August 2021

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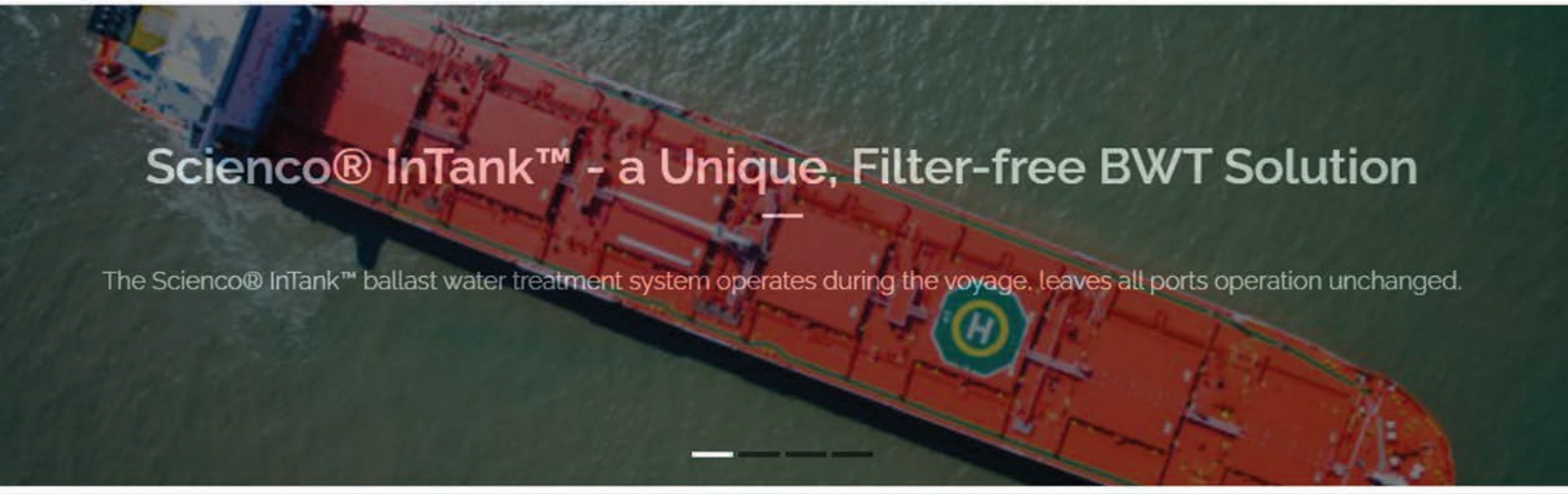

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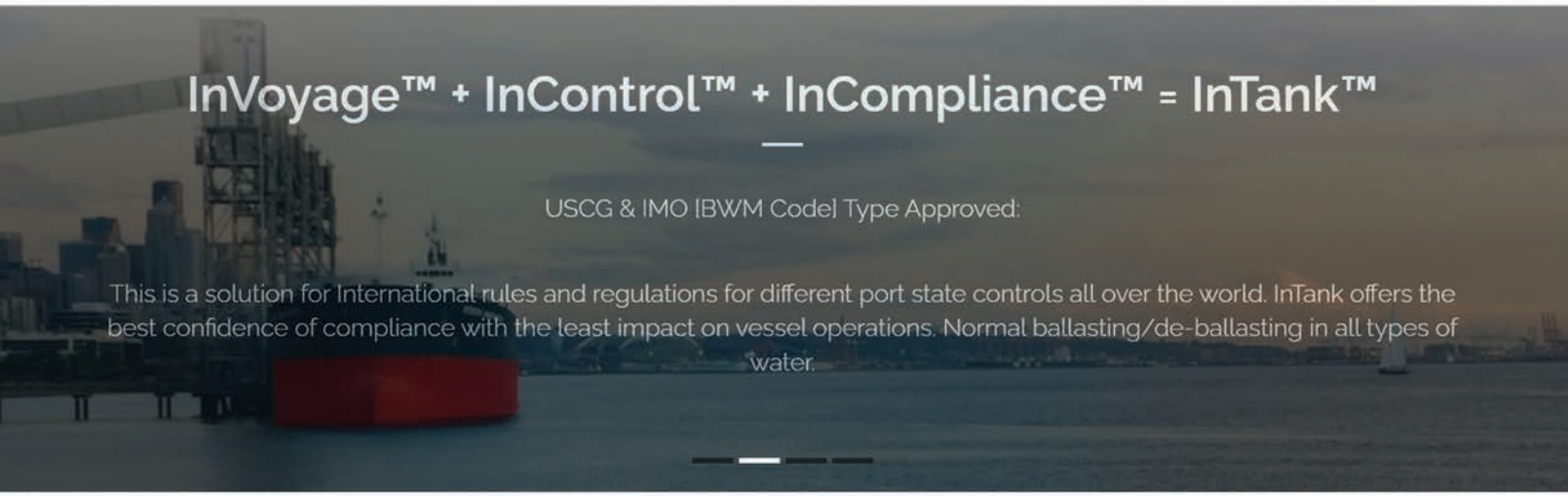

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NO. 8 / VOL. 83 / AUGUST 2021

Born in the Jungle
Ceiba is a true wooden sailing ship, a proof-of-concept taking shape in the jungles of Costa Rica.
Photo Source: SailCargo

On the Cover
"K" Line's Century Highway Green.
Cover Photo Credit: "K" Line

Features

Departments

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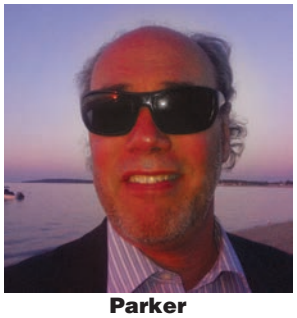

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August is our traditional 'Shipbuilding Annual', and in step with the last 18 months defined by COVID, this year's edition is done a bit differently. Throughout you will find, in my estimation, some fascinating stories on the engineering, art and business of building ships and boats, but I must admit that my favorite is **Rik van Hemmen's** article on page 16 discussing the importance of communication, start to finish, in the process. Ever since Rik started gracing our pages, we have been on the same page, literally, in terms of content and storytelling. This month's article entitled *"What we Have Here is a Failure to Communicate … in Ship Construction"* recalls how miscommunication during the construction of the 17th Century Swedish warship Vasa resulted in its sinking approximately 1400 yards into her maiden voyage.

As has been the practice since March 2020, all of my business 'travel' has been conducted remotely via Zoom, TEAMS and Google Meet, a collective medium which has helped me traverse the globe regularly, daily. After 18 months I'm certainly ready to get back on the road again, personally and professionally, to makes those connections that serve as the lifeblood of our business. But there is something to be said for the immediacy and access of the interview online, as one day last month I had the chance to bounce from Shanghai to Oslo to the jungles of Costa Rica in less than 5 hours. While not exactly a business imperative, the Costa Rica interview with **Danielle Doggett**, CEO of SailCargo, an organization building a small wooden sailing ship for commercial routes as a proof of concept, was one of the more fascinating chats I've had in awhile, if nothing else due to the sound of Howler Monkies in the background. The story on the construction of *Ceiba* in SailCargo's jungle shipyard was a great fit in our "The Path to Zero" coverage.

I also had the opportunity to meet with **Glenn Edvardsen**, CEO of UECC, to talk about a trio of LNG battery/hybrid PCTCs recently ordered by the company. As we talk relentlessly about 'future fuels' and massive GHG emission reductions being mandated in the coming 30 years, a common question I like to ask: *"As technology accelerates and changes rapidly, how do you make a decision on outfitting your fleet for the long haul?"* His answer was simple and direct: *"There is no perfect solution, start the journey now."* The story on Edvardsen and UECC starts on page 22.

Finally, while our core is talking about the shipyards and technology, a big and increasingly important piece of the shipbuilding puzzle is attracting, training and retaining the next generation of shipbuilders. Starting on page 34 **Edward Lundquist** writes a feature on the value of apprenticeship in workforce development, a great template for shipyards large and small, commercial and naval, domestic and global.

Gregory R. Trauthwein
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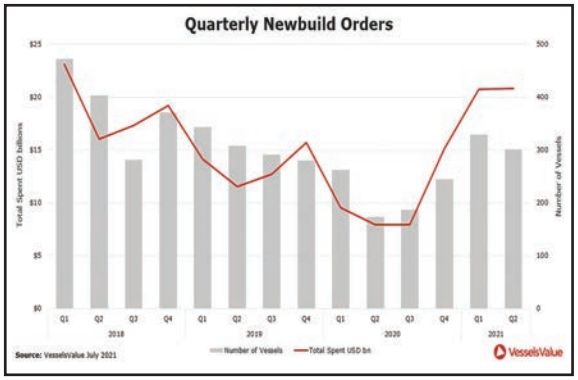
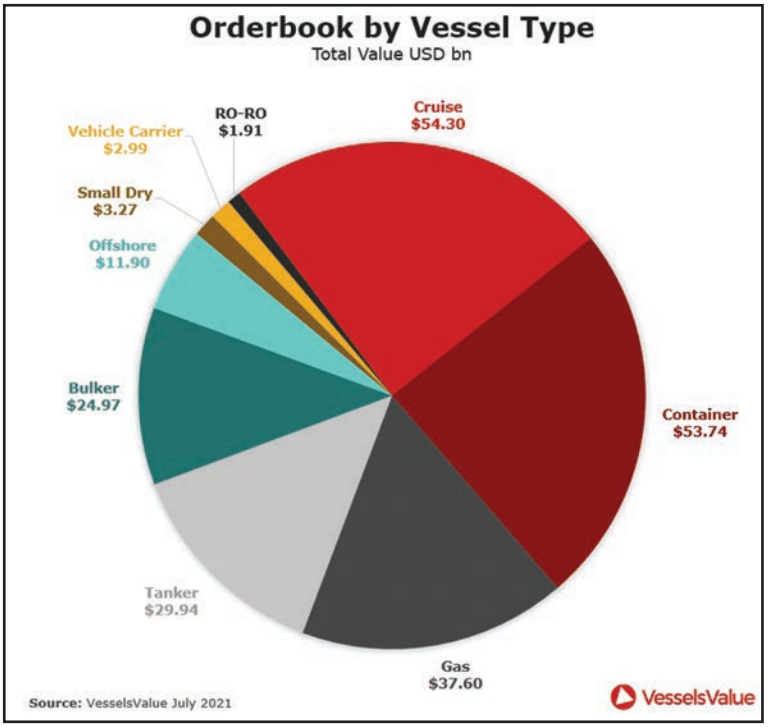
Shipbuilding Orders Rise

