their fleet and are expecting eight more this year. Plans call for 10 sister-ships by 2020 to bring the fleet up to 30 vessels. Although all will be catamarans, they will range in size from 50 to 54 meters in length.

Interestingly, in spite of the Philippines being the largest sources of deep-sea ship's crews, they have trouble recruiting experienced crew. Although they pay 30% more than most domestic lines, "we are left with young people or the less committed older ones," she said, adding that, in regard to safety and maintenance, "There is a tendency to say, 'It is only domestic' and neglect safety and maintenance."

To counteract this, the company has developed a sophisticated set of strategies to attract and develop excellent crews. "We wear uniforms," she explained, "We provide dormitory housing, no one sleeps

Photo Courtesy Alain Haig-Brown

Mary Anne Pastrana, EVP of Archipelago Philippine Ferries, explained the rapid growth and staffing challenges for its FastCat ferries.

Mrs. Supapan Pichaironarongsongkram, Chairperson of the Chao Phraya Express Boat and related companies, explained the three generation history of her firm.

Photo Courtesy Alain Haig-Brown

on the boats, We build pride with our motto: 'Ferry fast, Ferry safe, Ferry convenient.""

Most importantly the company has developed a relationship with Seaversity. This institute has developed sophisticated training programs that rely extensively on digitized representation of the ferry and mechanical components. "Before taking then onboard, we give a virtual tour," explained Seaversity's Ephrem Dela Cerma, Jr. "When we want to train on servicing a specific component like a generator, rather than have 20 students crowded around a single generator, we recreate it digitally and all 20 can have their own to work and learn on."

As one of the final presentations, the group was given an overview of the three generations of women who have operated the Chao Phraya Express Boat Company. Khun Supapan's grandmother, an aristocrat originally from Chaing Mai was given a charter to operate a cross-river ferry in Bangkok. Over time she, her daughter and now her granddaughter have built that cross-river ferry business into a fleet of 90 boats. The core of this business is the Chao Phraya Express boats, sleek wooden-hulled boats central to many workers' daily commune avoiding Bangkok's traffic clogged streets.

Khun Supapan explained that the river, with it burgeoning restaurants and shopping malls, is increasingly a destination for Bangkok's citizens seeking entertainment, shopping and food. The river, lined with spectacular temples, also attracts a lot of tourists. To meet these diverse needs, her firm has developed subsidiaries to convert classic wooden boats to water taxis to deliver people to high end restaurants, other boats are contracted to move shoppers from a sky-train terminus to hotels and shopping centers.

Most recently Khun Supapan has contracted Adam Schwetz, of Schwetz design in Freemantle Australia, to develop an aluminum catamaran tourist boat. With the metal cut and shipped to Thailand in kit form, the first boat is in service and a second is being assembled in the Express Boat's Ayutthaya Shipyard. This, and subsequent boats under construction, provides "hop-on-hop-off" service for those who buy a day pass to explore the river. The newest 190-passenger craft is a contrast to much of the classic wooden vessels that work on the river, but it is also a significant step by a well respected firm to maintain contemporary standards of service and safety.

The packed agenda of the 2019 Ferry Safety and Technology Conference marks a long-term commitment to progressive ferry design and safety by the members. Looking to the future, the Worldwide Ferry Safety Association, under Executive Director Roberta Weisbrod, continues to sponsor safe ferry design completions amongst maritime design schools. The 2019 competition was to design a safe and practical commuter ferry for Manila's Pasic River. The top three competing teams were brought to the conference to present their designs and to receive awards, with the Singapore Institute of Technology team picking up top honors. This was an impressive show all around.

Keith Henderson
Keith Henderson has been a contributor to New Wave Media publications for a number of years. Since 2001, he has been active in the Unmanned Surface Vessel business and is currently a Manager at Robosys Automation.

Put to the test: Autonomous Navigation

Global activity on the subject of unmanned vessels is gathering momentum as we read almost weekly of new developments in this field. In March, on the North Sea off the Netherlands coast, an autonomous navigation system supplied by Robosys Automation underwent a two day sea trial choreographed by MARIN under the auspices of a Netherlands Maritime Technology Joint Industries Project. The live test on board the 26m Damen Fast Crew Supply Vessel SeaZip3, used two other ships, to test and verify collision avoidance and COLREGS compliance. The two other collision avoidance target ships, were Octans, a 30m Research Vessel and Guardian, a 66m Anchor Handling Tug Supply.

Two months previously, the autonomous system was successfully tested against 11 potential collision scenarios on MARIN's ship simulator: the safe behaviour of the software for the same scenarios would then be trialed live on the North Sea.

The tests covered head-on, crossing, failing to give way and overtaking situations with the second target vessel adding complications e.g. by "crowding" the test area. At all times the SeaZip reacted to the scenarios in a safe manner, although more time would allow better "tuning" of the system for optimum performance.

Looking at the subject of autonomous shipping. What are the limiting factors holding back the acceptance/availability of autonomous vessels? Once a vessel is clear of port and on the high seas can the destination track be set and the vessel left alone until it nears its destination? Of course not, but why not? There must be a navigation system that will avoid all static and dynamic hazards, preferably a weather input to avoid storms and take into account currents and tidal factors. Then there needs to be observation of COLREGS and the Law of the Sea. Although much of the navigational data can by pre-programmed, updates can be fed during a voyage using RF or satellite, the major assumption being that there are no other vessels in the area. But what if there are? It's not just a question of sticking a video camera on the bridge, that isn't sufficient.

Assuming a perfect Collision Avoidance System is available, are the other systems of the vessel offering 100% reliability? Last month we saw the Norwegian cruise ship Viking Sky drifting near the shore when her four engines suddenly stopped. We are expecting CAS to behave perfectly yet it can only do so if the vessel's propulsion and autopilot systems offer the same reliability. If autonomous ships are to become more common, the existing systems must improve their reliability.

Commercial vessels and many recreational vessels are equipped with AIS. This is a useful navigational aid and allows the details of other vessels in the vicinity to be plotted. Together with ARPA these tools go far in offering a solution to the dangers of collision at sea. However as with many things, "garbage-in" equates to "garbage-out," in other words when the AIS is transmitting false information, the alarms built into the bridge systems will not work and can mislead to such an extent that a collision can occur. Procedures must be introduced to ensure AIS is not generating misleading information. For smaller vessels overall safety would increase if AIS was required for these vessels.

In congested waters, a VTS (Vessel Traffic System) is often the solution, acting as an ATC (Air Traffic Control) on the water. While VTS is a major, if not essential way to reduce accidents, it still relies on the human element and humans do make mistakes. The aero industry has had it's fair share of accidents and to prevent mid-air collisions, their TCAS has been standardised and improved with great effect.

TCAS (Traffic Collision Avoidance System) is a stand alone situation awareness system that sets off an alarm when there is a danger of collision and more importantly instructs both aircraft what maneuver to make to avoid the collision. The instruction is paramount and (temporarily) overrules any ATC instructions. It is self contained and operates worldwide. It introduces the novel concept of machines talking to each other, a concept that we will see more and more on land and sea with the increasing introduction

Autonomy Put to the Test: The two collision avoidance target ships were Octans (R), a 30m RV and Guardian (L), a 66m AHTS.

Guardian image courtesy: Netherlands Maritime Technology

Octans image courtesy: Robsys

of unmanned systems.

An important advantage ships have over aircraft, is that their radar can see and track other vessels (ARPA) while aircraft cannot. Ship speeds are relatively slow, so hazardous situations (usually) develop slowly. Intership and VTS communications are usually by voice over VHF, offering opportunities for misunderstandings due to language pro/de-ficiencies, accents, dialects etc.

The establishment of communications to be available direct to ships in the area, in an electronic format that can be inputted to the ship's navigation systems would be a major improvement and would be of immediate use by CAS whether on manned or unmanned vessels. A global standard is needed so shore and ship can interact with each other, otherwise there is the danger that a plethora of incompatible proprietary formats will develop.

The COLREGS compliant Collision Avoidance Systems developed for autonomous navigation systems such as offered by Robosys, can also serve as a "navigation aid" for manned vessels, providing not only a collision warning alarm but suggesting a safe heading correction to avoid the collision. Fortunately on a ship things do not move as fast as in aircraft, so it could be setup so that after the collision alarm is sounded, if not cancelled or an avoiding action not detected, after for example a 60 second delay, the CAS would instigate avoiding action automatically. A suitable AIS text and/or voice message could be transmitted on VHF to warn other vessels.

Present rules and regulations were designed for manned vessels, so inevitably some rules will need changing. Who is the master of the vessel, is he on board by telepresence, in other word he is elsewhere but in command by radio link? And if the link is lost and the vessel sailing fully autonomously with the onboard computer(s) driving the ship?

Ultimately who is responsible? As with the recent Boeing 737 Max crashes, is it the pilot for not (knowing how to) switching off the erronous software, or Boeing, or the software designer, or the airline? This is a legal area that will have to be thought through as more systems and ultimately the whole vessel is unmanned. The first unmanned vessels are with us and will multiply. It offers great improvements in safety, efficiency and convenience and will open up many new possibilities that are yet to be discovered.

SeaZip 3 and Octans during autonomous trials on the North Sea, March 2019.

Image courtesy: Netherlands Maritime Technology

Maritime Training Insights Database (MarTID) 2019

Budgets Rise, Safety Rules, Autonomy Impacts

The second annual global Maritime Training Insights Database (MarTID) survey recently closed, and full results will be published in the June 2019 edition of *Maritime Reporter & Engineering News*, and will be made freely available on **www.martid.org**.

MarTID is a non-commercial, joint initiative of the World Maritime University, Marine Learning Systems and New Wave Media, publishers of *Maritime Reporter & Engineering News*. The 2019 report offers a few new features in the follow up to the 2018 report. To start, the 2019 report was themed to examine more closely the impact autonomy in the maritime space will have on training initiatives for current and future seafarers. In addition, the 2019 survey features three sections dedicated to insights from ship owner/operators, seafarers and marine training institutions.

While the full survey results are analyzed and finalized, here we offer a sneak look at some of the defining trends that have emerged:

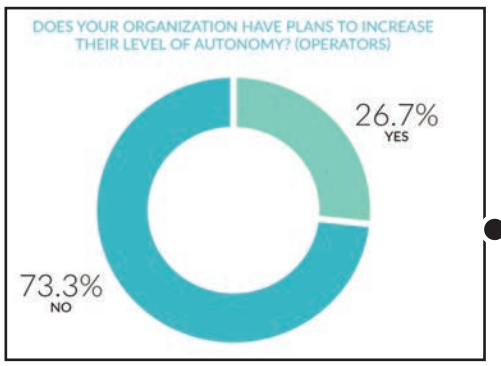
- **Autonomous operations** for vessel operators: Today: 62.5% are at no autonomous function; while 20 years from now 20% expect to reach AL4 (Human in the loop - Operator/ supervisory) and approximately 7% expect fully autonomous operations.
    - o **More than 70% of operators** do not have plans to increase their level of autonomy, and a similar percentage have not been having any discussion surrounding training needs for an autonomous future.

- The **top three drivers** for training for:
    - *o Vessel operators:* Reducing accidents, complying with regulations and managing crew competency
    - *o Maritime training institutions:* Complying with regulations, improving safety and improving crew competency, and for
    - *o Seafarers:* Safety, ship operations and security.

- **Maritime training budgets** continue to trend upwards, compared to the year before: more than 52% of vessel operators reported an increase in training budget, while over 62% of METI reported a larger budget for training. Around 60% of operators and 68% of METIs expect further increases in their training budget for the coming year.

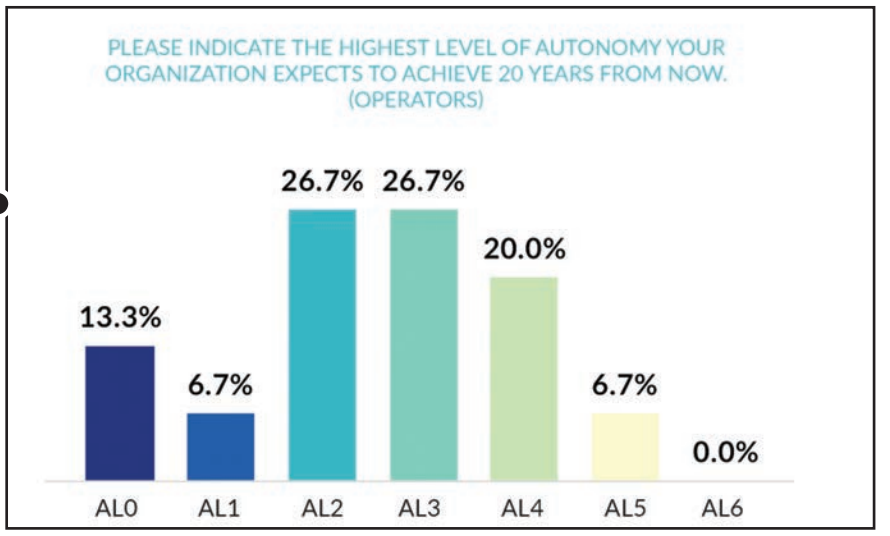
- Interestingly, more than 68% of **seafarers have increased their personal seafarer training expenditure** over the last five years, and more than 55% expect their personal training expenditures to grow in the upcoming year.

