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May 2015

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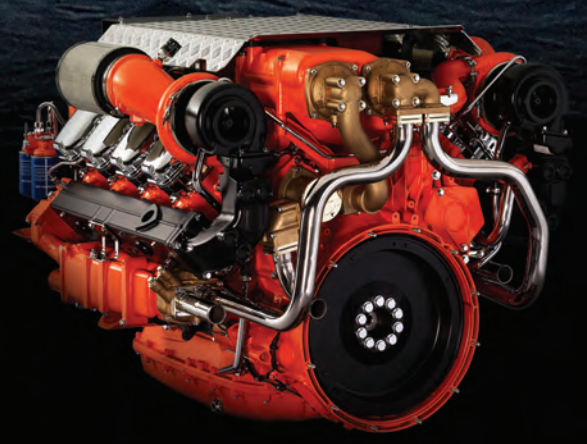

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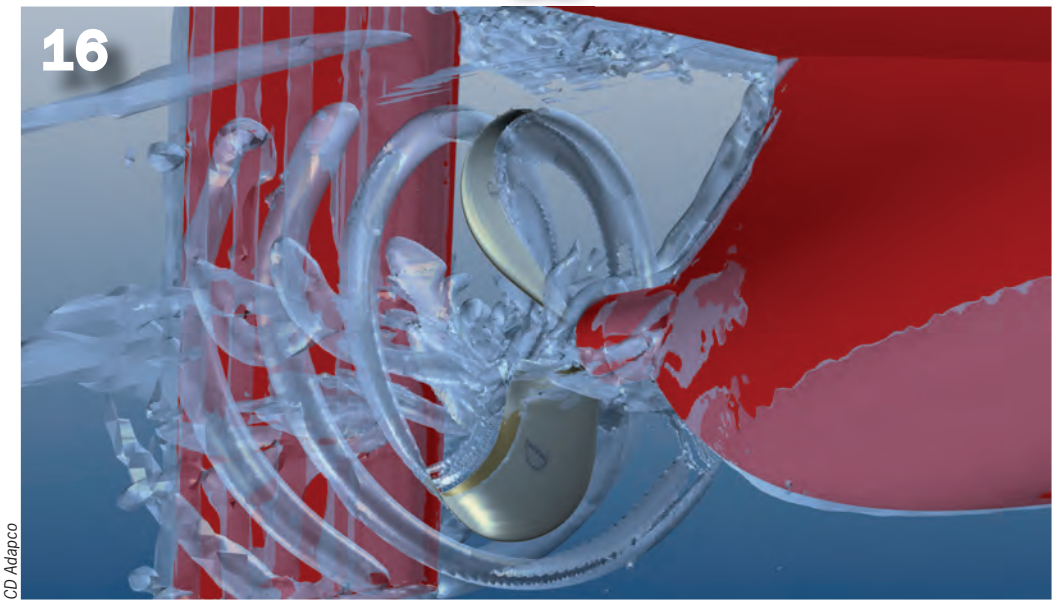

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GREG TRAUTHWEIN, EDITOR & ASSOCIATE PUBLISHER

Norwegians are seafarers, with maritime and offshore oil and gas tightly woven into the DNA of this population of more than five million. On the eve of Norshipping 2015, which is personally my twelfth Norshipping since 1993, the Norwegian Shipowners Association (NSA) released its annual "Maritime Outlook" report. Full insights on its findings start on page 42, and you can pick up the entire 126 page report online courtesy of the link provided in the story. I highly recommend a thorough read, as I believe the insights and projections contained within can be extrapolated and applied to most anyone doing business in the maritime and offshore O&G sectors. To boil it down in a couple of salient points:

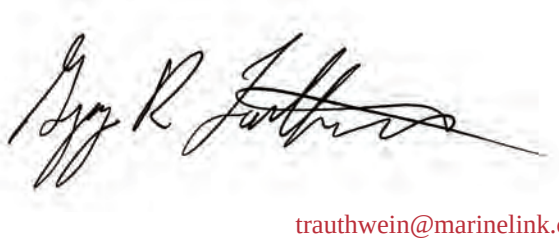
1. The world is crazy, and it seemingly is only going to get crazier.

At a glance, one might surmise that oil prices in the $50 to $60 range posed the biggest near term threat to the health and welfare of Norway, given its stature as one of the world's premiere oil producing nature, and the overall importance of offshore energy to its government's and corporation's treasuries. While subdued oil prices are a concern, it doesn't even make the "Top 3" in terms of the big picture. **Increasing tension and growing political instability** in several key world regions is rapidly on the rise, creating problems such as dwindling international cooperation and a spike in the number of global refugees, problems that will resonate across the maritime sector for many years.

2. General economic stagnation ... except in North America ...

In tandem with and exclusive of the first point, many of the world's major economies are still stalled in the wake of the global economic meltdown and lingering economic malaise of 2008. Seven years later, North America is one of the major economic bright spots, which is why the NSA counts the United States, Canada and Mexico as its top three countries for projected growth in 2015.

If you've never taken the opportunity to visit the Norshipping exhibition, I highly recommend the experience as I consider it to be one of the three best maritime exhibitions in the world. While Norway is the showcase, the event is packed with global maritime leaders from the ship owning, shipbuilding, ship equipment and service supply sectors, and from the preliminary view of the event for 2015 (http://www.messe.no/nor-shipping), all signs point to another successful week of business and networking in Oslo.



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Snarled in Traffic

Intermodal answers include the water.

Joseph Keefe is the lead commentator of MaritimeProfessional.com.

It was just last month that the (challenged) Keefe family packed up the SUV and set out for a little bit of spring break fun, mixed in with a college visit for my son, who will be a senior in high school next Fall. The decision to drive was, in part, an economy move but also made sense due to the relatively last minute nature of our plans. As it turned out, the trip to Florida and back from Charlotte, North Carolina, was without a doubt, the worst part of an otherwise pleasant week.

The GPS tells us that the one-way trip should take approximately 9-1/2 hours but we never got that number under 12 hours. Along the way, the reasons why quickly become transparent. Much of that Interstate corridor – Interstate highways 20, 95 and 75, for example – is badly over-utilized, too much of it is under what appears to be perpetual construction and the volume of freight borne by trucks over those same routes is staggering. I confess to cracking the seal on a lightly oaked chardonnay upon arrival in Sarasota.

On the way back, just before crossing into South Carolina from Georgia, large overhead neon signs warned of massive congestion ahead and all but told people to go and find another route. We did just that. Unfortunately, a few of those 53' container trucks did the exact same thing. Along the way, we got a unique view of back country South Carolina that most folks never get to see, added another (scenic) 90 minutes to the trip but also no doubt got home hours sooner than we would have, continuing along our nation's Interstate highways.

Underneath those trucks, the infrastructure is crumbling. Alongside those same vehicles, traffic has ground to a halt. I harp on the need for a true intermodal model for this island nation all the time. Never did the need for this come into clearer focus than during a frustrating trip along these choked highways. It simply doesn't have to be this way. In fact, just few miles from Interstate 95, the Atlantic Intracoastal Waterway beckons to freight shippers of all kinds. But, since maintenance funds are typically doled out by the feds based on tonnage on the waterway in question, achieving the necessary drafts along this valuable asset is proving to be problematic. It's the classic 'chicken and egg' story.

There are some success stories out there. The I-64 Express, for example, that runs between the inland port of Richmond, Virginia and Hampton Roads, has over time removed tens of thousands of trucks from the crowded I-64 corridor, while at the same time reviving the 'container on barge' concept. Championed by former U.S. Maritime Administrator and VA Transportation Secretary Sean Connaughton, that service is exactly what Ingram hopes to duplicate – and more. Separately and further to the north of Richmond, a ferry system running between Long Island, NY and Connecticut has for many years done the exact same thing. You see: it's not about pitting one transport mode against another. You are always going to need a truck to take that box to its final destination. In my dream scenario, however, that driver is actually going to be able to go home at night and sleep in his own bed. And for an industry (trucking) which boasts among the highest turnover rates in their over-the-road employees of any business sector in the country, you would think that this sort of arrangement might hold some promise. But, hey, what do I know?

The reasons why we can't seem to properly develop our so-called 'marine highway' system are many. The Harbor Maintenance Tax (HMT) on the short sea leg is surely one of them, but that's only part of the problem. It is also only one part of the story. I recently listened to a public radio feature on the intermodal equation here in America. And, as seemingly well told as (their) story was, it also rarely mentioned the maritime aspect of the so-called American intermodal story. That's not unusual, however.

We simply do not tell our story well enough, often enough and to the right people. That said; the annual "AWO Barge-In," held just this week in Washington, is exactly the kind of effort designed to raise the profile of the marine sector that we desperately need. That event largely targets Congress and the legislative sector. We need to do more in our schools and with the general public, as well. The very well presented American Petroleum Institute (API) television campaign that is currently airing on national television, extolling the virtues of America's energy industry is a perfect example of that.

There are forward thinkers out there. Take Ingram Barge Company, for example, who this month launched a test of a 'container on barge' service from Paducah, Kentucky to St. Louis, MO. "Currently our nation's highways and railways are operating near full capacity, while our inland waterways are vastly underutilized," said Dan Mecklenborg, Senior Vice President, Chief Legal Officer, Ingram Barge Company. "We know there is substantial room to grow in transporting goods on the rivers with minimal investment. And the inland waterways network is the safest and most environmentally friendly mode of transporting cargo in the U.S."

At a press conference trumpeting the event, intending to raise awareness of the capabilities of intermodal river transportation, Mayor Francis Slay of St. Louis, said, "The Maritime Administration predicts the U.S. will need to move an additional 14 billion tons of cargo by 2050 to accommodate population growth. This means we will need to almost double our freight movement capacity within 35 years. If we are to meet this demand, remain competitive in the global marketplace, and reduce our carbon footprint, then the inland waterway system should be used as a competitive option."

When the Ingram towboat leaves America's Central Port, the towboat will return to Paducah where the Riverport Authority will unload the intermodal containers using a 200-ton tower crane, the largest in all of North America. We can only hope that this will be the first of countless barge moves, with future ones laden with actual cargoes.

Ingram sees the future and the future includes dry cargo barges that just happen to fit containers nicely in good numbers. Sure, it makes for a "green footprint" but Ingram sees a different kind of green, as well. Good for them. Think about it: bulk in one direction; containers in the other. Or, perhaps, the concept will catch on so well that the barges will need to be dedicated to container service full time. We can only hope and pray.

There's no reason why U.S. waterways (everywhere else) can't be a part of that vision. That's the real story. That's the story that we need to be telling. And, just be thankful you weren't in my Honda Pilot last Saturday as we crawled across Florida – slower than a freight train in the rail yards of Chicago. In case you didn't know, that average rail speed in the 'Land of Lincoln' is less than 9 MPH. It almost makes barges seem fast.

Daddy wasn't happy on Saturday. And as the kids will tell you, if Daddy ain't happy in the car, nobody's happy. Let's get those containers on the water.

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Tankers Strong Market Extends Peak Season Earnings

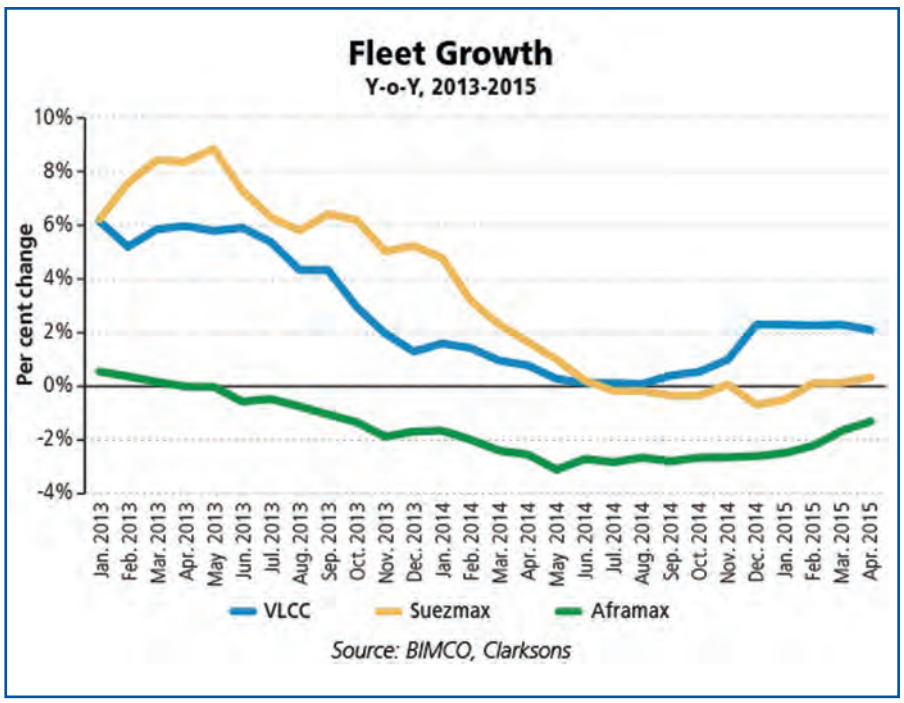
Tanker earnings for crude oil tankers have climbed to new strong levels in the first quarter of 2015, with averages not seen since 2008, the Baltic and International Maritime Council (BIMCO) reported.

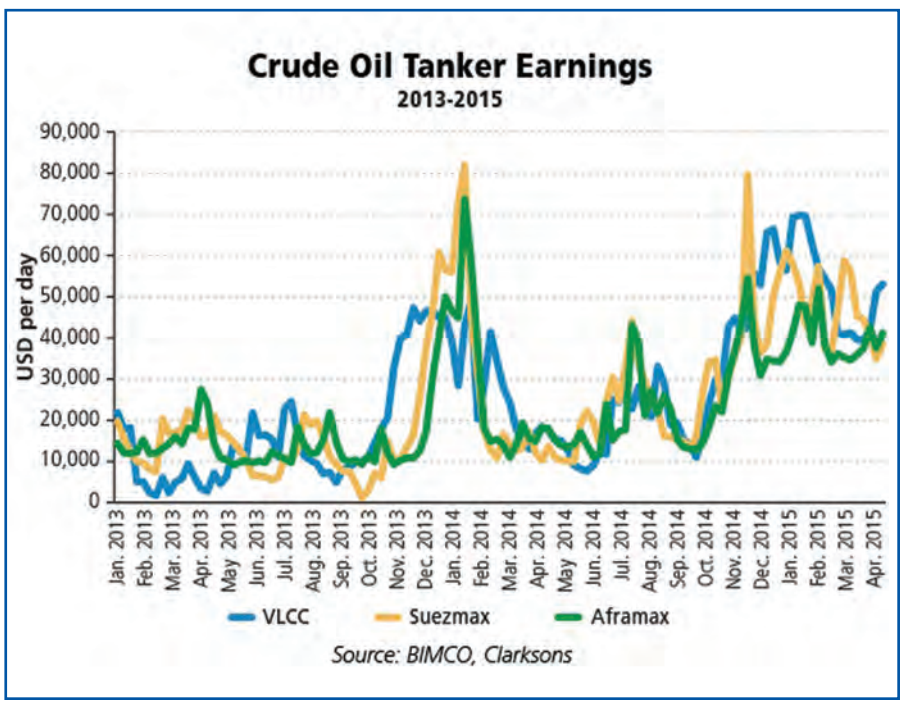
The demand for crude oil tankers remains high even though the winter months are far behind us. Following the winter peak season of 2013/14, crude oil tanker earnings collapsed and remained low during spring, before rebounding over the summer. In the winter peak of 2014/15, this has not been the case. The market appears to have kept the momentum going, keeping the crude oil tanker earnings at a high level.

The average earnings for VLCCs were around $51,000 per day in the first three months of 2015. That is 76% higher as compared to the first quarter of 2014, where it was around $29,000 per day. For Suezmaxes, earnings were at the same level, around $50,000 per day in 2015 as compared to around $31,000 in 2014. As regards to the Aframaxes the difference between the two years was a bit smaller however still noticeable with around $40,000 per day in Q1 2015 up from around $29,000 last year.

$51K

The average earnings for VLCCs were around $51,000 per day in the first three months of 2015, which is 76% higher as compared to the first quarter of 2014 ($29,000 per day).





Chief Shipping Analyst at BIMCO, Peter Sand, said, "The strong winter market for crude oil tankers was in line with our expectations. But on top of that is this extended run of strong earnings that proves the window of opportunity is still open as a result of very advantageous fleet growth levels for all crude oil tanker segments."

Although the steady demand for oil has played its part in this year's high rates, there is another more substantial factor in play. When we look at the fleet development from the previous years, it is clear that the fleet growth for the three crude segments has been low. For VLCCs, the average monthly fleet growth in 2014 was only 0.8% on a year-on-year basis. For Suezmaxes the number was 1%. In comparison the year-on-year numbers for 2013 where 4.6% for VLCCs and 6.8% for Suezmaxes.

For Aframaxes the numbers were even better. A decrease of 0.6% in 2013 compared to 2012 followed by another drop of 2.6% in 2014. A reduction of the fleet has shifted the supply and demand curves and it is safe to say it has contributed to keeping the earnings at the level we see today.

"BIMCO expects crude oil tanker supply growth at 2.2% in 2015. This is a three-year high. Fortunately, it's still a level that should see healthy earnings for crude oil tankers throughout 2015, all other things being equal," Sand added.

Source: BIMCO, Clarksons

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ARDENT

The New Name (& familiar face) in Maritime Salvage

Last month Svitzer and Titan Salvage announced plans to merge their salvage operations. **Peter Pietka**, former chief executive of Svitzer Salvage, takes the helm of the new combined company – to be dubbed Ardent and headquartered in Houston – on May 1. *Maritime Reporter & Engineering News* spoke with Pietka for insights on the path ahead.

By Greg Trauthwein

Svitzer, the salvage division of AP Moller-Maersk and Titan Salvage, a division of Crowley Maritime Corp., will effectively meld two of the enviable corporate cultures in the maritime world, bringing together a pair of companies which include strong family roots and larger corporate development.

Last month the pair announced the plan to combine the salvage operations into one, larger operation, equally owned by each company. Ardent 'opens its doors' on May 1, headquartered in Houston, Texas, with offices in the Netherlands, the UK and Singapore

Discussions on maritime salvage today start with words like "risk" and "compliance," meaning long gone are the days when salvors were viewed as cowboys, as the legal and financial risk penalties in maritime and salvage operations today mandate a level of sophistication, engineering and expert support unlike any other.

"You can't be a cowboy anymore," said Pietka. "Today you are dealing with two types of risk: risk to the personnel involved: for example we are accustomed to coming to ships on fire, in some cases where the crew has left because It's too dangerous, and our guys are boarding from a helicopter. If you deal with that type of risk you need to be incredibly disciplined. The other part is financial risk. In managing both personal and financial risk, you need to be highly disciplined," otherwise it's gambling.

Pietka believes his combined team, with its accrued knowledge and long experience, will be well positioned to continue to be successful in the combined company's traditional core segments – emergency response and wreck removal markets – while also expanding operations into other business lines such as offshore decommissioning and underwater and diving services.

"The company will become an industry leader in wreck removal and emergency response," said Pietka. "Further, while remaining integral to our new company, emergency response and wreck removal will be part of a wider ecosystem of services. We have come together to build a more modern and effective offering for the maritime sector."

"One Leg in Both Camps …"

Pietka, 48 and a Danish citizen, said his chief challenge in the short term will be communication among the entire team, building a common culture and ensuring all are onboard with Ardent's goals and direction. With a career spanning 25 years and having previously lived in the U.S. twice for more than 10 years, he feels well suited for the task.

Many years ago he served on the Maersk corporate council team working out of New Jersey, and subsequently he ran the Svitzer tug boat operations for North and South America based in Miami. For the previous three years, he has worked in the salvage business based in Holland.

"I have one leg in both camps," said Pietka, noting that challenges are inherent in any combined venture, particularly one involving companies from separate countries on separate continents.

Timing is Everything

Oftentimes corporate tie-ups are a direct result of prevailing, long-term market conditions, which appears to be the case in the creation of Ardent. "I think that our industry is facing two opposite pressures," said Pietka. "One pressure (from the marine and the insurance industries) is the requirement to invest in new equipment," that will be able to offer emergency response operations to a fleet of ships that are growing increasingly larger.

For example, if one of the world's massive new containerships gets in trouble outside of port, salvage companies need the equipment to offload the ship efficiently and safely. Another area of growing concern is the ability to respond to the complex emergency scenario posed by the growing numbers of vessels with LNG onboard. "But at the same time, we are seeing that there are fewer incidents."

"The intention of this merger was to create a company which is stronger than either of the two companies would have been on their own," Pietka said. "It has allowed us to create a stronger company, that is better positioned to meet the requirements at a lower cost basis."

In Pietka's view, Titan was the perfect partner for Svitzer Salvage, as Titan has been historically strong on the wreck removal portion of the salvage business, including its role in the salvage of Costa Concordia, considered to be one of the, if not the, most famous salvage of all time. Svitzer Salvage in turn was particularly strong in the emergency response sector.

"We were very complementary in terms of each other's strengths and weaknesses."

Meet Ardent

The joint venture formed with effect from May 1 and will be headquartered in Houston, Texas, with offices in the Netherlands, the UK and Singapore. The new executive management team will be led by Peter Pietka; with Jeff Andreini, chief financial officer; Renier van den Bichelaer, chief commercial officer; and Paul van't Hof, chief operations officer; and Chris Peterson, merger manager.

They said it ...

"Terminal operators should take precautions that are relevant to the specifics of their own operation. Bigger ships and greater container volumes will only augment the exposures that are already inherent in their current operations."

Phillip Emmanuel, TT Club, putting into perspective some of the sensationalism surrounding the recent growth trend in container ships.

"The choice of ballast water treatment system should not be the major constraint on a vessel's potential business or resale value."

Stephen Westerling Greer, *Alfa Laval*
(See story page 57)

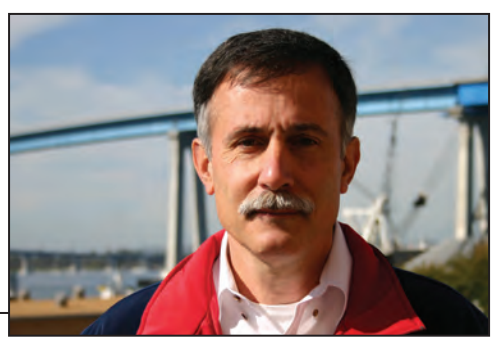
Halul Offshore

"This is another example of an initiative that moves the industry beyond concepts towards the reality of a design that can be built,"

Nick Brown, Lloyd's Register's Marine Chief Operating Officer
(see story page 70)

"The current dry dock that we have, the "Pride of San Diego," has a 26,000 ton lift capacity. The new one we're having built is 55,000 ton.

Bob Koerber, GM, BAE Systems Ship Repair, San Diego, CA
(See story page 52)



Maritime Security Threats Abound

"The first few months of 2015 have demonstrated, in the most visible way possible, just how complex and sometimes dangerous the maritime domain can be, as well as how important it is to maintain awareness, treat the risks and avoid complacency at all costs."

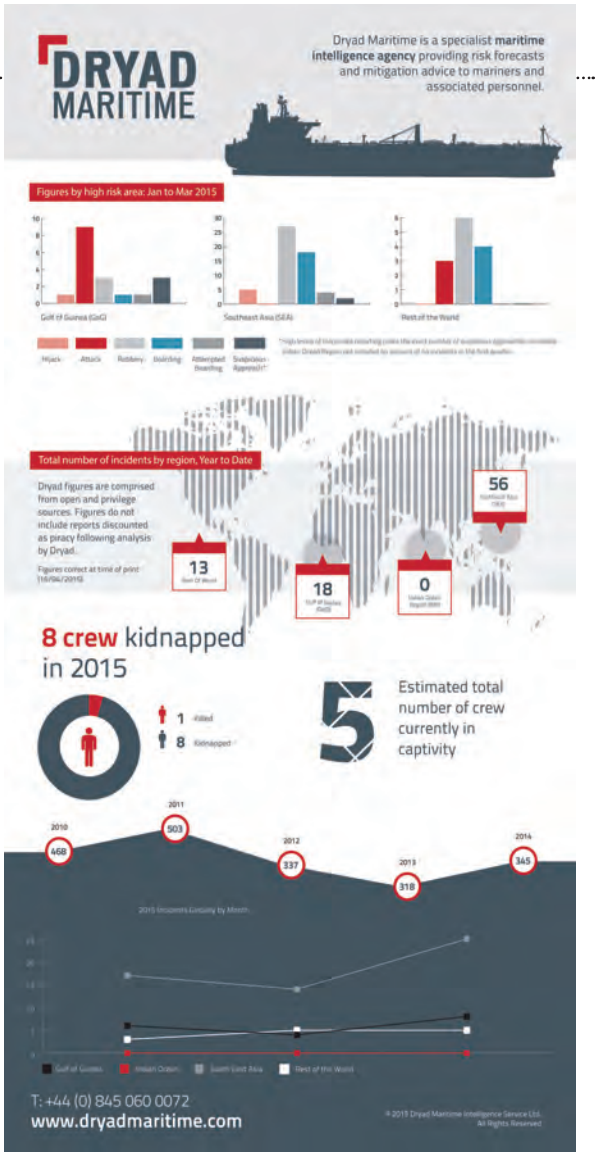
Ian Millen, COO, Dryad Maritime

Piracy and maritime crime is a complex matter, not one with easily identifiable or actionable answers. Dryad Maritime released its analysis of worldwide reported incidents of piracy and crime against mariners for Q1 2015, a report which includes but is not limited to traditional piracy and maritime crime, including also commentary on other threats and issues; from civil war and terrorism in Yemen and Libya to criminal gang enabled mass migration in the Mediterranean, a migration which resulted in an estimated 1,000 deaths during one particularly bad week in April 2015. Some highlights of the report include:

- The kidnapping of crew for ransom continues to pose a real and viable threat to mariners off Nigeria.
- Dryad reports that the privately funded Migrant Offshore Aid Station (MOAS) ship Phoenix will redeploy in support of efforts to save lives off of Libya. The number of people attempting to cross from North Africa to Europe is up 40% this year.
- The actions of the Houthi rebels in Yemen and the Saudi coalition response impacts maritime trade.
- In the Mediterranean, the situation on mass migration continues to dominate the news with disturbing stories of massive loss of life that is impacting commercial vessels as they render assistance.

Southeast Asia

There has been a reduction from the high number of incidents from 75 in Q4 2014 to 56 in Q1 2015. Although the total number of incidents are down by 36% when compared to the last quarter of 2014, there has been a continuation of attacks against vessels underway in the Singapore Strait. The hijacking and subsequent theft of fuel cargo from small regional product tankers, so prevalent during 2014, has shown no sign of letting up. There have been four vessels hijacked for this purpose, three of which were successful and one in which the Malaysian Maritime Enforcement Agency (MMEA) managed to intercept resulting in the arrest of nine hijackers.



Indian Ocean HRA

Q1 in the Indian Ocean HRA is dominated by the Northeast Monsoon, which brings moderate winds and sea states to the northern Arabian Sea and along the east coast of Somalia. These conditions do not preclude piracy, but despite 26 advisory notices being issued by UKMTO, there have been no confirmed piracy incidents. Of note: some 89% of vessel reporting incidents to UKMTO were carrying a security team, of which on 39% of the approaches fired warning shots. On no occasion were there any reports of weapons discharged from any suspect skiffs.

The disintegration of Yemen into civil war has seen the closure of seaports around the country. A coalition of Muslim nations led by Saudi Arabia commenced daily bombing raids against Yemen's Houthi rebels and warships from Saudi and Egypt commenced blockades of ports. Some national naval assets involved in the anti-piracy convoy system in the Gulf of Aden were retasked to evacuate foreign nationals from Yemen. The complex situation in Yemeni waters and ports is well reported but there is no political or military solution apparent.