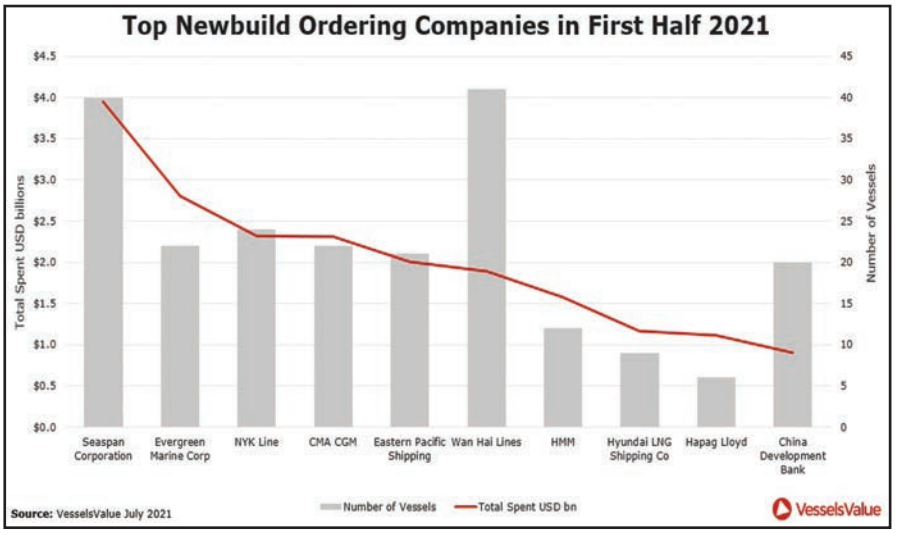
While it is still a far cry from 2018, the global shipbuilding newbuild orderbook is moving in the right direction following an abyssmal 2020. By volume, tankers lead the way with 818 ships on order. By value; cruise ships @ $54.3B.

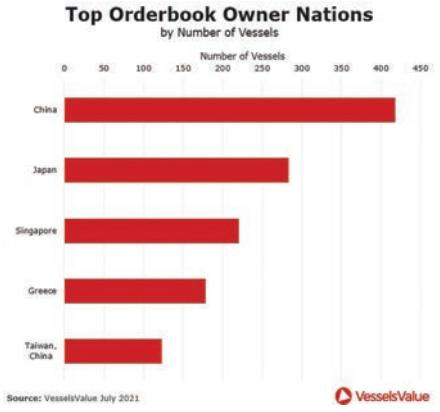


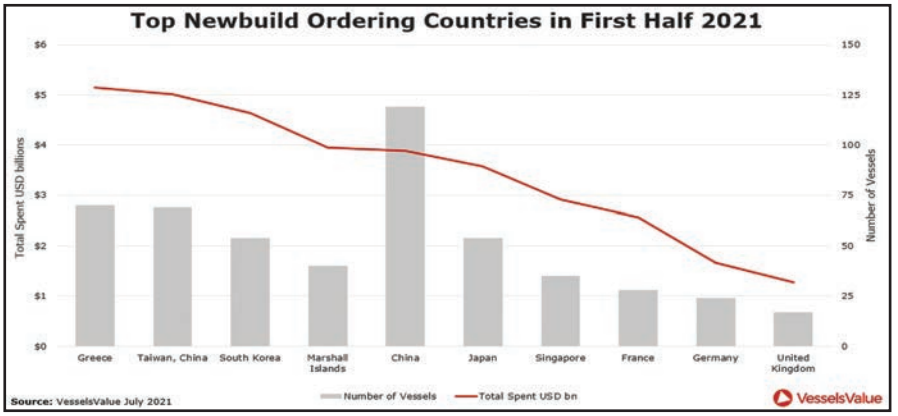


Newbuild Orderbook

Order Date		# of Vessels	Total Spent ($B)
2018	Q1	472	$23.10
	Q2	403	$16.04
	Q3	281	$17.30
	Q4	371	$19.18
2019	Q1	343	$14.17
	Q2	308	$11.54
	Q3	291	$12.73
	Q4	280	$15.71
2020	Q1	262	$9.55
	Q2	174	$7.92
	Q3	187	$7.91
	Q4	245	$15.15
2021	Q1	329	$20.76
	Q2	301	$20.81
	Q3 YTD	26	$3.09
Grand Total			**$3,087.50**







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Arlan Cochran,
Team Lead - Logistics Engineering and Marine Operations, NASA

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Dr. Latitia McCane
Director of Education, The Apprentice School at Newport News Shipbuilding

"There is no perfect solution, **start the journey now.**"

Glenn Edvardsen,
CEO, UECC, on choosing your path toward decarbonization

WORLD ENERGY REPORTS

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MARKET FORECAST

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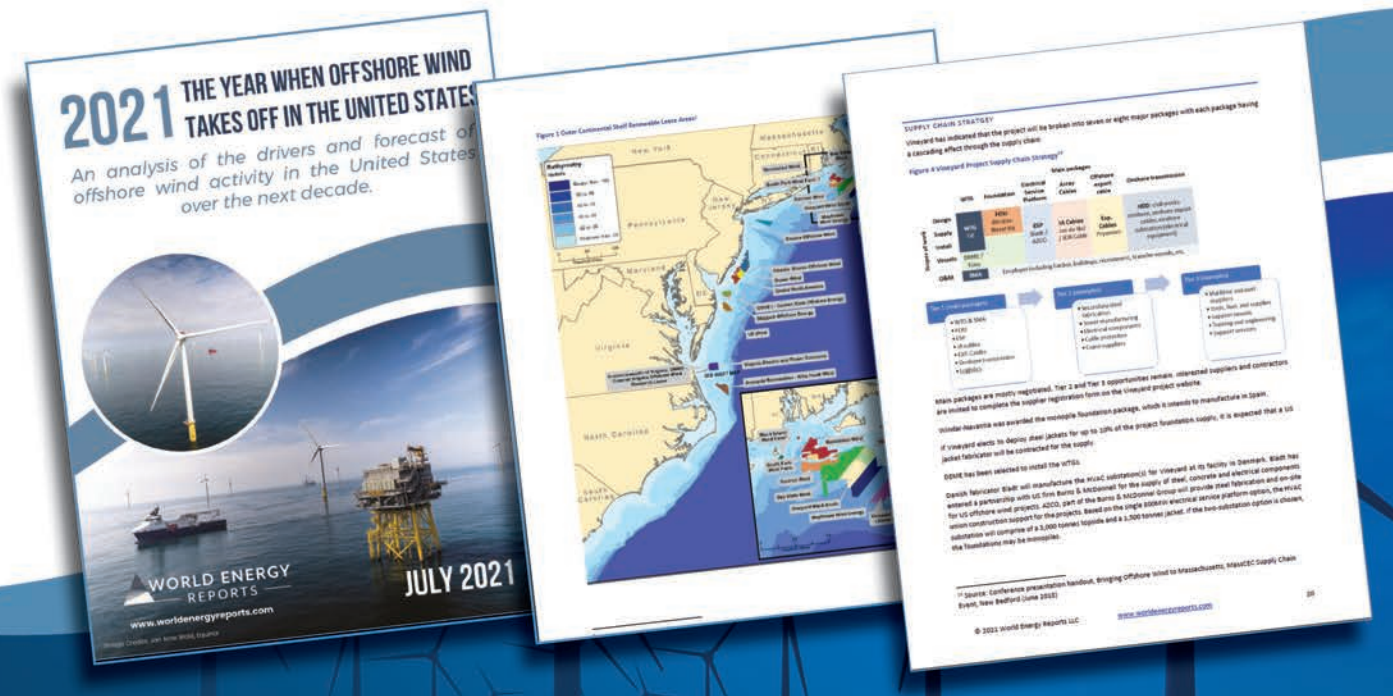

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Tip #27

Maritime Training and the Pandemic.

NOW WHAT?

The endless debate pitting face-to-face learning against online learning rages on and will likely continue to do so for some time. As we entered the pandemic there was a huge and hasty shift in maritime training practices (and in the world as a whole) to online learning. This was both positive and negative. It was positive because we can all be thankful that there was a safe and available alternative to face-to-face training. It was also positive because it accelerated the implementation of digital learning to a point that would have taken years otherwise. On the negative side, the emergency nature of the training implementation did not allow for the optimal amount of consideration and planning. Thus, many implementations produced poorer outcomes and experiences than would otherwise have been available.

Now the world is beginning to emerge from the pandemic. It is not over, but we are seeing the signs all over the industry. Nowhere in the industry is this more apparent than in cruise lines. Cruise lines were arguably the hardest hit segment of the industry (possibly with training centers coming in a close second), and interestingly nowhere else in the industry have we seen an increase in the use of elearning as we have in the cruise lines.

Given that our company serves a large percentage of the world cruise lines, this increase is very close to home. In analyzing our operations dashboards, in one example we saw peak elearning usage (measured by the number of exams being taken) spike recently by over 1,200% compared to the same period pre-pandemic. To put this in perspective, this was nearly 150,000 exams in a one-week period for one cruise line. This large increase was a result of the retraining needed as crew return to service, plus the increase in the overall amount of training crew are receiving as the industry continues to push the envelope further in terms of a more highly trained, professional mariner. So, I believe that there is little argument that the pandemic has advanced the use of digital learning many years forward. The question is, what now?

Broadly, the advancement in the use of elearning generally is going to create additional pressures for organizations that have not yet begun the move to online or blended training. An extensive body of research shows that online learning is as (or slightly more) effective than face-to-face learning. Additionally, on-line

learning tends to be more "trainee-friendly". Trainees can learn whenever they want, and wherever they want. The digital experience also conforms more to individual learning styles than does in-class training. If instead of online learning we consider blended learning, where in-person training is combined with on-line learning, the effect is even more strongly positive. In the blended case, learning outcomes are significantly better than face-to-face or on-line outcomes, as is learner satisfaction. For training centers, vessel owners and regulators, on-line learning also produces a deeper set of records and learning analytics that can be mined for audit purposes and continuous improvement. This, together with the pandemic-induced accelerated movement to on-line learning, means that organizations are going to face increased pressure from their employees and ultimately even regulators to digitize.

So, for many maritime training organizations it will soon be a time to take a step back, assess and consolidate. What training has been implemented on-line in response to the pandemic? How does its quality and organization stand up to the standards of a post pandemic world where "urgent" can't be an excuse for "barely acceptable"? In most cases the core of quality will have been created to be used as a starting point. From that starting point, we can plan what needs to be done to improve the content, presentation and program. What do we need to survey or measure to understand what is going well and what needs to be improved?

The pandemic has forced us, in many cases, to take the first big step. Let's use what we've done as an organizational asset and begin the cycle of continuous improvement that was unavailable to us in the heat of the pandemic battle. The world has changed, in some ways for the better.