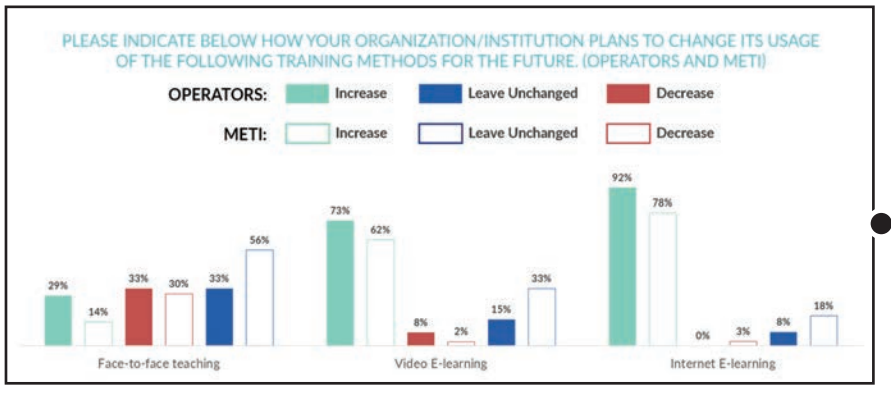
- For vessel operators and training institutions, only face-to-face classroom teaching anticipate a significant decrease in usage. Taking a look at operators in particular, **a majority plan to increase their usage of e-learning, both internet-based and video-based.** A majority of vessel operators also plan to increase their employment of mentoring and coaching.



PLANNING FOR AUTONOMY
Autonomy is not a priority for the majority of vessel operators, but for (an impressive) 26.7%, it is.

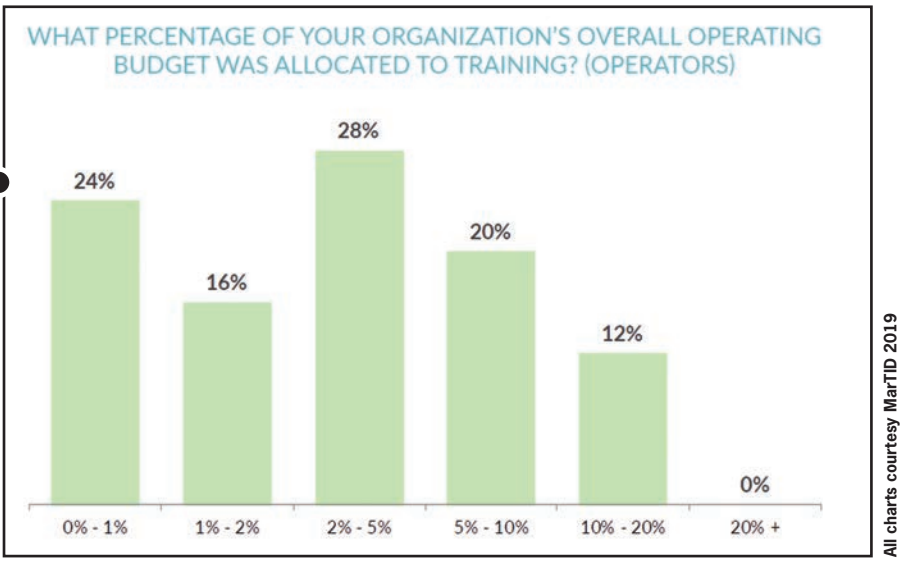
'FULL AUTONOMY' is more than a generation away.
It is a fair bet that 'full autonomy' will be the exception for the coming 20 years.





E-LEARNING, VIDEO ON THE RISE
Face-to-Face training will take a hit as technology evovles.

RISING TRAINING BUDGETS
Increasing focuses on safety and meeting regulatory mandate means more money spent on training.



All charts courtesy MarTID 2019

ROUGH SEAS OR SMOOTH SAILING?

» Navigating the changing compliance tides in Ballast Water Management / Treatment has never been easy. With systems approved and deployed worldwide, compliance issues will continue as system components and sub-assemblies need replacement or updating. Retlif's engineering staff is especially well suited to help BWMS manufacturers navigate unpredictable seas with 40 years of maritime regulatory and compliance testing experience. As a sub laboratory to numerous IL's and active industry participation, Retlif is well positioned to help define the route to compliance, whether it be USCG approvals or a full IMO G8 approval.

RICHARD REITZ
Director of Engineering
Retlif Testing Laboratories

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DESMI BWMS EARNS USCG APPROVAL

DESMI Ocean Guard A/S said its CompactClean Ballast Water Management System (BWMS) received U.S. Coast Guard Type Approval, which comes a few months after it received IMO type approval. The approval is valid for all salinities and sea water temperatures, and has no requirement for a special operating mode in the U.S. In fact, the stringent U.S. requirements are met everywhere in the world by running the

Image: Desmi

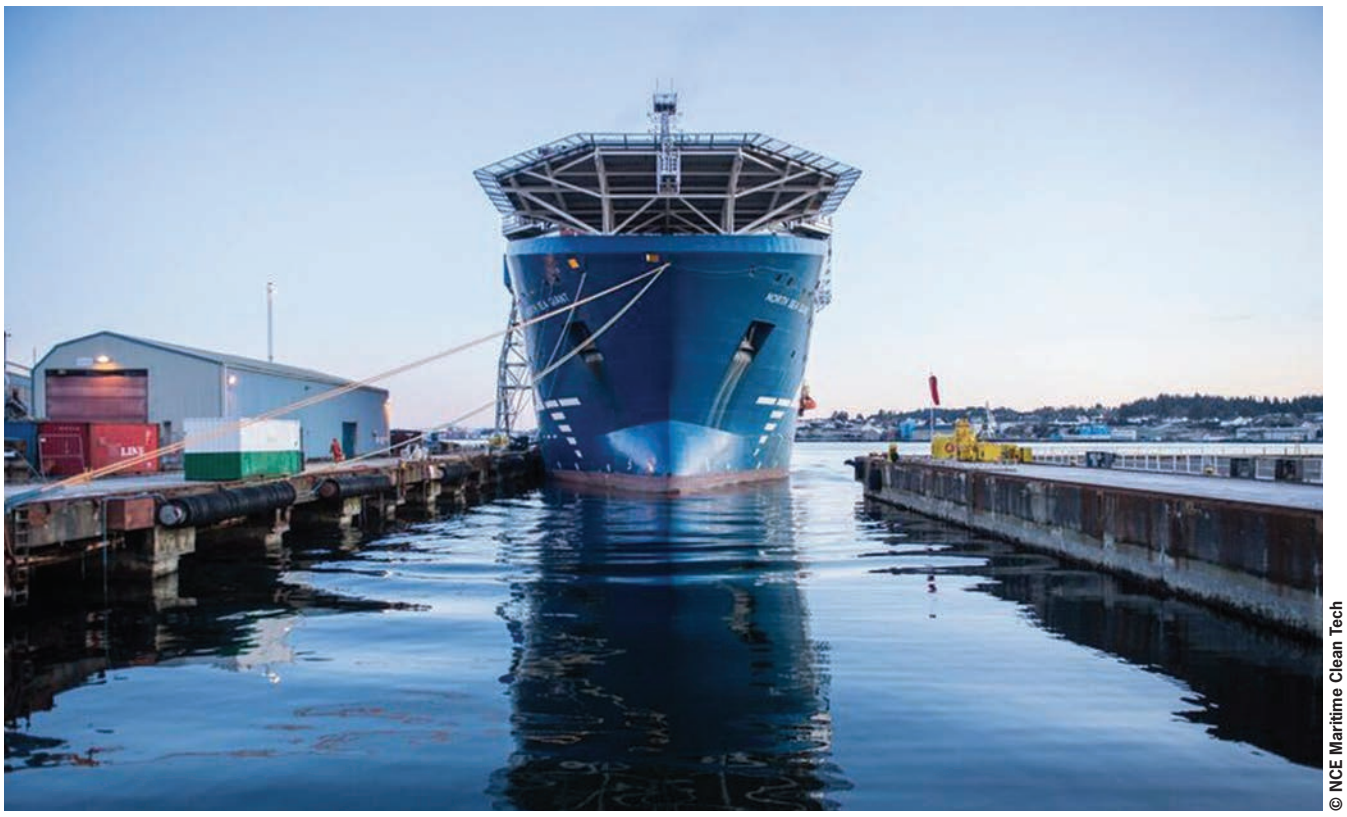
system in its normal mode. This means the system is fully approved and certified for discharge of ballast water anywhere in the world, no matter if it is fresh water, brackish water, marine water, cold water or warm water, the comapny says.

The USCG Type Approval includes a requirement for a minimum holding time between ballast and de-ballast operations of 24 hours. Additional testing has been performed to demonstrate that the minimum holding time requirement can be reduced to close to zero hours. The CompactClean BWMS comes in 14 different flowrate sizes, from 35 cu. m./hr. to 3,000 cu. m./hr.

Wärtsilä: Energy Storage on a 'Giant'

A benchmark installation of three energy storage systems by Wärtsilä onboard an offshore construction vessel features energy and load sharing capability. The system combines a diesel-electric configuration with batteries, and is designed to deliver fuel savings for the ship of as much as 50 percent, given optimal operating conditions. The installation was carried out in February 2018 onboard the North Sea Shipping AS owned subsea construction vessel North Sea Giant. In a second phase of the project, Wärtsilä commissioned an electronic bus link, a newly developed module that allows the ship to share load and energy optimally between the three Wärtsilä energy storage systems. This technology is expected to generate additional operating cost savings, and a total reduction in annual fuel consumption of 528,344 gallons. The estimated annual reduction in exhaust emissions is 5.5 million kg of CO2, 30 tons of nitrogen oxides (NOx), and 1,200 kg of sulfur oxides (SOx).

Another benefit of the energy storage system: reduced load fluctuations on the ship's diesel generators.



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Wärtsilä energy storage systems onboard the 'North Sea Giant' will deliver significant fuel cost savings.

Parntnership Sets Sights on Zero Emission Cruise Ships

The Age of Hydrogen Fuel Cells

GE's Power Conversion business and Nedstack, a fuel cell manufacturer, are collaborating on developing hydrogen fuel cell systems for powering zero-emission cruise vessels.

"Existing clean power solutions are focused on reducing emissions. Eliminating emissions altogether demands a paradigm shift," said Arnoud van de Bree, CEO of Nedstack. "Hence why GE and Nedstack have been working extensively on the 'marinization' of fuel cell technology to create a total zero-emission alternative that truly meets the needs of tomorrow's cruise industry."

GE and Nedstack envisage using this technology on passenger ships, replacing traditional diesel engines with fuel cells, and heavy fuel oil (HFO) with hydrogen.

To date, Nedstack and GE have designed the concept for a two megawatt hydrogen fuel cell power plant on an expedition vessel, and reportedly the review result has been highly positive and plausible.

Nedstack and GE have designed a concept for a multi-megawatt hydrogen power plant for passenger vessels.

"Ships are increasingly being required to shut down their engines in port. We've seen this in California, for example, and China has introduced an emission control area in the Yangtse delta.

However, the trend is shifting from emissions reduction to total elimination," said Azeez Mohammed, President and CEO, GE's Power Conversion business.

CAT Targets Cruise for its Multi-Engine Optimizer

Caterpillar is touting its Multi-Engine Optimizer (MEO) as a solution for existing cruise ships to burn less fuel, run cleaner, keep uptime and reliability high while keeping costs down.

Caterpillar's MEO is designed to lay over the top of a vessel's existing power management system, using proprietary performance maps and control algorithms to advise the system on which engines to operate and at what load. The second, Asset Intelligence (AI), is a total vessel monitoring solution that collects and analyzes data from onboard systems, then provides recommendations on when and how to take action. Specifically Cat contends that MEO and AI can:

Images courtesy Caterpillar

Cat's MEO

1. Decrease fuel consumption

It takes a lot of fuel to power today's ships — more than a billion dollars worth annually for some larger cruise lines. A 2-3 percent saving on a fuel bill could mean saving tens of millions of dollars without making a change to engines or vessel operations. MEO is designed to make that possible by using fuel maps to determine the best combination of engines and enabling dynamic asymmetrical load allocation: simply put, the ability to operate those engines at independent load factors. Precise fuel flow measuring for each individual engine results in the lowest possible fuel consumption for the entire system. AI helps reduce fuel burn by analyzing fuel and energy performance on board your ships, identifying operational practices and component maintenance issues that conspire to increase fuel consumption and costs.