For the full geographic analysis, visit www.dryadmaritime.com

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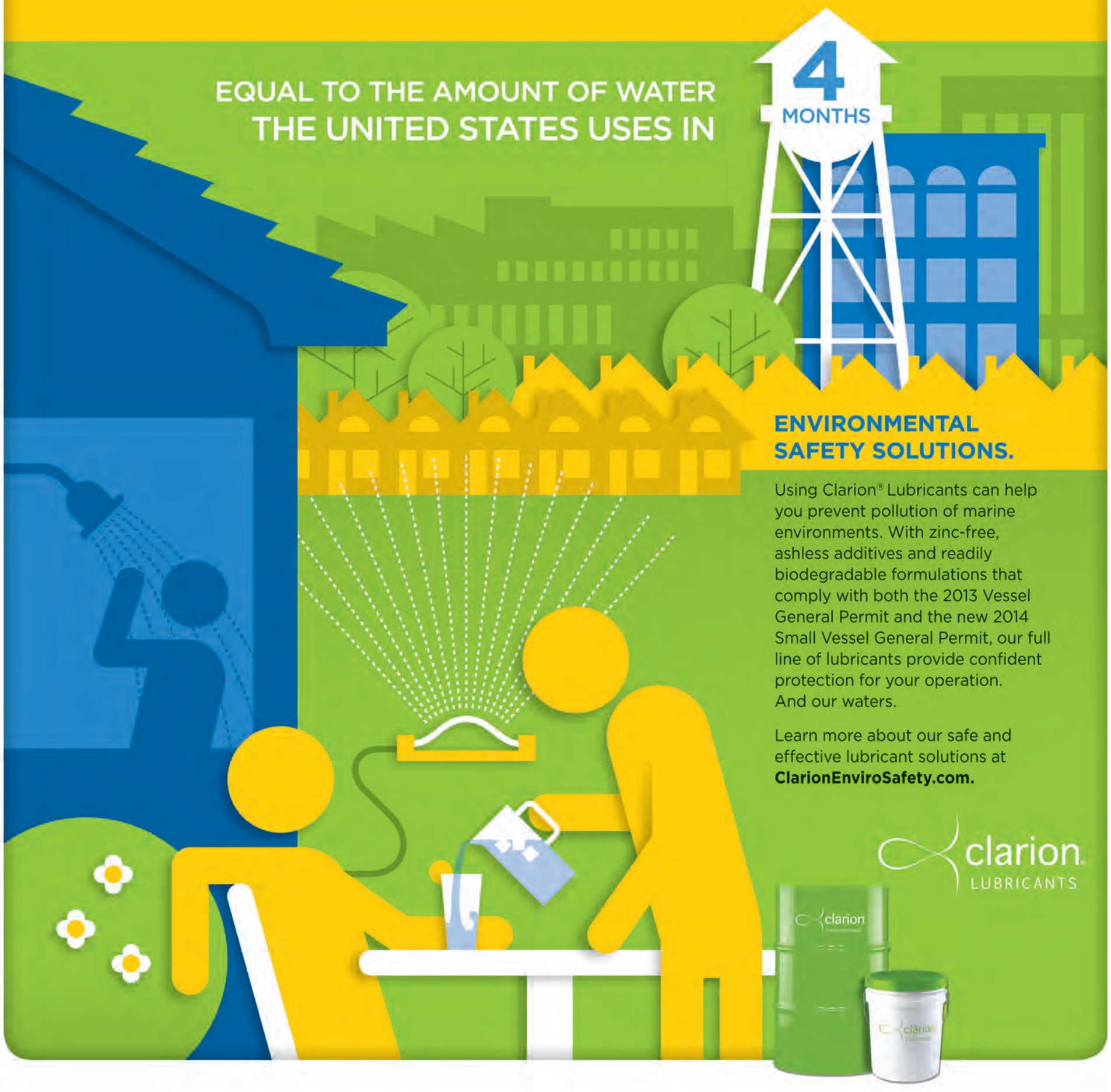

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Numerical Towing Tanks

A practical reality?

BY STEPHEN FERGUSON, CD-ADAPCO

Since the first commercial ship basin was commissioned in 1883, towing tanks have provided naval architects with a reliable method of predicting the performance of a ship at sea. Towing tanks are used for both resistance and propulsion tests, with towed and self-propelled ship models used to determine how much power the engine will have to provide to achieve the speed laid down in the contract between shipyard and ship owner.

The performance of a vessel depends on the hydrodynamic interaction between the hull, its propulsion system and its rudder, which all combine to interact with the environmental conditions. The flow past the hull influences the flow past the rudder, which in turn affects the quality of flow "seen" by the propellor. While it is certainly possible to obtain useful design information from experiments (or simulations) that investigate these components individually, in order to predict the at-sea performance of a vessel with a high degree of accuracy, it is necessary to include all three components in a single model. This is particularly important with the current demand for energy efficient "green ships" which is driven by a combination of legislation and economic necessity. Energy savings of a few percent can significantly influence the operational viability of a vessel.

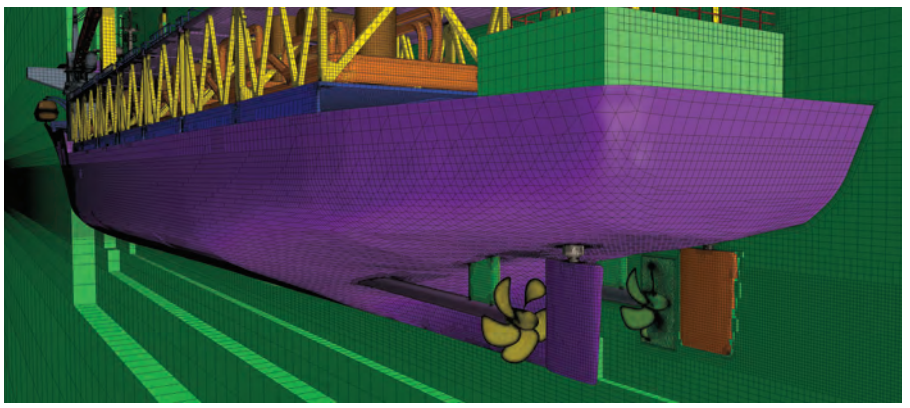
However, the cost and effort of producing a model and testing it, means that towing tanks are usually deployed relatively late in the design cycle, verifying and fine tuning an established design, rather than providing engineering data that could be used to drive the design into different, better, directions. In addition, any novel solution tested at model scale has increased uncertainty of actual performance at ship scale due to deficiencies of the scaling process.

Computational Fluid Dynamics (or CFD) has long been touted as a credible alternative to tank testing, providing a "numerical" model basin that could, at least in principle, be deployed much earlier in the design process, providing naval architects with a stream of engineering data that could be used to influence and improve the design. CFD also carries the distinct advantage of result accuracy independent of the scale at which they are calculated.

However, up until recently, that prospect has been limited by a number of challenges inherent in the CFD simulation process. In this article we consider how advances in CFD and hardware technology have addressed those concerns, and consider whether fully featured numerical towing tanks are finally now a practical proposition.

Challenge 1

Trimmed hexahedral mesh around the hull and rudder with polyhedral overset mesh around the propeller.



CHALLENGE 1: Meshing

CFD simulations solve the fundamental equations of fluid dynamics, through a process known as "discretization" in which a volume occupied by the fluids (both water and air) surrounding the vessel in subdivided into a number of much smaller control volumes (known as computational cells). Depending on the software used, these control volumes can be tetrahedra (four faced pyramids), hexahedra (six faced bricks) or polyhedra (control volumes with an arbitrary number of faces).

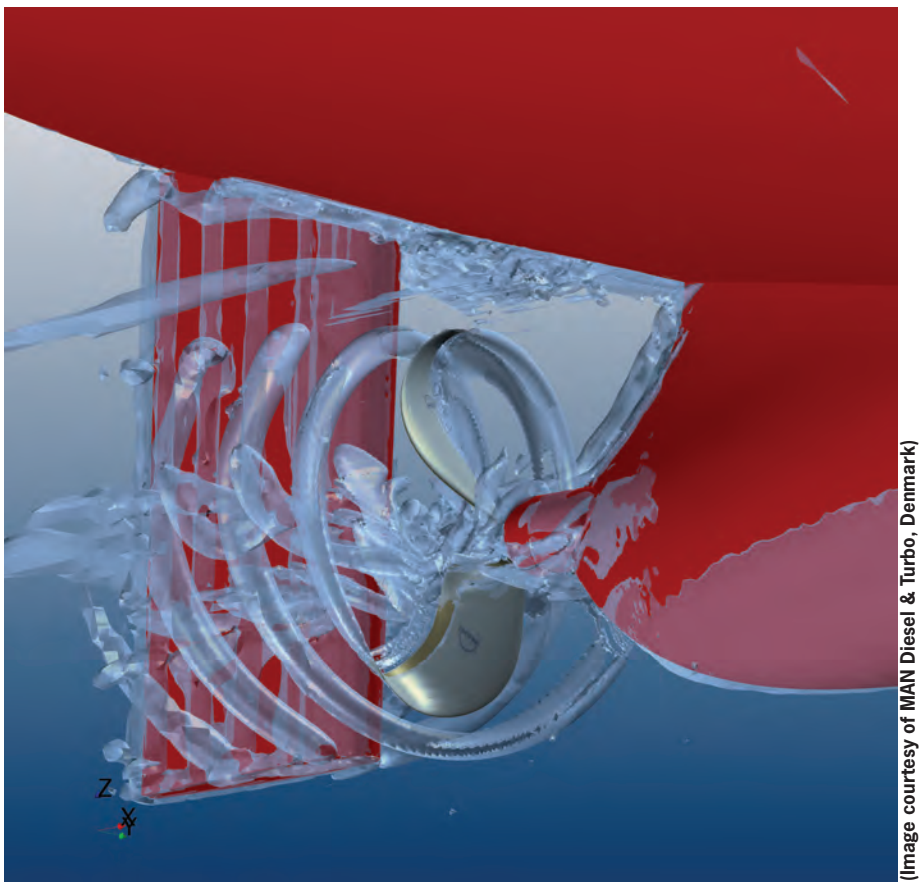
Constructing a computational mesh is one of the most important parts in conducting a CFD simulation, and always represents a compromise between accuracy and computational cost.

In practical terms, a "fine mesh" that is constructed from a large number of small computational cells provides a more accurate prediction than a "coarse mesh" of larger cells. However, a greater number of cells results in a larger computational cost, requiring more computer resources and longer simulation times compared with a coarser mesh. Since the computer resources available for a given simulation are finite and, in order to be useful, simulation results must be provided within a reasonable time-scale, CFD engineers have to choose how they spend their cells wisely, deploying smaller cells in areas of high rate of change close to the vessel and its wake, transitioning to larger cells further away.

Historically, providing a computational mesh that is fine enough to capture the

Challenge 2

Transient DES simulation of the self-propulsion of a bulk carrier using the tip modified Kappel Propeller showing flow around hull and propeller.



(Image courtesy of MAN Diesel & Turbo, Denmark)

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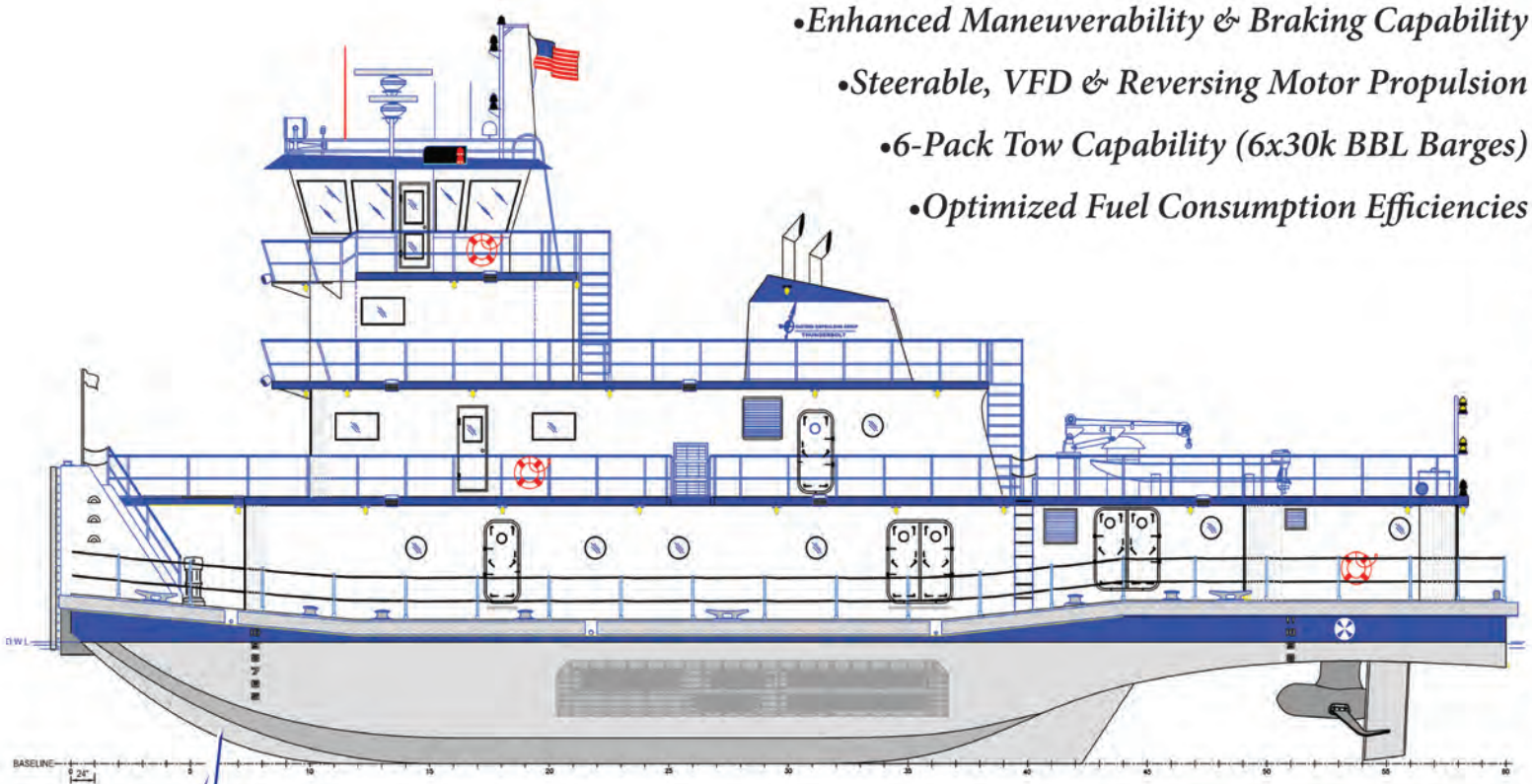

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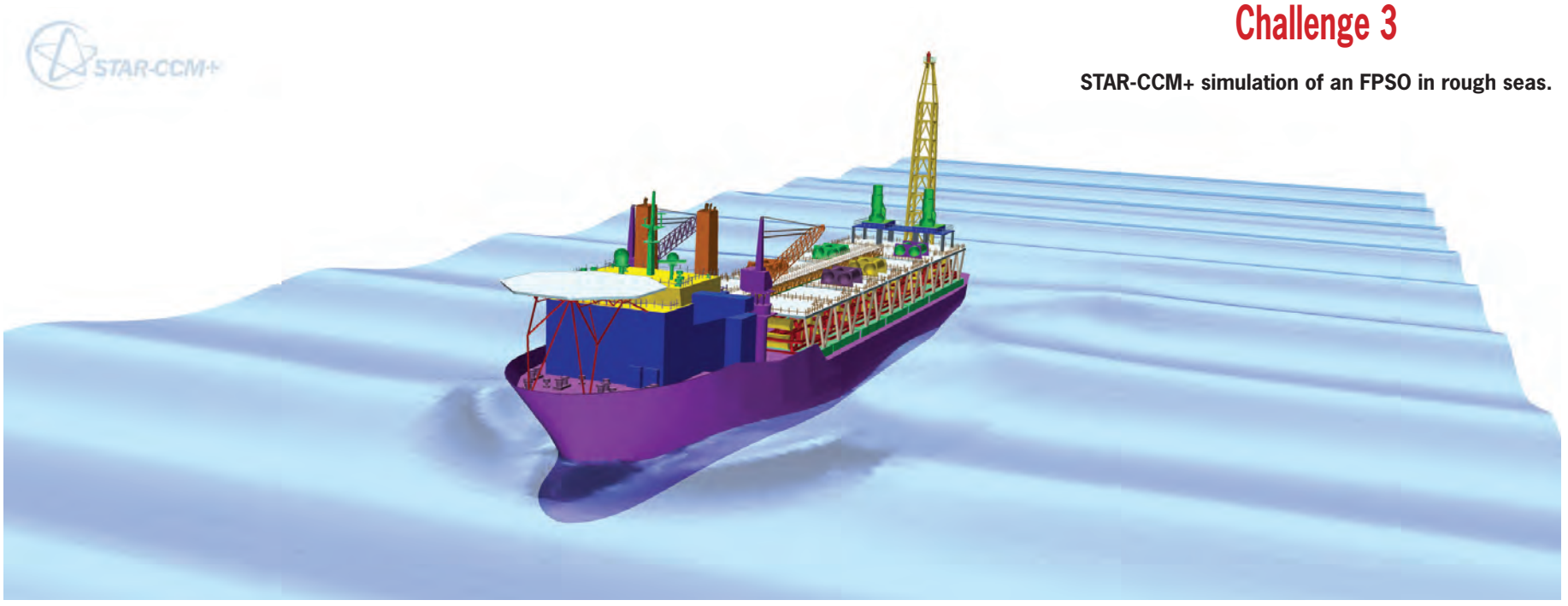
Challenge 3



STAR-CCM+ simulation of an FPSO in rough seas.

hull, rudder and propeller in a single simulation has been challenging, and engineers have often been forced to consider the components in separate simulations (and accounting for their interactions using boundary conditions).

However, recent developments in automatic meshing technology (that provide a high quality grid with minimal manual interaction from the engineer), computer hardware (which provides lower cost computational resources) and licensing (which reduces the cost of running simulations across multiple processors) has made self-propulsion and maneuvering tests a practical proposition.

CHALLENGE 2: Wave and Water Physics

In order to accurately predict the performance of a vessel, the numerical simulation has to correctly predict for both the influence of the vessel on the surrounding sea (wake predictions) as well as the increase in resistance caused by waves.

This represents a much greater challenge than the type of "single fluid" simulations that can be used to investigate an aircraft, land-vehicle, or fully submerged vessel.

Many CFD tools deploy a "Volume of Fluid" approach that assigns a value of "1" to cells that contain water, and a value of "0" to cells that contain air. In cells marked "1" the physical properties of water are used, in the cells marked "0" the properties of air are used.

STAR-CCM+ deploys a "High Resolution Interface Capture" scheme to accurately capture the position of the free surface between water and air; this is necessary to prevent the free surface from diffusing (with cells that have a value that is somewhere between "1" and "0"). This method ensures that the interaction between the vessel and the free-surface can be accurately captured. STAR-CCM+ also provides a range of built-in higher-order wave models that can be used to test the vessel under realistic sea states.

Additionally, STAR-CCM+ also includes an extensively validated cavitation model that can be used to predict and manage the phase changes caused by the propeller.

CHALLENGE 3: Vessel Motion

Unlike the simulation of an aircraft or road-vehicle, which in ideal circumstances moves forward in a single direction, the forward progress of a ship is heavily influenced by the surrounding sea-state. Even in still water, establishing the dynamic position of the ship in relation to the sea surface ("sink and trim") is critical to providing accurate resistance predictions. In rough seas, the full motion of the vessel in six-degrees-of-freedom must be correctly accounted for, as the vessel pitches, rolls and heaves in response to oncoming waves.

STAR-CCM+ accounts for 6DOF vessel motion in an automatic manner. The "Dynamic Fluid- Body Interaction" model integrates the forces acting on the vessel at every time step, and adjusts its position (in all-six-degrees-of-freedom) accordingly.

"Adjusts its position" means moving the computational mesh, which historically has been a difficult proposition, and various methods have been used to account for this motion. For relatively small movements, the vertices of cells in the mesh can be adjusted on a step-by-step basis. However, for large movements, this becomes impractical as individual cells become highly distorted, leading to inaccuracies in, or failure of, the simulation.

STAR-CCM+, uniquely among commercial CFD codes, solves this problem using "overset" or "chimera" meshes, in which the mesh around the vessel is independent of the mesh used to represent the sea. This allows the simulated ship to move as much as necessary. Furthermore, it can be used to model the interaction between multiple vessels or objects, such as one ship moving independently in the wake of another, or the collision of two vessels. Also, with overset mesh, the rotation of the propeller and rudder motion, in addition to propeller pitching, can all be modeled in relation to the ship motion, leading to robust, accurate self-propulsion and maneuvering analysis.

OUTLOOK

Having addressed the three main challenges to replicating the performance tests, CFD is now able to provide a useful tool to augment, if not replace, towing tank testing. Comparisons between STAR-CCM+ and tow-tank simulations have demonstrated a high degree of correlation between the two methods (typically within a few percentage points [1],[2]). Furthermore, CFD simulations also have the advantage that they can easily be deployed at full-scale if desired, reducing the uncertainty inherent in model scaling.

Although it is unlikely that any large vessel will be designed in the foreseeable future without some aid from towing tanks, CFD is now routinely being used as part of the design process by ship builders and naval architects across the world. Used effectively, CFD simulation can be used to reduce the amount and cost of physical towing tank tests by providing a more refined and optimized design that requires fewer modifications in order to meet contractual obligations.

It is also true that in certain parts of the industry, such as in the design of the high-performance vessels that compete in the America's Cup, towing tanks have been dispensed of entirely in favor of CFD. The winning yacht in the 37th America's Cup was designed using STAR-CCM+, as will be yachts raced by Ben Ainslie Racing and Luna Rossa in the next America's Cup.

What of the future? Unlike towing tanks, once you have developed a robust process for simulating the performance of a vessel, it is relatively easy to automate it. This opens the door to both "automated design exploration," where the proposed vessel is subjected to a wide range of potential operating scenarios, and "optimization," where the design of the vessel is automatically adjusted to account for deficiencies in the performance identified in previous simulations.

Widespread adoption of this approach will not only lead to more innovative and efficient ship designs (which can be developed at lower cost), but also more robust vessels that have been numerically tested against a much wider range of real-world operating conditions than could ever be considered using a towing tank alone.

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[1] http://www.cd-adapco.com/presentation/maneuvering-predictions-early-design-phase-using-cfd-generated-pmm-data

[2] http://www.dansis.dk/filarkiv/pdf-filer/2009/2/skibsdesign_force.pdf

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TRAINING

Cutting Costs While Remaining Cutting Edge

BY JENNY MATTHEW

Businesses are operating in tough economic times, with budgets being significantly cut during the current industry downturn. Unfortunately, when lowering costs is a key priority, learning and development budgets have historically been one of the first areas to take the hit, yet projects still need to be completed and delivered to the highest possible standard.

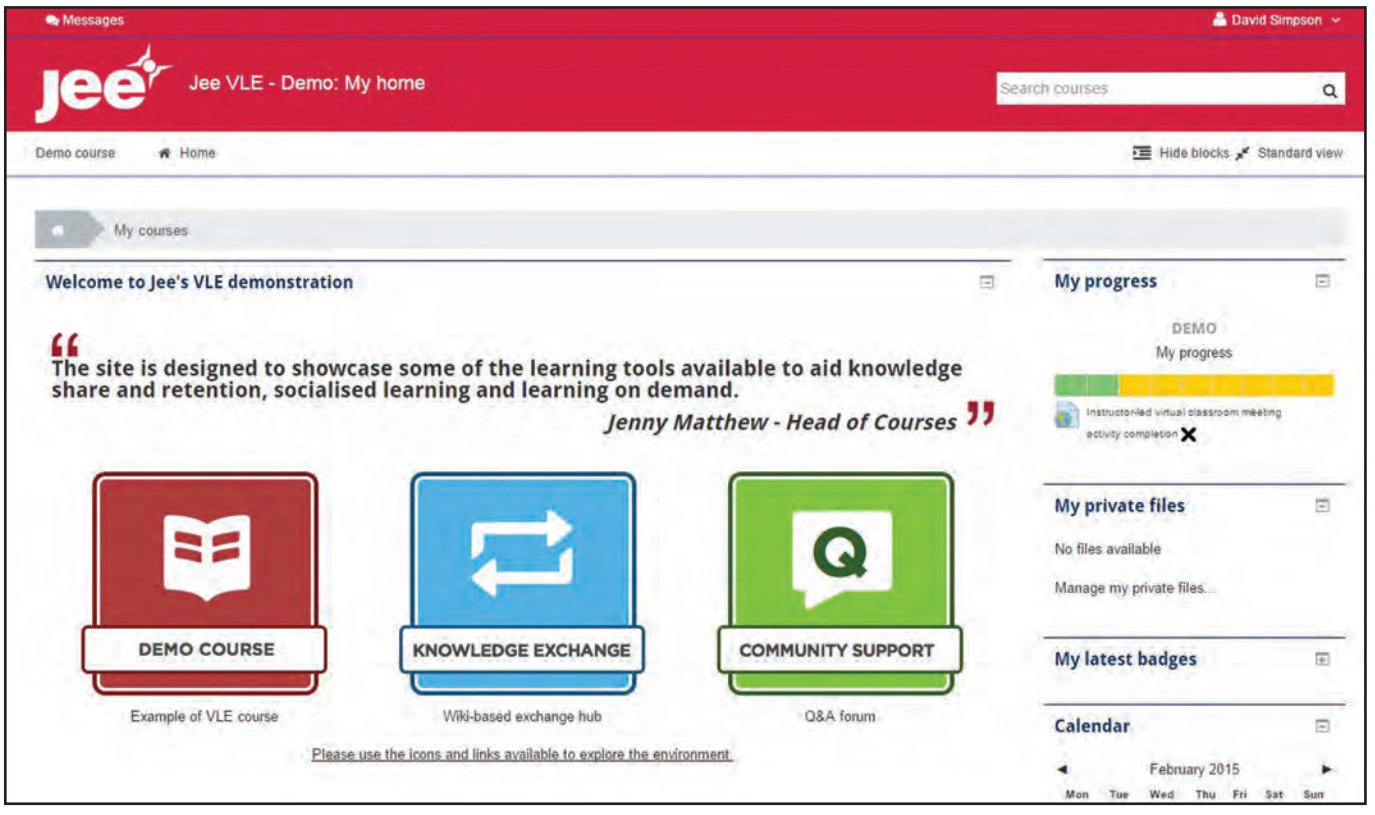
It's well-proven that investing in learning and staff development is essential to ensure immediate and long-term business objectives are met, such as greater efficiencies in project delivery, as well as supporting professional career development of staff.

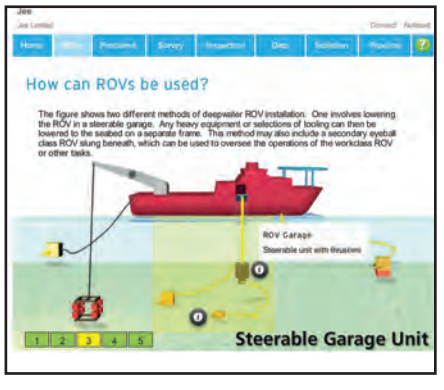
In addition, investment in training and staff development indicates a company's intention to nurture growth and create an environment where staff feel valued. Developing your staff and their capabilities helps to develop a cohesiveness within a company that will strengthen the resilience required to overcome most any downturn. Continuous learning and development is beneficial to the individual being trained, the company he or she works for, and the industry as a whole.

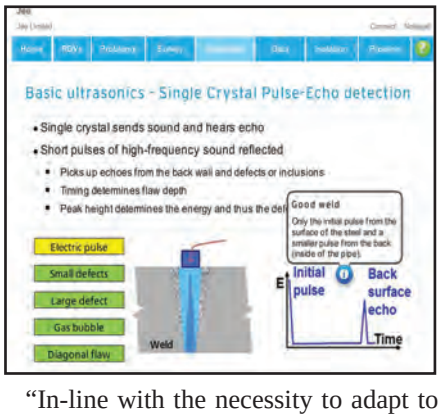
Training and people development should be a key part of a company's overall strategy, and rather than cutting deeply into training budgets, alternative cost saving solutions should be considered.

There are a number of ways to make significant cost reductions, while still ensuring your staff continue to feel valued, and their progression is seen as one of the company's key objectives. One of these approaches is online or blended learning.

The annual Learning Survey 2014 report commissioned by The Learning and Performance Institute (LPI) has confirmed that, although the traditional classroom remains a viable channel for workplace trainers, it is coming under increasing pressure from live online learning, self-paced e-learning and webinars.