Until next time, sail safely.

The Author

Goldberg

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U.S. Navy photo by Mass Communication Specialist 3rd Class Keenan Daniels/Released

"The United States military flies, sails, and operates anywhere international law allows."

U.S. Navy asserts "Freedom of Navigation" in the South China Sea

By Edward Lundquist

The 1982 Law of the Sea Convention recognizes the rights and freedoms of all nations to engage in traditional uses of the sea. According to the Department of Defense 2020 Annual Freedom of Navigation Report to Congress, "Unlawful and sweeping maritime claims—or incoherent legal theories of maritime entitlement—that are inconsistent with international law pose a threat to the legal foundation of the rules-based international order."

Not all nations adhere to this principle. Consequently, the United States is "committed to confronting this threat by challenging excessive maritime claims," the report said.

The U.S. Navy routinely asserts those right by conducting "Freedom of Navigation" operations (FONOPS) around the world. There are a number of claims around the globe with which the U.S. does not agree or accept. Last year U.S. forces met 28 excessive maritime claims by 19 countries, the DoD report said. This is perhaps most visible in the western Pacific, where the United States Navy continues to assert its right to operate freely in international waters by conducting FONOPS in the South China Sea, particularly in the vicinity of the Spratly and Paracel Islands.

USS Benfold (DDG 65) conducted a FONOP in the South China Sea on July 12, and "asserted navigational rights and freedoms in the vicinity of the Paracel Islands, consistent with international law," according to a Navy statement. "This freedom of navigation operation ("FONOP") upheld the rights, freedoms, and lawful uses of the sea recognized in international law by challenging the unlawful restrictions on innocent passage imposed by China, Taiwan, and Vietnam and also by challenging China's claim to strait baselines enclosing the Paracel Islands."

According to a statement from the U.S. Seventh Fleet, U.S. forces have operated in the South China Sea on a daily basis, and have done so for more than a century. "They routinely operate in close coordination with like-minded allies and partners who share our commitment to uphold a free and open international order that promotes security and prosperity. All of our operations are designed to be conducted professionally and in accordance with international law and demonstrate that the United States will fly, sail, and operate wherever international law allows –regardless of the location of excessive

maritime claims and regardless of current events."

The Peoples Liberation Army Navy (PLAN) claimed they "chased away" the Benfold. According to Tian Junli, a spokesman for the Southern Theatre Command of the People's Liberation Army (PLA), "The US military's actions seriously violated China's sovereignty and security, seriously damaged the peace and stability of the South China Sea and seriously violated international law and the norms of international relations – more ironclad proof it is engaging in navigational hegemony to cause the militarization of the South China Sea. We strongly condemn and resolutely oppose this, and we urge the US side to immediately stop their provocative actions and to strictly control their maritime and air activities. Otherwise, the US side will need to bear all consequences that arise from this."

The U.S. Navy said the PRC's statement about Benfold's mission was incorrect. "USS Benfold conducted this FONOP in accordance with international law and then continued on to conduct normal operations in international waters. The operation reflects our commitment to uphold freedom of navigation and lawful uses of the sea as a principle. The United States will continue to fly, sail, and operate wherever international law allows, as USS Benfold did here. Nothing PRC says otherwise will deter us."

A U.S. Navy press statement said that the PLAN statement was just "the latest in a long string of PRC actions to misrepresent lawful U.S. maritime operations and assert its excessive and illegitimate maritime claims at the expense of its Southeast Asian neighbors in the South China Sea. The PRC's behavior stands in contrast to the United States' adherence to international law and our vision for a free and open Indo-Pacific region. All nations, large and small, should be secure in their sovereignty, free from coercion, and able to pursue economic growth consistent with accepted international rules and norms."

Furthermore, the Navy statement said, international law does not permit continental States, like China, to establish baselines around entire dispersed island groups. "With these baselines, China has attempted to claim more internal waters, territorial sea, exclusive economic zone, and continental shelf than it is entitled to under international law. By conducting this operation, the United States demonstrated that these waters are beyond what China can lawfully claim as its territorial sea, and that China's claimed straight baselines around the Paracel Islands are inconsistent with international law."

What We Have Here is a Failure to Communicate... in Ship Construction

By Rik van Hemmen

My brother, who is the executive editor of my favorite boating magazine (Soundings), and I occasionally send strange tidbits to each other by email. For some reason he sent me an email about the 17th Century ship Vasa and focused on one of the causes of the vessel's failure to float properly.

This is the Wikipedia paragraph he focused on:

"The use of different measuring systems on either side of the vessel caused its mass to be distributed asymmetrically, heavier to port. During construction both Swedish feet and Amsterdam feet were in use by different teams. Archaeologists have found four rulers used by the workmen who built the ship. Two were calibrated in Swedish feet, which had 12 inches, while the other two measured Amsterdam feet, which had 11 inches."

My brother more or less suggested that it might make a good column subject for me.

Since brothers mince no words when they can slag each other I was going to dismiss his idea along the line of: "Oh Please, an article on the Vasa? And next you want me to write yet another article about the cause of the loss of the Titanic?"

But I didn't, because on rereading the note I realized he was probably referring to the Amsterdam foot, which had only 11 inches and that made me wonder. Was it shorter than other 12 inch feet (made of shorter inches) or was it actually divided in 11 inches? I checked and, I kid you not, that foot has only 11 Amsterdam inches!

Ever since coming to the United States I have had to submit to living with fractions of 12 in feet and 32nds of inches, but working in units that are fractions of a prime number? That must have started as a joke, or somebody set that measure for very nefarious purposes and then it did not disappear by common sense, just like in the US, where we are still stuck with the English system of measurement.

But that is not what this column is about. It is about ship construction. Untangling ship construction furballs has been a big part of my life, and while we can argue whether to use English units, or metric units, or warp fractions, the real cause of the Vasa failure is not measurement units; the real cause sits higher up. What it is really related to is a failure to communicate.

There is only one glorious truth about ship construction ...

Ship Construction is a Communication Exercise

Nothing beats this glorious truth. A good spec will help, a good design will help, committed builders will help, knowledgeable purchasers will help, but, in the end, only good communications can make the project succeed.

In every single ship construction disaster that we have been involved in, the actual cause of the failure was a failure to communicate.

A cost overrun is a failure to communicate. Cost overruns are a reality in ship construction. Someday I would like to see a ship built without a cost overrun, but building one-of-a-kind ships is really really difficult, and therefore there will be cost overruns whether paid for by the builder, paid for by the purchaser or shared. Not talking about a cost overrun the moment it raises its ugly head results in after the fact hyperventilating, paranoia, polarization, and all kinds of other mean and nasty things.

An argument over the color of the curtains in a cabin is a failure to communicate. In ship construction one can never assume that the builder and the purchaser have the same esthetics and therefore the color of the curtains needs to be locked down before material is ordered.

One may conclude that the onus to communicate is on the builder, but this is untrue. It is a complete and total two way street. A purchaser and a builder need to spend a significant amount of time before construction starts to become familiar with each other's expectations.

I am not talking about specifications; I am talking about emotional expectations. What is fair to me, and what is fair to you? Not just in terms of money, but

also in terms of hull fairness. What is my biggest concern? What is your biggest concern?

Some of these discussions may be quite awkward, but once these issues have been established, it will be possible to reach back to them and develop fair and reasonable solutions when things get difficult.

When I was young, I worked with somebody who always asked very sharp, almost rude, questions at the start of the project. Even I would feel a little uncomfortable and felt it would upset the customer. Today I know that it is not important to be friends at the start of the project; what is important is to be friends at the end of the project. Therefore, ask the difficult questions at the beginning, and tell your project partners that you ask those questions so the project can be finished as friends, and siblings at arms, instead of enemies.

Ship construction projects never are easy. There will always be complications, some rational, and some totally unexpected and wackadoodle, but not talking about them will not solve them.

Getting back to the Vasa, while it may have been inefficient to use two different measurement systems in the construction of the Vasa (something we still do today in ship construction), it did not have to result in a failure to float. As long as, at some stage, somebody pointed out to everybody else that there will be two measurement systems during construction. This may have been just before contract signing, or may at the cocktail party celebrating the signing, or maybe in the sauna.

Later in the game it would have been particularly annoying, but if there was no alternative, it would not automatically result in a failure to float. Communication will save the day.

Since I started with trivia I will end with trivia. Not everyone may remember it, but in 1981, Ronald Reagan, "The Great Communicator", pulled the plug on earlier efforts to get rid of the English Measurement System in the US. A pointless move that, among others, resulted in a failed Mars Climate Orbiter Mission in 1998. We need an actual great communicator who can get the US to finally buy into the metric system.

For every column I write, MREN has agreed to make a small donation to an organization of my choice. For this column I nominate the US Metric Association. https://usma.org/#information-about Metric.

Rule B Alter-Ego Vessel Seizures

By Keith B. Letourneau

Plaintiffs seeking to recover from ship managers or the vessels they operate but lacking a direct claim against a particular vessel have developed a clever strategy under U.S. maritime law. They seize a managed vessel under Supplemental Admiralty Rule B and claim the vessel-owning company is an alter ego of the defendant with whom the dispute really exists. In this way, plaintiffs can take advantage of the relatively low evidentiary bar to delve into protracted discovery to develop the alter-ego connection they need to prove up their case.

Rule B requires showing that the defendant is not present within the district to satisfy the existence of general-personal jurisdiction. The Supreme Court's general jurisdiction ruling in *Daimler AG v. Bauman,* 134 S.Ct. 746 (2014), has made it much easier to meet Rule B's requirement because it essentially requires the defendant's principal place of business to lie within the district, which is never the case for foreign flag vessels or their owning companies, thus enabling plaintiffs to almost automatically meet Rule B's "not present within the district" requirement.

The defendant shipowner can challenge the attachment at a post-seizure hearing where the federal courts typically apply a probable cause test, which equates to reasonable grounds for supposing the allegations are true. Invariably, Plaintiffs allege that the ship manager or ship-owning group are dominated and controlled by a single individual or entity and that the target defendant is but a corporate extension of the company with whom the plaintiffs' real dispute exists. Federal courts examine a laundry list of factors for purposes of assessing whether the ostensibly controlling corporation exercised complete domination and control over the purported subservient corporation, though more is required to pierce the corporate veil as discussed below. These factors often include:

1. **Whether the corporations maintain proper corporate formalities (holding annual board of director and shareholder meetings, holding proper elections, maintaining proper corporate records, etc.);**
2. **Whether the subservient corporation is adequately capitalized to meet its financial obligations;**
3. **Whether corporate funds are used for personal purposes;**
4. **Whether overlap exists in ownership, directors, officers, and personnel;**
5. **Whether the corporation share office space, address, or contact information;**
6. **Whether the alleged subservient entity lacks discretion in operating its business;**
7. **Whether business dealings between the companies are at arms-length;**
8. **Whether one entity holds that it is responsible for the debts of another;**
9. **Whether the dominating corporation uses the subservient entity's property as its own.**

See Pacific Gulf Shipping v. Vigorous Shipping & Trading S.A., et al, 992 F.3d 893, 898 (9th Cir. 2021).