2. Lower emissions

The current cruise ship order book includes a number of new vessels with liquified natural gas (LNG) as their primary fuel source to reduce emissions. That doesn't help existing vessels, as repowering a cruise ship is difficult due to the location of the engines, and converting to LNG is even more of a challenge because of the need for tanks to store the liquid. MEO is designed to help cruise owners run current engines more efficiently or AI to monitor and improve fuel burn — or both — to decrease fuel consumption. For every liter of diesel fuel saved, 2.68 kg of CO2 is eliminated.

3. Optimize maintenance

MEO is designed to help owners consolidate more power into every hour of operation, resulting in fewer actual engine hours over the same time span. That extends maintenance and overhaul intervals. You can also use MEO to balance engine use by hours or fuel, either to synchronize overhaul intervals (so you can do all the work during one shutdown) or stagger intervals (so you can continue cruising without needing a shutdown at all). AI is designed to allow owners to move from hours-based to needs-based maintenance schedules. It tracks all the data generated by a ships' systems, and can tell when maintenance and repairs are actually required.

4. Improve reliability

The days of ships operating with two or three additional main engines are long gone. Due to cost pressures, most cruise lines no longer carry as much redundant power on board. That means any unscheduled downtime — or in some cases, even scheduled downtime — runs the risk of losing a voyage. Engine reliability is more critical than ever. AI uses pattern recognition to learn about your ships' systems so it can predict failures before they happen. That means your crew can take action immediately to fix an issue, and if any parts are needed, you can have them waiting in the right port. In addition to the data and alerts it provides on board, AI also sends additional analytics ashore, where an engineering team can review to get ahead of problems.

Discover MEO on MR TV

Caterpillar executive Dra Wiersema discusses the MEO value proposition on MR TV:
www.marinelink.com/videos/video/the-big-virtual-engine-100173

ALFA LAVAL PUREBALLAST 3

Alfa Laval PureBallast 3 received an updated type approval from the U.S. Coast Guard. Alfa Laval PureBallast 3 was awarded an updated certificate from the USCG on April 4, granting the system type approval with zero-day holding time in all water salinities. PureBallast 3 owners in U.S. waters now have the option of discharging ballast

Image: Alfa Laval

water just 2.5 hours after taking it on. The holding time of 2.5 hours, which is due solely to a technical testing procedure, is only applicable if the vessel crosses over into another Captain of the Port Zone within this time. The reason UV treatment systems have had holding times in U.S. waters is the difference in testing methods used by the IMO and the USCG to verify biological disinfection performance. But, the recent signing into law of the Vessel Incidental Discharge Act (VIDA) paves the way for the USCG to reevaluate the IMO-endorsed method. If the USCG decides to accept the same testing principle used by IMO, suppliers of UV treatment systems will likely be able to reapply for USCG type approval based on the IMO testing methodology.

Sanmar, CAT: Hybrid Collaboration

Sanmar Shipyards was selected by Caterpillar Marine to build the first tug to incorporate its hydraulic hybrid propulsion system. Construction is currently under way with delivery scheduled for October 2019. The Cat Marine Advanced Variable Drive (AVD) is a patented system and Sanmar is the largest tug builder in Turkey with more than 40 years of experience, with notable accomplishments such as being the world's first builder of LNG powered tugs as well as the builder of the world's first commercial remotely operated vessel.

The model chosen for the AVD system from CAT is Sanmar's Boğaçay Series, and when completed it will be the 38th of this class to enter service. This class is designed exclusively by RAL for Sanmar. While it is the 38th the series, it will be the first hybrid version. Optimized for harbor tug operations, this compact tug design provides 70 tons of bollard pull and full firefighting (Fi-Fi 1) capability.

The AVD system is designed to provide significant improvements in both fuel efficiency and vessel performance through a fully integrated hydro-mechanical propulsion system. Different from a typical Power Take-In (PTI) solution, the AVD incorporates a planetary gear set allowing seamless clutch engagement of main engines, auxiliary engines, or both to provide a scalable power installation to meet any customer need in terms of maximum vessel speed, power, or bollard pull. This allows propeller speed independent of engine speed so optimal engine efficiency can be achieved, leading to a projected fuel savings of 15% to 20%.

Image: Sanmar

GEA CatFineMaster

The fine-grained, hard, brittle and highly abrasive catalyst residues in fuels, known as cat fines, can cause considerable damage to marine engines. Under extreme conditions, they even lead to the total failure of the main engine. GEA offers CatFineMaster as a countermeasure, and to date it has received an order for 20 CatFineMaster from the largest shipbuilding company in China, two to be installed in each of 10 tankers of a Danish shipping company to be built by 2020. The GEA CatFineMaster consists of a heavy fuel oil separator as the core and a feed pump. This pump can be controlled during operation in such a way that an optimally adjusted heavy fuel oil flow is guaranteed, taking into account the corresponding process requirements. The system is completed by the GEA IO control system and optional measurement and analysis equipment.

How it Works

To achieve optimum separation behavior with cat fines of different sizes, the system offers the possibility of varying two essential process parameters. On the one hand, the separation temperature can be changed. Hot separation at temperatures of up to 110°C reduces the viscosity of the fuel, making it even easier to separate the very small cat fines in particular. The second process variable is the flow rate, which is controlled by the feed pump to optimally adjust the flow rate of the fuel to the respective process requirements. This not only contributes to an additional increase in efficiency, but also saves energy at the same time. The CatFineMaster ensures an effective reduction of cat fines, which in detail means a target concentration of less than 5 ppm and separation of all particles larger than 3 µm.

AUSTRALIAN PUMP INDUSTIES

Sea Skipper High-Pressure Fire and Salvage Pump

After working with the Royal Australian Navy for several years, a small Australian pump manufacturer – Sydney-based Australian Pump Industries – which works on both the naval and commercial side of marine, developed a high-pressure fire and salvage pump dubbed the Sea Skipper, designed specifically for seawater applications.

While engaged in maintenance work on Australia's FFG fleet, Aussie Pumps' Chief Engineer, John Hales, saw workboats using commercial grade, agricultural style, self-priming centrifugal diesel powered pumps for seawater applications.

"You can imagine the condition the pumps were in," said Hales. "Some of them had cast iron impellers and aluminum bodies. Fasteners were cad plated steel. Engines were not specially treated in any way to protect them from rust," he said.

After a short time at sea, the pumps suffered severe corrosion and were unserviceable for one reason or another. The pumps with cast iron impellers and volutes, even though they may have had marine grade aluminum bodies, were never flushed out with fresh water after use.

After two or three months of being idle, those pumps had their impellers and volutes 'joined at the hip.' "In an emergency, that's the last thing you need," said Hales.

The company moved into high gear to figure out how they could take their own commercial agricultural high-pressure fire pumps, and turn them into seawater pumps. The standard product was developed for fighting bushfires in Australia's sweltering summer seasons.

First, the company started working with powder coating the bodies inside and out. Finally they realized that the only way to provide a solution, was to go to cast bronze impellers and volutes, 316 stainless steel fasteners and fitting zinc anodes.

The project evolved over a period of years, step by step, until the company had produced the final version of what they christened the Sea Skipper Fire Chief.

The pump delivers a 450 lpm flow and heads of up to 50 meters, equaling 100 psi pressure The pumps, already proven in bushfire fighting with Australian National Parks and firefighting authorities, are designed to have excellent self-priming characteristics.

The hydraulics of the big belly body on the pump allows a vertical suction lift 7.6m (25 ft.). Compared to other diesel pumps, they are light weight so are a two man lift, and they come with hot dipped galvanized carry frames, available in both recoil and electric start.

The L48 4.8hp Yanmar diesel provides loads of power and the pumps are remarkably efficient. Not only the Australian government uses the Aussie Pump product range but, other navies throughout the world, including the French, Indian, Bangladesh and Sri Lankan are gradually standardizing on the Sea Skipper range.

The Fire Chief Sea Skipper is the flagship product and is designed for firefighting at sea and salvage rescue work. The company is working on the production of bigger pumps in the Sea Skipper configuration that will handle flows of up to 1,800 lpm and suction lifts of over 8m.

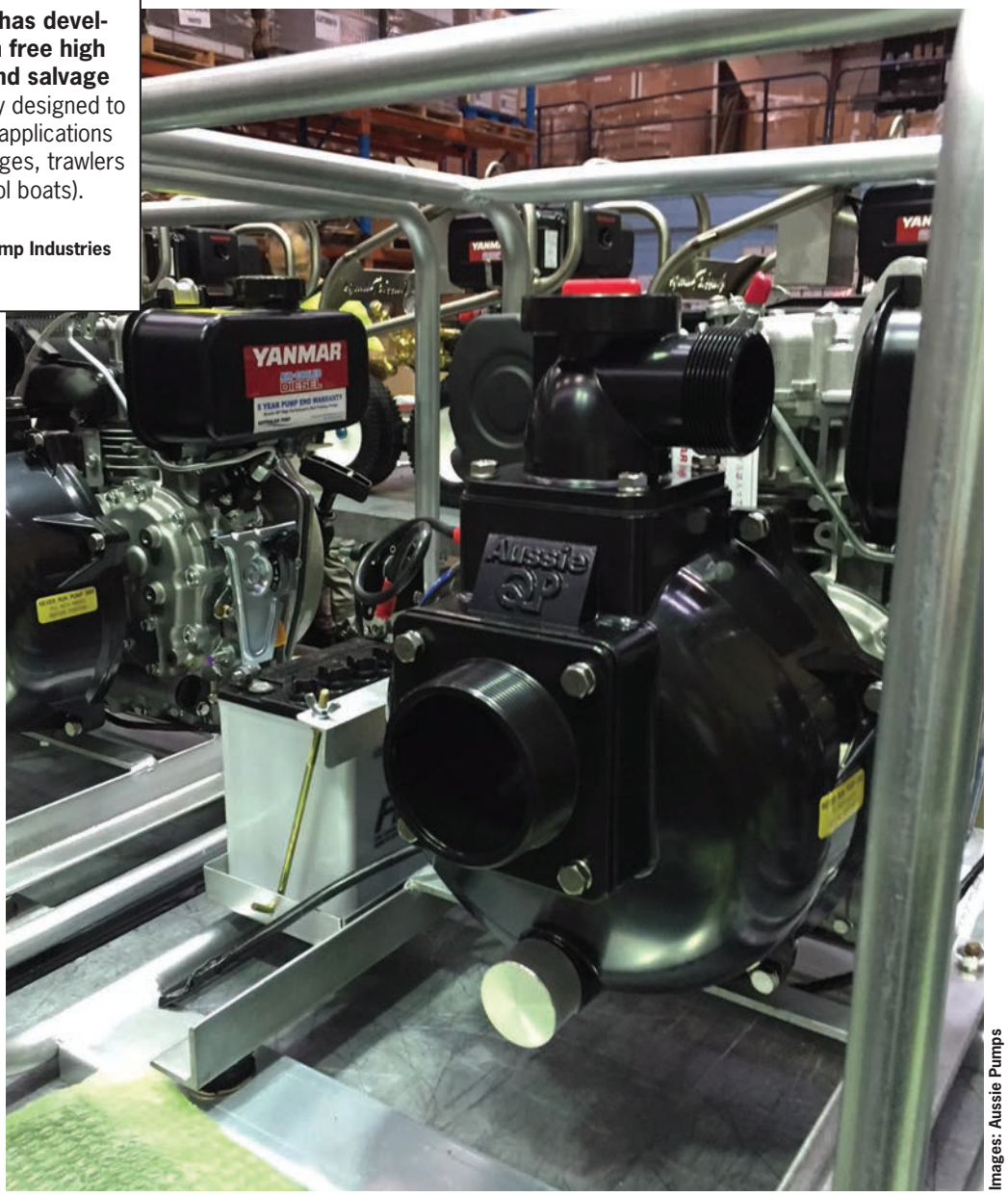
"We're getting enquiries now from around the world for a bronze impeller and volute trash pump that can be used for cleaning out oily bilges. That's a new project for us and we're just trying to evaluate the market potential," said Hales.

www.aussiepumps.com.au

John Hales has work extensively with the Royal Australian Navy on major ship availabilities. The Sea Skipper is his idea of being able to solve real firefighting at sea/ salvage issues where lives are at stake.