Jee Ltd. is an independent multi-discipline subsea engineering and training firm offering multiple channels for subsea engineering training, through in-company, public and online training delivery. The company recognizes that during buoyant market conditions, flexible training options are required to support learning during busy project periods and that cuts are inevitable during times of industry downturn. Since 2009, Jee has been investing in alternative solutions to meet its customers learning requirements during busy and slow periods.

"Online training, as with classroom training, provides quality teaching which is fully supported by skilled professionals in a facilitated environment - with the added bonus and advantage of accessibility, flexibility and cost saving," Jenny Matthew, Head of Courses at Jee Ltd., asserts. "A virtual classroom means that there is no need to pay for employees to travel to far out destinations, or incur the accommodation costs that come with it. The flexible approach also means that staff can engage in online training outside of work hours or around their work schedule at their choosing.

"In-line with the necessity to adapt to industry requirements and be progressive with those changes, Jee recently upgraded its e-learning site to accommodate the growing number of delegates, and to enhance its online and blended learning offering to the oil, gas and renewables industries.

"The energy industry is calling out for flexible training solutions that can be used as a cost-effective way of training for existing and new employees. This investment in our site, based on a 'Moodle' learning platform, is part of our ongoing commitment to provide comprehensive

"Learning and development should not be seen as an extra cost but as a vital element of project and business delivery. It should be acknowledged that cutting training budgets will have a significant impact on the business. Professional development increases productivity, improves employee interaction and reduces staff churn, all of which contribute to a positive impact on the bottom line."

Jenny Matthew, Head of Courses at Jee Ltd.

and flexible training programs."

Key features of the Moodle platform include improved functionality for a user-friendly experience, so delegates can easily navigate the site and track their course progress. Online support forums and chat tools enable peer-to-peer learning and knowledge transfer between delegates and tutors.

Matthew said "The Moodle platform is designed to be a supportive, integrated and interactive learning environment with on-hand tutors to monitor course progress and provide extra guidance when required – all essential features to provide the optimum experience for the end user.

"At Jee we offer delegates the best learning experience, and recognize the importance of blended learning techniques to maximize learning retention and enriching the Jee training experience.

"Our clients' needs are always at the forefront of our minds, highlighted through the investment in our online and blended learning systems."

Jee offers clients the ability to create a bespoke training program by choosing from a wide range of Jee's learning materials which include more than 200 course modules, and access to its substantial knowledge library of case-studies, videos, worked examples, assessments and quizzes.

The additions to the online platform form an integral part of the blended learning programs that Jee has developed. Blended learning ensures learning deliveries are optimized by selecting the most appropriate delivery method for each learning outcome. For example, a Jee training course may be separated into online learning, self-study, coaching sessions and a tutor-led workshop.

"We have an ongoing commitment to offer the most in-depth and up-to-date training to the oil, gas and renewables industries and what is required – regarding both content and delivery. With a training portfolio developed from our extensive engineering capabilities, the company's expertise lies in providing integrated services across the whole life-of-field, spending 80% of our time working on engineering projects and 20% teaching industry professionals about them."

Jee has built up a portfolio of 24 subsea engineering courses offered worldwide, with many taught in the energy hubs of Houston, Norway and Aberdeen.

"Learning and development should not be seen as an extra cost but as a vital element of project and business delivery. It should be acknowledged that cutting training budgets will have a significant impact on the business. Professional development increases productivity, improves employee interaction and reduces staff churn, all of which contribute to a positive impact on the bottom line - meaning it should remain a key element of any business's strategy.

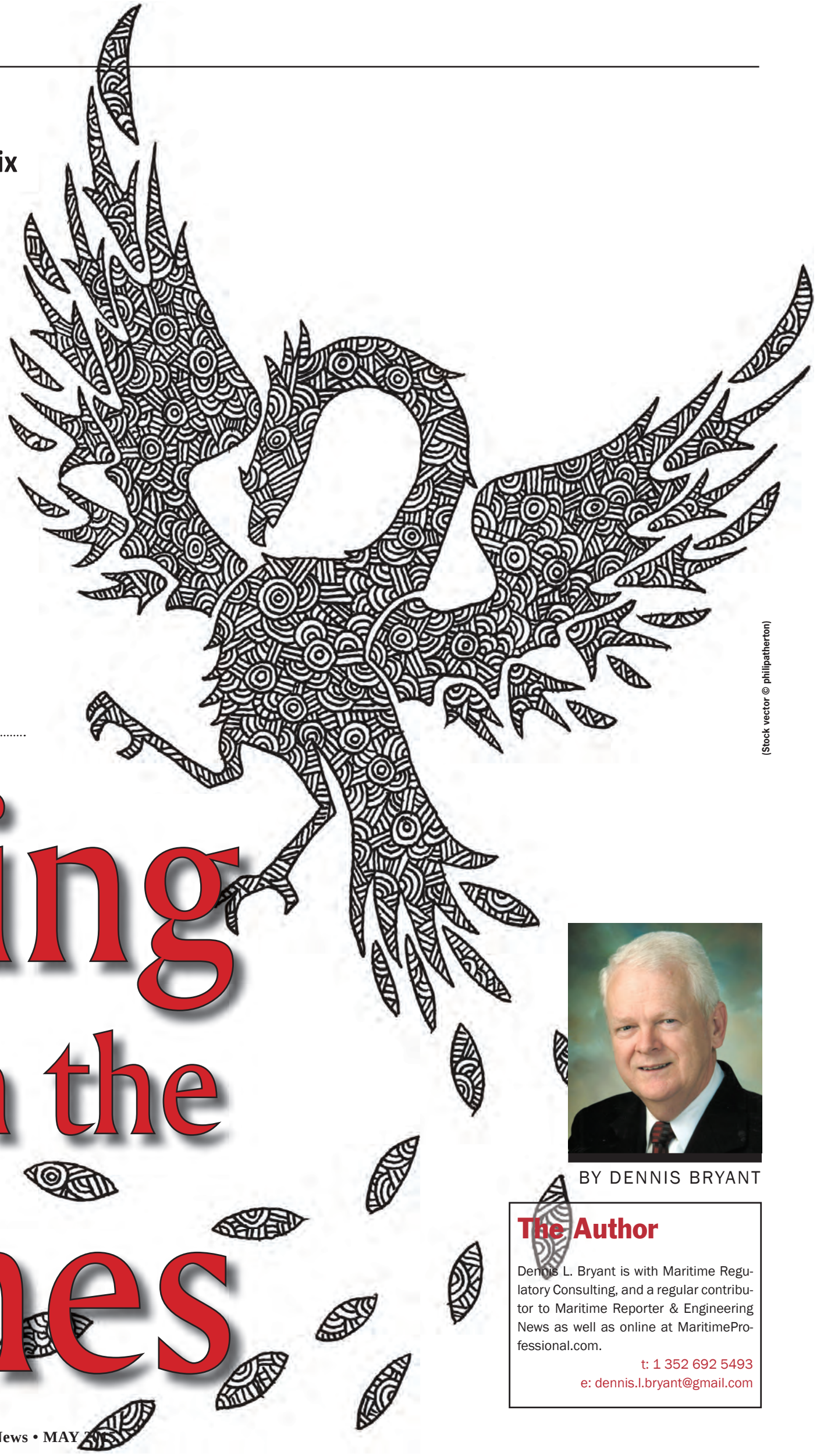
"Businesses should see this downturn as an opportunity to look at the bigger business picture, take advantage of cost-effective training solutions and the much needed 'time to learn' while the market has slowed and ensure that staff are at the top of their game to meet the needs and demands of a challenging market" said Matthew.

The Author

Jenny Matthew is Head of Courses at Jee Ltd. An accomplished senior marketing and business professional, Ms Matthew joined Jee in 2007 as marketing manager, taking up the post of Head of Courses and Marketing in 2011. She is responsible for the day-to-day operations and strategic direction and growth of the courses division.

e: Jenny.Matthew@jee.co.uk

In mythology, **the phoenix** is a long-lived bird that is cyclically regenerated or reborn. A phoenix obtains new life by **arising from the ashes of its predecessor.** The allusion fits the situation with Loran. Loran-A gave birth to Loran-C. After its death, **Loran-C** may be about to give birth to **eLoran.**



(Stock vector © philipatherton)

Rising from the Ashes

BY DENNIS BRYANT

The Author

Dennis L. Bryant is with Maritime Regulatory Consulting, and a regular contributor to Maritime Reporter & Engineering News as well as online at MaritimeProfessional.com.

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Unlike the hyperbolic Loran-C system, modern eLoran receivers can simultaneously measure the "time of arrival" of signals from many stations in multiple chains. Using solid-state transmitters and atomic clocks, eLoran provides extremely precise timing.

The federal government is now taking steps to reverse its 2010 decision to terminate the nation's LORAN program.

The LORAN program was initiated during World War II, when US and Allied forces fighting in the Pacific Theater needed a good means of navigation in that vast ocean. The US Coast Guard was charged with establishing and operating chains of Loran-A stations throughout the Pacific. With war's end, the program was extended to coastal areas of the United States and elsewhere. Over time, Loran-A was replaced by Loran-C, which provided both greater coverage and improved accuracy. As part of the digital revolution, the Coast Guard in about 2000 began exploring the possibility of developing an enhanced version of Loran, soon referred to as eLoran.

In an effort to reduce the hemorrhaging federal deficit, the Administration's Budget for 2010 proposed termination of the Loran program, using these terse words: "The Budget also supports the termination of outdated systems such as the terrestrial-based long-range radionavigation (LORAN-C) operated by the U.S. Coast Guard resulting in an offset of $36 million in 2010 and $190 million over five years." Although only the bean counters thought that this was a good idea, the Department of Homeland Security and the U.S. Coast Guard bit their respective tongues and went along, as did Congress. Thus, Loran-C was terminated as was work on developing eLoran.

Similar to Loran-A and Loran-C, eLoran is a low frequency terrestrial navigation system utilizing a number of transmission stations that emit precisely timed and shaped radio pulses. In eLoran, the pulses are centered at 100 kHz. Each station emits a sequence of eight pulses spaced 1000 microseconds apart. The stations are grouped into chains, each consisting of one master station and two or more secondary stations. The master station transmits first, followed by successive transmissions from each of the secondary stations of the chain. The master/secondary transmission sequence is repeated periodically, with the period between repetitions referred to as the Group Repetition Interval (GRI).

Unlike the hyperbolic Loran-C system, modern eLoran receivers can simultaneously measure the "time of arrival" of signals from many stations in multiple chains. Using solid-state transmitters and atomic clocks, eLoran provides extremely precise timing. The transmitters also provide a data channel carrying correction and integrity messages. Using built-in microprocessors, eLoran receivers output latitude and longitude directly, eliminating the need for Loran-line charts.

The eLoran system operates in much the same way as GPS or other global navigation satellite systems (GNSS), but as a complementary and independent system. There are no failure modes in common with GNSS systems. Operating at significantly higher power than satellite-based systems, eLoran is much more difficult to jam or spoof.

Since at least 2004, studies have pointed out the nation's (and indeed the world's) increasing reliance on GPS and other GNSS for positioning, navigation, and timing (PNT). Surveyors, farmers, and others rely on GPS to accomplish many of their tasks. Modern transportation networks rely on GPS for their operation and safety. Modern communication, financial, and power networks could not operate without the precise timing provided by GPS.

Of the 16 commercial sectors identified as vital to the nation's economy, security, and health – referred to as critical infrastructure sectors – at least eleven rely extensively on GPS. GPS technology and GPS-supported applications are deeply embedded into the fabric of our modern lives. Computers, cellular telephones, automatic teller machines (ATMs), and electronic chart display and information systems (ECDIS) would all cease to operate properly without the PNT output available from GPS.

While GPS is taken for granted, it is a relatively recent development and it is highly vulnerable. Solar flares and other high-energy electromagnetic fields (natural or man-made) can temporarily or permanently disrupt transmissions. Terrestrial or airborne transmitters can jam or block reception of satellite signals over wide areas. Due to the lower power of the satellite signals, receivers can be spoofed or fooled into accepting and utilizing bogus signals.

The Government Accountability Office (GAO) reported that there are significant concerns about the sufficiency of efforts of the critical infrastructure sectors to mitigate the expected adverse effects of GPS signal loss. Other studies have shown that the only reasonably available mitigation technology to address GPS signal loss is eLoran.

The federal government seems to be finally awaking from its self-induced slumber on this vital issue. On 23 March 2015, the Department of Transportation (DOT) published a notice seeking public comments regarding potential plans by the government to implement eLoran as a complementary PNT capability to GPS. On 27 March, Representative John Garamendi (D-CA) introduced the bipartisan National Positioning, Navigation, and Timing (PNT) Resilience and Security Act of 2015 (H.R. 1678). If enacted into law, the bill would require the Secretary of Defense, in coordination with the Commandant of the Coast Guard and the Secretary of Transportation, to provide for the establishment, sustainment, and operation of a reliable, land-based positioning, navigation, and timing system to provide a complement to and backup for GPS to ensure the availability of uncorrupted or non-degraded PNT signals for military and civilian users if GPS signals are corrupted, degraded, unreliable, or otherwise unavailable. The General Lighthouse Authorities of the United Kingdom and Ireland (GLA) has never given up on eLoran. Rather, since 2007 it has constructed transmitter sites and conducted at sea tests to determine the accuracy and robustness of the system. In partnership with other European nations, there are now nine operational transmitters providing coverage for northwest Europe. The Russians have converted their Chayka radionavigation system to broadcast a signal that is compatible with eLoran.

Only time will tell if the legislative and executive branches of the federal government have the political will to move forward on this vital and long-overdue initiative. The technology is readily available, but it will take determination to move these first tentative steps to reality. Scarce monies will have to be appropriated. Priorities will have to be rearranged. While the government has imposed a number of resilience requirements on the private sector, it has omitted to take one important step of its own. Movement is now being made to rectify that oversight.

In mythology, the phoenix is a long-lived bird that is cyclically regenerated or reborn. A phoenix obtains new life by arising from the ashes of its predecessor. The allusion fits the situation with Loran. Loran-A gave birth to Loran-C. After its death, Loran-C may be about to give birth to eLoran.

Threats to Global Navigation Satellite Systems

BY CAPT DAVID B. MOSKOFF & WILLIAM G. KAAG

Originally developed to guide Allied convoys safely across the Atlantic, the use of synchronized low frequency radio signals as a navigational aid revolutionized modern maritime navigation in the 1940s. Faced with operating ships and aircraft over vast areas, researchers pioneered the use of radio signals to aid navigation in regions where poor weather conditions made traditional methods—such as dead reckoning and celestial navigation—exceptionally difficult. This system was eventually named LORAN. When in range of three or more shore-based transmitters, LORAN receivers placed onboard ships and aircraft allowed operators to fix their location within minutes regardless of the weather. The original system, known as LORAN-A, and its eventual replacement, LORAN-C, were operated by the U.S. Coast Guard and other nations until 2010. The U.S. portions of the system were phased out in favor of the satellite-based Global Positioning System (GPS) which became operational in July of 1995. The latest LORAN Position Navigation and Timing (PNT) system known as "eLoran" is currently in use or under consideration in several countries. Eventually, Loran C systems throughout the world are expected to be replaced by eLoran.

"If this event had been a GPS failure instead of a GLONASS failure ... the entire world would have plunged into a catastrophe."

Nunzio Gambale, CEO of Locata,
after an 11-hour GLONASS outage

The impact of GPS on the commercial transportation industry has been enormous. Everything that moves—ships, cars, trains, aircraft, and even farm equipment—is now navigated by GPS, or a similar GNSS system. Companies worldwide use GPS to time- stamp business transactions, maintain records, and ensure traceability. Major financial institutions use GPS to synchronize their computer networks around the world. Large and small businesses now use automated systems that can track, update, and manage multiple transactions made by a global network of customers. These systems require accurate timing information available through GNSS Systems such as GPS (National Coordination Office for Space-Based Positioning, Navigation, and Timing, 2014).

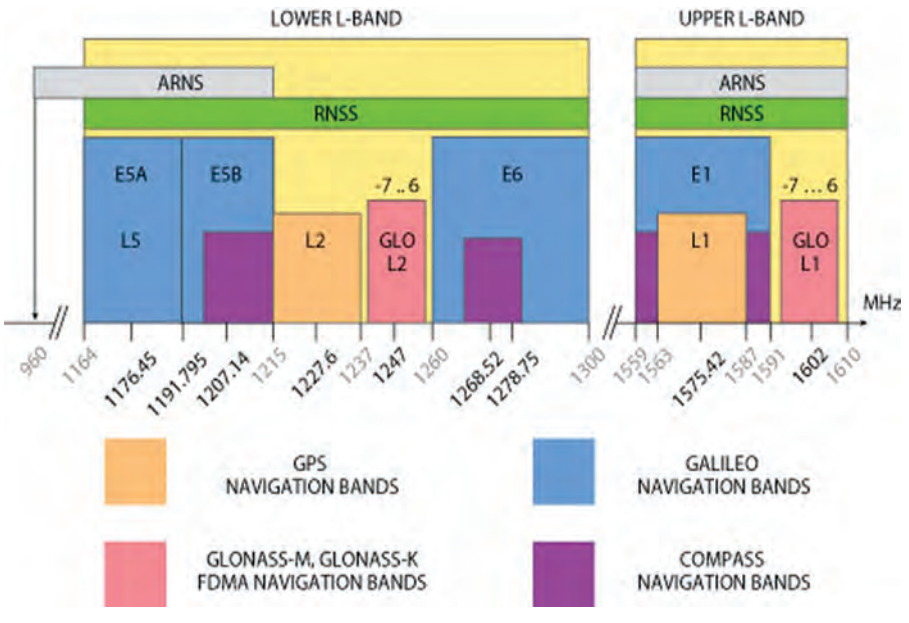
Reliance of the Maritime Industry on GNSS

The commercial maritime industry has become especially reliant on GNSS technology. eCharts provide a continuous, real time plot of the true and relative movements of both the vessel and nearby objects often using radar images and Automatic Information System (AIS) transponder signatures superimposed on the electronic chart (see Figure 1). Most merchant marine academies continue to teach their cadets skillsets such as how to fix a vessel's position using terrestrial and celestial bearings. However, these techniques are less often used in the modern shipping industry, which continues to move irreversibly towards the use of fully integrated electronic bridges. **Yet, in the event of GNSS compromise, these basic seamanship skills may be necessary to counter a cyber attack.**

Several other satellite based PNT systems are also in operation. In 1995, the same year that GPS became operational, the Russian Federation announced deployment of GLONASS. This system has been hampered by uneven funding and suffered a well-publicized 11-hour service outage in April 2014, among other failures. In Asia, China plans to deploy its BeiDou-2 (formerly known as COMPASS) satellite navigation system. The BeiDou-1(BDS) system currently provides only regional coverage, however China has announced plans to provide global coverage by the year 2020. In Europe, the European Space Agency (ESA) continues development of the Galileo

Figure 1: Sample eChart. (Ship Technology Global, 2014)

Figure 2: GNSS frequencies, including Radio Navigation Satellite Service (RNSS); and Aeronautical Navigation Satellite Service (ARNS) frequencies.
(MicrowaveJournal.com May 2012)



satellite navigation system. When complete, Galileo will provide low precision PNT services to the general public, while high precision services will be available for a fee to commercial and military subscribers.

GNSS Signals

Signals produced by PNT satellite systems range between 1162 and 1610 MHz (see Figure). U.S. GPS emits two types of signals: one which is broadcast on a single frequency and available free to all users; and a second signal which is broadcast on a separate encrypted frequency available only to the military. These two signals, are equally accurate. However the availability of the second signal on a different frequency allows the military to compensate for naturally occurring interference within the ionosphere, resulting in a more accurate fix and greater system resiliency.It is important to note that GNSS pulses are extremely weak. GPS signals have been compared to the light emitted by a "40 Watt light bulb as seen from 11,000 miles away (17,700 km)" (Daniels, 2014). As such GNSS signals are vulnerable to:

(1) Jamming and Interference. The broadcast of a stronger signal that intentionally or unintentionally blocks or impacts a GNSS satellite signal;

(2) Spoofing. The broadcast of a false GNSS signal, but at a slightly greater power which deceives the GNSS receiver into locking onto the spoofed signal. A spoofing attack can be very difficult to detect.

(3) Meaconing. The intentional delay and rebroadcast of a GNSS signal intended to introduce error to receivers;

(4) Extreme Space Weather (ESW). Solar activity such as solar flares, coronal mass ejections, high-speed solar wind, and the impact of energetic particles on the earth's ionosphere.

(5) Other Vulnerabilities. Kinetic or laser attacks to the satellite constellations or collisions with space debris are a few of other known susceptibilities of GNSS.

Shipboard Systems Affected by the Loss of GNSS Signals

A significant proportion of navigation equipment on the bridge of a modern ocean- going commercial vessel (see Figure 3) and various offshore energy platforms will likely be affected by the loss of GNSS signals.

For the components listed above, the loss of GNSS may not prevent the component from functioning through an alternate sensor input. However, tests conducted by the General Lighthouse Authorities (GLA) of the United Kingdom and Ireland in 2008 showed how easily error messages and auditory warnings prompted by the loss of GPS can easily distract (and overwhelm) a vessel's bridge team (Grant, Williams, Ward, & Basker, 2008). This can be especially dangerous for vessels operating in confined waterways, near shallow

Figure 3: Maritime navigation equipment that use GPS as a data input.
(Grant, Williams, Ward, & Basker, 2008)

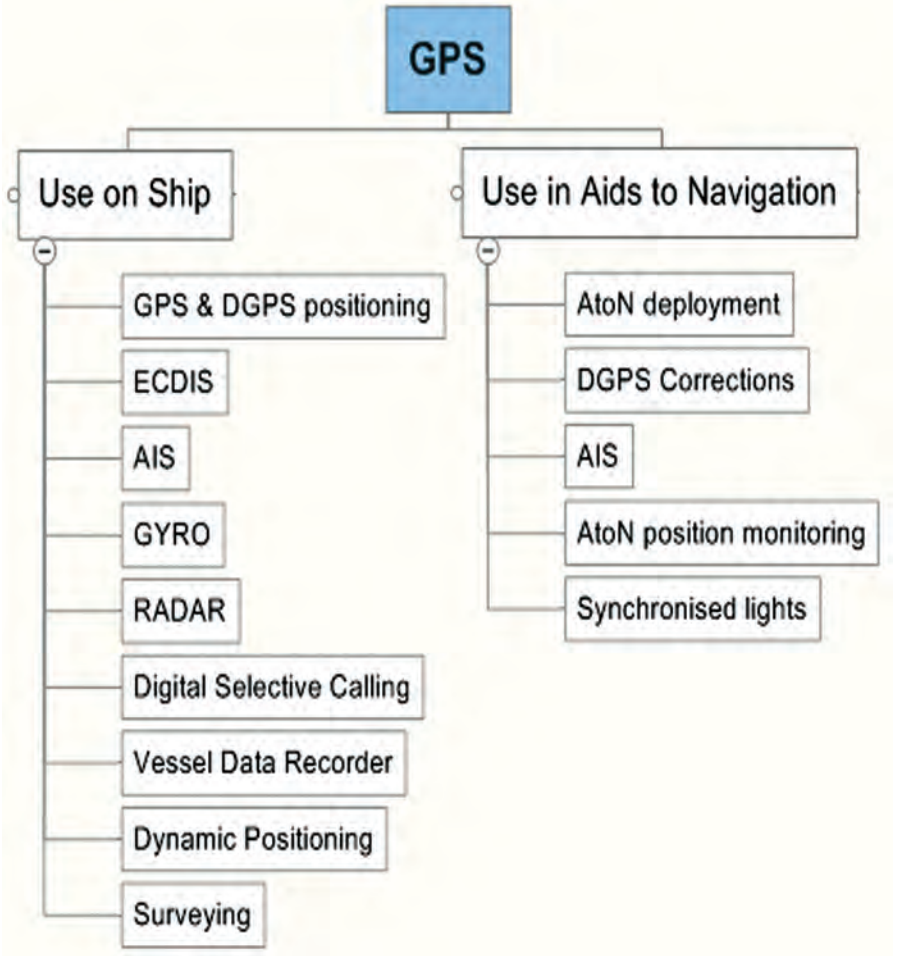


Figure 4: Small jammers that can be purchased via the Internet.
(Source U.S. Government)

areas, or maneuvering in higher traffic densities.

These vulnerabilities are not unique to the maritime industry. A number of other industries are also at risk. For instance, the aviation and financial industries are heavily dependent on properly functioning PNT systems and would be affected in varying degrees by a cyber-attack on GNSS.

Largely unique to the maritime industry however, is that much of marine environment information transfer is via radio frequency (RF) and not a dedicated hard-line network or directional microwave dish. A good example of this type of transfer is positioning signals by satellite systems. Data being sent to and from shipboard computers along with other shipboard technology is cyber; therefore interference with the data flow constitutes a cyber threat. Ergo, a Maritime Cyber Security (MCS) issue.

GNSS Jamming Equipment

With some exceptions, use of GNSS jammers is generally illegal in the U.S., Canada and Europe. Despite this, jammers of various sizes and power ratings (see Figure 5) are available via the internet. These small handheld jammers are extremely difficult for law enforcement officials to locate and suppress because they can be used intermittently, disguised or hidden easily, are highly mobile, and if necessary disposed of quickly by perpetrators.

Advanced GPS receivers are more resistant to jamming than conventional designs. For example, receivers equipped with nulling antennas are more resistant to jamming than receivers without them (Jones, 2011).

Figure 5 shows the area affected by a GPS jammer during tests conducted at Bridlington, U.K. along the coast of the North Sea in 2008. During the test a

Fig. 5. Coverage area of the GPS jamming unit at 25m above ground level on maximum power of 1.58W ERP.
(Grant, Williams, Ward, & Basker, 2008 - Image courtesy of DSTL).

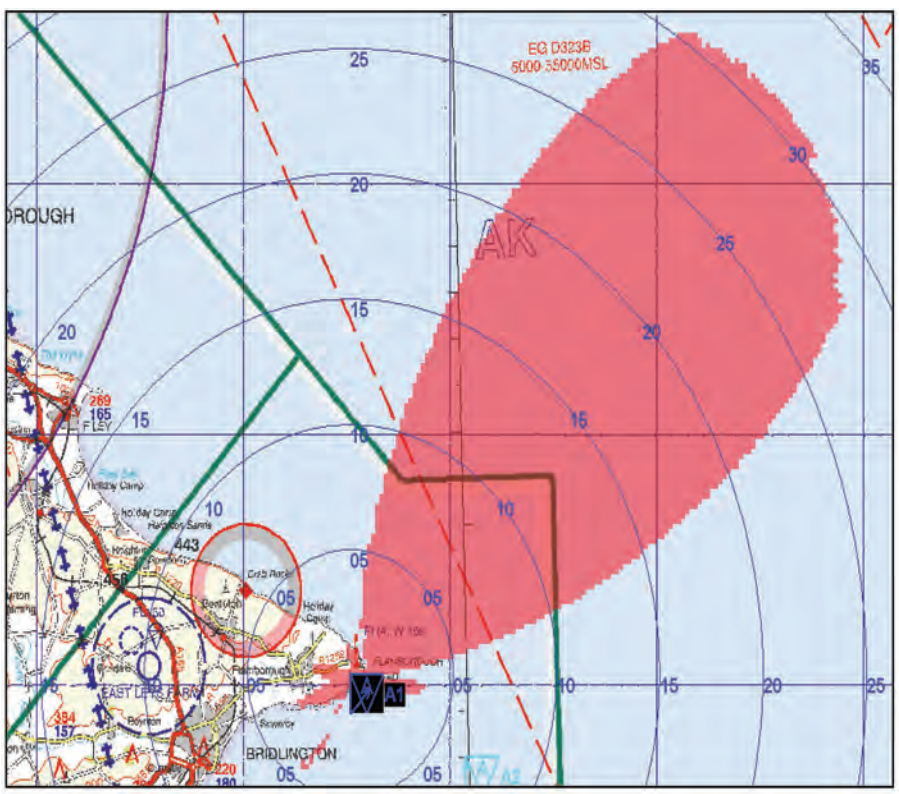


Table 1

Intentional High-Power Jamming of Korea

Dates	August 23-26, 2010	March 4-14, 2011	August 28–May 13, 2012
Jammer Locations	Kaesong	Kaesong and Mt. Kumgang	Kaesong
Affected Areas	Gimpo, Paju, Gangwon	Gimpo, Paju, Gangwon	Gimpo, Paju, Gangwon
GPS Disruptions	181 cell towers, 15 aircraft, 1 military vessel	145 cell towers, 106 aircraft, 10 vessels	1,016 aircraft, 254 vessels

Table 1: Source: (Seo & Kim, 2013)

jamming unit was positioned 25m above ground level with a maximum power of 1.58 watts. These tests demonstrated that relatively small jamming units can effect GNSS reception over great distances (Grant, Williams, Ward, & Basker, 2008).