The crux of the issue is that often international corporate special purpose vehicle ("SPV") structures do not meet the rigors of corporate separateness required in the United States, which makes them more susceptible to the veil-piercing argument at the outset of the case. U.S. federal courts apply the corporate-formality requirements of their respective circuits, and not those employed by the country of incorporation. The use of common officers, directors, offices, contact details, and common financial and operational management, while certainly more economical and efficient, makes it easier to argue that the group structure is dominated and controlled by one or two key individuals or parent company. Also bear in mind that U.S. federal judges are not familiar with the role of ship managers and how they operate and manage their vessel fleets, nor are they familiar with how vessel-owning groups are constructed as investment vehicles for institutional

investors. Plaintiffs can obfuscate corporate relationships by showing how daily financial management and operational decisions are made by relatively few individuals to create the appearance of domination and control.

By satisfying the probable-cause standard at the Rule E(4)(f) hearing stage, plaintiffs open the door to the discovery of documents and witness testimony that often entail considerable time (years), expense, and inconvenience by vessels' interests to respond. Once discovery is unleashed, the focus shifts to the nitty-gritty details of inter-corporate relationships and delving into the factors and conduct above. The process is daunting and entails enormous effort compiling the group's relevant corporate documents and vetting witnesses in preparation for invariably long depositions. Additionally, either the vessel remains under seizure during the intervening period or substitute security is posted for its release. The Supplemental Admiralty Rules permit security of up to 200 percent of the amount of the plaintiffs' claim and security from the vessel's protection and indemnity ("P&I") club may not be available for breach of contract claims, which often lie at the heart of these alter-ego cases.

Yet, overlap in corporate activities and operations and activities is not enough. There must be some evidence of wrongdoing. The gist of corporate fraud invariably involves the misuse of monies. The challenge for vessel interests at the Rule E(4)(f) stage is to contest the fundamental premise of the alter-ego claim, which is that the target defendant engaged in fraudulent activity or intended to circumvent statutory or contractual obligations. Under federal practice, fraud must be alleged with particularity—who did it, what was done, when was it committed, where was it committed, and how was it carried out. Are such allegations set forth in the plaintiffs' original verified complaint? Ultimately, it is this issue of fraud or wrongful conduct and misuse of the subservient corporation's assets that will decide whether plaintiffs' alter-ego claims will succeed. Using a forensic accounting expert to examine the defendant's financial books may yield the best defense.

To avert the misuse of the alter-ego doctrine, international vessel owning and operating groups whose vessels regularly transit to the United States should evaluate whether the corporate structures of the single-shipowning companies that comprise their groups are sufficiently robust to withstand the scrutiny they would surely undergo in a U.S. federal proceeding.

The Author

Letourneau

Keith B. Letourneau served as lead counsel for Vigorous Shipping & Trading in the Pacific Gulf Shipping case.

Ceiba Comes to Life in the "Jungle Shipyard"

Danielle Doggett, founder and CEO of SailCargo, updates the project to build Ceiba, a true sailing cargo ship taking shape in the jungles of Costa Rica.

By Greg Trauthwein

Danielle Doggett and her co-founders have been on a mission since 2014 to prove the viability of truly emission-free shipping courtesy of the construction of its $4.2m flagship Ceiba, a three masted sailing cargo vessel being built in Costa Rica.

"The name Ceiba comes from a type of tree, also called the kapok or silk tree and it is recognized by the Mayan people as a spiritual tree that connects this world with the next," explained Doggett in a recent interview with **Maritime Reporter TV**.

Ceiba 'By the Numbers'

Ceiba is about 147 ft. (45m) long three-masted square rigged, square topsail schooner, able to carry the equivalent of 10 TEU standard containers (about 250 metric tons of car). While Doggett freely admits she does not envision an ocean filled with 'little wooden sailing cargo ships' replacing traditional cargo carriers, Ceiba is a niche proof of concept project to prove that, on certain routes, true emission-free trade is an option.

"The mission of SailCargo is to prove the value of clean shipping. And we aim to do that by establishing a precedent with our flagship Ceiba. After doing that, we do hope to expand to a wide range within the maritime sector of larger ships, more modern ships, really whatever the client demands we will maintain true to emission free," said Doggett. "I don't envision a fleet of thousands of small wooden sailing vessels, replacing everything. Although I do firmly believe that a vessel such as Ceiba has its place in the right market and serving the correct markets that may already be underserved. Keep an eye on us, we have a lot in the pipelines."

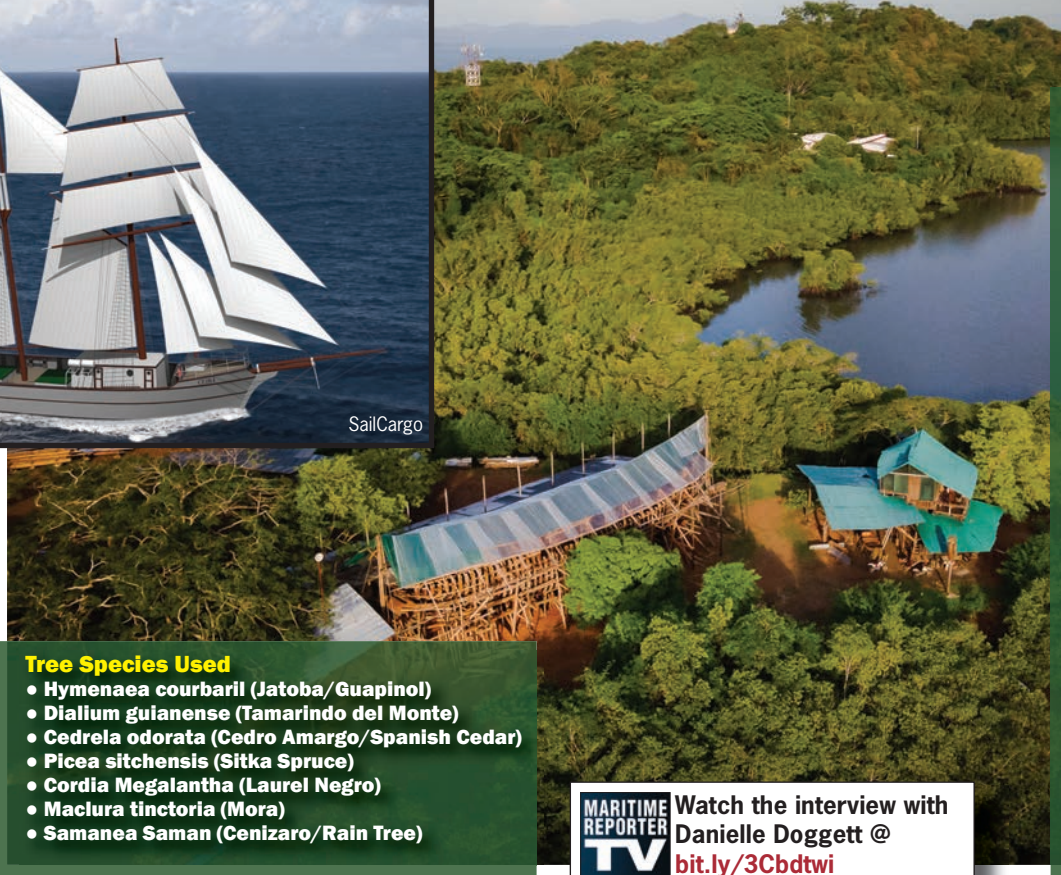
Ceiba's, which is being built from primarily local tropical hardwood, had her keel laid in January 2019 with an anticipated launch in 2022. "This will make Ceiba the largest emission free cargo ship in the world," said Doggett.

The project is fraught with challenges, chief among them building a ship in the jungle. "Building a ship in Costa Rica definitely comes with a unique set of challenges, in terms of personnel and supplies," said Doggett, saying that getting materials in, out and around Costa Rica can be a "shipping nightmare."

Undaunted, Doggett and her team simply have to plan in advance … far in advance, to ensure a smooth flow. The one logistical positive: ready availability of shipbuilding material. "Thankfully as a wooden ship construction, 99% of our wood is all from locally sourced Costa Rican forest; most of that comes between around a 100 km radius."

While logistics of moving materials is cumbersome, Doggett said getting people onboard this traditional ship construction project has not been an issue. "We're extremely thankful and lucky that as the world's largest publicly known traditional ship construction, we don't have to look very hard for talent," she said. "We have applications daily from people globally that they want to work with us, and our young shipyard has had 27 different nations already participating."


SailCargo



Technical Specifications

Dimensions
Length o.a. .....46m/150 ft
Length on Deck .....38m/124 ft
Length, Water Line .....32m/106 ft
Height of Rig .....33.5m/110 ft
Beam ..... 8m/26 ft
Draft .....4.3m/14 ft

Cargo Capacity
250 tons/350 cubic meters
9 TEU
Tonnage 281 GT

Crew
12 crew + up to 12 additional guest crew or trainees

Propulsion
Standard press 14 sails
12 additional hand sewn light-airs canvas
Sail Area 580 sqm (6,300 sq ft)

Naval Architect Pepijn van Schaik of Manta Marine Design is the lead architect behind Ceiba. His past work includes Tres Hombres, Europa, and Ópal.

Photos courtesy Sail Cargo

Tree Species Used
- **Hymenaea courbaril (Jatoba/Guapinol)**
- **Dialium guianense (Tamarindo del Monte)**
- **Cedrela odorata (Cedro Amargo/Spanish Cedar)**
- **Picea sitchensis (Sitka Spruce)**
- **Cordia Megalantha (Laurel Negro)**
- **Maclura tinctoria (Mora)**
- **Samanea Saman (Cenizaro/Rain Tree)**

MARITIME REPORTER TV **Watch the interview with Danielle Doggett @ bit.ly/3Cbdtwi**

UECC's Edvardsen on Decarbonization:

"There is no perfect solution, start the journey now"

UECC has emerged as a leader in regards to decarbonization, with an order earlier this year for its third LNG battery/hybrid Pure Car/Truck Carrier (PCTC). Glenn Edvardsen, CEO, discusses the strategy and the future for this Oslo-based ship owner.

Images courtesy UECC

Photo courtesy UECC

Glenn, to start, can you give a by-the-numbers overview of UECC?