Aussie Pump's has developed corrosion free high pressure fire and salvage pumps specifically designed to handle seawater applications (ideal for tugs, barges, trawlers and even patrol boats).

Image: Australian Pump Industries



Images: Aussie Pumps

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IMO 2020

Scrubbers: The Clock is Ticking

By Ishaan Goel, Project Manager, Albion Marine

Regulatory bodies around the world are trying to address the impacts 2020 sulfur cap would have post implementation. New challenges and issues are emerging as the date is coming closer. With under nine months left to implementation, there is no time now to plan for the installation of Exhaust Gas Cleaning Systems to meet the regulations right from January 2020. The majority of shipowners have no choice but to choose low sulphur fuel oil to comply, hoping the suppliers will deliver.

Technical and contractual issues remain unaddressed for long and the dilemma among the shipowners resulted them to wait to gain clarity as to what is going to come. Some believed that the date of implementation might get delayed while some wanted to see what the 'competitors' are going to do, while some think that the compliant fuel will soon be cheaper than high sulfur fuel oil. The silence from the refineries and the bunker suppliers did not help either, but it is safe to say that the expected demand of low sulphur fuel will not be matched in 2020.

"With LNG infrastructure not ready and about 15 months of lead time for some scrubber equipment, it is now practically impossible to consider these as options for compliance on January 1, 2020," said Sergiy Yakovenko, Director at Albion Marine Solutions.

Considering the time at hand, only a minor percentage of shipowners will have scrubbers installed onboard their vessels by January 2020. They will enjoy the benefits right from day one as their ships will not only attract more business, they will be less prone to delays due to fuel related breakdowns and fines due to non compliant fuel. With the present difference in fuel oil prices, the payback period for scrubbers is very attractive and with certain rise in the price of the low sulfur fuel oil post 2020, the payback period can even be less than a year for some ships.

The new fuel will come with old problems. As much as we are questioning the capabilities of refineries to meet the demand of the new fuel, the larger question to manage the safe and reliable operation of ships on new fuel still remains unanswered. The new blended fuel is likely to bring out serious quality issues with increased risk of instability and incompatibility. This incompatibility issue is not new to the industry with a lot of lessons learnt in the past. Shipowners need a Fuel Management Plan and they need it now! The other alternate fuel, Liquified Natural Gas (LNG) has far more challenges. LNG would require special storage tanks and heavy retrofitting work on ships to handle and burn LNG. Crew would need to be trained to operate and maintain machinery running on completely new fuel. On top of that, the bunkering infrastructure although improved is not yet robust enough and availability still remains uncertain.

Scrubbers have been termed as 'outdated technology' and many articles have concluded that scrubbers might not even be required in the long run. All these conclusions are based on assumptions that the alternate fuels will be made available in abundance and for cheaper within one to two years from the date of implementation. The very fact that these are just assumptions of what is to come does not mean that an existing technology with attractive payback period be termed 'obsolete'. However, some port states banning the discharge of scrubber effluents in port regions has complicated the design a bit, as hybrid ready scrubbers are the first choice for many shipowners now. It is time for the shipowners to review their strategy and spare a thought to a possibility that scrubbers might be the best solution for next half a decade, which is enough time for the payback for almost any vessel and that can make the operations of vessels very stable in an otherwise very volatile and fragile looking marine fuel market post 2020.

Jon Holloway & Jim Lerner
Jon Holloway (left) is the Head of Strategy for Danfoss Power Solutions, based in Hamburg, Germany. Jim Lerner (right) is Vice President of Sales, Eastern US, for Danfoss Drives in Houston, Texas.

Preparing for IMO 2020: Marine Emission Solutions

PART I: ENHANCING ENGINES & FUELS

Around 80 percent of global trade is carried by sea. With more than 125,000 commercial and naval vessels operating around the world, ship-engine emissions are projected to rise by 250 percent by 2050 unless controls are imposed. Pollution from ship engines is so significant that in 2016 the International Maritime Organization (IMO) issued "IMO 2020 Rule" to cut fuel sulphur content 86 percent by the year 2020. A component of acid rain, sulphur oxide (SOx) emissions contribute to ocean acidification that harms marine habitats and ecosystems. To comply with IMO 2020, commercial vessel operators and owners have two routes to take:

1) Enhance engines and fuels: Commercial vessel operators can purchase higher cost low sulphur fuel oil (LSFO) or marine gasoil (MGO)—or for a high initial capital cost, they can retrofit their engine systems with scrubbers to remove SOx from emissions in conventional fuels.

2) Use alternative propulsion systems: Operators can convert to alternative propulsion systems, such as liquefied natural gas (LNG) or modern electric systems that adopt hybrid technologies which integrate energy storage.

To gain an understanding of the best course to follow, ship operators and owners are advised to consider how regulations will affect the cost and availability of LSFO, the value of using improved engines and fuels, and the value of employing hybrid/electric drive technologies as an alternative to a 100 percent fossil-fueled ship.

Source: Danfoss

Regulations, fuel costs & availability

The IMO 2020 Rule requires ships to use MGO fuel with no more than 0.5 percent sulphur content compared to the current limit of 3.5 percent. In ships operating in Emission Control Areas (ECAs), which in North America extend 200 nautical miles from U.S. coasts, the sulphur content limit remains at the 2015 standard of 0.1 percent.

Sulphur and sulphur compounds naturally occur in petroleum, and special processing or low-sulphur feedstock is required to produce fuel with low sulphur content. Due to tight supplies and strong demand as the year 2020 draws near, there is no guarantee that LSFO supplies will be sufficient. To be confident in achieving the reduction from 3.5 percent to 0.5 percent, operators will need to do significant planning to ensure fuel is available for their vessel or fleet to avoid penalties.

Possible shortages could lead to significant price swings, making budgeting and investment scenarios complex. Industry analyst Wood Mackenzie forecasts a 25 percent increase in price for lower sulphur content fuel based on a SOx scrubber adoption rate of about two percent, but some scenarios could cause LSFO prices to spike by as much as 60

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Maritime Propulsion	21,803
Maritime Reporter & Engineering News	62,329
World Energy News	48,236

All stats from 01/23/2019

WOOD MACKENZIE FORECASTS **A 25 PERCENT INCREASE IN PRICE FOR LOWER SULPHUR CONTENT FUEL BASED ON A SOX SCRUBBER ADOPTION RATE OF ABOUT TWO PERCENT,** BUT SOME SCENARIOS COULD CAUSE LSFO PRICES TO SPIKE BY AS MUCH AS 60 PERCENT.

percent. The price premium per metric ton of fuel has averaged $225 between 2012 and 2017. As of October 1, 2018, the Houston bunker price was $465 for intermediate fuel oil (IFO380 = 3.5% sulphur) and $745 for marine gasoil (MGO = 0.5% sulphur), a price gap of $280.

In another scenario, an analysis by Stillwater Associates indicates that Rotterdam LSFO to high sulphur fuel oil (HSFO) spreads will increase from $2 in mid-2018 to $19 per barrel at the end of 2019, representing a percentage spread increase from 3 percent to 35 percent over 18 months, in anticipation of a sharp spike in demand for compliant fuel.

Foreseeing more complexity, analysts cited by Wood Mackenzie posit that the very low adoption rate of scrubbers used to remove SOx could lead fuel suppliers to jettison HSFO supply overall, disincentivizing further adoption of scrubbers. Overall, these scenarios indicate the uncertainty surrounding LSFO prices and availability. If supply chains for the necessary quantities and types of fuel are not ready, global marine operations could be disrupted.

From a global perspective, Nordic standards and markets are the most progressive in moving to low sulphur MGO, as evidenced by rapid adoption of zero-emission technologies in several waterways. These developments serve as an example for how the rest of the world may respond.

Leading the way in North America, the Port of Long Beach (PLB) is targeting zero emissions by 2035. Starting now, substantial changes are already underway that will affect equipment purchases to meet emission standards. Other ports on the West Coast also have bold strategies, following the lead of PLB.

Fuel & engine improvements

When considering compliance with IMO 2020, most operators naturally think about adapting their vessels and engines to use whatever fuels may be available. Taking this track, ship owners have three options:

1. Use technology options that can utilize low-cost high sulphur fuel (HFO) with SOx scrubbers or exhaust gas cleaning systems.
2. Use available LSFO and MGO at higher variable cost, but which avoids capex investment for scrubbers or exhaust gas solutions
3. Use liquefied natural gas (LNG), a fuel that is virtually sulphur free. LNG prices are generally equivalent to or lower than HFO, but distribution facilities are not widespread due to limited demand today and high infrastructure development costs. As such, the extent of future LNG availability is questionable. Some ports are willing to invest, but LNG will not be available everywhere. Furthermore, the switch to LNG requires conversion to a different fuel management system that employs large refrigeration units to keep the gas in liquid state.

As an alternative to being exposed to the variable costs of LSFO, owners and operators can meet 2020 emission standards by investing in various technology options that can utilize HFO. For example, advanced marine engine designs are available that conform to the U.S. Environmental Protection Agency's Tier 4 engine standards. Tier 4 engines incorporate several advanced technologies—including selective catalytic reduction (SCR) and exhaust gas recirculation (EGR) (Figure 2). These two technologies significantly reduce nitrogen oxide (NOx) emissions for compliance in NOx Emission Control Areas such as the North Sea.

To achieve marine-engine emission reductions, engine manufacturers are employing several different approaches, such as:

1. Using modular exhaust after-treatment system (EAT) to meet Tier 4 for workboats, allowing flexible component placement for ship designers. An SCR system coated with vanadium is used for greater sulphur resistance, allowing the use of high sulphur diesel fuel.
2. Using Tier 4 SCR technology for lower fuel and urea consumption compared to Tier 3 engine types, while achieving high engine efficiency and emissions performance. Moreover, weight is 50 percent lower, full power acceleration is faster and engine performance is not derated if the SCR system fails.
3. Using engines ready for LNG in addition to electric and hybrid propulsion systems that incorporate analytics, automation and emissions control systems. (Using LNG and "hybrid" or low-sulphur-content fuels can also be done with Tier 3 engines to meet Emission Control Area requirements.)
4. Using a combination of all available technologies while promoting EGR as a way to use smaller SCR.

Emissions sensors are critical components used in engine exhaust systems to track and prove emissions compliance. One example of an in situ emission sensor technology is the marine emission sensor MES 1001 offered by Danfoss IXA. The MES 1001 ensures that fuel switching and systems are working by combining continuous emission monitoring and data collection for authorities. The sensors can also deliver data to control SCR urea dosage, improving resource utilization and system performance.

For vessel owners interested in reducing fossil fuel consumption, hybridization and electrification technologies complement or offer an effective alternative with many benefits. Look for Part II of this article in a the June 2019 edition to learn more about the value of using alternative propulsion systems to meet IMO 2020.

Emission-reducing technologies to make even efficient engines operate more cleanly

Type of Technology	SCR: Selective Catalytic Reduction
Configuration	An "after-treatment" system placed off the engine to process engine exhaust.
Function	Injects urea into the exhaust stream where a catalyst converts NOx into harmless diatomic nitrogen, carbon dioxide and water vapor. Urea and water are known as diesel exhaust fluid (DEF), which costs less than diesel fuel and improves efficiency, so the added cost of the process is balanced by the savings.
Type of Technology	EGR: Exhaust gas recirculation
Configuration	Diverts some of the exhaust gas into the engine's fresh intake air
Function	Raises the engine temperature to burn off more particulate matter.
Type of Technology	DPF: Diesel particulate filter
Configuration	Located in the exhaust system to catch particulate matter (PM) in exhaust gas using precious metal catalysts
Function	Burns off PM automatically or through a regeneration cycle. Eventually DPFs need to be replaced when they accumulate ash. (EGR systems typically need DPF as well.)
Type of Technology	DOC: Diesel oxidation catalysts
Configuration	Also located in the exhaust system and may be located before an SCR mixing tube
Function	Changes diesel particulates to CO2 and H2O.

INNOVATIVE SOLUTIONS FOR GLOBAL MARITIME CHALLENGES

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Benefits of the Viswa Horizontal Scrubber

- Simple modular design and connections.
- Design and location allow quick installation, short ME immobilization time.
- Lower power consumption due to design and location.
- Easy maintenance.
- Unique design allows for low back pressure even without a blower.

Our unique and patented design delivers superior scrubbing while having a smaller foot print, which means easier installation/retrofitting. Our scrubbers have been designed to overcome the problems experienced by vertical scrubbers and provide innovative and efficient solutions to vessels in this time of changing regulations.

THE VISWA GROUP

William Burroughs
William is a Senior Principal Engineer at ABS responsible for promoting environmental related services and providing guidance in support of international, national and regional marine environmental regulations. Bill's previous experience includes Product Line Manager for the BALPURE BWMS manufactured by De Nora Water Technologies.