Threat Scenarios

At this time, the three most likely GPS maritime cyber threat scenarios to consider are:

• **Jamming of a port or other congested waterway by an individual or small group of non-state actors using small, portable jammers.** Rapid movement of these individuals, coupled with intermittent use of the jammer(s) would make it very difficult for local law enforcement officials to track and arrest the perpetrators quickly. Attacks of this type can lead to significant economic losses as well as loss of confidence by system users.

• **State-sponsored GNSS Jamming.** The most well documented examples of state sponsored jamming attacks occurred in the Republic of Korea (see Table 1). On three different occasions, the Republic of Korea was subjected to intentional, high-power jamming by North Korea over a wide area. The source of these attacks appear to have been large truck-mounted jamming units placed at strategic geographic locations (Figure 6). Amongst the many attacks, the 2012 attack affected over 1000 aircraft and 250 ships (Seo & Kim, 2013).

• **State-sponsored Spoofing.** Eventually, spoofing may pose a significant maritime threat to GNSS as it has the potential to lead vessels astray into dangerous waters, resulting in significant loss of life (cruise liners and ferries) or environmental damage. Presently, spoofing requires a level of technical sophistication that is normally presented through nation states. However, small groups have conducted successful spoofing tests, most notably students at the University of Texas under Professor Todd Humphreys.

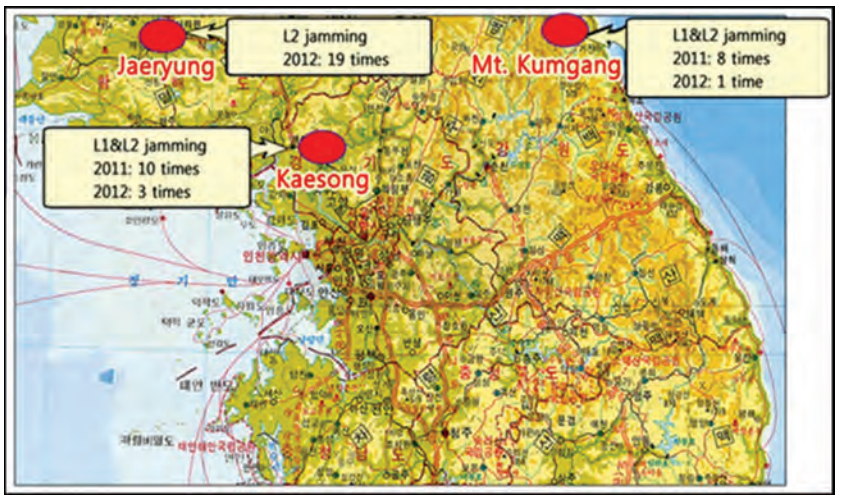
Primary Defenses Against Jamming

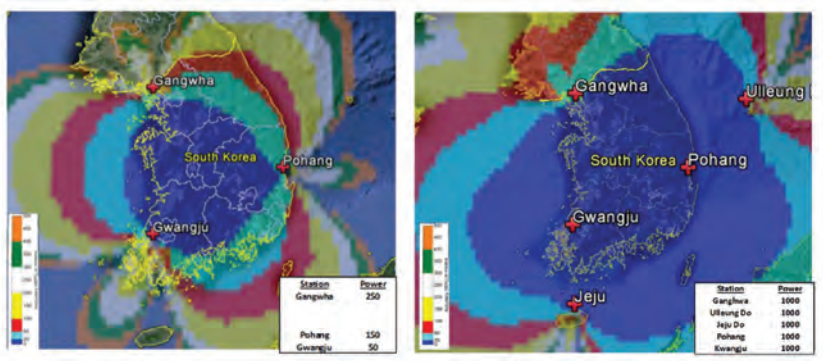
• **Improved Maritime Training and Education.** Ship crews should be taught how GNSS systems interact with ship systems and how to recognize when GNSS signals may have been compromised. The maritime industry should also be encouraged to maintain basic seamanship skills, such as dead reckoning and the ability to use piloting instruments. Routine ship drills should include signal loss and spoofing of the signal.

• **Improved Equipment.** Development continues on new GPS receivers that can identify non-GPS signals by their relative location (jamming and spoofing signals come from the terrestrial locations not satellites) and their strength (jamming and spoofing signals must by necessity be stronger than GPS satellite-generated signals). In addition to receiver signal strength alarms and specialized antennas, the effects of intentional jamming could be mitigated through the use of inertial navigation systems (INS) and

Figure 6: Location of North Korean Jammers.

(Seo & Kim, 2013)





Location and coverage of proposed Phase 1 South Korean eLoran transmitter

(Inside GNSS News January 2015)

radio frequency (RF) jamming detectors. However, at this point in time it is unclear when such equipment would be available to and employed by the commercial industry, or how much it will cost.

• **Installation of Powerful Alternate Ground Based PNT Systems.** Coastal nations most at risk should consider the installation of alternate (back-up) or complementary, land-based PNT systems, such as enhanced LORAN (known as eLoran). Rather than purely "back-up", it is "complimentary" in that the low frequency of the powerful eLoran signals permits PNT reception in GNSS denied environments. However, the main benefit of such systems is to provide PNT users with a second and more resilient PNT signal – one that is too powerful to be effectively jammed or spoofed.

Recommendations

Worldwide dependence on Global Navigation Satellite Systems (GNSS) continues to grow. Ongoing advancements in jamming technology and the availability of small, portable jammers constitute a significant threat to maritime commerce and safety. In the face of a GNSS jamming attack, most commercial ports could be forced to suspend operations until the source of the interference is located and suppressed. It is very possible that a group of individuals operating small, portable jammers could force the closure of a major seaport or international maritime chokepoint. The economic consequences of such an attack could run into the billions of dollars.

In the long-term we also anticipate that more powerful jamming technology and delivery systems (such as broadband jammers and drones) will become widely available and constitute two of the greatest threats to GNSS. The maritime community needs to become more vigilant, actively train to recognize and respond to cyber attacks including jamming and spoofing, and encourage the immediate installation of complementary PNT systems such as eLoran for strategic maritime locations.

The Authors

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The views expressed do not necessarily represent those of either of their agencies or the United States.

CAT's New Dual Fuel Engine M 46 DF

BY PETER POSPIECH

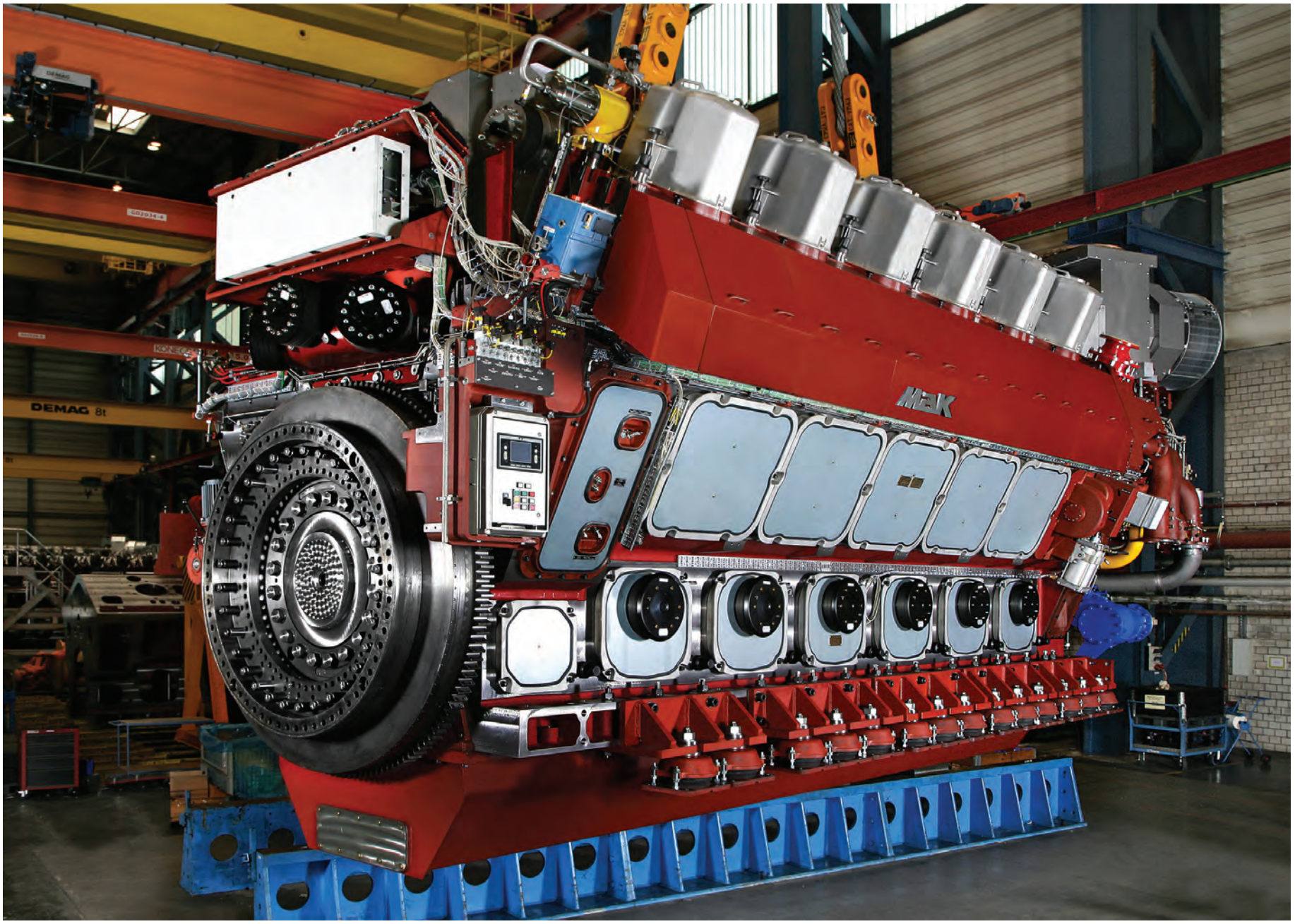
At the beginning of 2015 the exhaust limit values for sulfur oxides (SOx) grew ever tighter in emission controlled areas. And with the start of 2016, nitrogen oxides (NOx) values in certain emission control areas (ECAs) will be even more restricted. Dual fuel engines such as the newly developed MaK M 46 DF from Caterpillar help to support the drive for cleaner emissions in the maritime sector. Able to alternate from gas to diesel mode during operation, the new engine range offers the flexibility to operate vessels reliably in all geographical areas, whether the fuel in use is gas, marine diesel oil (MDO) or heavy fuel (HFO). In gas mode, the M 46 DF features industry-leading fuel consumption and will comply with IMO Tier III as well as EPA Tier 4 regulations.

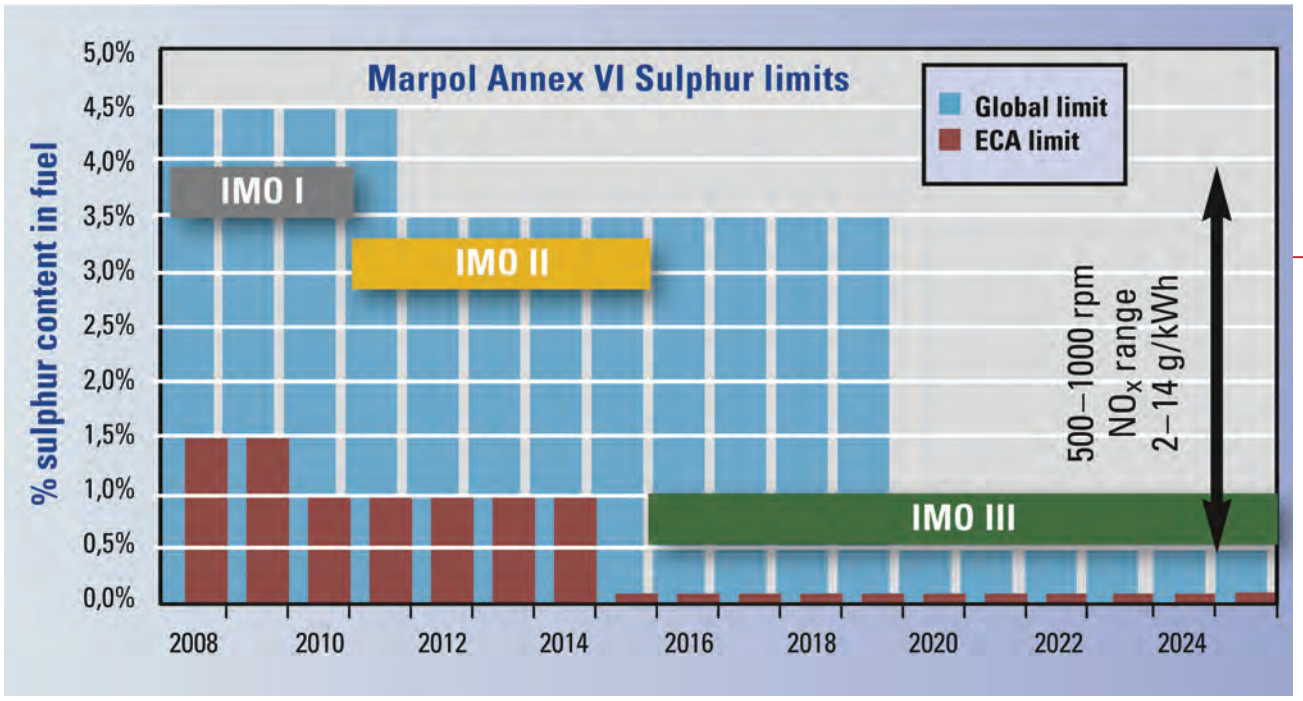
The M 46 DF

The new M 46 DF range will expand the Caterpillar Marine's market to large vessels such as ferries, cruise ships, tankers, offshore vessels, dredgers, large tugboats that will be particularly affected by new edicts in designated ECAs. The design enables shipowners to satisfy future, tougher emissions legislations without having to fit exhaust after-treatment plants.

As Hartmut Bartel, head of New Product Introduction at Caterpillar Motoren GmbH, Kiel, explained: "This M 46 DF engine is designed on the basis of our very successful M 43 C medium speed engine, with the aim to meet and exceed the M 43 C reliability and life-time expectations, while maintaining its class leading position regarding operational efficiency and durability. Applying the same design philosophies, the M 46 DF will share the same footprint with the M 43 C providing the opportunity to retrofit M 43 C engines, which we already have proved on a LNG carrier in a single main

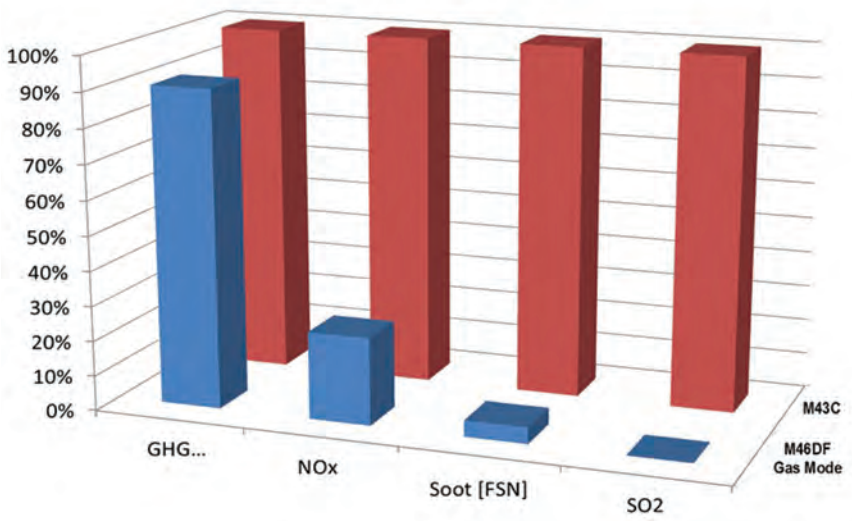
The M 46 DF engine, ready for shipment.

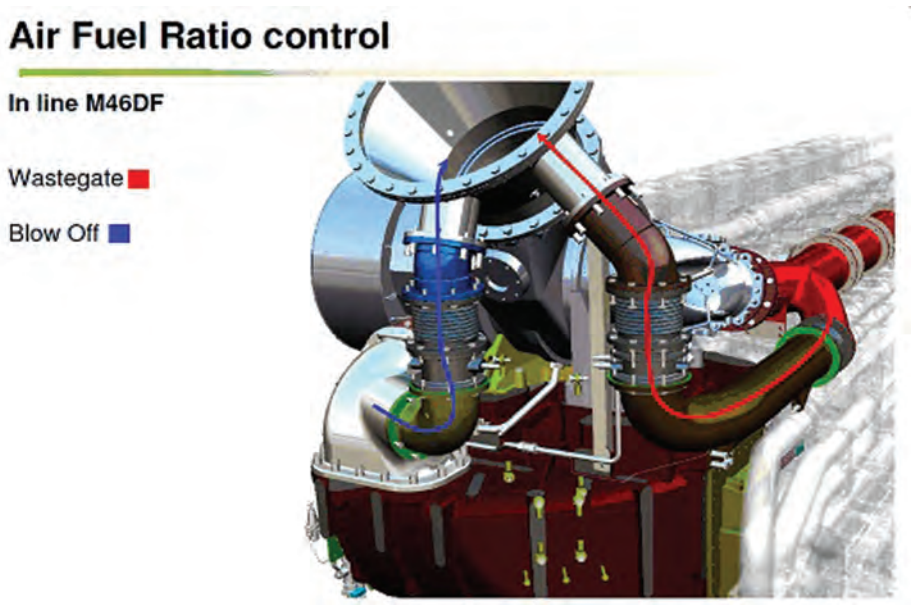




Upcoming IMO III emission regulations, selected operation profiles and diesel fuel costs make the M 46 DF a preferred engine regarding lowest cost of operation.

Emissions of the M46 DF in gas-mode compared to a diesel engine (M43).



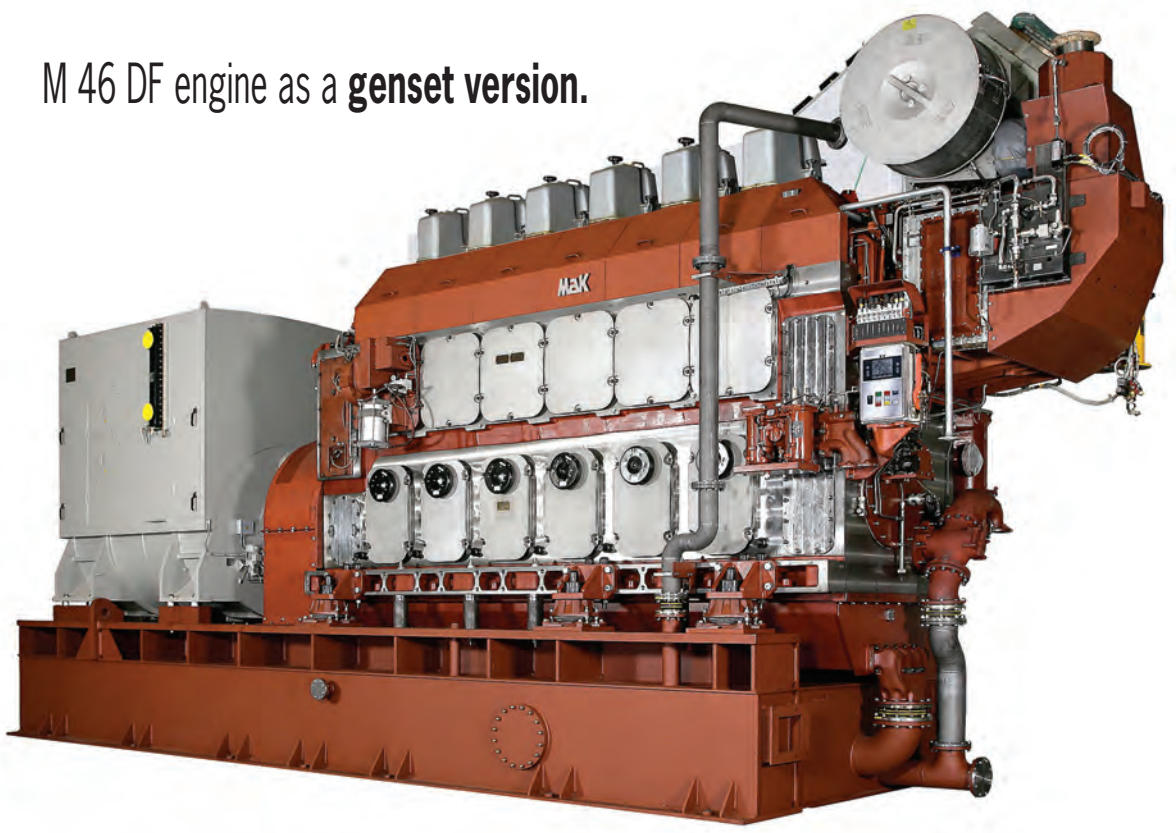


Technical Data M46 DF

	DIESEL Mode	GAS Mode
Emission	IMO II	IMO III
Bore, mm	460	460
Stroke, mm	610	610
Speed, rpm	500/514	500/514
Power, kW/cyl	900	900 (MN>80)
BMEP, bar	21.3/20.7	21.3/20.7
Liquid fuel Consump. g/kWh@ 100%	186	1.9
Gas fuel Consump. kJ/kWh@100%		7,200
Efficiency (development target)	45.0	50.0

Without engine driven pumps. Tolerance for SFOC and efficiency +/- 5%

M 46 DF engine as a **genset version.**



propulsion application in last year."

The M 46 DF combines a conventional Diesel with a pilot injection gas engine and is available as six, seven, eight and nine cylinder inline as well as 12 and 16 cyIinder V-configuration. With a bore and stroke of 460 mm x 610 mm (displacement of 101.3 l per cylinder), the M 46 DF will be set to deliver 900 kW/cylinder at 500/514 rpm (5,400 to 14,400 kW) with a bmep of only 21.3/20.7 bar, ensuring that the traditional reliability and robustness of MaK Marine engines is maintained.

The M 46 DF is a turbocharged, charge air-cooled, non-reversible four-stroke dual fuel engine which can be operated in two different modes:

* In conventional diesel mode, in which diesel (MDO) or heavy fuel (HFO) can be burned.

* In gas mode, in which natural gas can be burned. This includes natural gas (NG) and liquefied natural gas (LNG).

The engine can be changed at any time between gas and diesel operation. Gas operation can be provided down to 20% low-load conditions. IMO Tier II exhaust limit values are achieved in diesel operation with a conventional PLN injection system. The new engine has a so called cylinder selective gas injection and features also a Common-Rail-Ignition Fuel oil system for gas operation. Required efficiencies at the same time fulfilling IMO Tier III NOx limit values are achieved under two percent ignition oil amounts. With this the advantages of a very fast charging pressure control is achieved by using a blow-off valve. The system has been designed in such a way that in gas mode a load range of 20 to 100% can be achieved.

Emission Reduction

By using natural gas fuel in marine engines pollutant emissions can be significantly reduced. Sulfur dioxide, soot and nitrogen oxide emissions, all fuel-related, are very low as compared to diesel engines. Despite the reduction of the pollutant emissions, the M 46 DF achieves in gas mode efficiency levels (50%) which are comparable with a diesel engine (M 43 C).

The development of the M 46 DF was started as the answer to the upcoming exhaust emission limit values in the ECAs. These nitrogen and sulfur dioxide emission limit values can be achieved with a dual fuel engine in gas mode completely by means of measures taken inside the engine. By combining both the combustion processes completely new operation possibilities can be achieved in comparison with an Otto-Gas-Engine (spark plug ignition). One example is the improved transient performance in gas mode. With the aid of the diesel injection system an engine speed control stability at rapid load requirements can be achieved – which is not possible with pure gas engines. Caterpillar in-house-developed electronic control system can also react immediately on gas quality fluctuations or on an unsteady gas supply. Hence the dual fuel engines are also very interesting for the oil industry.

Flexible Camshaft Technology

The FCT system (Flexible Camshaft Technology) to switch the engine valve timing is also used on the M 46 DF. It allows in diesel as well as in gas mode load dependent optimized valve timing. Beside others this is the basis for knock-free operation over the entire load range – especially with high mean effective pressures. The attached drawing shows impressive the effect. Here you can see the knocking and misfiring limits of the M 46 DF. The operation range knocking combustion and beginning misfiring can be extended in gas mode by the FCT system. The FCT system supports in diesel mode the optimal air supply and therefore an efficiency optimized and smoke reduced low load operation.

The new M 46 DF dual fuel engine - which is assembled at Caterpillar's facility in Rostock, Germany - designed with an ignition oil system for very low diesel fuel consumption is an alternative in regard to pure diesel engines as well as also to pure Otto-Gas-Engines. The efficiency of the dual fuel engine in gas mode can be further optimized under compliance of IMO Tier II NOx limit values. The further stringent reduction of emission pollutants are the driver of alternative fuels. A dual fuel engine will maintain its position in the market because of regional different mandatory exhaust levels and fuel price differences. The lower emission level of the DF-engine compared to a diesel engine and a higher operating safety as compared to Otto-Gas-Engines makes him the ship propulsion of the future.

Design & Operation

WIND FARM SUPPORT VESSELS

Offshore wind farm development has been led globally by the UK, followed by Germany. Both countries have governments with long term commitments to renewable energy. Denmark, Belgium and The Netherlands are building wind farms, but they are a long way behind the leaders in offshore wind. In 2014 the UK accounted for over 50% of all the offshore wind energy generated globally. All of these countries border the North Sea, a notoriously stormy sea area, which has a high frequency of wind to drive the turbines.

BY JOHN HAYNES

Pictured is Alicat, South Boats IOW 26m Wind Farm Support Vessel operated by Seacat Services.

Traditional survey vessels are first to arrive in a potential wind farm area. Typically the seabed owner wants to assert that there are no hazards or obstructions before offering leases. Once leases are granted commercial developers will then carry out their own surveys to confirm depths and seabed data plus investigate typical wind and sea conditions before construction begins. Compared to oil and gas sector drilling surveys, this is straightforward work for offshore survey vessels and their crews.

First stage of wind farm installation typically involves heavy lift construction vessels and construction support vessels. Tasks for installation vessels include the transfer of support structures and turbines offshore. On site these vessels establish provision of bases for lifting and installation operations. These vessels can also provide offshore access and accommodation for crew. This phase of the installation process includes transportation of the nacelle, hub assembly, blades, towers and array cables from construction port to site.

Once the wind farm construction phase is underway, the first sub IMO / sub 80 feet vessels on site are Wind Farm Service Vessels (WFSV) which can overlap roles with Crew Transfer Vessels (CTV). The multi-role WFSV enables fast personnel transfer with the capability for utility work such as moving equipment, delivery of spares, enforcing safety zones, conducting environmental studies and providing support for divers.

Current fleets of WFSVs have been specifically designed to work in the wind farm support sector. As with the North Sea oil and gas industry, in the early days of wind farms, former fishing boats were used for a wide range of tasks. As catamarans offer reduced resistance to motion and reasonable stability purpose built catamarans are now the hull form of choice for most WFSV working in northern European waters. As the demand for wind farm support has intensified, vessels have been specifically developed for transiting to wind farms in a wide range of conditions then delivering technicians onto wind farm turbines.

In recent years the majority of vessels have been designed to 24m with wide beams to get maximum working space and payload onboard. A large ratio of length to width enables vessels to travel at planing speeds with good lateral stability and reduced vertical motion.

These specialist designs comprise of a pair of hulls reinforced by substantial vessel superstructure and high bridge position, which gives good line of sight for the captain when embarking personnel or cargo from the bow. Vessels have evolved with improved underwater hull shapes to reduce engine power requirements and reduce fuel costs which are a significant part of operation and maintenance costs. When boats are chartered to a wind farm the boat owner provides vessel and crew for a fixed period with fuel costs usually borne by the wind farm operator.