United European Car Carrier is a pan-European trading carrier, trading up to the Baltic, as far east as Turkey and down to north Africa. We operate about 18 vessels (of which) UECC-owns six, ranging from (a capacity of) 5,000 cars down to 1,000. Besides transporting cars, we also lift quite a lot of breakbulk (300,000 tons/year), as well as high and heavy, a flexible fleet with strengthened decks and ramps. I think it's worth mentioning that our ambitions is to be the leading provider of sustainable short sea operation.

UECC made the news earlier this year with the keel lane for its third LNG battery hybrid PCTC. Can you give an overview of this series of vessels as well as the typical or planned operating routes?

We ordered three new vessels, the first one to be delivered in October 2021, with two more next year. We already have two dual fuel LNG vessels from 2016. We are on a path with more sustainable vessels, with reduced emissions being the number one priority. These are dual-fuel ships, not strictly LNG, meaning we have flexibility. Do we believe LNG will be the fuel of the future? No, not at all. We think something better will come along, but today it is the most environmentally friendly fuel on the market. When we see something better come along, I'm sure we will also be able to burn that. (With these three new ships) we also introduced the battery element, which we think is extremely important. It's not like we are able to sail on battery alone; then, probably, the battery package would be bigger than the vessel. But we are able to reduce the emission even more than when only running on LNG.

It seems that "flexibility" is a key word in your operations, your future. Can you give some more specifics on the hybrid power

plant chosen, with insights on the anticipated greenhouse gas reductions expected versus a traditional diesel-only powered vessel?

It's widely known that the greenhouse gas reduction of 23% is achievable from LNG. But with the battery element on top of that, we are even able to reduce a few more percentage points. But we know that the SOx and the NOx are also very important, (and with LNG) these are down to almost zero. So that's quite an achievement itself.

With all of the new and emerging propulsion and emission reduction options, can you give the compelling rationale behind this solution that was chosen for these three ships?

Our strategy is not to sit back and wait for the perfect solution to come along. I think we need to take action now. LNG is a proven, compliant, and immediately viable solution to reduce shipping greenhouse gas emissions. Flexibility is the name of the game and that's what we have by choosing LNG. We are run by NYK Line and Wallenius Line, 50/50. Environmental sustainability is in the DNA of both companies.

Glenn, can you put in monetary terms the additional investment that is needed to

MARITIME REPORTER TV **Watch the interview with Glenn Edvardsen @ bit.ly/2V9kpsZ**

Images courtesy UECC

build a ship with this type of propulsion and propulsion management system, versus a ship that is just with traditional diesel power?

A few years ago they were all saying, "Yes, it's good, but the LNG plant is so expensive and hard to justify." Yes, it is an additional cost. But in order to meet all and exceed the new regulatory requirements (and taking into consideration the other potential solutions) and achieve the same emission standards as you have with the LNG, we are not very far off today's conventional vessel. But if I was to answer your question, it all depends on the size of the vessel. For these vessels, we usually talk about between $6 to $7 million (in additional cost).

That leads perfectly into my next point, because I noted with interest in the press release regarding the keel laying for the third vessel, you mentioned that this is not just good for the environment, but it's a business imperative. Can you elaborate on that?

I think it speaks for itself; it is a business imperative. The (automotive) industry needs to show that not only are their vehicles focused on decarbonization, but that their logistic chain is, too.

What do you consider to be the greatest challenge for UECC in this de-carbonization path?

When people asked me back in 2014 if we saw a risk in building the LNG vessel, I said frankly, not at all. We looked at it as a great advantage, a competitive advantage. We were sure of the direction we needed to go; we saw the direction the world was heading. The challenge will be money. We know that in introducing environmentally sustainable vessels, there will always be an add-on cost. With that, we need sustainable rates. We have an opportunity here to offer them a great product, but it doesn't come for free, you need to pay a little bit more for it.

For shipowners mulling their options, what is your one best piece of advice?

Don't sit back and wait for the perfect solution to come along. There are viable technologies, there are opportunities out there. So don't sit back and wait, jump on it.

ROCKET MAN (on the Water)

Arlan Cochran, Team Lead

Logistics Engineering and Marine Operations, NASA, discusses the preparation and execution of moving the Space Launch System core stage from the Michoud Assembly Facility in New Orleans onboard NASA's Pegasus barge.

By Greg Trauthwein

MARITIME REPORTER TV **Watch the interview with Arlan Cochran @ bit.ly/2UX7CdI**

THE PEGASUS BARGE, carrying the Space Launch System (SLS) core stage, passes through Port Canaveral on its way to NASA's Kennedy Space Center in Florida on April 27, 2021, after journeying from the agency's Stennis Space Center in Mississippi. The core stage is the final piece of Artemis hardware to arrive at the spaceport and will be offloaded and moved to Kennedy's Vehicle Assembly Building, where it will be prepared for integration atop the mobile launcher with the completed stack of solid rocket boosters ahead of the Artemis I launch. The first in a series of increasingly complex missions, Artemis I will test SLS and Orion as an integrated system prior to crewed flights to the Moon.

NASA/Frank Michaux

Arlan Cochran is not your typical Team Lead - Logistics Engineering and Marine Operations. But then again, the National Aeronautics and Space Administration (NASA) is not your typical marine operator.

Prior to his role at NASA to ensure the safe, efficient move of – among other things – the most powerful rocket on earth via barge, Cochran was a computer science major who worked in the automotive logistics field. "I was doing a lot of automation for logistics solutions when we were noticed by a couple of government contractors in Huntsville, Alabama," said Cochran. "One of them invited us to NASA's manufacturing facility in New Orleans to provide the same solutions for NASA that we were providing in the commercial world." In 2016, Cochran was offered the opportunity to join the NASA team, and less than a year later a barge position opened up in this group, and Cochran took the helm.

THE PEGASUS BARGE

Today Cochran and his team – which includes four NASA engineers and three contractors – are all about utilizing the Pegasus barge to ship NASA's cargo. "Our contractors provide our barge crew, our tug services, and help us stay in compliance with ABS and environmental type policies," said Cochran. While the notion of barge transportation – low and slow – might seem an odd combination, Cochran said that NASA has a "humongous" legacy on barge operations.

"All of the programs, the Apollo program, the Shuttle program, and now the Artemis program have all utilized marine transportation and could not do those programs without it, actually," said Cochran. Today the Pegasus barge is the barge for multiple programs. "Not many people realize it, but in every aspect we have to have that barge transportation, so really cool in that perspective."

After completing its journey from NASA's Stennis Space Center in Mississippi aboard the Pegasus barge, teams with Exploration Ground Systems (EGS) and lead contractor Jacobs transport the massive Space Launch System (SLS) core stage to Kennedy Space Center's Vehicle Assembly Building in Florida on April 29, 2021. Once inside the VAB, it will be prepared for integration with the completed stack of solid rocket boosters atop the mobile launcher ahead of the Artemis I launch. The first in a series of increasingly complex missions, Artemis I will test SLS and Orion as an integrated system prior to crewed flights to the Moon.

NASA/Kim Shiflett

The most recent trek found Pegasus ferrying the massive core stage of the agency's new rocket, the Space Launch System (SLS), from the Michoud Assembly Facility in New Orleans to other NASA centers for testing and for launches. SLS will be the most powerful rocket ever built for deep space missions, including missions to Mars, and at 212-ft.-tall with a 27.6-ft.-diameter, the core stage includes the cryogenic liquid hydrogen and liquid oxygen tanks that will feed four RS-25 rocket engines, and also contains the vehicle's avionics and flight computer. The SLS core stage will be the longest item ever shipped by a NASA barge.

"The core stage has been in design and development for many years, and the Pegasus barge has been right along with it," said Cochran. "The first thing that had to happen was that Pegasus had to get longer and stronger. We went out there, and we were originally 50 feet short of what was needed for the core stage, but we didn't cut out just 50 feet and add. We cut out 115 feet and came back with 165 feet of restructured steel to be able to handle this large article."

Pegasus was designed and built in 1999 to transport the external tanks of the space shuttles from the Louisiana shore to NASA's Kennedy Space Center on the eastern coast of Florida – a 900-mile journey that includes both inland and open-ocean waterways. Pegasus replaced Poseidon and Orion, barges that were used to carry Saturn rocket stages and hardware for the Apollo Program. Pegasus completed its final space shuttle-related voyage in 2011. Pegasus had to be modified and refurbished to carry SLS for its new mission. The SLS core stage is more than 50 feet longer than the space shuttle external tank and, including ground support and transportation equipment, and more than 600,000 pounds heavier. In 2014, crews at Conrad Shipyard LLC in Morgan City, La., were given the task to refurbish the barge. A 115-ft. section of the barge was removed and replaced with a 165-ft. section specially designed to increase the cargo weight Pegasus can accommodate, as well as lengthening it from 260 to 310 ft.

The Army Corps of Engineers Marine Design Center in Philadelphia, with help Bristol Harbor Group of Bristol, RI, performed the naval architecture and marine engineering design, as well as management of the Conrad contract. The modifications were completed in 2015.

This lift for NASA went far beyond a barge and its load. "This article, besides just its size and weight, also has the ground support equipment that actually transport it, so you had to handle that weight also for the barge," said Cochran. "We had to do a lot of different training exercises that were structural test articles … just like the core stage had to be tested, so did the Pegasus."

Given the nature of its mission and value of its cargo, Cochran and his team are able to tap a wealth of resources that far transcend commercial maritime operations.

"(In addition to our contractors), we have access to the Coast Guard which is there to support us, for security and things of that nature. We also have access to the Air Force (above Kennedy that helps us monitor the conditions to make sure we're safe when we do travel), and now the Space Force,

*"**I'll say this:** the barge is just like officiating: nobody notices you if things go smoothly; the only thing you'll be known for is if you have a problem."*

BARGE PEGASUS FACTS
Length: 310 ft. (94.4 m)
Width: 50 ft. (15.24 m)
Usable cargo deck length: 240 ft. (73.15 m)
Usable cargo deck width: 36 ft. (10.97 m)
Usable cargo deck height: 41 ft. (12.49 m)
On-Board Power: Three 200 kW generators
Engines: None. Tugboats or towing vessels are required to move the barge

NASA/Juan Busto

which handles the weather for us. Mother Nature always wins; if she decides to send something to you, she's going to win. We make sure that we mitigate those (risks through the best information)."

Once enroute, monitoring of the barge and its load is continuous to ensure that neither is experiencing unnecessary loads. "We have monitoring devices on the barge to make sure that it's not experiencing any unnecessary loads, which may mean we reduce our speed when waves get a little higher. It also may mean that we seek safety, if conditions warrant." The SLS cargo itself – who's value Cochran could not disclose – has its own monitoring, as it is particularly important to ensure consistent pressure is maintained in the two tanks as well as to avoid unnecessary condensation buildup in the articles. But with all of the science, tech and know how, Cochran said "the best thing we have is our people. It takes a lot of good folks to make sure this works. Our planning, our prep, and our training leads us to what we do, which is successfully delivered the articles for the NASA programs."