Global Ballast Water Treatment

TRENDING TOWARD COMPLIANCE

A new state-of-the-industry report has identified the pathways to the successful operation of ballast water treatment systems, as well as the complex challenges that lay ahead for owners who seek compliance with new and emerging regulations. The report, published by ABS, was compiled from information-sharing workshops in some the world's primary maritime centers, and a survey of more than 60 shipowners and about 500 vessels with installed ballast-water management (BWM) systems.

While the report showed an industry broadly trending towards compliance, it also revealed concerns among owners about the operational reliability of the treatment systems, insufficient crew training and post-sales technical support from vendors.

The survey, which was conducted throughout December last year and January this year found the proportion of systems that were 'operationally problematic' to have doubled, to 59% from 29% a year ago. While the trend may cause concern, it could also show the effect of a rush of new BWM systems coming online to meet compliance.

About 35% of the BWM systems were deemed to be fully operational at the time of the survey, suggesting that the majority of owner/operators were having reliability-related challenges. Feedback from the workshops – held in New Orleans, Athens, Hong Kong and Shanghai – indicated that the inability of some vendors to respond globally to technical issues had caused prolonged system outages, in some cases compromising charter opportunities.

Source: ABS

Seven types of systems were examined in the survey, including those using:

- Filtration + Side-stream Electro-Chlorination (EC) + Neutralization (used by 29% of respondents)
- Filtration + UV Treatment (20.7%)
- Ozone Treatment + Neutralization (19.9%)
- Filtration + Full Flow (In-line) EC + Neutralization (17.8%)
- Full Flow (In-line) EC (7.5%)
- Filtration + Chlorination via chemical addition (5%)
- Filtration + Deoxygenation (0.2%)

The survey and workshops examined a wide range of vessel types, including: bulk carriers, container ships, gas carriers, general cargo carriers, heavy load carriers, LNG carriers, product carriers, tankers and vehicle carriers (see chart below).

Finding the Path to Compliance

In general, strict attention to plans for most problematic areas – installation, crew training, commissioning, operations, maintenance and repair – improved the chances of efficient and compliant operation for whatever BWM technology an owner chose. The workshops identified best practices to support smooth systems integration and operation, including post-operational experiences with problems that arose during retrofitting. Key Insights included:

- The importance of advance planning, including the creation of detailed timelines that anticipate delays, to help control the cost of retrofits
- Incorporating ship-specific contingency measures into the BWM plan to help avoid in-service downtime and financial penalties
- System-specific training for shoreside support and ships' crews proved critical for effectively operating and maintaining any system
- Monitoring data and operational trends to better understand the system design limitations can help the crew to predict the challenges of the vessels' operational routes, and
- Working closely with the vendor's after-sales support team helped to achieve an uninterrupted operation of the system, globally.

In general, the process of retrofitting BWM systems proved more complex than installing systems on new ships, one that required careful planning to fully integrate with existing water ballast systems. For example, because retrofitting systems can be more time-intensive than installation on a newbuild, the requirements of the engineering contractor and class approval needed to be carefully considered to keep plans on track.

To save time, pre-packaged components and some equipment for the system should be, if possible, pre-manufactured locally, closer to the shipyard. The engineering of the retrofit process needed to be carefully planned – and the installation rehearsed – before dry-docking the vessel.

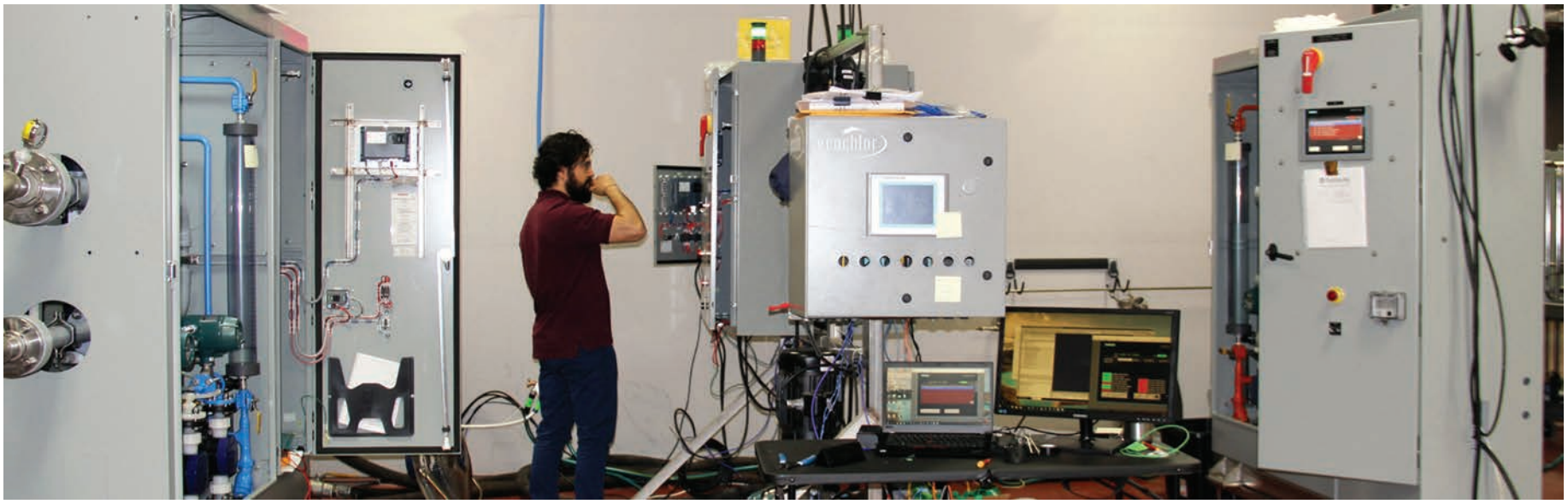
Industry Concerns: Operational Reliability

Aside from compromising regulatory goals of preventing the transfer of invasive species in ships' ballast tanks, a lack of dependability of any BWM system could result in non-compliance and financial penalties, port state detentions or commercial losses for the owner.

Operational reliability was influenced by many factors, such as software problems, using equipment or components not supplied by the original manufacturer (items such as filter elements, sensors,

How to Engineer a Reliable Ballast Water Management System

By Pete Thompson, V.P. of Operations, Ecochlor



Electrical engineer performs FAT on the Ecochlor treatment system generators at the new ProFlow manufacturing factory in North Haven, Connecticut USA.

The ability of Ballast Water Management Systems (BWMSs) to operate reliably over the lifetime of the vessel is not something that happens by accident. In fact, reliability comes down to the choices that engineers make when designing and specifying a new BWMS. It's no secret that minimizing equipment failure and maximizing long-life means using high quality components in the build and simplifying the system operation so that there are fewer moving parts.

However, creating a well-constructed BWMS that will operate trouble-free over the long term means additional production costs – costs that manufacturers must justify so that shipowners fully understand the value of reliability against the very real risks and costs associated with breakdowns and non-compliance.

Build for the Life of the Vessel

"When we consider equipment design, the first criteria we look at is quality. We work with our supplier network and our customers so that we have the relevant operational data to ensure that the equipment will hold up to our strict durability and endurance standards," says Leif Melhus, Ecochlor Engineering Manager. Melhus continues, "We make sure that our suppliers understand the ship operators' requirements and the nature of the environment that the equipment must operate within. In this way we can ensure that our systems are 'fit for purpose' all the way down to the component level."

Engineered Reliability

This attention to detail has a downside in increased costs, with the final system prices potentially a little higher than the lowest market expectations. Melhus counters this by adding, "While cost is a consideration, it is not the primary factor when we are choosing components. This means that sometimes our production costs might be a bit more, but we know that our customers will see the benefit of the choices we make through increased reliability and the dependability of the Ecochlor BWMS to operate for years to come. This 'engineered reliability' ensures that our customers maintain compliance with the ballast discharge standards."

Unfortunately, not all BWMS manufacturers have followed this principle. Some systems have been built with cost rather than quality in mind, and whilst these might have been the least expensive option in the market many ship operators have found out the real costs when they turned them on. Not only did these systems not work, but in some cases the manufacturer didn't have the capacity to service the equipment to bring it back on line. In other cases, the manufacturer has left the industry completely! It has been a costly lesson for shipowners to replace these systems with more dependable options.

"The Ecochlor system was built to last the life of the vessel," shared Tom Perlich, Ecochlor founder. In 2006, we retrofitted the *Moku Pahu*, a U.S. flag, Jones Act bulk carrier with a route from Hawaii to San Francisco. With ballast operations in California, this vessel encountered some of the strictest regulations in the world. For 13 years this ship ran ballast operations using the original installed system until her last voyage in January of this year. As our longest continuously operated BWMS we enjoyed not only a highly collaborative relationship with the crew but also the ability to gather valuable data on the system's components over the years. That experience has been fed right back into the systems that we deliver to customers today."

Reliability is a Growing Concern with Shipowner/Operators

In March, the American Bureau of Shipping (ABS) released the 2019 *Best Practices for Operations of Ballast Water Management Systems Report*, a culmination of feedback from shipowners and operators with installed BWMS who participated in three conferences over a span of two years. The report is based on a survey, discussions and workshops that were used to review the "industry's progress toward compliance and identified best practices that supported successful BWMS installation and operation."

Through these channels, BWMS operational reliability was recognized as growing problem. Their concern was based on a history of system failures and the hardened stance of regulators in the enforcement of BWM compliance.

Some of the reliability issues addressed in the report were "the use of unreliable or non-OEM equipment or components (filters, sensors, sampling pumps, valves, actuators, electrolytic cell assemblies, dosing sub-systems, UV reactors, etc.)."

Other common problems included: "fluctuating and unstable TRO sensor and monitor readings that are sensitive to environmental conditions…; frequent outages and replacement of UV lamps and clogging of filters that require frequent or continuous back-flushing operations…; [the] inability to operate EC-based BWMS in freshwater or low salinity water conditions, requiring alternative arrangements to carry salt water or brine solutions…; and, predicting low UV transmittance challenges (affecting all UV-based BWMS) caused by weather (seasonal) or other variables… ."

Overall, as summarized from 487 installations using seven BWMS treatment technologies on a variety of vessel types – 65% were either inoperable or had problematic ballast operations and only 25% ballasted regularly with a testing protocol for efficacy in place.

Planning for Reliability

Reliability can be determined by looking at the time between equipment breakdowns and system operation. At a minimum, BWMS manufacturers should be able to reference how many of their systems are operational at any given time. Ecochlor goes the extra mile with this thinking, using real-time data analysis to ensure that reliability and system uptimes are maintained at the highest possible levels.

Ecochlor Service Manager, Max Hasson said, "The ongoing monitoring of every Ecochlor system that is installed on a vessel, wherever it is in the world, is an important factor in helping us keep their system fully operational. The crew sends us operational data after every ballast operation and that information is incorporated into a weekly internal fleet update charting the vessel position, next port of call, last ballast operation, chemical tank levels, operational concerns, requested parts, and a preventative maintenance schedule. We don't sit back and wait for the next service call; we plan our way to increased reliability for the ship's crew."

Conclusion

There are many factors that come under consideration when engineering a BWMS for longevity, durability and reliability. With financial penalties, shipowner's reputation, port state detentions/barred entry or charter losses as consequences of BWM non-compliance, securing a reliable system is paramount to good business practices. Reliability costs money, but the unreliability of a BWMS will cost you even more.

sampling pumps, valves, actuators, UV lamps, etc.), or the improper installation of a system by the shipyard. Common problems revealed by the report are:

- Fluctuating and unstable readings from total residual oxidant (TRO) sensors and monitors that are sensitive to environmental conditions. These sensors are used for active-substance-based BWM systems to control the chemical dosing during treatment (some makes) and to control neutralization chemical injection during de-ballasting to reduce the TRO for compliance with local regulations
- Frequent outages and replacement of UV lamps and clogged filters that require frequent or continuous backflushing (particularly in high turbidity water conditions), causing reduced throughput from the ballast pumps
- Inability to operate EC-based systems in fresh or low salinity water conditions, requiring alternative arrangements to carry salt water or brine solutions to achieve the minimum salinity requirements for the system's feed water
- Predicting low UV transmittance challenges (affecting all UV-based systems) caused by weather or other variables (i.e., shipping density or dredging operations, etc.).