In the early stages of wind farm development vessel sizes ranged from 15 to 18m (50 to 60 ft.).

Due to the International Load Line convention vessels are typically delivered below 24m LLL (Load Line Length). In recent years the majority of vessels have been designed to 24m with wide beams to get maximum working space and payload onboard. A large ratio of length to width enables vessels to travel at planing speeds with good lateral stability and reduced vertical motion. Vessel coding or classification ensures that vessels are built and equipped to a recognized stan-

Launched in 2014, Seacat Intrepid is a South Catamaran 26m (85 ft.) from UK builder South Boats IOW with design by Alicat Marine Design. Propulsion for the Wind Farm Service Vessel is via 2 x Rolls Royce 56A3 waterjet powered by a pair of MTU 1450HP diesel engines.

dard. The majority of European WFSVs are coded by national authorities to operate up to 60 miles from a safe haven. As wind farms go further offshore vessels will need to be more capable and it is normal practice to be certificated by a recognized classification society such as DNV–GL.

WFSV catamarans, generally constructed in aluminum or GRP and composite, can currently accommodate up to 12 passengers. The operations which transport technicians to wind farms for maintenance typically drop off teams of three technicians at each turbine for the day's work. Recent conferences, including the January 2015 Royal Institution of Naval Architects conference 'Design & Operation of Wind Farm Support Vessels' have demonstrated that industry now wants to move more personnel on a single vessel. There are ongoing discussions between the IMO, national legislators and classification societies to create a revised interpretation of 'industrial personnel' to raise the numbers of professional passengers on vessels servicing the offshore energy industry. Commercial pressures are relevant, but safety and compliance are critical issues driving the debate.

A 24m catamaran may be required to carry up to 30 tons of cargo. When moving technicians transit speeds range between 20 and 25 knots with some vessels having a top speed of 30 knots. Fixed pitched propellers are used to drive around 50% of WFSV. Water jets are used on around 40% of the current fleet. Water jets offer good maneuverability and the shallow draft can be essential on some offshore wind farm sites. Other propulsion systems include controlled pitched propellers (CPP) with various new systems under trial and evaluation.

Once the wind farm is completed and connected to the grid preventative maintenance and corrective maintenance are ongoing tasks for WFSVs. The schedule of visits to turbines includes routine surveys and inspections. The aim is to keep the entire wind farm ready to generate wind for the maximum number of days per year. Preventative maintenance programs are designed to decrease the number of failures, limit downtime and extend the life time of the turbine, foundation and associated components.

Transit time and accessibility to the wind farm are often weather dependent. In the North Sea sites further from shore typically experience larger significant wave heights. Transferring maintenance personnel and their equipment from vessel to wind turbine safely in various sea states is a major challenge in offshore wind farm operations. The turbine foundation is fixed to the seabed resulting in considerable relative movement between the vessel and the structure. Turbine transfers, known in the industry as 'bump and jump', are where a vessel uses engine power to push the bow against 'j-tubes' which run vertically on the outside of the access ladder while technicians step from vessel to turbine. Thrust is applied to increase friction and reduce motion between specially designed bow fenders and the landing platform. Maintenance technicians step onto the turbine access ladder which is set back from the j-tubes by 450mm (18 in.) providing a safety zone to prevent personnel on the ladder from being crushed. Large waves, especially when coupled with strong currents, can cause the vessel to lose position or contact with the turbine. Current technology and vessel designs limit this operation to 1.5m (5 ft.) significant wave heights.

Turbine transfers can be assisted by passive or active motion compensating systems. Vessels fitted with damping systems aim to reduce vessel motion enabling transfer operations in rougher sea conditions. These systems use technologies to monitor vessel accelerations caused by wave motion and compensate reducing the relative motion between the vessel and turbine structure. Systems include the MaXccess, Momac, Amplemann and Houlder TAS systems. On the down side, their inclusion in vessel design increases purchase costs, raises weight on deck and reduces working deck space. Time taken to deploy each system varies, but overall there needs to be a quantifiable gain measured in more days transferring personnel and more hours working on turbines. A long term industry aim is to improve the economic viability of wind farms by widening the crew transfer weather window to include significant wave heights above 1.5m.

With boat crews and technicians spending their working lives at sea, often on station for seven days at a time with 12 hour shift patterns, passenger and crew comfort onboard has become a priority. Technicians need to arrive at the wind farm feeling well and rested before transferring to the turbines. Once on the turbine it is a physical working environment and the industry has introduced climbing fitness standards. Vessels use specialist suspension seats which are designed to minimize fatigue and the effects of impacts caused by the motion of the vessel. UK seating and component manufacturer KPM Marine has launched a lightweight modular interior system that enables below deck spaces to be constructed quickly on workboats and professional fast craft. KPM Technical Director Julian Morgan said, "Safety, comfort and functionality are essential on the modern vessel. We have designed a range of seats specifically for fast workboats. Our modular units include workstations, storage, heads, showers, galley and bunks. The system is designed to reduce weight plus flooring, ceiling or wall panels can be easily removed for access during the build process or if the vessels role changes in the future."

Launched in 2014, the South Catamaran 26m (85 ft.) is the first of a new hull form from UK builder South Boats IOW with design carried out by Alicat Marine Design (AMD). Andy Page, Design and Project Manager at AMD, said, "The combination of these specialists, plus a wealth of hull form development and tank testing, has resulted in a next generation

Alicat - South Boat's IOW 21m Wind Farm Support Vessel operated by Seacat Services transporting container

craft. The vessel has been optimized for high speed passage, turbine access and loitering in harsher conditions meaning it has the capability to be utilised in sea areas such as the German North Sea and UK Round 3 wind farm developments that are further offshore." Featuring finer initial entry and significantly higher wet deck clearance, the 26m is expected to remain operational at 2.5m (8 ft.) significant wave heights. It is available in twin waterjet, IPS or quad engine CPP configurations. Andy Page added, "Alicat and Global Marine Design are now offering the new Alicat 27m (88 ft.) in 12-man or 24-man configurations with a modular superstructure that facilitates easy conversion for survey roles. Of note is the very high cargo payloads offered by this vessel, potentially up to 60 tons."

The year 2015 sees the first U.S. windfarm support vessels in construction. A 21m WFSV designed by Alicat Marine Design under license from South Boats IOW in the UK is a proven design which is being tailored to suit the US market and U.S. Coast Guard requirements. The vessel is being built by Blount Boats of Rhode Island and will be in operation by 2016.

CTruk is a UK based designer and builder of composite high speed craft. CTruk CEO & Chief Designer Andy White said, "Innovation and R&D are the starting points for every CTruk project and the core of the company's business. Our objective is to deliver vessels and systems that are fully compliant with the customer's operational requirements."

Based on a proven workboat design concept, the CTruk MPC22 is a 22m (72 ft.) composite twin-hull with 7.6m (25 ft.) beam and 1.25m (4 ft.) draft. This fast workboat has a 20-tonne flexible payload capability. CTruk's patented moveable wheelhouse and flexible deck pod system mean that the vessel can fulfill multiple roles. The vessel can be used to transfer 12 technicians or remove its passenger pod to make use of 72 sq. m. (2500 sq. ft.) of deck space for cargo and equipment transfer. The vessel utilizes the Volvo IPS system for optimal bollard pull and service speeds, further increasing the fuel efficiency of CTruk's lighter weight composite catamarans.

German boat builder Abeking and Rasmussen has optimized the Small-Waterplane-Area-Twin-Hull (SWATH) design for patrol boats and fast workboats. By reducing the volume of a hull at sea surface and achieving a large proportion of the vessel's buoyancy beneath the waves a SWATH vessel can be more stable in rough seas at high speeds. SWATH vessels normally have a twin-hull arrangement. The 24m Cat-SWATH 24 Pax from Danish Yachts is the first of a series of carbon composite crew transfer vessels designed and built for the offshore

CTruk MPC22 Composite Twin Hull Wind Farm Support Vessel - Fast Workboat

shore wind industry. With bow and stern thrusters supporting the propulsion of fast variable pitch propellers the 24m Cat-SWATH can reach speeds of up to 23 knots. The vessel aims to enable operators to undertake boat landings in up 2.5 metre significant wave height.

The coastal countries of northern Europe are all experienced maritime nations with access to innovative design, high technology and solid construction expertise that has helped to develop the vessels that support offshore wind. The last 10 years has seen the wind farm service vessel market expand significantly with a steady evolution in design as the operators aim to become more competitive and meet charterer's requirements. Key drivers for new designs are fuel efficiency and the ability to access wind farms in higher sea states.

At the UK Seawork event in June 2015 includes a panel discussion entitled 'Windfarm Access Vessels - are catamarans the right solution?'

As the world starts to look at the viability of ocean energy, the current crop of specialist catamarans will be considered as the benchmarks that next generation renewable energy support craft will evolve from.

The US Bureau of Ocean Energy Management (BOEM) has seen strong interest in offshore renewable energy projects on the Outer Continental Shelf. BOEM is working closely with various east and west coastal states regarding offshore energy development and is in the process of coordinating federal-state task forces.

There are lessons to be learned from northern Europe which accounts for the US 'start smart' approach to offshore renewable energy.

The Author

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Norway's (winding) Path Ahead

$1.5T

The value of the global fleet has increased 10% per annum since 2000, growing to $1.52 trillion in 2013/2014. The Norwegian fleet is valued at $87 billion, growing 8% per year

A precipitous plunge in energy pricing is problematic for a prodigious oil producing nation such as Norway, but it really only tells a portion of the story when evaluating the immediate future for the collective maritime and offshore energy markets. Prolonged stagnation in the global economy, growing political tension and instability in several world regions, and a general breakdown in international cooperation all conspire to make the path ahead a perilous one for this wealthy nation of five million. If history serves as a barometer however, Norway will simply pull on its boots, get to work and figure out the best path forward.

by Greg Trauthwein

What Norway lacks in population size it compensates nicely in maritime might. The country has a population a shade north of five million, ranking 121st out of 240 countries. But the country is unique in its connection to and affinity for the sea, and cumulatively the maritime industry employs more than 110,000 people (or about 2% of the population) and contributes a value creation of 175 billion NOK ($21.6 billion) per annum. This is according to "Maritime Outlook 2015: Navigating in a New Climate," a report recently released by the Norwegian Shipowners Association (NSA). While the numbers in the most recent report are impressive, which is an imperative annual tome which discusses the recent history and future direction of the Norwegian market, the numbers do not, never have and never will tell the whole story.

"Maritime" and all that it entails is in the DNA of seemingly every Norwegian, a history, culture and cluster that works as fluidly and efficiently – amongst themselves and in the global maritime community – as any in the world.

While the level of saturation of maritime – and in more recent times the offshore energy sector – is enviable, in some ways it is an economic tightrope act, as both industries are notorious for heavy cycles up and down.

1800

There are 1800 Norwegian ships and rigs in action around the world. There are 176 Norwegian ships on order, a cumulative value of $12.4 billion.

2015 & Beyond

While the prolonged drop in energy pricing is having a direct effect on many Norwegian companies, the dynamics of the industry and its people are diverse and no single factors works to define the whole.

- **Norway is expensive.** While it is a literal hotbed of maritime knowledge and insight, the prospect of ships stamped "Made in Norway" is increasingly rare, as low-cost competitors have cropped up globally, even in the construction of some of the world's most technically complex vessels.
- **The Maritime Cluster is a core economic engine.** More than 110,000 people worked in the industry in 2013, creating value creation of more than $21.6b, the highest ever recorded and an 11% increase from 2012. Norwegian shipowners accounted for $13.6b. (Note: In Norwegian currency, the Norwegian Krone (NOK), this equaled 102 billion NOK … the first time ever that shipowners created more than NOK 100 billion in value.)
- **Norway is international.** While small in population, Norway is influential in many global circles, particularly in terms of maritime and offshore oil and gas. Norway and its companies have effectively helped to redefine the Offshore Service Vessel market today, for example, and the design, outfitting, construction and ownership of these high-performance, high-value, high-spec boats are quietly taking over the Norwegian maritime scene. In fact, according to the NSA report, Norway is the world's second largest owner of Offshore Service Vessels, second only to the United States. In terms of growth markets, Norway today sees the U.S., Canada and Mexico, followed by Southeast Asia, Brazil, West Africa and China as its most important growth markets.

While the numbers are impressive, the tone looking forward is decidedly reserved, and across the maritime and offshore oil and gas sectors there generally are sentiments that profitability will be lower in 2015, except for the deep sea segement.

While Norwegian shipowners still anticipate an increase in turnover to 268 billion NOK in 2015 (versus 262 billion NOK in 2014), this 2.3 percent increase is markedly less optimistic than the 6 percent increase anticipated in the "2014 Outlook" report. More telling are sentiments surrounding the Norwegian OSV market.

According to the Outlook 2015 report, OSV owners expect turnover to fall by 4.2 percent in 2015, a number made more significant when you consider that it would mark the first fall in turnover in the OSV segment since 2002. Following is a broad statistical abstract of findings from the Maritime Outlook 2015 report. The report in its entirety is a fascinating read, with insightful articles which dig deep into some of the societal, environmental and political issues that are drivers for global maritime trends. Visit:
https://www.rederi.no/en/aktuelt/2015/outlook-2015/

The Value Play

The Norwegian Shipowners Association, courtesy of a study by Menon Business Economics, finds that the value of the global fleet has increased 10 percent per annum since the year 2000, growing in value from $443 billion in 2000/2001 to $1.52 trillion in 2013/2014. (The study based the valuation on newbuild costs in the various vessel segments adjusted for fleet age and size.) On the Norwegian side of the ledger, its fleet was valued at $87 billion 2013/2014, showing an annual growth of close to 8 percent in the same study timeframe.

110,000

More than 110,000 people worked in the industry in 2013, creating value creation of more than $21.6b, the highest ever recorded and an 11% increase from 2012.

In the last 10 years the Norwegian fleet has tripled in value, and today it makes up nearly six percent of the global fleet, measured in value. In terms of fleet value, the world maritime powers "Top 10" stack up as follows:

1. **Japan**
2. **Greece**
3. **Germany**
4. **China**
5. **USA**
6. **Norway**
7. **U.K.**
8. **Singapore**
9. **South Korea**
10. **Denmark**

The Norwegian-Controlled Fleet

Despite its small population size, Norway maintains one of the world's largest and most modern fleet of ships, powered by a strong maritime cluster. Today Offshore Service Vessels – smaller vessels than the traditional deep sea fleet but much higher technical specification and value – make up the largest sector by number of ships, exceeding 600 vessels at the beginning of 2015.

Modern OSV design and technology has strong roots in Norway, and as Gard Sem of Sperre notes in a related story on page 48 of this edition, Norway is an "OSV Mecca."

While the size and shape of the collective Norwegian fleet is impressive, it is not immune from trends seen in other developed countries, specifically the precipitous fall of the vessels flying the Norwegian flag, via either the NOR or NIS regimes.

Ten years ago 57% of the Norwegian controlled fleet flew the Norwegian flag; today 42% flies the Norwegian flag. Conversely, the number of ships in the Norwegian fleet sailing under foreign flags has grown from 697 in 2005 to 1036 in 2015, a jump of nearly 50%.

The Norwegian fleet as a collective is generally regarded as young and technically advance, a notion proven in numbers, as the average ship age in the Norwegian international fleet has fallen by three years since 2005 to an average age of 11. Part of this anti-aging progress is due to the fact that larger, older tonnage has 'flagged out.' At the same time, Norwegian international ship owners possess a healthy new build order book. As of January 1, 2015, Norwegian shipowners have 176 ships on order with a combined value of $12.4b, a 20% increase (in terms of the number of ships) over the previous year, though a far cry from the record 378 ships on order in 2008. Of the 176 ships on order at the beginning of 2015, half were due for delivery in 2015, and around 35% due for delivery in 2016. Of the 176 vessels on order, 32 percent are being built in China, 24 percent are being built in South Korea, and about 15 percent are being built in Norway, confirming the longstanding trend of declining new ship orders in Norwegian shipyards.

Norway Fast Facts

Population:	5,147,792
Population Rank:	121 (out of 240)
Capital:	Oslo (795,000)
Area:	125,004 square miles
Language:	Norwegian
Religion:	Evangelical Lutheran
Currency:	Norwegian Krone
Life Expectancy:	79
GDP per Capita:	$33,000
Literacy Percent:	100

Sources: National Geographic, CIA

The Proving Ground.
Maritime innovation is in the Norwegian DNA, and its rugged coasts and waters have made, and broken, a long list of maritime technologies.

Mastering Fleet Management

by Eric Haun

Fleet management software developer Tero Marine has served the shipping industry for nearly three decades with a product range led by its software suite TM Master, now a leading fleet management brand with more than 2,000 licenses worldwide.

The Bergen, Norway-based company and its fully integrated marine information system TM Master have managed to stay competitive amidst an explosion of companies providing fleet management and software solutions to the maritime market. Serving a clientele that includes navy, commercial shipping, workboat and offshore vessel operators, Tero Marine strives to assist ship owners and managers from planning through execution.

TM Master facilitates storage, editing and retrieval of information through a database shared by four modules: TM Maintenance, TM Procurement, TM Human Resources and TM Quality & Environment. (See module functions in Table 1.)

"The integration of all the different modules in TM Master makes it a really strong tool for supporting ship owners or managers' operations, regardless of the size of their fleet," said Jan Erik Haarvei, CEO of Tero Marine. "The fully integrated suite makes planning and execution of very different operational tasks possible by the use of one tool only: TM Master."

Together, TM Master's modules help to protect users' vessels, crew and cargo, all the while facilitating efficient operations and reducing expenditure, an endeavor that appears to be gaining greater significance throughout the industry now more than ever as owners and operators increasingly seek options for trimming costs.

"We know that we are under constant scrutiny to deliver high product value, and in 2015 this is more important than ever," Haarvei said. "We have to prove to our clients that TM Master helps them [perform] ship operations smarter, by showing them that it really is reducing costs, increasing efficiency and improving control and safety."

Adding to this notion, Haarvei stated the recent decline in oil price has been a "strong indicator" in the OSV market, for example, an area which forms a piece of Tero Marine's core market. "A large chunk of our revenues comes from the OSV business," Haarvei said. "In a time when the oil price slides, and future fleet demands are uncertain, focus is now on exploration, production and supplier costs. Ship companies will turn every stone to cut costs, and Tero Marine will have to prove that TM Master is worth the investment. We are confident it will pass the test. In fact we believe that our software is part of the solution to the challenges our customers face, as TM Master has a proven track record as a cost-saver."

Citing an example, Haarvei said Tero Marine recently held its first user conference in Singapore where a client in the region presented a study focusing on how TM Master has helped improve its operations.

"[The client] set up TM Master on 10 vessels and three shipyards, with access from three office locations. The main goal was to have one single centralized system for maintenance, inventory, procurement logistics and cost control. In addition to all this, they also use [Tero Marine's] crewing module, integrated with the rest of the system."

"The way this client has integrated TM Master in their operations is quite impressive, and for us a case study that truly shows the possibilities within our software," said Haarvei. "When a client saves millions of dollars every year by using TM Master, we know that our product delivers on the promise we are

"Ship companies will turn every stone to cut costs, and Tero Marine will have to prove that TM Master is worth the investment. We are confident it will pass the test."
Jan Erik Haarvei, CEO of Tero Marine

making."

Haarvei said Tero Marine is targeting growth by evaluating its global strategy to bolster ambitions in new target areas. Presently 60-70 percent of its clients are in Europe, though the company has a presence on every continent, with offices and representatives in Norway, England, Singapore, Brazil, United States, United Arab Emirates, Russia and the Philippines. "We are growing steadily in the APAC region and in South America," Haarvei noted. "These regions will be very important for us in the years ahead."

Table 1

Procurement

TM PROCUREMENT helps users stay on top of fleet-wide procurement activities, saving cost and time.

- On board procurement with full purchasing functionality
- Approve requisitions received from a vessel
- Replication engine that ensures that the ship is notified of any changes
- Advanced and reliable replication
- Cross fleet KPIs

Maintenance

TM MAINTENANCE helps plan and manage scheduled, preventive, corrective and condition-based maintenance.

- Record, schedule and manage all data pertaining to maintenance activities
- Cross fleet KPIs
- Cross fleet job standardization
- Analysis of maintenance history and reporting
- Manage components, spare parts and consumables

Human Resources

TM HUMAN RESOURCES is a tool for crew management, and supports personnel work both on board as well as onshore.

- Personal data, incl. medical information like vaccines and health certificates
- Employment history, education, courses and certificates
- Plan future crew changes and activities
- Hours of work, hours of rest
- Approval and reporting

Quality & Environment

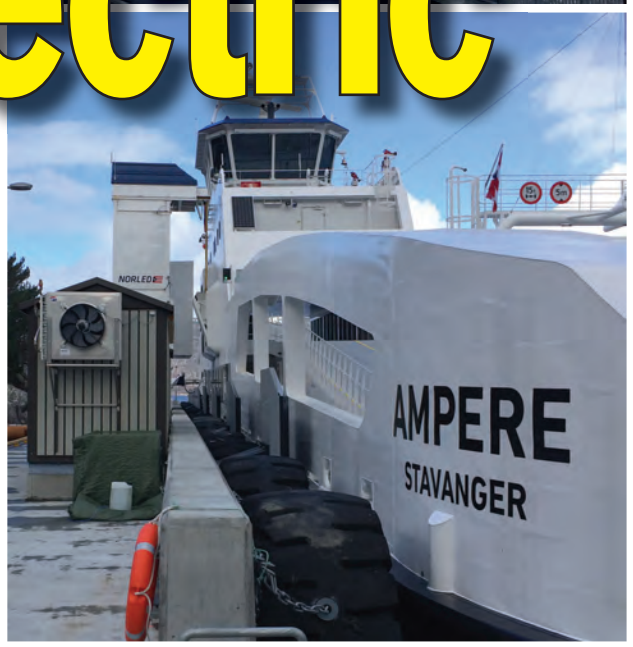
TM QUALITY & ENVIRONMENT ensures that quality management is implemented throughout the organisation.

- Incidents and failure reporting
- Consequence evaluation
- Forecasting; see future needs for spare parts, manpower, maintenance
- Document handling throughout your entire fleet
- Voyage E-log reduces reporting requirements

Norway

It's Electric

Norwegian Car Ferry Debuts World's First **All-Electric Propulsion System**



Charging Station Connected: The automated vacuum mooring system.

by Kerry Darnell, Commercial Business Development, Siemens Marine and Shipbuilding

Norled Ampere, the world's first all-electric car ferry, began service this year carrying up to 120 cars and 360 passengers across the 4.2-mile (6.8 km) Sognefjord channel that separates Norway's villages of Lavik and Oppendal and empties into the North Atlantic's Norwegian Sea.

The 260-ft. vessel recharges its dual 450 kW/hour battery packs after each docking in less 10 minutes – faster than today's smartphones and the turnarounds of many conventionally powered ferries.

Operated by Norled, a Norwegian shipping company under license from the nation's Ministry of Transport, the Norled Ampere includes a Siemens BlueDrive PlusC propulsion system that drives fore and aft screws.

The system features a vessel energy-management subsystem, battery packs, and vessel automation and control, including communication and control of the shore power charging unit. This system makes it fully automated and hands-free.

Matching Load Demands

While the Siemens solution delivers a range of frequencies and voltage for diesel, dual-fuel or gas-operated vessels, the Norled Ampere uses a custom-built, all-electric model. This eliminates the cost and emissions of the 264,000 gallons (one million liters) of diesel fuel that its predecessor's 2,000-hp engine burned each year. In fact, the Norled Ampere will annually keep 570 tons of carbon dioxide and 15 tons of nitrogen oxides out of the atmosphere.

Designed for Efficiency

The Norwegian shipyard Fjellstrand AS designed the twin-hulled vessel, working with the Siemens Marine & Shipbuilding propulsion team on the design and center-hull placement of its BlueDrive PlusC gensets. The shipbuilder specializes in slim, lightweight aluminum hull designs, which the Norled Ampere uses. With this design, the hulls weigh about half those of conventional catamaran ferries, further improving the Norled Ampere's operating efficiencies and reducing its power requirements. It's estimated that the Norled Ampere needs just 400 kW of power to cross the Sognefjord channel at 10 knots. The lighter weight also offsets the combined 11-ton weight of the BlueDrive PlusC battery packs – and the system itself saves 30 percent more space when compared to traditional, constant speed systems.

Norled sees other benefits of the all-electric, variable-speed propulsion system, including:

- **Fast response times to improve ferry operation, handling and safety:** Intensive testing proves that even under variable speed control, the system supports highly demanding dynamic positioning. This is especially critical for the Norled Ampere's safe docking operations, when most accidents can happen.

- **Less noise and vibration to improve the passenger experience:** The all-electric system cuts the Norled Ampere's noise and vibration, compared to diesel engines. This includes engine-room and structural-born noise that carry into passenger area . That's particularly true, given that dies l engines in conventional ferries typic lly operate at full-speed, generating he most noise and vibration.

- **Less mainter ance and repairs, improving uptime and reduce operating costs:** With ewer moving parts, more solid-state c mponents and the elimination of diese engines, the Norled Ampere's propulsi n system requires less maintenance, aving Norled labor costs and reducing pare-part inventory.

The Onshore Stor

Ironically, the mo st interesting part of Norled Ampere's propulsion package isn't on the vessel - it's on dry ground. One of the prima y design challenges was solving for h w the ferry could charge its high-ca acity battery packs between crossings. Pulling a full charge

Ironically, the most interesting part of Norled Ampere's propulsion package isn't on the vessel – it's on dry ground. One of the primary design challenges was solving for how the ferry could charge its high-capacity battery packs between crossings. **Pulling a full charge into the batteries in less than 10 minutes** would put too much stress on the modest electrical grids serving the Lavik and Oppedal villages.

into the batteries in less than 10 minutes would put too much stress on the modest electrical grids serving the Lavik and Oppedal villages. The ferry would literally cause power outages for entire communities. An alternative charging approach was required for dockside charging at each terminal.

Siemens worked with an energy company to develop a shore-based recharging station and optimized it to work with the ferry's battery packs. The stations incorporate a liquid-cooled version of an energy storage system. It contains modules that use advanced lithium polymer cells, with a total charging capacity of 1.46 MWh. The energy management system monitors both thruster control as well as downstream consumers on the grid. It also controls the electrical flow between the batteries and the propulsion system. The flow of energy can be controlled bi-directionally, allowing for an overhauling load to be put back into energy storage. The recharging stations slowly charge themselves from the villages' hydroelectric power grid continuously and at a very low current draw. At each ferry landing, the shore power-charger can quickly charge the batteries while passengers and cars are unloaded and loaded.

Keeping Norway Green

Out of 60 nations ranked in the 2014 Global Green Economy Index, Norway was second only to neighboring Sweden - and not by much. Government support of innovations like the Norled Ampere ferry is a big reason why the nation can wear its green designation with pride. Although Norway is one of the world's top oil-producing nations, it's blessed with abundant hydropower, which provides most of the country's electricity and helps all-electric ferries like the Norled Ampere contribute to the Earth's environmental well being.

Norway

Cool Runnings

Pleat specifications	DN65	DN80	DN100	DN125	DN150	DN200
Titanium height (cm)	50	50	100	100	100	100
Titanium width (cm)	25	25	38	38	56	56
Folding height (cm)	6	6	6	6	6	6
Max elements (cm)	6	10	8	12	10	14
Cooling surface per element (m2)	1,8	1,8	5,8	5,8	8,5	8,5
Max cooling surface (m2)	11	18	46	70	85	119
Titanium weight per element (kg)	4,6	4,6	12,2	12,2	20	20
Total weight per element (kg)	16,6	16,6	33,5	33,5	50	50
Range guideline						
Propulsion engines 1–3 MW	■	■	■	■		
Propulsion engines 3–6 MW				■	■	■
Propulsion engines 6 MW +					■	■
Auxiliary engines 0,5 - 1,5 MW	■	■	■			
Central coolers 0,5 – 2 MW	■	■	■	■		
Any other marine application				■	■	■

Sperre says it has a superior solution for equipment coolers onboard ships. Late last year it teamed with W&O to distribute its Sperre Pleat Coolers in the U.S. *MR* spoke to from Sperre's Gard Sem (pictured) for insights. ***By Greg Trauthwein***

While Sperre Pleat Coolers are designed to provide customers several advantages, including performance and the compact size, Gard Sem, vice president of sales and marketing, was most eager to discuss the maintenance characteristics of the system. The Sperre Pleat Cooler design is a module-based design with open elements designed to make completion of the required disassembly and cleaning process easier and quicker. "There are a couple of primary benefits of the pleat cooler solution," said Sem. "First is time, **as it takes one person one hour to clean this cooler, anytime, anywhere.** Second is extended performance: users report extended periods between cleaning, with some clients claiming to get 18 month of use without cleaning the coolers."