International Wind Turbine and Foundation Installation Vessel Market

As of end-June 2021, more than 100 turbine and foundation installation and maintenance vessels will be required for offshore wind projects planned over this decade.

By Philip Lewis IMA/WER

More than 100 turbine and foundation installation and maintenance vessels will be required for offshore wind projects planned over this decade. Almost all of the current fleet of international wind turbine installation vessels will be technically redundant as installation vessels by 2025 as a consequence of the rapidly growing wind turbine sizes, greater water depths and increase in foundation size. Demand will be satisfied by over 60 newly constructed or upgraded vessels – presenting a $14 billion-dollar opportunity for engineering firms, shipbuilders and conversion yards, equipment suppliers, service providers and those who finance marine assets.

Foundation installation requirements are also rapidly changing. Market requirements are now shifting to purpose-built wind foundation installation vessels capable of handling the largest monopile foundations. More specialized vessels will be required for this purpose.

As well as uncertainties posed by the rapidly evolving technological terrain, installation vessel owners are also having to navigate their way through evolving local content requirements in Taiwan, Japan, the United States and elsewhere.

China is a relatively closed and busy offshore wind market with its own demand drivers. Chinese WTIVs are unlikely to operate outside of China. In fact, it is more likely to see smaller installation vessels redeployed to the Chinese market, especially as they become less technically suited to international demand.

Summary Forecast for Global Wind Turbine Foundation Installation Vessel Orders

Summary Forecast ($bn)	Vessels	CAPEX ($ billion)
WTIV	49	11.8
Wind Foundation Installation Vessel	12	2.4
Total	61	14.2

Source: WER Database

These are the findings in a new report "International Wind Turbine and Foundation Installation Vessel Market" just completed by ***World Energy Reports***.

The 70+ report provides a guide to understanding the drivers that will shape requirements in this growing, globalizing and technically evolving industry. The report examines the structure of the installation industry, profiles the underlying market drivers, forecasts wind installation activity through 2030 and identifies installation vessel technical requirements to meet future demand.

Introducing offshore wind turbine and foundation installation vessels

Until now installation requirements have been largely satisfied by WTIVs and heavy lift vessels deigned for the oil & gas and port/salvage market. Market requirements are now shifting to larger capacity WTIVs and purpose-built wind foundation installation vessels capable of handling the largest monopile foundations.

A WTIV is a self-propelled self-elevating jack-up with a crane capacity of 600 tonnes or greater for lifting a WTG set in 5-6 lifts. WTIVs perform a range of functions as part of the offshore wind farm supply chain:

A new generation foundation installation vessel is a self-propelled DP2/3 vessel with a large deck space for carrying foundations from the manufacturer's facility direct to site and with a crane capacity of 3,000 tonnes or greater.

Offshore Wind Overview

From the first eleven 450kW Wind Turbines 5MW Vindeby Windfarm, commissioned in 1991 in Denmark, offshore wind has grown to reach over 32GW of cumulative installed capacity by the end of 2020 provided by 18 countries. Almost all capacity is bottom-fixed – except for some floating wind pilot arrays.

WTIV Activities and Attributes

Scope	Activity/ Demand Driver	Key vessel attributes
WTG T&I	WTG transportation from marshalling ports to offshore construction locations and installation of WTG sets is the main demand driver for WTIVs. A complete WTG set comprises of the tower, nacelle and blades. Lead-time ~2-3 years. Medium term contracts (months).	**Higher lifting mode:** Crane hook outreach and height above deck for lifting WTG components without damaging fragile blades and nacelle. **Stability:** Provided by the jacking system to reduce marine related movement. **Carrying capacity:** Judged by the VDL (variable deck load) and free deck area.
WTF T&I	Transportation of foundations (mainly monopiles) from manufacturing facility or marshalling port to site and installation of WTF's. Demand driven by WTGs and occurs ~1/2 to 1 year before WTG installation . Lead-time ~2-3 years. Medium term contracts (months).	**Heavy lift mode:** Crane with a hook height to install monopiles and jackets. **Carrying capacity:** Judged by the VDL (variable deck load) and free deck area.
WTG O&M	Scheduled and unscheduled maintenance and repair services. Includes blade repair and major component replacement. Shorter lead times. As the industry matures, with a greater number of WTGs offshore, O&M support demand will increase.	**Crane capacity.** Crane hook outreach and height above deck for lifting WTG components without damaging fragile blades and nacelle. **Availability:** O&M campaigns have helped WTIV owners maximize fleet utilizations and reduce idle time between construction jobs.
Decom-missioning	Decommissioning at the end of the 20 to 30-year turbine life.	**Crane capacity:** Crane hook height and capacity.

Image credit: Fred Olsen Wind Carriers (top image), SIF (bottom image)

Wind Foundation Installation Vessel Activities and Attributes

Image credits: OHT

Scope	Activity/ Demand Driver	Key vessel attributes
WTF T&I	Transportation of foundations from manufacturing facility or marshalling port to site and installation of WTF's. Demand driven by WTGs and occurs ~1/2 to 1 year before WTG installation. Lead-time ~2-3 years. Medium term contracts (months)	**Heavy lift mode:** Crane with a hook height to install monopiles and jackets. **Carrying capacity:** Judged by the deck load and free deck area.
WTG T&I	DP3 WFIV vessels are seen as having a capability to install WTGs, especially in areas of poorer soil conditions for jack-up operations (such as Taiwan).	**Higher lifting mode:** Crane hook outreach and height above deck for lifting WTG components without damaging fragile blades and nacelle. **Station keeping:** Provided by DP3 dynamic positioning capabilities.
Decommissioning	Decommissioning at the end of the 20 to 30-year turbine life.	**Crane capacity:** Crane hook height and capacity.

Northwest Europe and China accounted for 99% of installed capacity at the end of 2020.

The UK was the single biggest market, accounting for 32% of global capacity by at the end of 2020. Germany was the second largest market with 24% of capacity. This activity has supported the development of a significant industrial base for wind farm component manufacture installation capabilities. Europe and the UK has taken three decades to industrialize the offshore wind supply chain. The 1990s and early 2000s where characterized by comparatively small demonstration projects aimed at testing offshore wind technology. Commercial scale wind farms only started to appear at the start of the last decade. Wind farm development in emerging non-European markets (Taiwan, Japan, the U.S.) has been supported by European manufacturing capacity and installation vessels.

China has witnessed a surge in offshore wind activity since 2015, grid connecting 22GW of capacity by the end of 2020. The foundation of the current offshore wind boom is subsidies available for projects approved before the end of 2018 and grid connected by end 2021. Much of China's initial wind farm activity can be classed as intertidal, in very shallow water falling within 10km offshore. More recently wind farms have moved outside of the tidal zone into offshore waters. China is a relatively closed and busy offshore wind market with its own demand drivers.

For a wind turbine and foundation installation perspective, we see three relatively distinct markets driving demand:

International: This segment is considered largely open for all international assets. Over time, certain markets like Taiwan, Japan, the U.S., and South Korea will see an increased supply of locally flagged and owned assets at which time these markets will become increasingly locally content driven. Bottom-fixed solutions (up to 60-70m) will drive growth. Floating wind segment will develop through this decade in most of these markets, both for deeper water (over 60m water depth) or in shallow water poor soil conditions – possibly for the Baltics and Taiwan.

China: A discrete installation market, that may take assets from the international supply but is unlikely to contribute to the international supply side in the foreseeable future. Initially an intertidal market, China is developing as a bottom-fixed market.

Vietnam: A largely intertidal market not requiring modern purpose built WTIVs/WTVFs.

In the mid- to long-term, we are tracking offshore wind projects in 38 countries. Our Base Case forecast identifies around 235GW of installed capacity by 2030, around 96% of which will be bottom fixed. This activity will drive the installation of over 9,300 wind turbines and foundation in the international market through 2030 and over 8,000 in China.

The international and Chinese market will be installing different turbines and foundations. The international market will be mainly supplied by three leading OEMs – Siemens Gamesa Renewable Energy, GE and Vestas. The largest wind turbine installed today is the 8-10MW turbines. 12-14MW turbines will dominate mid-decade activity and 15MW+ turbines will be deployed at scale from 2027. The Chinese market will move away from 4-6.5MW turbines to 10MW and over by the middle of the decade.

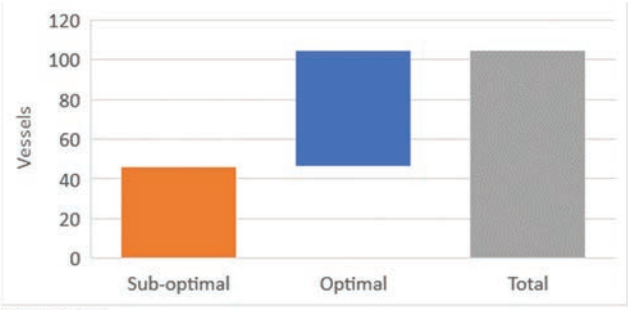
Underlying Technical Drivers

The speed of wind turbines output evolution has been rapid – larger wind turbines deliver higher outputs and higher capacity factors which leads to project cost reductions. As the size of wind turbines grows, so too must the size of WTIVs.

Larger wind turbines output results in heavier and larger components (nacelle and hub, blades, and towers). The heavier

Summary of Market Size, Local Content Preference and Development Type

Offshore Wind Turbine and Installation and Maintenance Fleet by 2025



Source: WER

components drive heavier foundations to support the increased wind turbines loads. The longer cardon fiber blades that all larger rotor diameter wind turbines have drive higher lifting heights.

Foundations will generally be installed in the year before turbine installation. The steel monopile has been the predominant bottom-fixed foundation solution in the international market to date. It is expected that the monopile will continue to be deployed in large numbers of international projects in the future. We anticipate that monopiles and jackets will account for over 95% of bottom fixed foundations through 2030. Larger wind turbines and deeper waters are resulting in very large monopiles, most of which cannot be installed by today's WTIV fleet.

Wind Farm Construction and Maintenance Vessel Fleet

We forecast a global fleet of around 105 wind farm construction and maintenance vessels by 2025. Close to 60 WTIVs and foundation installation vessels will provide the backbone of the wind farm turbine and foundation installation capabilities by the middle of the decade. Although being suitable to perform wind farm maintenance duties, our forecast indicates that the majority will focus primarily on construction work.