Selecting the Right Technology

Another technical challenge for retrofitting is that no single BWM treatment technology met the demands and operational needs for all types of vessels. Indeed, there is 'no silver bullet.' The selection of the most suitable system depended on several factors, including:

- Vessel configuration, ballast capacity and pump sizes
- Trade routes and vessel-operating profiles
- Differences between high and low ballast dependent vessels (i.e., retention times)
- Ability of the system to support gravity ballasting or de-ballasting operations
- Ballast water treatment rated capacities (TRC), the maximum continuous capacity (expressed in cubic meters per hour) for which the system is type-approved
- Available space for installation and excess power capacity, and
- Equipment installation and design issues when integrated with the vessel's machinery and piping systems

Vendor Support & After-Sales Service

Both workshop and survey feedback indicated that there was inconsistent global after-sales support from vendors. The limited ability of some vendor's to attend technical issues caused prolonged system outages, and caused problems with charter opportunities. Waiting for service technicians to correct small problems raised the prospect of interrupted cargo operations. Too often, technicians attending the vessels had to order spare parts to restore the system; sometimes, the attending technician was unable to conduct all troubleshooting requirements, or resolve software problems.

Software and Hardware Challenges

Feedback from the workshops identified cases where faults in control-system software and hardware failures caused unexplained alarms and interrupted the operation of the system, affecting cargo operations.

Some vendor-service technicians were unable to verify the authenticity of the control software or prove that the software updates for the systems had been approved by the USCG or the required Type Approval Administration.

There were problems downloading electronic logs (i.e., data retrieval). Often, operators were unaware of software problems until the vendor attended the vessel, or until they were challenged by a port state control officer.

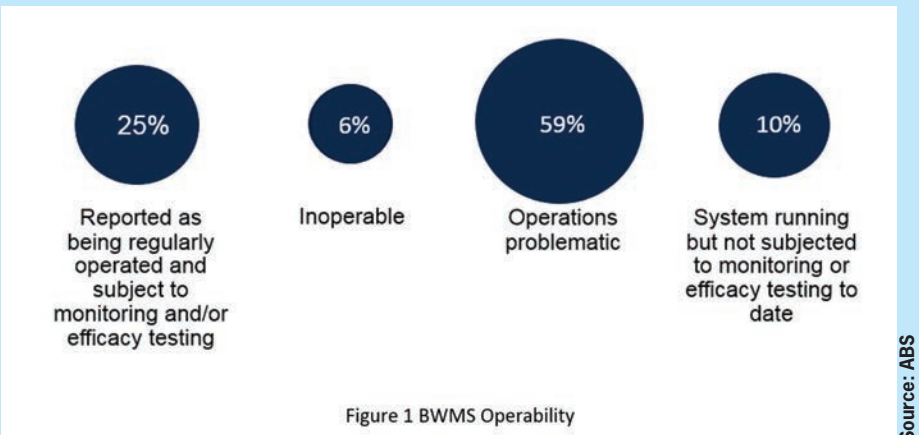
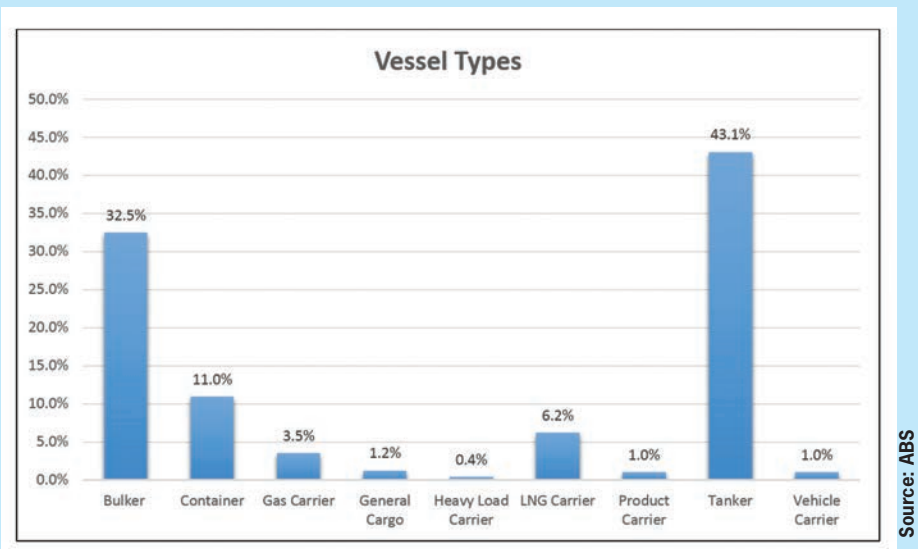


Figure 1 BWMS Operability

Source: ABS



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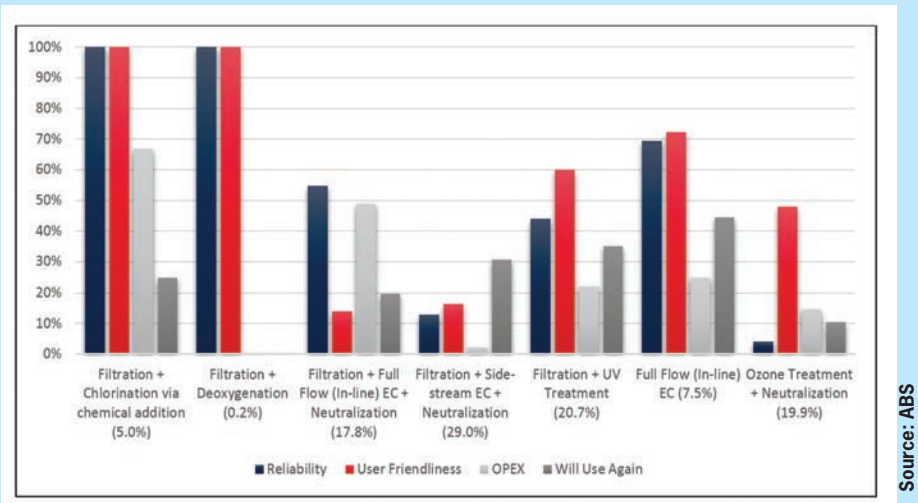

Source: ABS

Crew Training and Competency

Crew training to support reliable operations, maintenance, troubleshooting and repairs has proven problematic, according to workshop attendants. Transferring any experience with a specific BWM technology from one crew to another was challenging; training often proved not to be transferable between systems.

Operation, Maintenance and Safety Manuals (OMSM)

There was found to be a real lack of consistency among OMSMs, with some proving to be less useful than others; instructions regarding routine maintenance and troubleshooting were not always well defined. The manuals were found to be either too complicated (operators struggled to understand the vendor's instructions) or too generic (not ship-specific enough). Operators were unable to use them quickly to detect malfunctions, leading to prolonged outages.

The manual's shortfalls limited troubleshooting capabilities, potentially making operators more reliant on a limited number of vendor's technicians to resolve in-service systems problems. Other issues included that manual lists for spare parts and consumables were impractical or insufficient for in-service operations, potentially resulting in:

- Urgent requests for the delivery of spare parts, and
- Inconsistent systems operation if the spares and consumables are not delivered to the vessel fast enough
- Insufficiently consolidated periodic maintenance schedules, and
- Manuals not being written in the working language of crew, making it harder for the crew to comprehend the instructions

Overall, and across all technologies, about one third of owner/operators were happy with the reliability of the systems they had installed; the owners themselves bore some of the responsibility for the underperformance.

The skill sets of the crews operating the systems were found to be insufficient; it is noteworthy that some the highest levels of dissatisfaction came from owners whose personnel had received training on the fly during commissioning, as onboard-acceptance testing was conducted. Finally, only about 40% of owners considered their systems to be 'user friendly,' a measure that spoke volumes about the industry's present overall comfort with the technology.

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Type II MSDs should include long-term performance requirements. For 40+ years, Scienco/FAST provides long-term, advanced, wastewater treatment systems and technical support.

In 2011, one of the first MarineFAST® Marine Sanitation Device (Type II MSD) units ever sold was retired after 38 years of continuous commercial marine service. The customer then promptly replaced it with another MarineFAST unit.

The FAST® (Fixed Activated Sludge Treatment) process actually in the real world and not just in land certification tests without filters, membranes, microprocessors, adjustments, gimmicks or trained operators. It is a submerged fixed film aerobic sewage treatment process. There are no adjustments and performance does not depend upon the skill of the operator. The process can handle any combination of blackwater, graywater, ground food waste, freshwater, seawater, vacuum toilets and conventional toilets.

HOW IT WORKS:

1. In the tank, fixed media is submerged beneath the surface of the water in the treatment tank.
2. A microbial film grows on the surfaces of this fixed media and uses the incoming organic matter in the sewage as "food" to remove from the water.
3. Oxygen is provided by an aeration blower to keep this microbial population aerobic and active.
4. The resulting "effluent" is clear odorless water with high oxygen content and exceeds any known effluent standard worldwide.

There are no moving parts in contact with sewage and no adjustments. Clogging is virtually impossible and proper operation does not depend upon the skill of the operator. In the July 2011 official testing for MEPC.159(55) and without filters or membranes of any kind, a standard FAST Model L-3XM produced:

- BOD5 = 4.1 mg/l versus 25 required.
- TSS = 5.8 mg/l versus 35 required.
- COD = 30 mg/l versus 125 required.
- Coliform = 4 versus 100 required.

The result is a much lower sludge accumulation rate than other units. Also, the sludge is heavier and more concentrated than that obtained from any suspended growth system, including membrane bioreactors (MBR's). One byproduct of this biological oxidation process is carbon dioxide which is vented to atmosphere. Another byproduct is a fine residual sludge of partially oxidized organic material that settles into a storage compartment at the bottom of the tank.

For marine and offshore applications, this effluent is disinfected and then discharged to the surrounding waters. Unless otherwise specified, design and construction of standard marine sewage treatment units shall follow basic guidelines for correct sizing and installation. All standard FAST units are certified for installation on USCG inspected vessels. This not only insures safe and high quality equipment, it also recognizes that as regulations change previously uninspected vessels are increasingly becoming USCG inspected vessels.

When vessels are scrapped, it is not unusual for operators to remove the FAST units and transfer them to newly purchased vessels. Older units can be easily be updated and upgraded as required to meet the newest regulations. All claims for the FAST process and for FAST sewage treatment systems are supported by more than 65,000 installations worldwide and over 40 years of research, development and real world operating history.

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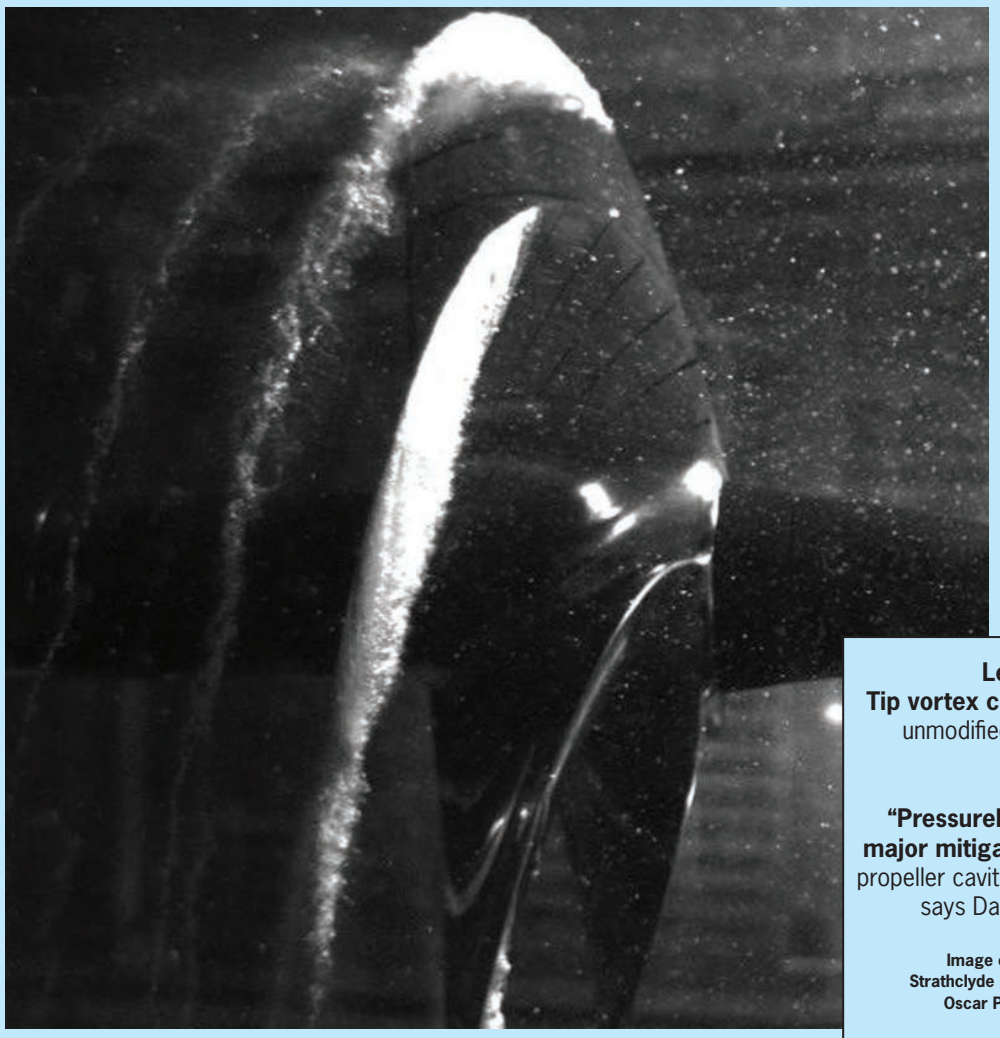
Prop Tech to Cut Underwater Noise



Left:
Tip vortex cavitation from unmodified propeller.