As anyone operating a commercial vessel can attest, ease of maintenance, particularly on the fly, is quintessential to long-term commercial success. Sperre studied the market thoroughly before bringing its solution to market.

While it has been on the market for a little more than three years, it took seven or eight years to develop. "Before Sperre decided to bring this product to the market it did a tremendous amount of testing to ensure that the product was ready to go from day one."

Another advantage Sem touts regarding the modular nature of the system is the quick turnaround to deliver a system for the customer. "Our product is module based, and very easy to put together; I can provide a class-approved cooler in 48 hours, ready to go."

Meet the Sperre Pleat Cooler

In Sperre's design, a single pleat element housed in its own cartridge replaces between 15 and 20 plates and gaskets, and according to the company reduces maintenance time up to 80% for the entire cooler. The Pleat Coolers are available in a variety of sizes (see table above) and offers solutions for central cooling, auxiliary, and various combinations of engine cooling. According to Sperre, the technology is built on the same basic principles as conventional plate coolers, with the exception of the larger plate size, formed as one element. Each cooling element consists of continuous titanium from coil that is folded (pleated) and sealed at each end, as well as a frame with handles that encloses the titanium element. While Sperre has had its greatest success to date in the OSV market – largely because of the dominance of the OSV market in Norway – Sem said the company's coolers are suited for any maritime and offshore reference, and to date has more than 100 vessels sailing with the technology. But to truly extend its presence globally, Sem and company knew that it would need strong partners with intense market knowledge and penetration, much as it found W&O to be in North America.

"W&O has a tremendous presence with the sheer number of manpower that they have in sales around the U.S.," said Sem. "It's also the technical aspect of how the company is structured; they have a lot of sales people and a very strong engineering group. We could not do it ourselves in the U.S., operating from Norway." While the partnership was just launched late last year, it has already bore fruit, as Sem notes orders in hand in the oil & gas and fishing industry sectors.

The Sperre system is suited to both newbuilds and retrofits, the latter the primary focus today with low oil pricing. Ultimately, Sem sees his greatest challenge today as simply bringing market awareness to the solution and encouraging sampling. He's aiming for more references such as a Singapore owner with a fleet of 54 tug boats that were having major issues with its cooling, cleaning units two to three times per month, per boat, and changing gaskets two to three times per year. "I told him: you can try this cooler for six months. If you don't like it, I'll take it back," Sem said. The goal was to cut down cleaning to one time per month. At the time of the interview, the vessel has been running for more than nine months without cleaning. "Before the six months was up, the owner made an order to change out and retrofit all of their coolers for the fleet."

Kleven Delivers to Olympic Shipping

Photo: Martin Hauge Nilsen

Offshore construction vessel Olympic Bibby, build no. 371 from Kleven Verft, has been delivered to Norwegian shipowner Olympic Shipping. The vessel has a long term charter with Bibby Offshore, and its first job will be on the British sector of the North Sea. The naming ceremony was held in Olympic's home harbor Fosnavåg April 9. The vessel measures 87.5 x 19m, making the entrance to the narrow harbor (22m wide) a spectacular sight. The vessel is of MT 6021 design from Marin Teknikk, has accommodation for 68 persons, and is purpose built for subsea inspection, maintenance and repair work. Olympic Bibby is the seventh offshore vessel delivered by Kleven to Olympic since 2011, and later this summer vessel number eight, Olympic Nike, will be delivered from Kleven Verft.

Nautisk Launches NaviTab

Nautisk unveiled its latest navigational solution: NaviTab from Nautisk, a unique concept that replaces a vessel's onboard Navigational Publication library. Hundreds of books have been uploaded onto a hi-spec hand-held device, suitable for use both onshore and on the bridge. "Currently, all vessels sailing global routes must carry a full portfolio of navigational publications (NPs) in order to sail compliantly and meet SOLAS Regulation," said Nautisk CEO Thomas Fjeld. "These NPs include a number of IMO Publications, Sailing Directions, Pilot Guides, Radio Signals and list of lights. Having to carry this amount of hardback books on the bridge of a vessel where space is already at a premium can be challenging for most shipowners and navigating officers. In addition to storage issues, each and every publication needs to be manually updated for the latest corrections, an exercise which can be extremely time consuming and one which potentially offers a chance of human error."

"NaviTab is a brand new solution developed by our team of experts that we expect to revolutionize the way vessels manage their onboard NPs. NaviTab stores hundreds of up to date NPs on one single tablet device, which is updated automatically and can be used by shore based and onboard teams."

NaviTab's optimized search engine automatically locates the latest available publications in a vessels' holdings and licenses latest editions as and when they are available, meaning that whatever route a vessel is sailing and wherever it is in the world, it will always be compliant and its publication holdings up to date. Users can search in seconds to find the relevant publication for a particular voyage, bookmark essential notes and add their own. Information and notes can be easily cross referenced and essential data highlighted using the hand written text recognition feature.

www.navitab.com

NaviTab

Damen boosts composite focus

Coming off a year which saw the Damen Group record its highest ever order intake over a 12-month period, a production value of roughly $2.25b and 160 newbuild deliveries, the shipbuilder looks to expand in the composite vessel market.

By Eric Haun

A close-up look at the composite build process.

Shipyard worker at Damen Shipyards Antalya.

A composite Interceptor 1102 built at Damen Shipyards Antalya.

(Photo: Damen

For Damen, building with composite materials is nothing new. Already using composites for decades in some of its high speed craft, naval vessels and ferries, the Netherlands-based shipbuilder looks to take composites to the next level. The Damen Group took over Vitters' high-tech composite shipyard Cyrus in Antalya, Turkey in June 2013, starting production just three months later as Damen Shipyards Antalya. Directed by Dutch general manager Auke Van Der Zee, the 100% Damen-owned yard has a staff of 125 Turkish employees and has fully transitioned from custom yacht building to the serial construction of high speed commercial workboats up to 40m long. The yard is now operating at full capacity with three production lines, capable of building 35 composite vessels per year from its portfolio including four vessel types: FCS 1605, Stan Patrol 2205, Interceptor 1102 and Damen Water Bus. Using its existing knowledge of logistics, design, outfitting and standardized construction, and combining it with outside expertise in composite fabrication, Damen has developed knowledge to enable effective series-production of composite professional vessels for the port, offshore and security sectors.

"Times are changing," Van Der Zee said. "Everything that moves – everything that has to do with transport – is moving into composites," he added, citing cars, planes, trains and even racing bikes as examples. Even infrastructure components such as wind generator blades and bridges are built using composites.

By definition, composite construction involves fabrication using different parts or elements, in this case fiber and resin. These materials are much lighter than steel or aluminum, making for vessels that are are faster, consume less energy, or both. Additionally, composite materials do not corrode, and their fibers can be aligned to optimize flexibility, strength and robustness. "The advantage of composites is you can make it strong where you want to make it strong," Van Der Zee explained.

Damen said its newly developed building technique enables it to build lighter vessels (10 percent lighter than aluminum) with lower fuel consumption, less maintenance and a smaller environmental footprint, fitting the shipbuilder's overall strategy for reducing energy consumption over the coming years.

Though Damen's composite build process required a relatively large upfront investment, including R&D and tooling, once the molds are created, serial production enables lower production costs and shorter lead times.

Damen's serial production process at Antalya provides a large cost advantage when vessels are produced in batches of five or more, Zan Der Zee explained; a composite vessel built in serial production is typically 200,000 to 250,000 euros cheaper than a comparable aluminum model with identical outfitting. However, this build process makes one-off orders expensive and impractical, and any corrections required mid-production can be very costly. Additionally, serial composite construction takes away some of the yard's regular flexibility. Once the mold is being produced, there can be no more modifications.

Nevertheless, Damen believes composite building will prove to be a welcome addition to its portfolio on top of existing steel and aluminum offerings. The success of the composite program at the Antalya yard has allowed Damen to add a separate facility – Antalya II – for steel and aluminum fast crew suppliers (FCS) 5009.

BAE Systems Investing in San Diego

A discussion with Bob Koerber, General Manager, BAE Systems Ship Repair, San Diego, CA

Bob Koerber, general manager of BAE Systems Ship Repair in San Diego, served on active duty as a surface warfare officer from 1981 to 1987, then continued to serve as a Navy Reservist, retiring as a captain in 2007. His last reserve assignment was as the Deputy Commander of Naval Special Warfare Command. As a SWO he served aboard USS Hull (DD 945?) and USS Brooke (FFG 1). He has been employed by the San Diego yard for 27 years.

By Edward Lundquist

What's new here in San Diego?

A lot of good things happening in the yard. This is a very exciting time to be with this company. We're putting more upgrades in this facility now than I've seen in the last 27 years. We've just dedicated (significant investment) a brand new—Pier 4—where we can berth two more ships. The other big investment is a new dry dock. The current dry dock that we have, the "Pride of San Diego," has a 26,000 ton lift capacity. The new one we're having built is 55,000 ton—that's twice the lift capacity.

So what does that mean for the port? Currently there are two dry docks – NASSCO has one called the Builder; we have the Pride of San Diego. With roughly 60 ships home ported in San Diego today, and only two docks, there are severe limitations on the maintenance capability within the port. With the 19 additional ships coming out here, we did an analysis and ran the models and decided to make this major investment for the facility in order to support the Navy. The contract for the new dry dock has been signed and the build has commenced. We expect it will be fully operational by the end of 2016. In conjunction with the new dry dock, we're going through the entire facility accomplishing upgrades, including; new offices, restrooms, yard services, and increased machine and electrical capability.

These investments will enable BAE Systems to do more work within the port and will enable fleet maintenance to remain within the port thus benefiting the city and the surrounding commu-

The current dry dock that we have, the "Pride of San Diego," has a 26,000 ton lift capacity. **The new one we're having built is 55,000 ton—that's twice the lift capacity.**

Bob Koerber, GM
BAE Systems Ship Repair, San Diego

nities of San Diego. If ships have to go elsewhere for maintenance and repair, the Sailors go, too, and that represents a big loss to the local economy. Bottom line; these investments helps us to better support the Navy and keep jobs within this port - it helps the City of San Diego.

We understand the multi-ship/multi-option repair and modernization contracts will not be continued. How will that impact your yard? And how will we achieve the stability and predictability of the deployment, maintenance and training schedule?

Rather than knowing what ships we'll be getting, and planning accordingly, we will have to bid on each and every availability. This complicated the decision about the new dry dock.

But at the same time, it might make you more competitive.

That's correct.

We understand that there will be an emphasis on giving small contractors an opportunity to prime some of these jobs that have traditionally been awarded to the master ship repair facilities. If one of those small companies needed to include a dry dock in their bid, they would have to come to you or NASSCO, which would make you a sub to them. They would not have include the cost of that infrastructure, such as piers, dry docks, and cranes, in every bid, but you have to pay for it whether the Navy puts a ship in it or not.

We have not seen the new contract vehicle for San Diego, however, we don't believe that the U.S. Navy will task a small business with the requirement to dock a ship

So it's not just the physical infrastructure. And these are not trivial.

No, they're not. They're major investments.

If during an availability you open up a void and find something that something that needs to be done, but wasn't part of the planned work in the package, wasn't budgeted or scheduled for, but it has to be done before you can get to that next piece of work, and you can't wish it away. So what happens to that?

If the work is authorized by the government contracting officer, a contract modification is issued, priced, and negotiated prior to work commencing.

(Continued on page 55)

Imbari stands strong

Mammoth dry dock investment to support construction of 20,000 TEU containership series

During the second half of the 20th century, the Japanese ruled commercial shipbuilding.

Today, numerous competitive forces in the Far East, led by South Korea and China, have continued to throw massive resources into building and maintaining modern shipbuilding dominance, so much so that it may seem as though the days of Japanese shipbuilding have passed for good. "Any single shipbuilder in Japan cannot fulfill a large-scale order, for example, for 10 ships," an industry official told the Japan Times last September.

Imabari Shipbuilding disagrees.

The company is currently building one of the world's largest dry docks to complete a record-breaking order for 11, 20,000-TEU ultra-large container carriers.

Imabari Shipbuilding, Japan's largest shipbuilder, gets its name from Imabari City, which sits on the coast of Shikoku, the smallest of the four main islands of Japan, on the shores of the Seto Inland Sea. The island of Honshū is across the sea to the northwest, and the island of Kyūshū just a small distance to the southwest. The Pacific Ocean and the Sea of Japan are both easily accessible from Imabari, while three islands shield the city from Tsunamis and the dangers of the open ocean, making this port city a haven for shipbuilding. The people of here have been shipbuilders since before sail gave way to steam and wood was replaced by metal. Dozens of shipbuilders and marine machinery and equipment manufacturers call Imabari home. In May, the city will host the annual international maritime exhibition, Bari-Ship 2015. Imabari is the heart of maritime Japan.

It was here that Imabari Shipbuilding was formed in 1942, when all the Imabari shipyards were consolidated into one company. The war was on and the Navy needed ships, big ones, and lots of them. After the war, it was the shipbuilding industry that helped to revitalize Japan's war-torn economy. By the time the 1960's arrived, Japan's shipbuilding industry had supplanted Europe's as the world's largest. Up until 1999, Japan produced a majority of the world's ships. South Korea surpassed Japan's production in 2003, with China passing them both a few years later.

Today, the Imabari Shipbuilding group operates nine factories and 12 building facilities that produce a total of over 90 vessels per year. In 1995, Imabari delivered the La Loire, a 4,800 TEU post-panamax behemoth that was the largest in the world at the time but seems downright pocket-sized by today's standards. Now, just 20 years later, the company is scheduled to deliver a 14,000 TEU containership, which is already dwarfed by new deliveries from South Korean and Chinese shipyards.

Japanese shipbuilders have been forced to adjust to the competition from their Southeast Asian neighbors. Many have moved towards specialization, focusing on creating high-value-added vessels, including cutting-edge eco-friendly ships. The thinking goes that Japan's technology, especially safety technology, allow it to create some of the highest quality vessels, but keeping pace with Chinese and Korean rivals in terms of production and size would be seemingly impossible. Tsuneishi Shipbuilding, Japan's third largest shipbuilder, has moved much of its production overseas to stay competitive, favoring the lower labor costs offered by the Philippines.

Imabari is choosing neither specialization nor outsourcing, instead doubling down on its local workforce and pursuing the world's largest ship orders. The 11-ship order is a huge victory for the company, a victory secured with the help of the Marubeni Corporation, which will be delivered to an unnamed "overseas shipping company." But delivering that order would be impossible without the construction of a dry dock project that will cost about $333 million.

The new drydock will be built at the company's Marugame Headquarters, which is an hour and a half drive up the coast of the inland sea from Imabari. The newbuilding drydock will measure 600 x 80m (1968.5 x 262.5 ft.). Construction has already started on the new facility, which the company says will be completed in October 2016. After that the deliveries of the new container ships, which will be 400 m (1312 ft.) long and 59 m (193 ft.) wide, will begin in early 2018. The first delivery, Imabari believes, will be the largest in the world.

The newbuilding drydock will measure 600 x 80m (1968.5 x 262.467 ft.) and cost about $333m.

(Continued from page 53)

How do you see the pivot west changing your workload here?

It'll be 19 more ships coming to San Diego. That's roughly a 30% increase in number of ships. This is a major increase. It's not just us, it's all the infrastructure that supports the ship yards. It impacts the entire port; the entire city. It has an impact on all the surrounding businesses, the vendors and suppliers.

And, as you mentioned, you are making other major improvements?

We've gone through and renovated every building in the yard in some capacity. We've expanded the electric department with a new controller overhaul shop and connector shop. In the paint department we've added a new paint repair/spray rig repair facility. We're installed new table saws in the carpenter's shop and updated the automated burn table in the sheet metal shop. In the structural shop, we've added new weld booths for training our shipfitters, and built a new office facility for the structural shop supervisors. Across the street, in the machine shop, we've purchased an additional shaft lathe to repair main propulsion shafts for the ships Throughout the entire facility we've installed new LED lighting

As BAE Systems Ship Repair grows its work force here in San Diego, you're going to have to train more people. What are some of the investments you're making in training?

We are constantly training, not only new hires but all employees as well. We have a training center within the facility and staff of personnel to ensure we remain current with requirements. We have teamed up with many training /education providers including Southwestern College to support our employees.

I know you have an apprenticeship training program. How important that is that here at your yard?

As the work force ages, we must find the talent to replace our retirees. We depend on programs such as the apprenticeship program to ensure we maintain our skilled workforce. Programs such as the apprenticeship are vital to our industry.

Your next door neighbor is NASSCO. They are your biggest competitor. They are you're your competitor in Norfolk. And while you compete against each other, you also cooperate. There's also collaboration.

Correct. Although we are competitors, we also share resources in support of the U.S. Navy

Like their paint shop or your dry dock. So…

We share dock, pier space, and personnel as required.

How do you level load that work? If you automatically give them a percentage of the work, you could still have peaks and valleys.

Right. When we see a big peak coming up for a specific craft, we ask if they can support and vice versa.

How does the Navy look at that? Do they look at that positively? Does it limit competition?

It has no effect on competition. We're still competitors. When it comes time to winning the work, we're definitely very competitive. The Navy benefits through the full utilization of assets within the port.

So it's pretty fair.

Yes. We have to stay that way.

If the government wants to get more competition, you can't really submit a low-ball bid.

There are 4 MSRs on the waterfront, all competing for the same work.

What happens if NASSCO doesn't get any more new construction?

Can't answer for NASSCO but I'd guess they'd be more aggressive for repair / maintenance contracts.

How would you characterize your impact on the San Diego economy?

Bottom line – Vital. We have approximately 2,000 BAE employees, plus another 4,000 subcontractors, vendors, and Navy personnel coming through our gates every morning to work on those ships, roughly 5-6 thousand people per day coming in this facility.

What trends have you noticed with the ships coming in here?

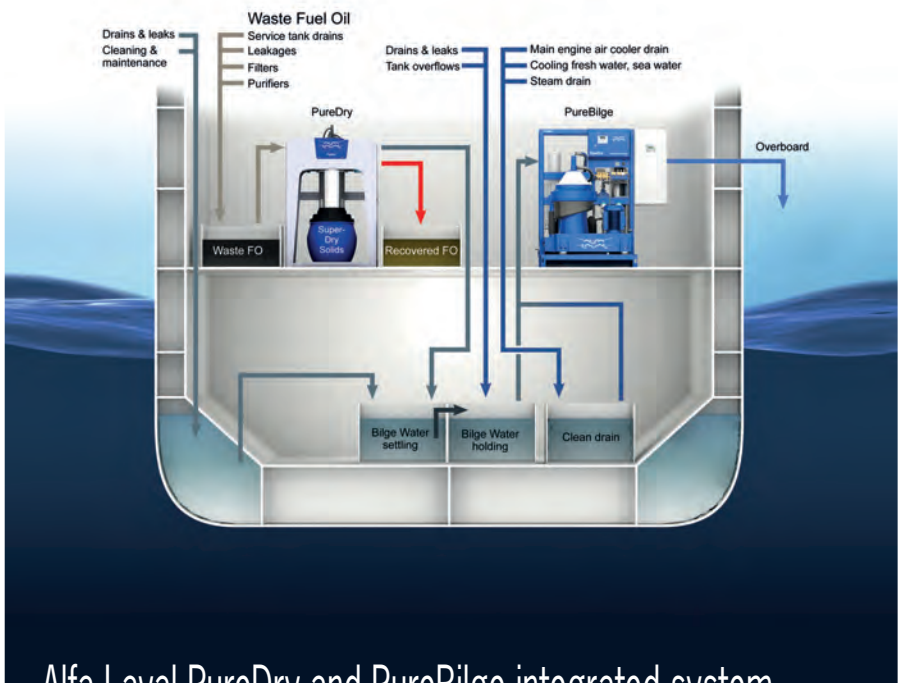
Due to a combination of extended deployments and an aging fleet, the material condition of the ships have required a more significant scope of repairs

Alfa Laval

Upgrades, new products for BWT, Oily Waste Treatment & Exhaust Gas Cleaning

Alfa Laval, a provider of specialized products and solutions based on heat transfer, separation and fluid handling technologies, addresses engineering and environmental requirements in a wide range of areas. The company recently announced a number of new developments and products for use in ballast water treatment, oily waste treatment, and exhaust gas cleaning.

By Tom Mulligan



Alfa Laval PureDry and PureBilge integrated system

Expanded BWMS Range

As IMO ballast water legislation nears implementation and with the USCG Ballast Water Discharge Standard already in effect, Alfa Laval is expanding its PureBallast range of ballast water management systems with the introduction of new upgrades and a new reactor for system sizes from 170 to 87 cu. m./hr.

The PureBallast 3.1 upgrades are designed to improve system performance and simplify operation through a new human-machine interface while retaining flexibility in installation as well as simple, rapid maintenance procedures. The smaller systems represent a major expansion from the previous minimum flow of 250 cu. m./hr., enabling this purification technology to be implemented in a wide range of smaller vessels.

"Smaller PureBallast systems will be a full match for their larger counterparts, with reactor construction in SMO, effective power management and compact, performance-enhancing CIP," said Stephen Westerling Greer, Global Business Manager for the PureBallast range.

"When Alfa Laval launched PureBallast commercially in 2006, it was into a market full of uncertainty. Little was clear about the real-world challenges of meeting the IMO Ballast Water Management Convention, to say nothing of when it would take effect."

During the early development of PureBallast, Alfa Laval aimed to meet the IMO legislation without affecting vessel operations. Having achieved this, the company changed focus to consider the practical requirements of ballast water management systems, including the development of explosion-proof and energy-efficient systems. The latest PureBallast systems are designed to achieve efficient space usage and power management while providing breadth of capacity. Alfa Laval is now moving its focus from vessel requirements to business needs.

"Neither the operations on board nor the vessel's area of operations should be affected," said Westerling Greer.

“The choice of ballast water treatment system should not be the major constraint on a vessel’s potential business or resale value.”

Stephen Westerling Greer,
Global Business Manager for the PureBallast range

“The choice of ballast water treatment system should not be the major constraint on a vessel’s potential business or resale value.”

Performance in any Waters

PureBallast handles water in liquid form at frigid temperatures, and since January of this year has been certified for all water types: fresh, brackish and marine. “Three-water certification is important, and not only for those trafficking the Baltic or the Great Lakes,” Westerling Greer said. “Many ports we think of as brackish are farther from the marine end of the transition zone and closer to fresh water, which means the systems installed should be able to operate with freshwater constraints.”

Even in marine water, PureBallast performs efficiently. Large PureBallast systems of 1000 cu. m./hr. or more, which operate at 52 kW in most port situations, can be ramped up to 100 kW when needed for harbors with low UV transmittance. The UV treatment in all PureBallast systems, which is already enhanced with AOT (advanced oxidation technology), can also be combined with fine filtration for performance in

“Many vessels today get rid of their waste oil by pumping it onto receiving barges, which is yet another messy procedure for the crew to deal with. PureDry eliminates this procedure and all of its drawbacks.”

Pauli Kujala, Senior Business Manager,
Oily Waste Treatment Systems, Marine & Diesel Equipment, Alfa Laval

PureDry

PureSOx2

low-clarity and coastal waters. In this way, water with a UV transmittance of just 42% can be treated at full flow.

“The numbers are much more than a mathematical exercise,” Westerling Greer explained. “Some of the world’s key trading ports have water with poor transmittance, where the UV transmittance can be at or even below 50%. Other ports have temperatures that tend towards zero, or are essentially freshwater ports. Because water conditions are variable, a system operating at its limits near these parameters will run into difficulties, whereas PureBallast can treat water in all of these situations, providing it is liquid. The vessel’s operations are not compromised, which is an industry benchmark for other systems to be compared against.”

Alfa Laval has been selected as a consultant on several panels developing standards and providing information on UV disinfection treatments and in March of this year the company submitted a USCG type approval application for PureBallast.

“For a decade, Alfa Laval has been pushing ballast water treatment forward,” said Westerling Greer. “We went through the learning curve early on to develop benchmark systems with a focus on the user’s operational and business needs. Having started as a pioneer, we are now a consultant with a strong role in educating the market.”

PureDry: Oil Recovery and Sludge Minimization

The Alfa Laval PureDry oil recovery system was designed to enable shipowners and operators reuse the HFO fraction of waste oil, but the system also provides major benefits in minimizing sludge. Pauli Kujala, Alfa Laval’s Senior Business Manager responsible for the PureDry and PureBilge purification systems, reports that more than 160 units have been sold since the launch of PureDry in 2013, major purchasers including Carnival Corporation, Dynacom, Frontline, MSC, Norwegian Cruise Line, Petrofac, Spliethoff, Stena and Wallenius. One of the most prominent vessels employing the system is the record-breaking container ship MSC Oscar, while Petrofac’s JSD 6000 deep-sea pipelaying vessel has also had it installed.

PureDry was introduced to provide both a new means of separation and serve a new application, that of waste fuel recovery. However, according to Kujala, waste fuel recovery alone does not explain enough why the system has sold to major companies across all sectors of the shipping industry:

“When we developed PureDry, fuel savings were in focus 100%,” he said. “But customers are just as interested in PureDry now that fuel prices have dropped. Simply put, removing fuel from waste oil has advantages we never envisioned from the start.”

Eliminating Liquid Waste

The PureDry system can recover a significant amount of fuel from waste oil, with recovery levels as high as 1-2% of a vessel’s fuel consumption being typical, but it also provides an effective means of minimizing sludge. As its name implies, PureDry separates the oil and leaves no liquid residue, allowing ISO 8217 quality fuel to be returned to the bunker tank and the extracted water

A Royal (PureSox) Scrubbing

PureSox exhaust gas cleaning systems have been gaining ground in the cruise ship market, with four scrubbers being ordered by Royal Caribbean Cruises Ltd. (RCL). Three of these are PureSOx 2.0 systems, the fourth being the first test inline version of PureSOx. Deliveries include retrofits on three of RCl's Freedom Class ships and on one of the company's Voyager Class vessels. Freedom of the Seas (pictured), Independence of the Seas and Liberty of the Seas will have a hybrid scrubber with multiple inlets, and Adventure of the Seas will have an inline hybrid with one main engine connected.

to be sent to the bilge treatment system. Waste product consists of 5-10 kg per day of non-pumpable 'super-dry' solids that are landed and treated as dry waste or incinerated.

"The super-dry solids are the suspended solids that comprise around 1% of the waste oil, and everything else is 100% eliminated," Kujala said. "In an integrated system with Alfa Laval PureBilge, all of the oily waste streams are dried up. The oil is gone, the water is gone. There's nothing to pump and virtually nothing to dispose of."

No Pumping Sludge onto Barges

The advantage of sludge minimization is that it simplifies the waste management process while giving much tighter control over fuel consumption. Dry landed waste is treated in a conventional manner, no additional offloading procedures being required.

"Many vessels today get rid of their waste oil by pumping it onto receiving barges, which is yet another messy procedure for the crew to deal with," Kujala said. "PureDry eliminates this procedure and all of its drawbacks, which has proven reason enough for some customers to buy it. The super-dry solids go straight out of PureDry and into a container, and the container itself goes straight onto land."

Saving a Tonne (of fuel)

Kujala points out another benefit of the system: for some customers, sludge reduction into super-dry solids also eliminates the need for sludge incineration, which means the prevention of fuel being wasted.

"To get three tonnes of sludge to burn, you typically have to add one tonne of diesel," he said. "Environmental considerations aside, the equation makes little sense if you can do things another way. Though sludge can still be incinerated outside of Emission Control Areas, customers would rather get fuel back with PureDry than use even more fuel to get rid of their waste.

"Customers have a range of motives for investing in PureDry, only one of which is recovering waste fuel," he added. "PureDry was developed for one clear business case, but you can't always predict how or why a product will be adopted by the market. For some marine customers, the strongest business cases are ones Alfa Laval didn't see from the beginning."