An additional 45+ vessel, grouped as sub-optimal for installation activities, will support some construction work, particularly in China, as well as servicing important O&M demand.

The figures exclude some 125 oil & gas and port/salvage heavy lift vessels, some of which have been used to support offshore wind projects in the past and will occasionally provide solutions on specific project challenges in the future.

A $14b CAPEX Opportunity

Our forecast identifies a demand of more than 35 optimal WTIVs and foundation vessels are required to meet international turbine and foundation installation demand through 2030 amounting to over $10 billion of CAPEX. The Chinese market demand will be met with around 25 additional WTIVs and foundation vessels for close to $4 billion of CAPEX. Details off the forecast are provided in the report.

Workforce Development: Apprenticeship Programs help Build the Fleet

Naval shipyards and industry partners see business growing, but finding enough trained and qualified workers is a challenge.

By Edward Lundquist

PHNSY

General Dynamics Electric Boat will invest $1.7 billion to modernize and upgrade its Quonset, R.I. and Groton, Conn., facilities over the next ten years," said Sean Davies, vice president for EB's Quonset Point Operations. "Here at Quonset, we are investing $700 million that will increase our outfitting space by 13 acres, to support work on the Virginia and Columbia class of submarines. When we are complete, we will be adding 600,000 square feet of submarine module outfitting space here on our Rhode Island campus, which represents one of the largest construction projects undertaken in the state in recent years."

Because the modular sections for the Columbia-class that will be fabricated at Quonset Point will be substantially larger and heavier than previous submarines, the company is building a new and larger ocean transport barge with about 6,000 tons of capacity to transport the modules along the East Coast between Newport News, Groton and Quonset Point. EB also plans to build a new floating drydock to accommodate the new Columbia class subs.

The Groton shipyard is also undergoing a major expansion. The new 200,000-sq. ft. South Yard Assembly building will eventually be the home of 1,400 skilled shipbuilders who will deliver the Columbia-class, and is part of an $850 million expansion at the EB Groton shipyard.

Electric Boat is experiencing significant hiring of designers, engineers, trade and industrial skilled employees to support the growth and expansion. In 2020, EB hired 2,000 people, mostly in the second half of the year due to earlier COVID limitations. In 2021, the company expects to hire 2,400 engineers, tradesmen and support personnel.

Led by the Southeastern New England Defense Industry Alliance (SENEDIA), a next-generation industry partnership supported by workforce development stakeholders, including state workforce agencies, academic institutions, training providers, and Manufacturing Extension Partnerships and Procurement Technical Assistance Centers in Connecticut, Massachusetts and Rhode Island are helping develop the qualified workforce that will design and build the submarines of today and the future. This effort is in the process of expanding to all the New England states.

Bond points to EB's "pipeline partnerships" in both Connecticut and Rhode Island that helps to develop qualified, skilled and available personnel. "Our partners provide the basic skills in the trades for our new hires so they can be productive as soon as they set foot in the shipyard. This has been critical not only in building skills, but also dramatically reducing our first-year attrition. In most cases, we've been able to cut our first-year attrition in half because of the way we onboard them and introduce them to shipbuilding."

"We will put more than 1,000 people through those pipelines in Rhode Island, and we have a parallel pipeline in Connecticut," said Davies. Our training programs used to focus on either Connecticut or Rhode Island, but SENEDIA brings a cross state and regional perspective, so we can expand into Massachusetts and further into New England."

Developing skilled talent to design, build and repair ships requires partners. SENEDIA was awarded an $18.6 million contract in August 2020 from the Department of Defense to develop the Next Generation Submarine Shipbuilding Supply Chain Partnership, a robust New England regional workforce development program that will serve the needs of submarine shipbuilding employers and open up job exploration and employment opportunities to more than 5,000 potential workers.

"One of our key goals at SENEDIA is to help engage the next generation workforce so that they see and consider the many high-wage, high-demand, high-growth opportunities, whether STEM or trade/industrial skill related, there are through defense-related career pathways," said SENEDIA Executive Director Molly Magee. "These careers make a tremendous impact on our national security, and the demand for skilled talent in our sector continues to grow."

Magee said SENEDIA sees itself as the bridge between companies looking for talent and people looking to learn, train and work. "SENEDIA's internship program has seen incredible success in kickstarting careers across IT and cybersecurity, engineering, supply chain management, undersea technology, and beyond. More than 90 percent of our interns find a job

Over the past 100 years, more than 5,800 men and women have graduated from the Pearl Harbor Naval Shipyard & Intermediate Maintenance Facility (PHNSY & IMF) Apprentice Program. Upon successful completion of the program, apprentices are promoted to journey workers and attain an Associate in Applied Science (A.A.S) Degree in Applied Trades. Lauryn-Mae Pang became an apprentice diesel crane mechanic, then worked on her bachelor's degree through PHNSY's Apprentice to Engineer (A2E) program. She's now a nuclear mechanical engineer at the shipyard.

Shelby West

Nuclear Quality Division's (Code 2350) Nuclear Quality Support Specialist Catherine Hobb, a graduate of the Norfolk Naval Shipyard apprenticeship program observes her brother Rigging and Equipment Operation's (Code 740) Apprentice Noah Coburn as he rigs up equipment. Their father, Richard Coburn, also had a career at NNSY, graduating from the apprenticeship program in 1987.

after graduation, and many with the companies for which they interned. Interns get paid, hands-on, on-the-job work experience, and our host companies get to know and train prospective employees."

She further emphasized the important role of southeastern New England as the hub of submarine shipbuilding and undersea technology. Defense jobs support the building of the submarine and the technology and design of the systems on submarines and unmanned undersea vehicles. A strong undersea defense helps ensure our national security.

"As part of our DoD award, we launched www.BuildSubmarines.com to serve as a workforce resource, including a talent repository where prospective trade and industrial skilled workers can share their contact information and connect with employers. We have also developed a supplier database, allowing companies who are or could be part of the submarine supply chain, to highlight their company and capabilities. In our latest effort through the Submarine Shipbuilding Supply Chain Partnership, we have initiated an incumbent worker training reimbursement program, which will reimburse supply chain companies 100 percent of trade and industrial skill training costs, up to $30,000," Magee said. "This is an investment in the individual employee today, and in the strength of our industry tomorrow, as many of these skills are transferable and are essential to the continued growth of submarine shipbuilding."

New talent, tools

While ship builders and repair yards have always been concerned with training new workers, the challenge today is especially acute because senior level workers are retiring, and, as a group, the current workforce lacks the appropriate array of digital skills to fully utilize the next generation of tools, said retired Rear Adm. Brad Williamson, the executive director of the Hampton Roads Maritime Industrial Base Ecosystem (MIBE).

"The new workers who will build Columbia-class submarines when that program is at full rate production are in now middle school. These same workers will need to be trained in modern equipment and will also need these skills to build the new un-

manned and autonomous platforms that are expected to make up a larger and larger portion of our fleet in the years ahead," Williamson said. "These skills require the adoption of the latest technology, not only in the shipyards and ship repair facilities, but in the training pipelines that produce these workers."

Plus, Williamson said, the maritime industry is competing with other industries for talent. "In Hampton Roads, we face current and future hiring competition both for specific skills and for general personnel who might choose to enter the maritime trades. This includes non-naval maritime projects such as Hampton Roads Bridge-Tunnel Expansion, offshore wind infrastructure and construction, and other industries in the region.

On the Public side, Williamson said that the Norfolk Naval Shipyard is overhauling its training program and facilities and has done a remarkable job at better understanding the competencies required for each availability and where those skills lie within their workforce, and then most importantly, getting after the delta up front to ensure they have the right workforce in place once the availability starts. "MIBE is partnered with NAVSEA on working to create alignment with the skillsets between the private and public side. This is not an easy task, but a worthy effort to see how much alignment we can achieve. Some of the larger forward-leaning private maritime yards have invested in their own training pipelines, but this is not necessarily an option for smaller repair facilities."

MIBE focuses extensively on building better linkages with middle school and high school programs to bring maritime trades into view. "We partner with our Virginia Digital Shipbuilding Program which does extensive STEM outreach and we have proposals pending for Congressional approval that would provide funding to support maritime trades training in these school systems specifically designed to assist those in underserved communities," Williamson said. "Our message is quite simple, these maritime trades can provide not just a job, but a long-term career and the chance for continued growth and opportunity."

With the demand for skilled employees in the maritime trades, there is competition between the government and industry for talent, as well as other fleet concentration areas or naval shipbuilders beyond the Tidewater region. "This is why our current efforts with NAVSEA are so important," said Williamson. "The goal is to someday have a workforce that could theoretically flow across public-private lines so that one unified workforce could meet Navy demands in the most efficient manner possible."

Life changing opportunities

Starting a career in the maritime trades can be life changing. So, Pearl Harbor Naval Shipyard engineer Lauryn-Mae Pang has some advice for young people looking for a career: "Change it up!"

She is a product of the Pearl Harbor Naval Shipyard – Intermediate Maintenance Facility (PHNSY-IMF) Apprenticeship Training Program, which is certified by the U.S. Department of Labor and administered through a contract between Honolulu Community College. PHNSY's 2019 class was its biggest ever, with 278 graduates. The 2020 class, the 100th anniversary of the program, had 208 graduates, bringing the total number of apprentices to 5,800 since the program began. Apprentices received a minimum of 7,200 hours of on-the-job training, trade theory, and academic study during the program. Upon successful completion of the program, apprentices receive an Associate in Applied Science (A.A.S) Degree in Applied Trades and are promoted to journey workers in trades such as structural, mechanical, electrical/electronic, piping, air conditioning and refrigeration, and temporary services. Apprentices spend half the day in the classroom and the other half working with their shop.

Pang was working multiple jobs, when she saw the announcement of the Shipyard Job Fair. I was able to talk to people from the different shops about the various trades. I applied to take the test, passed it and went through the interview process, and was accepted to the program," she said.

Pang said it was a little overwhelming at first. "I didn't know anything about being a diesel crane mechanic. But the shipyard really took me in and taught me all the skills that I would need, and not just for that job, but a lot of other things.

Pang learned about the Apprentice to Engineer (A2E) program, where qualified and motivated Apprentice Program graduates can pursue a four-year engineering degree with her tuition and related educational fees paid by the Navy.

"Since I entered the apprenticeship program to have a career, this seemed like a good next step. It was a big motivator for me," said Pang.

Ten years later, Pang attended the University of Hawaii at Manoa College of Engineering and earned her Bachelor of Engineering Degree. "After I got my degree, I was assigned to work with the nuclear engineers in Code 2320. They're involved with anything involved with nuclear submarine propulsion. I recently transferred to 2310 and working on the structural side of nuclear engineering."