"PressurePores has a major mitigating effect on propeller cavitation and URN," says David Taylor

Image courtesy: Strathclyde University and Oscar Propulsion

Propeller technology has traditionally been the holy grail of efficient, effective marine propulsion, and a new technology developed by Strathclyde University and Oscar Propulsion promises to "substantially reducing the underwater radiated noise (URN)" generated by ships' propeller cavitation.

During the development at Strathclyde using comprehensive computational fluid dynamics (CFD) modelling and cavitation tunnel tests, it was demonstrated that the PressurePores system can reduce cavitation volume by almost 14% and underwater radiated noise (URN) by up to 21dB.

The patented Oscar PressurePores system is designed to reduce propeller tip vortex cavitation by applying a small number of strategically bored holes in the propeller blades. The addition of these pressure-relieving holes is designed to allow ships to operate with a more silent propeller with a minimum of compromise on its efficiency.

"Underwater radiated noise is one of the most adverse environmental by-products from commercial shipping, yet unlike other forms of marine pollution, there is no legislation yet in place to prevent this type of environmental damage," said David Taylor, CEO, Oscar Propulsion. "Increased levels of shipping noise, especially in the low-frequency range, disorientate marine fauna and disrupt their communication signals, leading to behavioral changes or local extinction. We now have a cost-effective, easy-to-apply solution to prevent this from happening. Introducing holes in propeller blades to reduce root cavitation, for example, is not in itself new, but achieving high levels of noise reduction by strategically placing relatively few holes, while maintaining efficiency, is new."

The results were further verified in separate tests on the sub-cavitating propellers used by the Princess Royal, a 19m research catamaran operated by Newcastle University. The original, unmodified model propeller was tested and used as a reference. Then CFD analysis and model tests were carried out on two propellers of the same design, one with 33 strategically-introduced holes in each blade, another with 17 holes.

The outcome showed that PressurePores technology substantially reduced tip vortex cavitation and URN. "Remarkably, it was found that the optimum number of holes could be as few as 17 per blade tip so long as they were placed in the most effective positions," said Taylor.

"It's not a case of simply drilling holes into the blades, as this will affect the propeller's thrust capability. CFD modelling at Strathclyde allows us to know exactly where to place the holes for maximum efficiency and optimum noise reduction." Taylor added.

Professor Mehmet Atlar, the Research Director of the Department of Naval Architecture, Ocean and Marine Engineering at the University of Strathclyde, said: "For a ship with non-cavitating propellers, the dominant URN is associated with the hull and propeller flow, as well as the ship's machinery and electrical sources. As soon as the propeller incepts cavitation, the dominant source becomes propeller cavitation, whilst these other sources still contribute. As a result, a series of periodic tones at discrete blade rate (low) frequencies and its multiples, takes place. This is accompanied by a spectrum of broadband (high) frequency noise due to cavitation and its complex dynamics".

It is interesting to note that propeller cavitation can generate as much as 180dB of underwater radiated noise and can be heard by marine life 100 miles away.

Oscar Propulsion is now looking to partner with shipping companies and propeller designers or manufacturers to commercialize the PressurePores concept.

MARITIME REPORTER AND ENGINEERING NEWS

2019 Editorial Calendar

JULY

AD CLOSE: JUN 23

Cruise Vessel Design & Outfit

MARKET FEATURE: **Expedition Cruise Vessel Construction**

TECHNICAL FEATURE: **Training and Simulation**

PRODUCT FEATURE: **Autonomy, Robotics & Drones**

THOUGHT LEADERSHIP: **Maritime Software Solutions**

AUGUST

AD CLOSE: JUL 25

The Shipyard Edition

MARKET FEATURE: **Heavy Lifting: Cranes, Winches, Windlasses & Capstan**

TECHNICAL FEATURE: **Icebreakers**

PRODUCT FEATURE: **Welding & Cutting Equipment**

THOUGHT LEADERSHIP: **Energy Efficiency Systems**

EVENT DISTRIBUTION

Offshore Europe: Sep 3-6, Aberdeen, Scotland
Seatrade Europe: Sep 11-13, Hamburg
NEVA 2019, Sep 17-19, St. Petersburg
Seatrade Offshore Marine & Workboats: Sep 23-25, Abu Dhabi, UAE

SEPTEMBER

AD CLOSE: AUG 24

Satellite Communications

MARKET FEATURE: **Containership Technology**

TECHNICAL FEATURE: **Marine Firefighting, Safety & Salvage**

PRODUCT FEATURE: **Controls & Bridge Automation**

THOUGHT LEADERSHIP: **Maritime Port & Ship Security**

EVENT DISTRIBUTION

Shipping Insight: Stamford, CT
Clean Gulf: Houston, TX
Interferry 2019: Oct 5-9, London, UK
KORMARINE: Oct 22-25, Busan, Korea

OCTOBER

AD CLOSE: SEP 22

Marine Design Annual

MARKET FEATURE: **Alternative Marine Fuels**

TECHNICAL FEATURE: **Coatings: Deck, Hull and Tank**

PRODUCT FEATURE: **Software Solutions: CAD/CAM**

THOUGHT LEADERSHIP: **Ship Classification Societies**

EVENT DISTRIBUTION

SNAME: October 29 - Nov 2, Tacoma, WA
Europort: Nov 5-8, Rotterdam
Blue Tech Week: Nov 4-8, San Diego, CA

NOVEMBER

AD CLOSE: OCT 25

Workboat Edition

MARKET FEATURE: **Propulsion, Thrusters & Gears**

TECHNICAL FEATURE: **Multi Mission Boats; Patrol, Escort, Fire and Search & Rescue**

PRODUCT FEATURE: **Deck Machinery Product Guide**

THOUGHT LEADERSHIP: **Offshore Wind Power**

EVENT DISTRIBUTION

Workboat Show: Dec 4-6, New Orleans, LA
Marintec China: Dec 3-6, Shanghai China
INMEX China: Dec 12-14, Guangzhou, China

DECEMBER

AD CLOSE: NOV 22

Great Ships of 2019

MARKET FEATURE: **Top 10 Shipbuilders**

TECHNICAL FEATURE: **Digitalization in Ship Design & Construction**

PRODUCT FEATURE: **Bridge Electronics and Communications**

THOUGHT LEADERSHIP: **Maritime Emission Reduction**

EVENT DISTRIBUTION

SNA 2020 - Crystal City, VA

Information may be subject to change

Squid: The All-Electric Dolphin Watcher

Deep in the blue waters of Key West, Honest Eco's founding captain, Billy Litmer, said its dolphin watching tours help their guests "understand and interact with wildlife from a curious yet courteous proximity."

In creating his eco touring company, Litmer invested in everything he needed to guarantee an unforgettable experience for his guests; knowledge, custom boats and quality gear.

His boat is called Squid, and Litmer built it from the hulls up. He asked David Walworth, an MIT educated boat designer and builder, President of Walworth Yacht Designs, to design the perfect boat for the dolphin watching excursions. Walworth suggested that the multihull boat would be a great platform for going electric. The combination of the Sunflare panels and the lithium batteries make electric propulsion possible—and accomplishes much more than the usual 12-volt battery that runs the lights and radio and other small onboard electrical needs. Squid has two BMW i3 batteries. That's about 1200 pounds of lithium ion battery. That meant the solar panels themselves had to be light. The12 custom-sized modules produce 2000 watts of power and weigh as little as 120 pounds combined; or 25% of the weight of traditional solar panels.

Squid is a one-of-a-kind vessel. It's the first of its kind plug-in, lithium ion battery-powered, hybrid charter boat with purely electric motors. Electricity is stored in the batteries, which can be recharged from shore power, the Sunflare panels, or when the dolphins are hard to find, a top EPA tier diesel range extender generator. When the dolphins are easy to find the boat will often not require any use of the generator on the second trip of the day, running purely on battery and solar.

The design ensures that on the longest days on the water, the boat burns only 3 gallons of diesel fuel per trip compared to 14 gallons per trip. Since the Squid can carry just over twice the passenger load of the old boat, the per person fossil fuel consumption drops from 2.3 gallons per guest to 0.25 gallons per guest.

It's also one of the first near-coastal hybrid catamarans to make it through the challenging United States Coast Guard certification process. Litmer said, "there was not much precedent for getting this boat certified. There was no rule book." He said on a few occasions they'd work for weeks on the boat just to have the Coast Guard ask him to rebuild what they'd thought they had finished.

Honest Eco's founding captain, **Billy Litmer** (right) asked **David Walworth**, an MIT educated boat designer and builder, President of Walworth Yacht Designs, to design the perfect boat for the dolphin watching excursions.

All image courtesy Honest Eco and Sunflare

2019 GREAT SHIPS

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DEADLINE: NOV 11 2019

MARITIME REPORTER AND ENGINEERING NEWS

Vard Delivers Ponant Cruise Vessel

Vard delivered Le Bougainville, its third expedition cruise vessel for Ponant. The 131m long, 184-passenger vessel, is the third in the series designed and built by VARD, following on from the delivery of Le Laperouse in June 2018 and Le Champlain in October. Vard Søviknes is now working on a fourth sister ship, Le Dumont-d'Urville, scheduled for delivery to French-owned PONANT in June this year.

Created to be intimate in nature, with just 92 state rooms and suites, all of which boast balconies or private terraces, the ships balance environmental care with cutting edge design and passenger-centric innovation.

Le Bougainville, as with all the vessels from this series, is fitted with the Blue Eye, a multi-sensorial underwater salon will allow guests to discover and experience the underwater world via two portholes in the form of a cetaceous eye looking out on to the sea bed, non-intrusive underwater lighting, and hydrophones integrated into the keel retransmitting the natural symphony of the deep water, as well as

Le Bougainville has started its first sailing from Malaga, Spain, from where she commenced her maiden voyage.

The vessel build project was defined by close cooperation throughout the Vard and Fincantieri network and with Ponant itself. Le Bougainville's hull was built at Vard Tulcea in Romania, before being towed to Vard Søviknes in Norway for equipping and final outfitting. Vard Electro conducted equipment and electrical system installation work, while Vard Design in cooperation with Sterling Design have developed and designed the vessel. The vessel was delivered from Vard Søviknes on 5th April 2019.

Vard became part of Fincantieri in 2013, and is headquartered in Norway, with 9,000 employees spread across nine strategically located shipbuilding facilities and several specialized subsidiaries.

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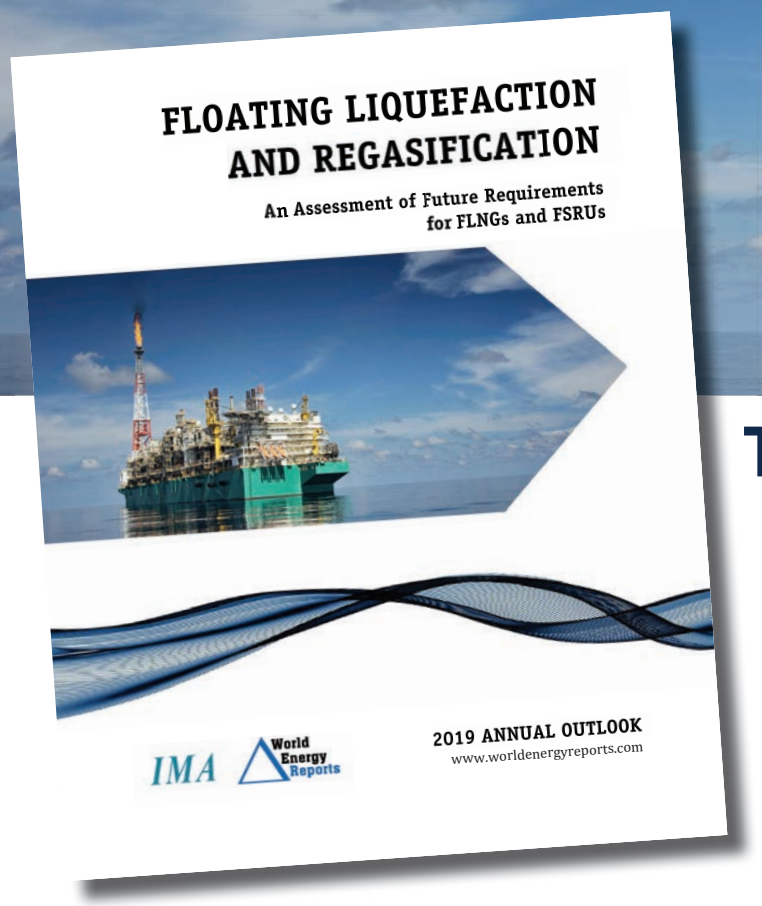
REAL TIME ANALYTICS & REPORTS FOR THE FLNG/FSRU MARKETS

The LNG industry is going through a dramatic transformation. Our 2019 Annual Outlook and real-time FLNG/FSRU database is unique. It is not simply a static report, rather a dynamic and ever-changing database with a continuously updated wealth of data, statistics, exclusive insights and analysis and critical project management contacts designed to keep you a step ahead of the competition.