RCL Orders PureSox

Alfa Laval has also revealed that its PureSox exhaust gas cleaning systems have been gaining ground in the cruise ship market, with four scrubbers being ordered by Royal Caribbean Cruises Ltd. (RCL) following a lengthy selection and qualification process. Three of these are PureSOx 2.0 systems, the fourth being the first test inline version of PureSOx.

Deliveries will extend over the next few months with the systems installed as retrofits on three of RCl's Freedom Class ships and on one of the company's Voyager Class vessels. Freedom of the Seas, Independence of the Seas and Liberty of the Seas will have a hybrid scrubber with multiple inlets, and Adventure of the Seas will have an inline hybrid with one main engine connected.

Reducing Environmental Impact

Cruise industry operators are increasing their commitment to reducing environmental impact and have been using scrubber technology to achieve their objectives, even though its implementation on cruise ships can be more difficult than on other vessels because of space and stability limitations on these vessels. In spite of these issues, the standard U-shaped configuration of PureSOx 2.0 could be successfully incorporated into all three of RCL's Freedom Class vessels.

"This is a flexible configuration that reduces installation cost by allowing multiple engines to be connected," said René Diks, Manager Marketing & Sales, Exhaust Gas Cleaning at Alfa Laval. "Space for the scrubber itself was found behind the existing funnel, in front of the rock-climbing wall. The water cleaning unit and circulation tanks, which are necessary for hybrid operation, will be located high up and on the same deck, which will avoid the need for an additional booster pump."

For the RCL vessels, it was important to employ a hybrid operation system with both closed-loop and open-loop modes. The ships sail U.S. coastal waters and are subject to US VGP discharge legislation, which has stricter standards than those of the IMO.

The PureSOx installation aboard Adventure of the Seas will also be a hybrid system but this had to overcome further challenges because the space available was even less and the stability issues even greater than aboard the Freedom Class vessels. The resulting design means that Adventure of the Seas will be the first vessel to install an inline version of PureSOx, developed at the Alfa Laval Test & Training Centre in Aalborg, Denmark.

"The cruise industry, with its environmental profile and unique technical considerations, places high demands on a SOx scrubber," Diks says. "Alfa Laval PureSOx provides a great deal of flexibility in meeting those demands, and will offer even more flexibility when the inline version is officially launched."

The Author

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From the Margin to the Mainstream

The rise of permanent magnet motors and generators

By Mika Koli

Since the boom of the NdFeB magnets industry, the usage and potential applications for permanent magnet machines have grown exponentially to the detriment of traditional induction systems. In special applications like elevators, cranes, hybrid vehicles or renewable energy, permanent magnet machines have already become the preferred technology. In the marine sector, they are now starting to be the main competitor to mainstream solutions.

Permanent Magnet Materials for Electrical Motors

The development of permanent magnet materials has progressed quickly during the past few decades. First, the materials were based on cobalt-tungsten-chromium iron alloys. Aluminium-nickel-cobalt alloys were discovered in the 1930s, but the development of samarium-cobalt in the 1960s, and finally neodymium-iron-boron based magnets (NdFeB magnets) in the late 1970s, made it possible for electrical motors to benefit from permanent magnet materials.

Ever since, NdFeB magnets have been generating a great amount of interest among leading industrial players, thanks to their high level of energy density as well as other useful material properties, like corrosion resistance and temperature tolerance. In particular, the large remanence and coercivity of SmCo and NdFeB magnets have led to the application of these materials in industrial motor and generator drives.

Although standard induction machines (IM) have ruled the electric machine business for years, the exceptional possibilities offered by NdFeB magnets have led to a consistent, spectacular growth of their production and utilization around the world.

Improving Efficiency

A synchronous PM machine contains Neodymium-Iron-Boron (NdFeB) magnets, which are materials with a very high flux density. This makes them ideal for variable-speed motors and generators throughout the entire speed range, significantly cutting back on fuel consumption. A PM machine is typically 2–4% more efficient at full load and 10% more efficient at part load when compared with induction machines. These efficiencies result from a lack of current losses in the rotor, the absence of an exciter and reduced winding losses.

Induction machines have relatively good performance above ~1000 rpm, but are typically not very good at low speeds due to increasing rotor losses based on the relative slip of the rotor. This slip is dependent on the torque.

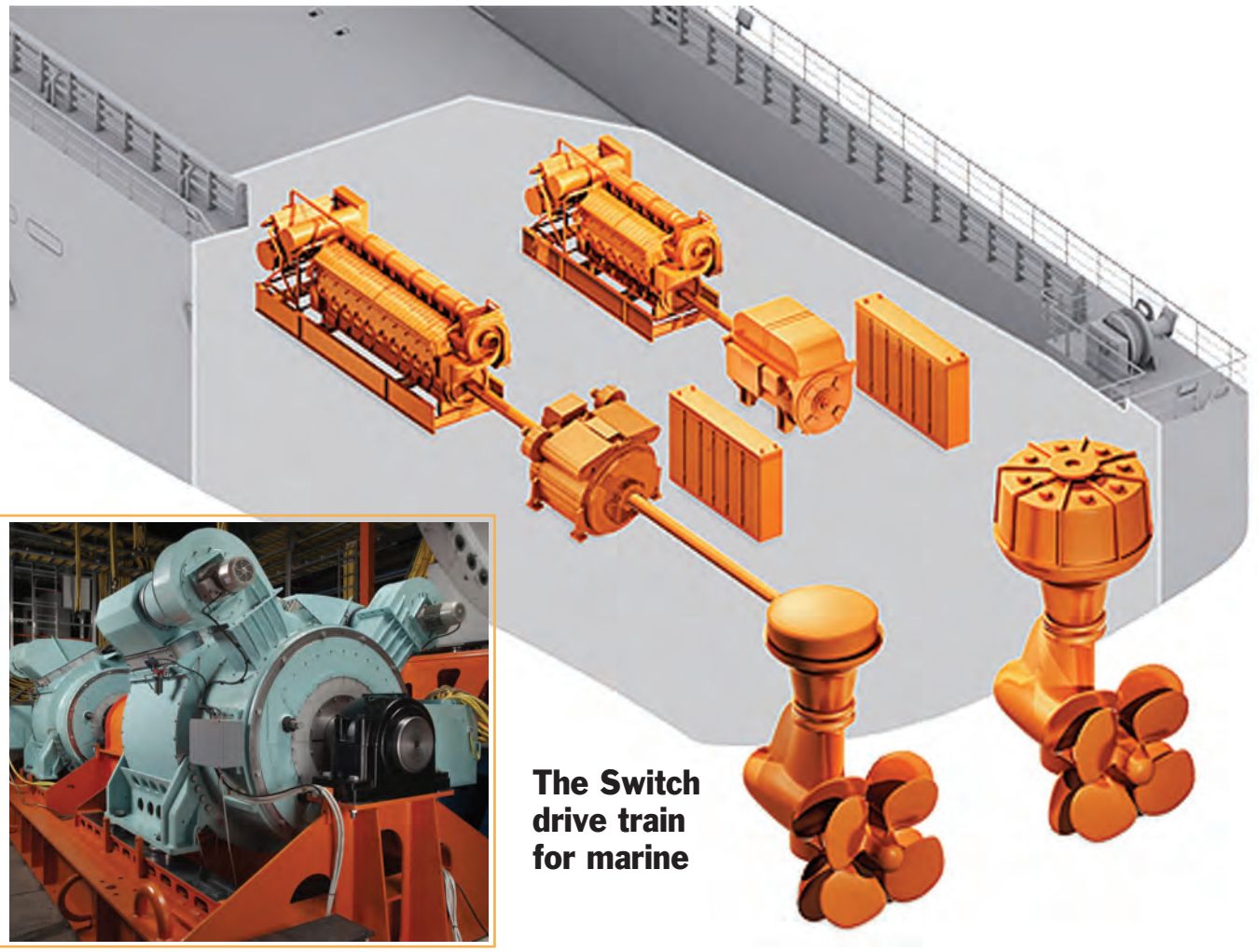
As an example, where a 50 rpm slip with constant torque means, at 3000 rpm, only a 1.7% relative slip causing a ~1.6% reduction in efficiency, it represents a 17% relative slip at 300 rpm, dramatically reducing the efficiency by 17%. PM machines do not have slip and thus the "slip-loss" component of the rotor is non-existent. In high-power applications at 300 rpm, it is therefore possible to achieve efficiencies of about 98%.

Adjustable Speed Control

Besides high efficiency for a large speed range, the main reasons to select a PM machine are low speed and the need for speed control. To handle highly fluctuating load cycles, guarantee longer engine life, cut back on fuel consumption and reach lower exhaust values, adjustable speed control is ideal. The Switch integrates a frequency converter in the drive train package to offer the accurate and adjustable speed control needed for dynamic positioning and demanding load cycles in offshore and special vessels. This avoids the low or no-load running of generators, which minimizes engine heat stress, reduces fuel consumption and eliminates undesired start/stop engine cycles.

Using adjustable supply frequency also allows full speed control of the machine. Generally with 4Q control and an external cooling arrangement, the speed torque curve of a PMSM is a box (Figure 1) that covers the whole speed torque range.

The Author



The Switch drive train for marine

Diesel Generators and Marine Propulsion

PM machines offer special seafaring vessels the opportunity to lower operational costs by optimizing the fuel consumption of the diesel engine. Ships often use diesel generators, not only to provide auxiliary power for normal consumption, but also indirectly for the main propulsion. There are two different main types of diesel engines: 2-stroke and 4-stroke. The main difference from the generator point of view is the rotational speed. The 2-stroke engine has a rated speed from 50 to 200 rpm, while a 4-stroke engine is typically above 500 rpm.

Two-stroke engines in marine are mainly used for propulsion. But as the power generation may be integrated into the main propulsion system, it has to apply the same speed as the main engine or the revolutions have to be raised with a step-up gearbox.

The Switch manufactures both direct-driven shaft generators in frame sizes of 1000 and 1500 and high-speed generators in frame sizes from 450–710. So-called shaft generators are direct drives built around the main propulsion shaft, which are part of the main propulsion line. High-speed machines (~1500 rpm) are connected to the propulsion line through the gearbox. In addition to power generation, machines may also be used for electric propulsion. In such cases, separate auxiliary generators produce the propulsion power. These auxiliary generators are typically 4-stroke diesel engines.

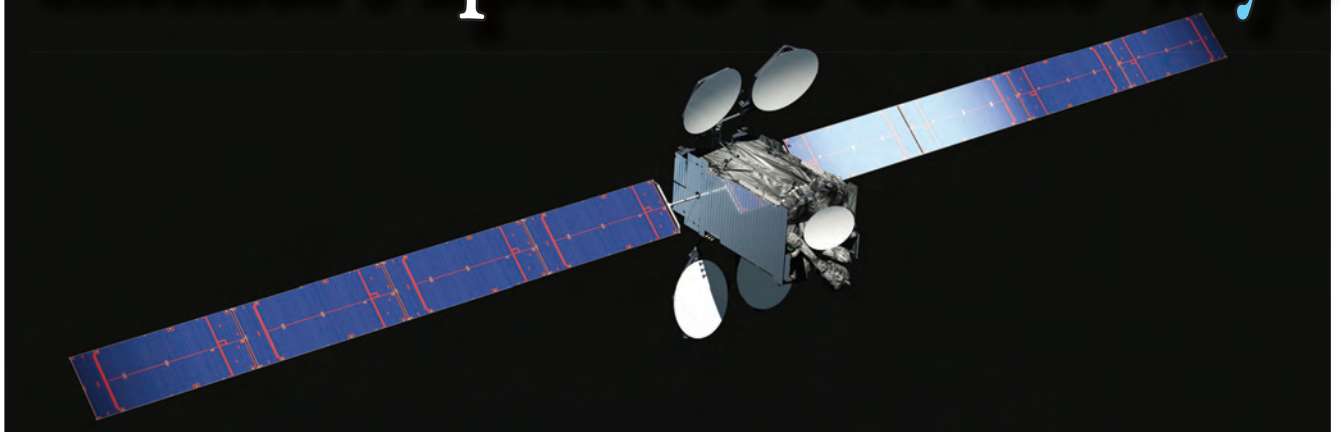
At the end of February, WE Tech Solutions placed orders for two PMM 1000 M shaft generators from The Switch with the option for an additional two to be used in future WE Tech Solutions projects. WE Tech Solutions utilizes the PM machine both as generator and motor in their direct-drive permanent magnet shaft generator solution. The solutions will be delivered by WE Tech to Besiktas Shipyard in Turkey for installation in two 15100 DWT asphalt carrier new buildings recently ordered by Canadian ship owner Transport Desgagnés. For this type of vessel, the ability to switch to the Take Me Home mode provides Auxiliary Propulsion Drive (APD) in the same package is key. The solution provides considerable fuel and service cost savings achieved from having the auxiliary generators turned off when in sailing mode.

PM machines are also known for their unmatched design flexibility. Thanks to the high power density, PM machines can pack more power in a package that is far more compact, lighter in weight and smaller in size compared with induction machines.

The Author

Mika Koli works as the Business Development Manager for Marine at The Switch. One of his main responsibilities is to help develop the advanced drive train technology for marine applications based on permanent magnet and frequency converter technology.

Intelsat's EpicNG is on the Ways



While the true uptake of broadband across the maritime sector has been slow to develop, a number of market conditions are conspiring to drive the service mainstream. Intelsat's Kurt Riegelman discusses the matter with Maritime Reporter & Engineering News.

While the advent of full broadband in the maritime sector is the exception rather than the norm, the tides are changing as companies increasingly deploy fast, modern 'land-like' comms in an effort to achieve everything from attracting and retaining crew, to streamlining business operations at sea and enhancing safety.

"Shipping companies are increasingly relying on true broadband access to improve day-to-day operations and profitability," said Kurt Riegelman, Sr. Vice President, Sales & Marketing, Intelsat. "Broadband connectivity allows ship managers to quickly request and receive support from onshore staff for important business and operational tasks as well as offer value-added services, such as environmental tracking and cargo status to customers. Improved connectivity also enhances crew safety and wellness."

The evolution of maritime communication networks at sea is in many ways analogous to the maturity of software solutions at sea: initially a piecemeal approach to address emerging needs rather than a holistic 'big picture' approach, premised partly by the fact that technology and capability has emerged rapidly.

"Network providers also face unpredictable market demand, as commercial maritime trading patterns continually shift," said Riegelman. "Communications providers need to ensure they have the right capacity to serve the future demand distribution across the existing network, especially in high traffic areas."

Just as land-based network operators face tough decisions premised on many offerings purporting to provide similar capability, at-sea communication network managers face similarly difficult decisions, seeking to maximize hardware investment for as long as possible while trying to evaluate the needs of today and in the future.

The Intelsat Maritime Solutions

"Maritime customers have come to rely increasingly on Intelsat's C- and Ku-band satellite services to provide connectivity for the shipping, offshore and cruise sectors worldwide," said Riegelman. "Intelsat's Global Broadband Mobility Network, the world's only global Ku-band mobility offering, was built specifically to deliver broadband infrastructure to the aeronautical and maritime sectors. The network of 13 customized beams on 10 satellites is fully integrated with Intelsat's existing satellite fleet and the IntelsatOne terrestrial infrastructure. This global hybrid network provides end users with always-on, true broadband access with data rates up to 50 Mbps."

According to Riegelman, Intelsat enables network operators to adjust their services to provide customers bandwidth when and where it is needed. Bandwidth portability allows network operators to shift capacity in response to customer needs, while operator roaming allows end users to transfer onto Intelsat's network in real time. Its services will be further enhanced by launch of the Intelsat EpicNG platform, which is designed to deliver high performance and high throughput with an open architecture.

Intelsat EpicNG

"EpicNG is fully integrated with the existing Intelsat fleet, supporting global coverage from the start of its deployment," said Riegelman.

The first of six EpicNG satellites, Intelsat 29e, is scheduled for launch in Q1 2016, providing services over the Americas and the North Atlantic. Intelsat 33e, which will bring capacity to Africa, Asia and Europe, is scheduled to be launched in the second half of 2016. Finally, four additional EpicNG satellites are designed to provide resilience and connectivity for the busiest global routes.

Technical highlights of the EpicNG system are spot beams and frequency reuse technologies, which help in concentrating the power of the individual transponders over a smaller area, allowing for higher modulation schemes that dramatically increase the number of bits delivered per MHz, ultimately designed to result in lower cost per bit for the service provider.

The Intelsat EpicNG platform is designed to enable throughput in the range of 25-60 Gbps per satellite, and for the maritime sector, each EpicNG spot beam will be designed to deliver total throughput of 290 Mbps to vessels.

"Leading maritime service providers, including Harris CapRock, MTN and Airbus Defence and Space, have already committed to Intelsat EpicNG," said Riegelman.

KVH Industries

New KVH Maritime Sat TV Antenna System

KVH Industries, Inc. introduced the TracVision TV8 maritime satellite TV antenna system. TracVision TV8 is designed to provide the tracking, reception and extended coverage area needed for yachts and merchant vessels calling on ports around the world. It is compatible with nearly all Ku-band services around the globe, and it also supports such services as DIRECTV, DISH Network and DISH HD, and Bell TV in North America, and TrueVisions, Astro, and Sky TV in the Asia-Pacific region.

The 81 cm (32 in.) diameter TracVision TV8 enables yacht owners to enjoy satellite TV programming while on the water; the system also makes it possible for commercial maritime operators to ensure their crew has access to the recreational entertainment services that are now recommended by international regulations such as the Maritime Labor Convention (MLC) 2006.

Features of the new system include the streamlined IP-enabled TV-Hub delivering easy setup and operation. For advanced functionality and performance, the TracVision TV8 includes single coaxial cable for power, data and video for easy installations and retrofits; high-performance tracking for crystal-clear television picture in heavy seas; IP-enabled antenna control unit with Ethernet connection and built-in Wi-Fi interface for access to system information from any Wi-Fi device; advanced inertial-based stabilized search for fast satellite acquisition; exclusive RingFire antenna technology for stronger signals, wider geographic coverage and better reception; DVB-S2 technology for compatibility with current and future Ku-band satellites; and IP AutoSwitch option for multiple receiver installations enabling simple automatic satellite switching on DISH Pro and DiSEqC compatible services.

www.kvh.com

Harris CapRock One

Harris CapRock Communications launched the industry's first unified, fully managed satellite, wireless and terrestrial connectivity service designed to reduce customers' voice, data and equipment management costs. Customers in the energy and cruise industry need to obtain reliable, always-on communications when their vessels, drilling sites and ships change their global positions and communications needs. With Harris CapRock One, they can replace current single or dual-band communications support options with a multiple-medium solution designed to provide optimal connectivity at any given time. Onboard passengers can continue to stream data to their tablets, smartphones and other connected devices without interruption while crews leverage the same connection for their needs. Harris CapRock One's supporting intelligent communications director (ICD) is a geographically-aware smartbox that recognizes the location of the multi-band antenna and carries a database of the network footprints available everywhere on Earth. The system uses an embedded network intelligence to make performance-based decisions, routing traffic from specific applications over the transport medium best suited for the task depending on speed, latency, location and cost.

www.harriscaprock.com/hcr-one

Building the World's Largest 4G Offshore Network

Statoil selected Maritime Communications Partner (MCP) to deploy and operate its high speed 4G-network on the Norwegian Continental Shelf (NCS). It's a six-year contract with a four-year option, which calls for MCP to build what is essentially the world's largest 4G network at sea. Initially 15 rigs, two light well intervention vessels (LWI), two subsea inspection and maintenance vessels (IMR) and 50 supply ships will be covered. The agreement includes existing and new oilfields operated by Statoil. It also opens up for expansion into the UK Continental Shelf and other areas of Statoil's international operations.

US Hoists: Making the Big Haul, Italian Style

The process of efficiently lifting and moving boats on land is an age-old conundrum. While 'US Hoists' is a relatively new name in the boat lift sector, in reality it blends more than four decades of boat lift experience with some of the most modern, automated boat lift technology on the planet. Thomas A. Tebbens II, president of US Hoists Corporation, explains. US Hoists Corp. of Calverton, NY recently teamed with Boat Lift SRL of Italy to deliver the Italian company's innovative marine hoists and shuttle machines to North America, providing parts and service domestically for Boat Lift customers. Thomas A. Tebbens II, president of U.S. Hoists Corporation sees the partnership as the perfect conduit and the first step in his plan to expand the company's boat lift business, starting with parts and service supply, extending to refurbishments and rebuilds and culminating in new unit sales and manufacturing.

The "New Old" Company

"The company US Hoist was started in 2009 when we took over a company called Acme Marine Hoist," said Tebbens. At the time of the acquisition, Acme Marine Hoist was 42-year-old company headquartered in Bayport, NY. "Acme Marine Hoist was one of the first manufacturers of boat hoists and boat lifts in the northeast (US)."

While Tebbens and his crew are relatively new to the boat lift business, Tebbens is a third generation owner of Tebbens Steel based in Calverton, a family company started in 1944 by his grandfather Alfred Tebbens, a company that has evolved with the times and today stands as a supplier in the high-end residential construction business on the East end of Long Island. "The boat hoist business is similar, but at the same time it is very different," said Tebbens.

Tebbens initial attempt to buy Acme Marine Hoist in 2005 was rebuffed by the owner. But subsequently, after the owner passed away and the owner's grandson took on the business, the wheels for sale were set into motion.

While he inherited some new build contracts with the company acquisition, the tactic from the outset was to focus on spares, repairs and refurbishments, positioning the company for new build business when the time was right.

Italian Style (& Substance)

While ACME Boat Hoist was his entrance into the boat lift market, Tebbens cannot hide his enthusiasm for the line of products offered via his new partnership with Italy's Boat Lift SRL, a company which custom designs its boat lifts and carts, offer a palate of standard design features that includes a 90-degree steering system with electronically synchronized winches; sliding lifting points and remote control equipped with display and remote assistance service.

"When I took over (ACME Boat Hoist) in 2009, I set a goal of the type of equipment I would like to build, looking at our competition and saying 'Whatever they can do, we're going to do it better,'" said Tebbens. "And when I went to Italy, they were already doing it!"

So US Hoists entered an agreement as the sales agent and as the sole provider of parts and services for Boat Lift's hoists in North America.

Tebbens is hopeful that the relationship, built on a solid base of service and support, will eventually lead to a deal for a license to build their hoists and carts in the U.S. For the moment though, the focus is on repairs, spares and service, and to that end US Hoists invested to ensure that it maintains an adequate stock of parts in the U.S., ready for installation should the need arise. Boat Lift mobile boat haulers come standard with a number of features designed to enhance efficiency and safety, including:

- 90-degree steering system
- Radio controlled
- 4 steering wheels, 2 steering wheels or sideways movement
- Electronically synchronized winches

*(*The maneuverability and ease of driving the motorized cart lift and transport system was confirmed, as Maritime Reporter was given the opportunity to take a unit for a 'test drive' across US Hoist's parking lot in Calverton. While we didn't lift a boat, the driving and overall handling was intuitive and simple to master. • G. Trauthwein)*

MEDS: Get Connected & Protected

Late last year Radio Zeeland DMP launched MEDS, and advanced monitoring system that integrates laser sensors, day and night vision cameras and software to alert crew or authorities in a safety or security event.

"MEDS (Maritime Early Detection System) is designed to be a security and a tracking product," said David Leone, president, Radio Zeeland DMP.

"It can be used as it is in the cruise line industry for man overboard, or an anti-piracy device, or if a ship owner wants to monitor the deck of a supply vessel, or the legs of a rig to determine when there is a supply boat approaching."

The proprietary core of the system is a laser sensor that transmits up to 82 meters at 190 degrees, designed to be used as a stand-alone or in concert with a web of sensors providing total coverage of a larger area.

The sensors are networked with a camera system – which can be the ship or facility's existing camera system or one provided by Radio Zeeland DMP – so that not only is an alert triggered, but immediate image verification is provided.

"Nobody sits around and watches CCTV all day," said Leone. He said that when the sensor trips, the camera starts recording 15 frames before sot that the event is provided in a continuous loop. The user of the system then sees a split screen: real time video as well as the roll-back video showing the original event that triggered the alert. This provides the operator with immediate actionable intelligence, as well as a means to determine early in the process if it was a false alarm, such as a large bird flying through the sensor field.

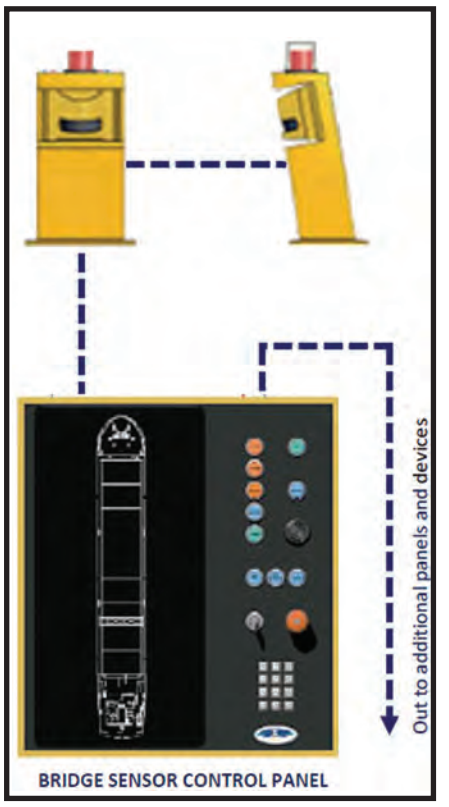
"There are many products that provide security monitoring, but MEDS is different as it provides a total package of monitoring on virtually every aspect of the vessel," said Leone.

SIGMA 1100

The company also launched SIGMA 1100, an engine data display unit specifically designed to make the job of monitoring engine parameters easier on crews stretched thin. The unit is compact and able to read out two engines at the same time, visualizing the information on screen.

"The SIGMA 1100 can provide valuable data quickly, especially when vessels have two different engines," said Leone. "Using the SIGMA 1100, data such as fuel consumption, coolant temperatures or RPM are easier to interpret with its intuitive pictograms that vary according to function."

The unit features three types of page layouts: a main page with a fixed template to show the I/Os, an overview page that is customizable for digital numeric readouts, and an alarm page that will send out an alert if a digit goes beyond a pre-defined level.



Matson Monitors Cylinder Liner Wear

The cylinder liner is a crucial part of a ship's engine, as monitoring wear not only extends operational life but also prevents unexpected and costly repairs, with the average cost for a replacement liner at over $150,000. Matson has installed Parker Kittiwake's LinerSCAN onto several of its vessels as part of a range of condition monitoring tools. Payback proved immediate, as on the first voyage after installation, the LinerSCAN system indicated increased wear on the cylinder liners. Upon investigation, Matson detected damaging levels of cat fines in the system on one of its vessels, identified the cause of the issue and addressed the problem before damage occurred.

Monitoring Wear

Matson purchased five LinerSCAN system in January 2014, with the first installation made on Manukai in March, the second on R.J. Pfeiffer in May and the third on Maunalei in August, with the remaining two installations to follow. The LinerSCAN system can be used to minimize liner wear, improve maintenance scheduling, decrease sampling and testing costs, optimize lubricant feed rate and detect the result of the ingress of catalyst fines. Using magnetometry to quantify the iron in used cylinder oil, the LinerSCAN sensors report changes caused by abrasive wear and even routine inspection, highlighting periods of increased physical or thermal stress. By monitoring wear levels in real time, engineers are alerted to escalating cylinder liner damage and are able to react quickly to changes, enabling preventative maintenance during the ship's passage to the next port and insuring against expensive downtime.

On the R.J. Pfieffer's first voyage following installation of LinerSCAN, high levels of wear were reported in the used cylinder oil following a fuel switch from Marine Gas Oil (MGO) to Heavy Fuel Oil (HFO), suggesting the presence of cat fines in the fuel. Upon inspection, it was discovered that a fuel filter had been incorrectly installed in the main fuel line. Filters are installed as a precautionary measure in addition to the purification system, and in this instance Matson had instigated the installation specifically to prevent damage. LinerSCAN was able to detect the increased level of wear in the cylinders due to cat fines, resulting from the filter not performing correctly.