THE 2019 ANNUAL OUTLOOK

76

FLNG Projects Tracked

There are numerous FLNG and FSRU projects in the planning stage. Not all will move to development. To sort the likely from the unlikely we developed a methodology to rate projects based on specific "success drivers".

130+

Exhibits & Infographics

The 2019 Annual Outlook contains over 55 exhibits and more than 70 infographics, so that you can easily visualize the market data being presented.

150+

Pages of Analysis

There are numerous FLNG and FSRU projects in the planning stage. Not all will move to development. To sort the likely from the unlikely we developed a methodology to rate projects based on specific "success drivers".

THE ONLINE DATABASE

We don't just provide a snapshot of the floating liquefaction and regasification sector. Our online fully searchable LNG database updates all of the project information on a 24/7 basis. As we receive new information about projects from our network of industry contacts, the database is immediately updated to reflect the latest situation.

Database users are able to select any combination of data about projects and export the data to excel for evaluation – or use the sorting and graphics provided with the database for making comparisons and benchmarking.

The FSRU database is a revolution in market insight, it provides real time analytics and information... Everything you need to stay informed of developments in the Floating Liquefaction and Regasification sector.

NO OTHER RESEARCH FIRM PROVIDES MORE INSIGHT INTO THE FLOATING LIQUEFACTION AND REGASIFICATION MARKET. CONTACT US TO LEARN MORE AT:

www.worldenergyreports.com

ZF Marine

ZF: New CBM Tech for Thruster Systems

ZF Marine Krimpen recently debuted its Condition Monitoring System designed to help shipping companies and fleet operators maintain the safety and efficiency of their ships. It is equipped with various sensors and an intelligent electronic evaluation unit. The system measures vibrations which indicate the condition of the bearings and gears in the thruster's upper and lower gearbox. The measurement results help the operators identify early on which components need to be replaced or maintained, meaning repairs can be planned in advance. It also is designed to help extend the service life of the monitored systems and components.

www.zfmarinepropulsion.com

Shell Launches Alexia 40

Shell Marine is introducing Shell Alexia 40 – with a Base Number of 40 – a new two-stroke engine cylinder oil specifically for use with engines running on 0.5% sulfur content Very Low Sulphur Fuel Oil (VLSFO). Shell Alexia 40 has undergone thousands of hours of trials on board four ships with the latest engine types, using representative IMO 2020-compliant fuels, to verify performance at sea. The new product will be available for use in Singapore from June 1, 2019 and will be gradually introduced to other main supply ports within the Shell Marine global network such as the U.S., China, United Arab Emirates and the Netherlands before January 1, 2020. The launch of Shell Alexia 40 will coincide with an introduction of the new Shell Alexia two-stroke engine oils portfolio.

www.shell.com

Shell

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FuelTrax Works with Opsealog

FuelTrax, a pioneer for electronic fuel monitoring systems (EFMS), has formalized compatibility with data integration service provider, Opsealog. Opsealog works in partnership with customers to integrate with FuelTrax data and to generate additional analysis and controls for upstream level management. Opsealog and FUELT FuelTrax RAX currently work together on three vessels, and through formalizing this compatibility, both organizations expect this number to expand amongst their mutual client base.

www.fueltrax.com

CMR Group

CMR E-Pulse Designed to Extend Engine Life

As the technology development cycle continues to accelerate, CMR Group claims its new tech can last a generation. CMR Group has reportedly developed a new approach to extending the life cycle of engines: E-Pulse. E-Pulse is a new control system built around an integrated touch screen-operated local operating panel, main control cabinet and junction box microprocessor package. It is designed to reduce the requirement for future control system refit, providing advanced operational functionality alongside comprehensive engine alarm and monitoring, safety, control operational capabilities for 20 years.

www.cmr-group.com

Hougen Magnetic Drill Kit

Hougen Manufacturing released a new portable magnetic drill kit: the HMD2MT Fabricator's Kit. This kit features the HMD2MT #2 Morse Taper magnetic drill bundled with a number of accessories to give steel fabricators the ability to tackle more jobs by using less tools. The new all-in-one Fabricator's Kit combines the HMD2MT magnetic drill along with the 83000 tapping kit, 08821 drill chuck adapter and a ½-in. Hougen drill chuck.

www.hougen.com

Hougen

New Pumps for Exhaust Gas Cleaning Systems

KSB SE & Co. KGaA

For on-board exhaust gas cleaning systems KSB ITUR Spain S.A. developed its ILN type series of vertical in-line centrifugal pumps with closed impeller and mechanical seal. With its redesigned hydraulic system, the pumps meet the tough requirements specified by the authorities regarding operating behavior and efficiency. The water-tight rolling element bearings require neither re-lubrication nor maintenance. The casing materials are aluminum bronze and super duplex steels. The maximum flow rate of the (60 Hz) pump sets is 3,700 cu. m./hr., and the maximum head is 160m.

www.ksb.com

The Norway Way

While Norway is small in terms of population – with an estimated 5,372,191 inhabitants as of 2018, ranking #120 in the world – it is a true giant in the maritime world, ranking #5 in the world with 2,058 vessels at a cumulative value of $44.24 billion. When evaluating Norway, though, one must look beyond the sheer numbers as 'maritime' is tightly woven into the Norwegian DNA. It's companies and organization form an enviable cluster of maritime wealth and knowledge, and collectively it is a world leader in the advancement of efficient, sustainable shipping technology and practices (see pages, 28, 36 & 40 of this edition).

Sources: U.S. CIA World Factbook, VesselsValue

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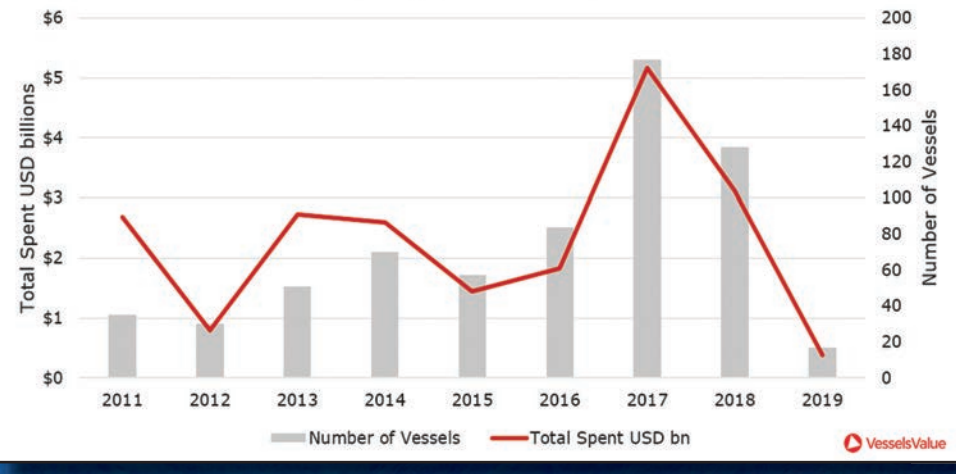
Top Owning Nations by Value
(source: VesselsValue)

Company	Number of Vessels	Total Value USD bn
Greece	4,687	$101.15
China	5,497	$93.36
Japan	4,562	$92.27
Singapore	3,012	$49.48
Norway	2,058	$44.24
United States of America	2,637	$43.42
South Korea	1,624	$30.89
Germany	2,445	$30.43
United Kingdom	1,094	$26.83
Denmark	989	$22.81

VesselsValue

Norwegian Second Hand Purchasing History
(source: VesselsValue)



Norwegian Fleet by Vessel Type
(source: VesselsValue)

Vessel Type	Number of Vessels	Average Age	Total Value USD bn
Tanker	500	11.4	$11.95
MODU	87	11.2	$8.80
Bulker	314	9.3	$5.68
OCV	138	10.8	$4.85
LNG	40	7.0	$4.19
OSV	396	11.5	$3.13
LPG	67	9.1	$2.48
Container	154	11.1	$2.31
Small Dry	319	22.7	$0.72
Reefer	43	26.7	$0.13
Grand Total	**2,058**	**12.9**	**$44.24**

VesselsValue

Norwegian Fleet Orderbook
(source: VesselsValue)

Vessel Status	Number of Vessels	Total Value USD bn
Live	1,944	$36.07
On Order	114	$8.17
Grand Total	**2,058**	**$44.24**

VesselsValue

BUYER'S DIRECTORY

This directory section is an editorial feature published in every issue for the convenience of the readers of MARITIME REPORTER. A quick-reference readers' guide, it includes the names and addresses of the world's leading manufacturers and suppliers of all types of marine machinery, equipment, supplies and services. A listing is provided, at no cost for one year in all issues, only to companies with continuing advertising programs in this publication, whether an advertisement appears in every issue or not. Because it is an editorial service, unpaid and not part of the advertisers contract, MR assumes no responsibility for errors. If you are interested in having your company listed in this Buyer's Directory Section, contact Mark O'Malley at momalley@marinelink.com

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David Clark Company (Wireless Headset Communication Systems), 360 Franklin Street, Worcester, MA 77060, USA , tel:(800) 298-6235 , www.davidclarkcompany.com/marine

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Marine Exhaust Systems of Alabama, 757 Nichols Ave. Fairhope, Alabama 36532 , tel:(251) 928-1234, mark@mesamarine.com

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Sisco Identification Solutions, 3595 Fiscal Court WPB, Fl. 33404

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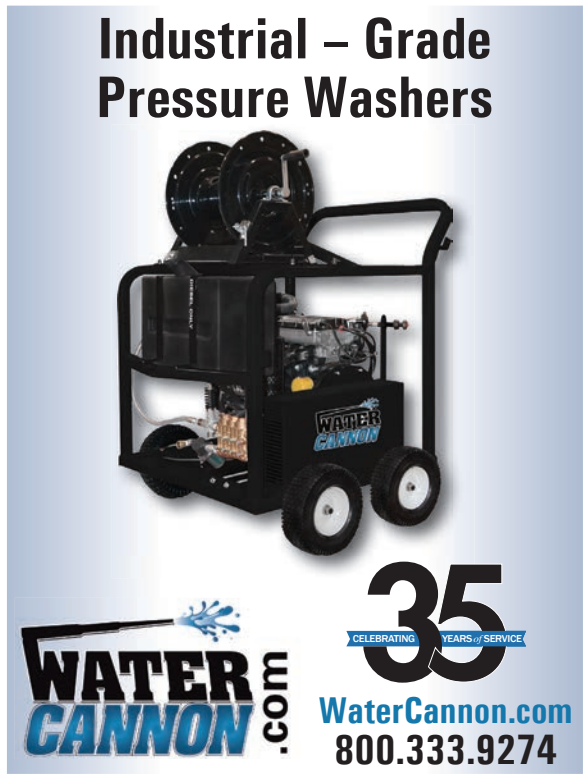

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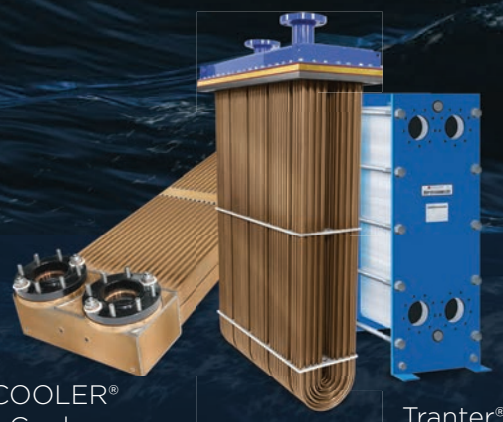

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