Given that LinerSCAN is a fully automated online tool enabling "real time" monitoring, it offers benefits compared to offline devices. "There is a clear benefit in knowing what is going on at an exact point in time - not just when the engineer can get to a machine for a routine, scheduled sample and analysis," said Gene Myers, M&R manager, Matson. "By monitoring the scrape down oil for ferrous wear, LinerSCAN can continuously and automatically provide complete sets of trend data showing levels of wear in each cylinder, enabling immediate corrective action to be taken if abnormal wear levels are indicated. This allows the application of corrective measures to avoid the damage of the liner, including checking the fuel cleaning system, increase in feed rate of cylinder lubrication oil, preventative maintenance during the ships passage to the next port or even a route change if necessary, and ultimately insures against costly ship downtime.

ABB Helps Improve Efficiency on the World's Largest Ships

(Photo courtesy of ABB)

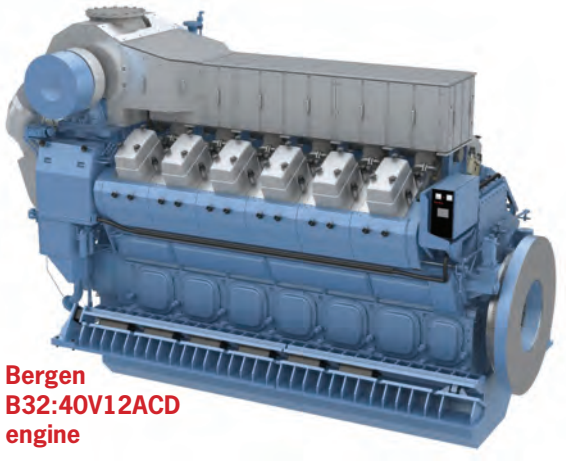
ABB has designed turbochargers powering the largest ships in the world. First came the China Shipping Container Lines (CSCL) Globe with capacity of 19,100 TEU completing its maiden voyage in February 2015. This was followed by the Mediterranean Shipping Company (MSC) Oscar at 19,224 TEU. Both have engines incorporating ABB-designed turbochargers and are each the first of a series of vessels to launch in the coming months also featuring turbochargers designed by ABB.

The largest vessels of any type in service, the CSCL Globe and MSC Oscar are the only containerships in operation with capacity of over 19,000 TEU. In addition to their design, which allows this record-breaking cargo capacity, they host the largest engines on any ship. This advanced engine technology, coupled with ABB turbochargers improves engine efficiency, lowers fuel consumption and cuts emissions. The turbochargers designed by ABB, and fitted under license by Hyundai Heavy Industries (HHI) on both vessels, have a very positive effect on fuel consumption, a key issue for such large ships which also face the challenge of lowering emissions.

Each ship is equipped with MAN diesel engines. The Globe is fitted with three ABB A185-L turbochargers, while The MSC Oscar features ABB 180-L turbochargers. In addition the auxiliary engines on both were designed by ABB, fitted under license by HHI. These two ships are also the first of a series that will feature the same engine and turbocharger configuration.

www.abb.com

Rolls-Royce to Power Ice-Class MPV



Bergen B32:40V12ACD engine

Rolls-Royce

Rolls-Royce secured a contract to supply a power and propulsion package for an ice-class multipurpose vessel under construction at Keppel Singmarine for Singaporean shipowner New Orient Marine Pte Ltd. The propulsion package includes a 1,650kW and two 3,000kW tunnel thrusters, two US ARC 0.8 main azimuth thrusters and a single 3,000kW retractable thruster. As well as four Bergen B32:40V12ACD and two Bergen C25:33L6ACD generating sets which will supply the requisite power to the £132 million offshore vessel.

Designed by Keppel Offshore & Marine's ship design subsidiary, Marine Technology Development, the DP3 vessel will be built to Ice Class Arc 5 notation for operation in ambient temperatures down to -30°C. New Orient Marine, a subsidiary of Luxembourg-based Maritime Construction Services, is due to take delivery of its first ice-class vessel in July 2017. Rolls-Royce will start delivering equipment to the Keppel Singmarine in January 2016.

www.rolls-royce.com


Rolls-Royce

East


Rolls-Royce

Rishton


ABS

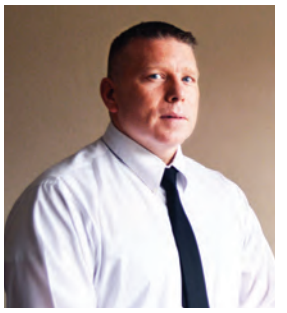
Fireman


U.S. Deptartment of State

Simons


Great Lakes Towing Co.

Gajewski


Great Lakes Towing Co.

Owens

East to Succeed Rishton as Rolls-Royce CEO
John Rishton will retire as chief executive of Rolls-Royce on July 2, 2015 and will be succeeded by Warren East, whose appointment follows an extensive international search, the company announced today. East was CEO of ARM Holdings from 2001 to 2013, and has been a nonexecutive director of Rolls-Royce since January 2014.

ABS Appoints Fireman CTO
ABS named Howard Fireman as Senior Vice President and Chief Technology Officer (CTO) effective April 20.

Simons Named IEA Deputy Executive Director
Paul Simons, a senior United States diplomat with a strong background in energy and economic policy, was selected to be the new Deputy Executive Director of the International Energy Agency. Simons will take up his position on July 8, 2015.

Otto Marine Appoints See as Group CEO
Otto Marine Limited appointed existing Executive Director, Michael See Kian Heng as its Group Chief Executive Officer. The former Group CEO, Garrick James Stanley will take up the role of President of the group's Shipping and Chartering segment, which is the largest segment contributor of the group.

Gajewski, Owens Join Great Lakes Towing, Shipyard
The Great Lakes Towing Company & Great Lakes Shipyard announced that Graham Gajewski has been named naval architect, and Patrick Owens has been named operations coordinator.

Gibbs & Cox Names Hans VP
Gibbs & Cox, Inc. appointed Matthew P. Hans as Vice President of the Platform Solutions Group. He will be responsible for profit and loss, financial management, and cost and schedule control for all Platform Solutions programs.

Seaspan Marine Appoints Gethings VP
Seaspan said that Jenny Gethings has joined Seaspan Marine as Vice President, Business Development. She has more than 25 years in the marine industry.

Ingram Barge's Sehrt Elected AWO Chairman
The members of the American Waterways Operators (AWO) elected a new slate of leaders during its Spring Convention. David G. Sehrt, Chief Operating Officer and Senior Vice President of Ingram Barge Company, was elected Chairman, succeeding outgoing Chairman Frank Morton, Director, Turn Services LLC. James F. Farley, President of Kirby Offshore Marine, LLC, was elected Vice Chairman. Sehrt will serve at AWO's Chairman until April 2016.

Bollinger Receives Two SCA Awards
Bollinger Shipyards was presented the 2014 Award for Excellence in Safety for the 10th consecutive year, and was also presented the 2014 Award for Improvement in Safety by the Shipbuilders Council of America (SCA) on April 23, 2015, during the association's Spring General Membership Meeting in Washington, D.C. Accepting the awards was Bollinger's President and CEO Ben Bordelon.

Chet Morrison Contractors Promotes Guidry, Reeves
Leroy Guidry has been named president of Chet Morrison Contractors. In additon to this new position, he will continue to serve as chief financial officer, a position he's held since 1998. He has over 30 years of experience in the oil and gas industry, primarily in executive management positions. Kelly Reeves has been named vice president of marketing.

Reps. Courtney, Wittman Honored for Maritime Leadership
United States Congressmen Joe Courtney (D-Conn.) and Rob Wittman (R-Va.) received the Maritime Leadership Award from the Shipbuilders Council of America (SCA), a national trade association representing the nation's shipbuilding and repair industry. The award recognizes individuals who have demonstrated exceptional leadership, dedication and support to the shipbuilding and repair industry.

US Designates Three Marine Highway Projects
U.S. Transportation Secretary Anthony Foxx has designated three new Marine Highway Projects.

- The Mississippi and Illinois Rivers, previously designated as the M-55 and M-35, connecting Chicago and Minneapolis to New Orleans, will serve as primary routes for a new container-on-barge service.

- The M-495 Potomac River Commuter Ferry Project will connect work and residential centers located along the Potomac, Occoquan and Anacos-

Seaspan

Gethings

Bollinger

Bollinger CEO, Ben Bordelon center, SCA's Matthew Paxton & Ian Bennitt

Chet Morrison Contractors

Guidry

Chet Morrison Contractors

Reeves

Bollinger

Reps. Courtney, Wittman honored

tia Rivers.

• The third service is a proposed route that will provide access to origins and destinations east of the Hudson River for freight arriving and departing the Port Newark Container Terminal.

New Onomichi Marine Tech Center

Eco Marine Power (EMP) in cooperation with its strategic partner, Teramoto Iron Works Co. Ltd., said the companies agreed to establish a development and test facility in Onomichi, Hiroshima, focused on marine technologies for the shipping and offshore industries. The new facility, to be known as the Onomichi Marine-Tech Test Center or Onomichi MTTC, will be co-located at the Teramoto Iron Works Chojahara Workshop. The center will include a large outdoor evaluation area that will allow for innovative devices such as EMP's EnergySail to be tested.

Nordic Yards Appoints Aly MD

Dr.-Ing. Herbert Aly has been appointed as the new Chairman of the Board of Management of the Nordic Yards Group, succeeding Dr. Vitaly Yusufov, who will preserve his links with the company as a member.

NAVSEA Dedicates Building to Historic Shipbuilder

CNO Adm. Jonathan Greenert delivers remarks during the dedication ceremony for the Humphreys Building at the Washington Navy Yard.

(U.S. Navy photo by Nathan Laird)

Naval Sea Systems Command (NAVSEA) headquarters officially opened its recently redesigned, renovated and renamed building with a ceremony April 20 at the Washington Navy Yard. With a nod to NAVSEA's mission, Building 197 will be known as the Humphreys Building, named in honor of **Joshua Humphreys, the original designer of the U.S. Navy's first six frigates.**

"As America's first warship designer, he laid the foundation upon which the Navy and NAVSEA is built ... As the designer, builder maintainer, and armorer of today's Navy, NAVSEA carries on Joshua Humphreys' work, and in fact our history and future are forever intertwined," said NAVSEA Commander Vice Adm. William H. Hilarides. During the 17-month renovation, NAVSEA took the opportunity to bridge the gap between naval history and current innovations in shipbuilding with help from the Naval History and Heritage Command and the National Museum of the United States Navy. A series of history display panels featuring a timeline of naval shipbuilding highlight the important role of innovation in shipbuilding throughout the Navy's history since Joshua Humphreys' era. It is located near a section that honors the 12 people who died when a lone gunman attacked the building Sept. 16, 2013. Humphreys was born in Haverford, Pennsylvania, on June 17, 1751. He started early on as a ship's carpenter apprentice in Philadelphia. His reputation grew in the colonies as a naval architect. In 1776, he was commissioned to build ships in Philadelphia and prepare them for the Revolutionary War. Years later in 1794, he was charged with building the Navy's first six frigates.

Humphreys used his innovative designs and applied new technology to improve ships' speed and efficiency. His most famous frigate is USS Constitution, the oldest commissioned warship afloat. Joshua Humphreys died on Jan. 12, 1838.

1

2

Damen Design Ice-Class Ro-Pax Ferries

(Photo courtesy of Damen)

Isla Bella

TOTE Launches World's First LNG Powered Containership.

Algoma Central Invests $160m in Fleet Expansion

4

(CNW Group/Algoma Central Corporation)

Yu Feng Ping, president of DSIC and Nick Brown, COO of Lloyd's Register Marin.

3

(Photo courtesy of Lloyd's Register)

1 TOTE Launches World's First LNG Powered Containership

One of the most heralded ship newbuild projects in a U.S. shipyard in a generation has come to fruition at NASSCO in San Diego, where more than 3,400 gathered last month to watch as the world's first liquefied natural gas (LNG) powered containership, christened Isla Bella, was launched. Shipowner TOTE, in partnership with General Dynamics NASSCO, celebrated the completion of the first of two Marlin Class containerships headed to Puerto Rico later this year. By switching to LNG, TOTE is reducing NOx emissions by 98%, SOx by 97%, carbon dioxide by 72% and particulate matter by 60%.

2 Damen Design Ro-Pax Ferries

The 80-m ice class Ro-Pax ferry MV Veteran was launched by Damen Shipyards Galati in Romania, the first of a two-vessel contract, with a design stemming from a Canadian-Danish partnership between Fleetway and Knud E. Hansen. Both ferries will be able to transport up to 60 cars and 200 passengers.

3 "Reduced Ballast Capacity" Tanker Designs

The 'Clear Advantage' tanker design series is reported to reduce ballast requirements by 40%. Dalian Shipbuilding Industry China (DSIC), Dalian Ocean Shipping Co. and Lloyd's Register, completed a joint industry project to develop a minimum ballast ship VLCC, have continued to develop a further detailed designs to provide a series of reduced ballast Suezmax and Aframax tanker designs.

4 Algoma Central Invests $160m in Fleet Expansion

Algoma Central Corporation acquired a 2009-built handy size self-unloading ocean class vessel, the Gypsum Integrity, from Gypsum Transportation Limited. The vessel is being renamed the Algoma Integrity.

In addition, the company announced that that it has signed contracts with a subsidiary of Uljanik d.d. of Croatia, for the construction of two new Equinox Class 650 foot self-unloading dry bulk lake freighters.

5

6

Image: Wärtsilä

Crown Point
102-ft. towboat from Vigor for Tidewater T&T.

7

Image: Damen

5 Vigor Delivers Towboat Crown Point
Tidewater Transportation and Terminals took delivery of Crown Point, a new custom-built, state-of-the-art towboat commissioned at Portland's Vigor Industrial, the first of a series of three joining the company's current fleet of 16 vessels and 160 barges in mid-April. It measures 102 x 38 ft. and is powered by two Caterpillar 3516C EPA Tier 3 certified diesel engines producing 2240 BHP, each at 1600 RPM.

6 Wärtsilä's New AHTS Vessel Design
Wärtsilä launched a new anchor handling tug supply (AHTS) vessel design at Sea Asia. Wärtsilä estimates that the new design provides a reduction of 20-25% in fuel consumption compared to conventional diesel mechanical four engine solutions.

7 Damen Introduces New OPV Design
Damen gave a sneak preview of its newly designed second generation offshore patrol vessels (OPVs) during the annual OPVs & Corvettes Asia Pacific conference in Singapore. Damen's Sea Axe hull shape is used for these second generation OPVs for improved seakeeping and low heave accelerations, designed to make the vessel comfortable, even in stormy seas. Since the hull is designed to reduce water resistance, the new OPV is also designed for fuel efficiency and capable of speeds up to 25/26 knots.

Seaperch

Underwater Robotic Championships
UMassDartmouth Site of Fifth National SeaPerch Challenge

This year the SeaPerch Program will celebrate a half decade of national underwater robotic championships. On the last Saturday in May, the fifth National SeaPerch Challenge will be held on the University of Massachusetts Dartmouth (UMassD) campus where 150 teams of middle and high school students from across the country will compete on the national stage.

The phenomenal growth of the event is evident with a simple look back to the inaugural National Challenge, staged in Philadelphia five years ago attracting 38 teams and 187 students.

In May more than 1,200 students, family and friends will gather for a weekend of learning, sharing, competing and excitement. On the line will be the title of national SeaPerch championship, with trophies in all three competition events along with a number of new special awards.

Hosted by the New England Regional SeaPerch Committee, registered participants and spectators will be treated to the "college experience," as the entire weekend's activities, including Friday night's Ice Cream Social and Saturday's in-pool and poster competition events as well as the Awards Ceremony, dorm room accommodations and meals through Sunday morning, will be available for all participants on the university's picturesque campus near Buzzard's Bay.

What is SeaPerch

SeaPerch is the innovative K-12 underwater robotics program, sponsored by the Office of Naval Research (ONR) and managed by the Association of Unmanned Vehicle Systems International Foundation (AUVSIF).

It is geared to train trains teachers and group leaders to inspire students to build their own Remotely Operated Vehicles (ROV) following an academic curriculum consistent with national learning standards supporting Science, Technology, Engineering and Mathematics (STEM) subjects with a marine engineering-based theme. The program promotes hands-on learning of engineering and scientific concepts, problem solving, teamwork and critical thinking, and introduces students to potential and rewarding career opportunities in naval architecture, marine, ocean and naval engineering.

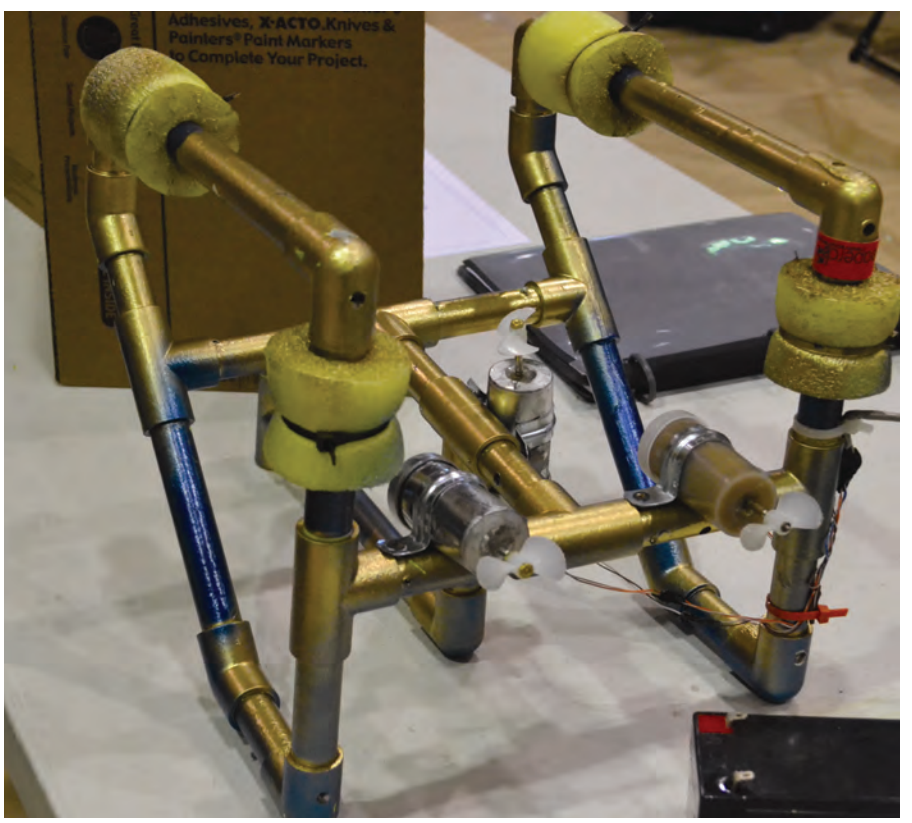
"With guidance afforded by AUVSIF and with ONR's commitment to SeaPerch, we have grown exponentially, reaching more than 200,000 students to date," said Susan Nelson, Executive Director of SeaPerch. Over the years, in excess of 14,000 teachers and mentors have committed to supporting student learning through this stimulating and fun hands-on activity and to promoting student discovery and excitement of STEM subjects leading to a potential future career path.

Diverse and Targeted

The program reaches a diverse population, so participants in the National Challenge frequently include students from inner cities to remote rural areas of the country to Native American reservations in Minnesota to the islands of Hawaii, all of whom have now been introduced to STEM though SeaPerch.

Beginning on Friday afternoon, May 29, arriving teams will first check into their UMassD dorm rooms, then head over to registration where they will check in and submit their ROVs for a compliance review. For those vehicles requiring adjustments and/or repairs, a triage station with spare parts and tools will be available. Following dinner at the Resident Dining Hall, teams will be treated to an Ice Cream Social where students from all over the country can meet, mingle and compare their design enhancements and innovations. All participants will receive National SeaPerch Challenge T-shirts and giveaway bags with items contributed by the SeaPerch program and its corporate sponsors.

Competition day, Saturday, May 30, will begin at the university's Tripp Athletic Center with the continuation of registration check-in and compliance reviews. Susan Nelson will preside over the opening ceremony in the gymnasium, with a number of speakers as well as last minute technical instructions for the teams.



> **"With guidance afforded by AUVSIF and with ONR's commitment to SeaPerch, we have grown exponentially, reaching more than 200,000 students to date,"**
>
> **Susan Nelson**, Executive Director, SeaPerch

The Competition

Teams may consist of a minimum of one student and one adult leader, and while there is no restriction on the maximum number of students that can participate, five members is the average. A juried poster competition is planned for the middle and high school teams to introduce their designs through graphic displays, with top qualifiers to deliver oral presentations about their design philosophy, construction challenges, and to answer questions from the judges. The in-pool technical competition events requires students to steer their ROV through the Obstacle Course consisting of five, 22-in. diameter submerged hoops oriented in different planes. Each year, the second in-pool event changes, requiring the students to design their vehicles specifically to meet the ever-changing missions. This year the event, aptly named "Finesse," will test the students' ability to perform precise maneuvers on the pool bottom. Detailed specifications for both underwater events have been posted on the SeaPerch website, www.seaperch.org, for teams to construct their own events for practice prior to the national competition.

Approximately 150 judges and volunteers are also anticipated to attend during the day in order to adequately oversee the multiple poster presentation and in-pool competitions as well as to ensure a rewarding and memorable day for all attendees.

On Saturday evening the Awards Ceremony will take place again in the Athletic Center. Here, first-through-third place trophies in each event for middle school, high school and open classes, special awards and the naming of the 2015 national champions will be made by Susan Nelson.

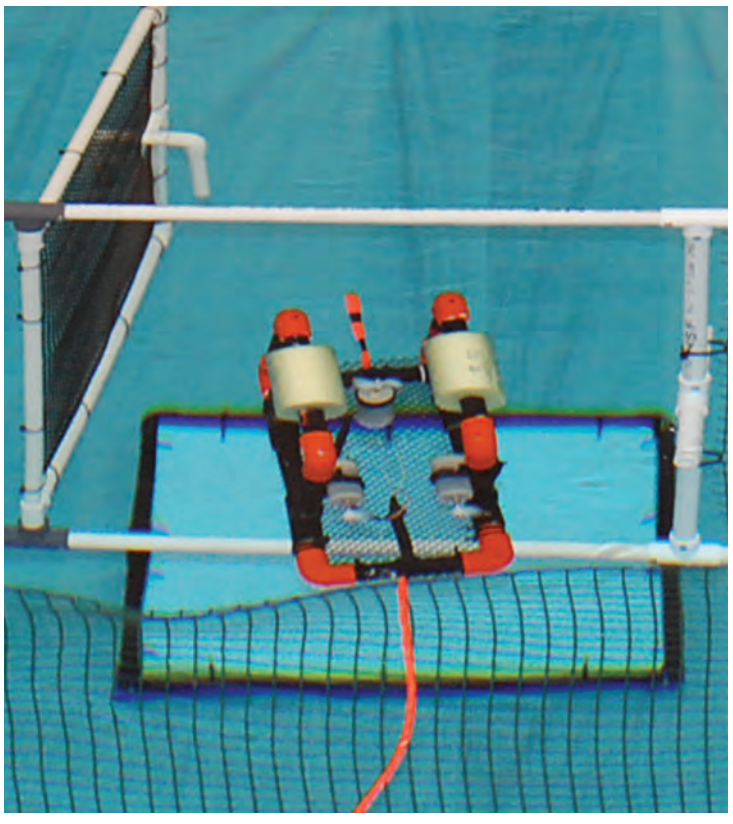
Invited speakers, representing corporate sponsors, local and state congressional representatives, ONR, U.S. Navy, U.S. Coast Guard and other military branch personnel, will be able to take part in the day's activities, as well. They have been encouraged to arrive early and observe the competitions, judge various events and speak first hand with the students before addressing them that evening about the importance of STEM to their future careers.

All student team members will receive participation medals, and be photographed by team for the benefit of their families and schools. Additionally, Certificates of Participation will be available both for student participants and for teachers and advisors to download following the National Challenge. At the conclusion of the award presentations all registrants will enjoy an outdoor lawn party and barbeque.

Sunday, May 18, will be a free day for the teams to explore on their own the rich cultural history and outdoor activities in the greater Dartmouth area including parks and historic sites such as the nearby New Bedford Whaling Museum and Battleship Cove National Heritage Museum on the waterfront in Fall River where the Battleship, USS Massachusetts, the destroyer, USS Joseph P. Kennedy, Jr., the submarine, Lionfish, and PT Boats from the South Pacific are on display.

Seaperch: Get Involved

Sponsorship opportunities are still available for individual, local and corporate funding, and can be viewed on the SeaPerch website. Contact Susan Nelson at snelson@seaperch.org for those interested in sponsorship the event. Also, judges and volunteers are always welcome. Should you be interested in participating as a volunteer or judge on May 30, please contact Cheri Koch at koch@auvsifoundation.org.



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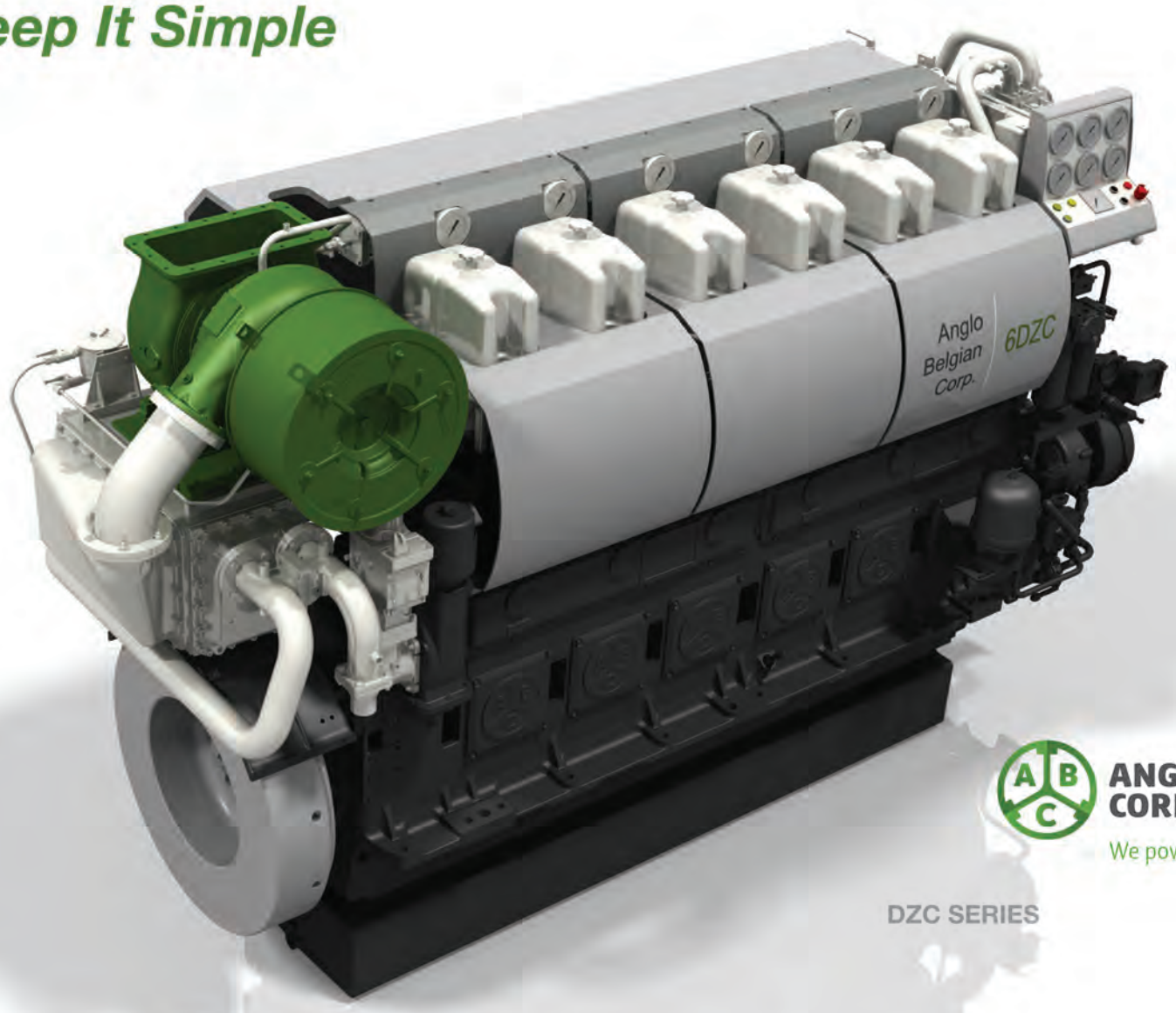

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