Even now she receives a significant amount of training, like everyone else at the yard. "It's something that never stops." Pang said the knowledge and skills she's received have been invaluable. "I started when I was 29. I've accomplished a lot in ten years," she said. "If I could have done it differently, I would have done it a lot sooner."

She doesn't hesitate to recommend the apprenticeship program to someone with some confidence, curiosity and drive. "Take the risk. Try it out. Trust the process. Take in what the shipyard has to offer. I didn't think that as a diesel crane mechanic doing small jobs that I would eventually become a nuclear mechanical engineer working on entire propulsion systems. So, just go out there and do it! Change it up!"

The Apprentice School @ Newport News Shipbuilding

Inside the Program to Train Next-Gen Shipbuilders & Leaders

The Apprentice School at Newport News Shipbuilding trains shipbuilders and leaders to build some of the highest value maritime assets on the planet: U.S. Navy ships. Dr. Latitia McCane, Director of Education, The Apprentice School at Newport News Shipbuilding discusses the challenges and rewards of the job.

While most shipbuilders lament the dearth of interest from the next generation to take up a career in shipbuilding, Dr. Latitia McCane, Director of Education, The Apprentice School at Newport News Shipbuilding has the opposite problem, sorting through nearly 4,000 applicants to fill only 200 spots annually.

A chemist by training, Dr. McCane's entire career has been in and around the 'earn and learn' model, as she benefited from financial assistance from the likes of the National Science Foundation and the National Institute of Health for tuition, books and fees for her STEM path of study. "So when I got the phone about coming here and being the Director of the Apprentice school, it took me back to my roots of earn and learn," said Dr. McCane.

SHIPBUILDERS AND LEADERS

The Apprentice School at Newport News Shipbuilding is much more than learning a shipbuilding trade, as Dr. McCane notes it is the "leadership factory" for the storied shipbuilder, looking for students that not only have the requisite technical aptitude and complex problem-solving skills, but also ones that have a strong background and aptitude in math and science. "Our students have to take a lot of mathematics, physics and ship construction," mixed with an athletic program that is aimed at building leadership, another pillar of the Apprentice School.

Students earn $18/hour during the apprenticeship, elevating to about $64,000/year once they graduate.

Today the school has about 800 students, a student body that is male dominated with about 83% being male versus 17% female. "Our goal this year is to grow the number of females that we have within our school," said Dr. McCane

Finding a diverse and qualified student body means partnering with local communities and schools – K-12. "We have about 40 plus students who we've matriculated through our pre-apprenticeship program, where we're exposing them for one year, teaching them about the maritime trades, and also,

The Apprentice School at Newport News Shipbuilding is much more than learning a shipbuilding trade, **it is the company's "leadership factory."**

Dr. Latitia McCane

Director of Education, The Apprentice School at Newport News Shipbuilding

MARITIME REPORTER TV **Watch the interview with Dr. Latitia McCane @ bit.ly/3rKFLJd**

teaching them about what it feels like to be an apprentice," said Dr. McCane, and exposure and mentoring regimen now in its second year. Ultimately, the success of The Apprentice School and the shipbuilder too is increasingly pegged to these outreach programs, partnering with communities to expose them to the possibilities of a career in shipbuilding.

"We have 45 high school students that we're training virtually right now, exposing them to the trades," said Dr. McCane, and the process of getting families involved in the educational process is deeply personal to her. "I'm a product of a manufacturing because my father worked in chemical manufacturing and he took me to his chemical company. I told myself 'when I grow up, I'm going to work at my dad's chemical company.' And I did that, as they gave me internships while I was in high school. So being able to feel it, touch it (is an important part of the process. When I got my first chemist position and I had to put that hard hat on, it was my comfort zone because I grew up in my dad's world."

The Apprentice School, like the rest of the world, has been impacted by COVID, which has resulted in investment in educational technologies to better reach students – both prospective and actual – at a distance. "One of the things that we've been fortunate this year is how do you do technical training in this pandemic? And so we've been fortunate enough to be able to bring in some augmented and virtual reality training," said Dr. McCane. "We've been fortunate to be able to get federal and state funding, to help us with the technology that we need to reach them. Like I said, we're engaging with 45 high school students today. We have three training programs that we're doing with them virtually. We wouldn't be able to do that if we didn't have our augmented and virtual reality equipment that we purchased over the past year because of the investment that our federal government and state government is putting into our communities. We're investing in people, young people with bright minds, and I think that that's the best feeling in the world."

Luis E. Contreras, President, Ciramar (left) said the company aims to invest $50m in the shipyard to increase capacity and efficiencies.

Photo courtesy Ciramar

Dominicana Caribbean Shipyards Opens

Last month Ciramar Shipyards signed a strategic alliance with Fassmer Technical Projects to build and repair ships in the Dominican Republic under the Dominicana Caribbean Shipyards name.

"There's been a need for a long time for a new shipyard to rise within the Caribbean region and the Americas in general, to be able to professionally service various ship types that transit the area," said Craig R. Gundry, GM, Fassmer Technical Projects. "Luis and I came together a number of years ago and started a relationship working with each other in different ways. We were doing retrofits in various industries, including the cruise and oil and gas. As (we were) structured, we could already service a good amount of vessel types. But with (this) upgrade where we're going to be able to do retrofits, conversions and major repairs on post-Panamax vessels."

Through the agreement, Ciramar will expand its portfolio of solutions providing attention and service to a potential market of more than 7,000 ships that traverse the region annually, enabling it also to tap opportunities in the growing U.S. offshore wind power industry.

Ciramar traditionally services about 65 dry dockings per year across a wide range of vessels, from tankers and barges, to bulk carriers, container ships and tugboats. Oftentimes it found itself with vessels waiting in line to get serviced.

Via the collaboration with Fassmer, Luis E. Contreras, President, Ciramar, said the idea is to provide faster turn-around on service, effectively expanding capacity to accommodate more, and larger ships each month. Contreras has high hopes for the collaboration with Fassmer, as currently Ciramar has three floating dry docks and 120,000 square meters of land, with a planned investment of $50 million to expand the facility. "That means adding another dry dock and also bringing a synchronized platform to move ships around the shipyard."

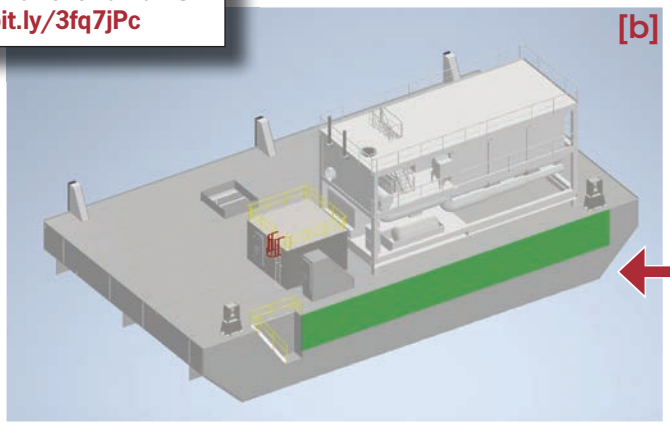
Ciramar is a nearly 40-year-old company founded in 1984 by Contreras' father, also named Luis, who graduated from the United States Merchant Marine Academy, with an advanced degree in naval architecture from the University of Michigan, making him the first naval architect in the Dominican Republic.

While the deal to expand will impact the shipping community with more options, Contreras sees a big impact for the local economy too, as the shipyard currently has about 400

Craig R. Gundry, GM,

said the Fassmer Technical Projects team leans on 171-years maritime experience in helping to make efficient a whole range of maritime services, from [a] ballast water installation, [b] newbuild projects and [c] retrofits.

MARITIME REPORTER TV **Watch the interview with Fassmer & Ciramar @ bit.ly/3fq7jPc**



(employees and contractors) people working. "This new alliance … will allow the generation of more than 600 specialized direct jobs in the first stage, projecting an expansion to more than 1,200 direct jobs in the next three years," said Contreras.

Fassmer is a 171-year old German company with long experience in shipbuilding and repair, and this new teaming seeks to leverage that experience in a geographically ideal locale.

"There are lessons learned, best practices and knowledge transfer that we can impart," said Gundry, ultimately giving the Dominican yard the tools, knowledge and training needed to deliver "European standards" in regards to ship repair and drydocking. The scope of the deal also includes maintenance, manufacture and local marketing of mechanical products, including propellers, stabilization and steering systems, thrusters, azimuth thrusters; as well as naval automation; ship repair; and personnel training with consulting in the design of naval devices.

By Greg Trauthwein

Photo courtesy Crowley

Crowley Takes Delivery of 55K-barrel ATB

Crowley took delivery of its new 55,000-barrel, articulated tug-barge (ATB), the Aurora/Qamun. The 410-ft. vessel is the second ATB in Crowley's fleet, after the Aveogan/Oliver Leavitt, to be dedicated to the Alaska market. Outfitted with EPA Tier IV engines for reduced emissions, the ATB has a range of 4,300 miles to access most locations in Alaska. The vessel also features Z-drive propulsion and 400 hp bow thrusters, allowing it to move smoothly in tight areas. The Aurora/Qamun meets Ice Class and Polar Code requirements, which include increased structural framing, shell plating, and extended zero-discharge endurance with shallow water capability. More details are available on this specifications sheet.

Master Boat Builders built the tug, with the barge built by Gunderson Marine LLC.

Crowley operates and manages 42 Jones Act qualified large petroleum transportation vessels that carried nearly 570 million barrels of product with more than 5,700 transfers in 2020.

Cemre builds LNG-Powered Purse Seiner/Trawler

The fishing vessel Selvåg Senior was designed by Norway's Skipsteknisk and Selvåg AS and built at Cemre Shipyard for Sorheim Holding. Capable of both trawling and purse seining, the 79.5 x 16.2-m vessel will have a molded depth of 6.9 m. The RSW holds, in the DNV-GL classed vessel, will have a total volume of just under 2,550 cu. m. The main propulsion engine will be a medium-speed Wärtsilä 8V31DF, producing 4,800 kW at 750 RPM. The main auxiliary genset will be powered by a Cummins QSK60 generating 1,724 kWe/3x440 VAC/60Hz at 1,800 RPM. The QSK60 engine will be fitted with IMO Tier 3 compliant SCR after treatment systems. She has a 15-knot design speed and accommodation for up to 14 crewmembers. Up to this point the new fishing vessel is like most other modern and recent Norwegian new builds. The difference is in the fuel carried in a 352 cubic meter LNG tank. The liquified Natural Gas fuels the 4,800 kW main.

Making an innovative green vessel is more complex than a simple change of fuel for the main engine. To further protect the environment, the vessel is designed to minimize energy use. The LNG is stored at -140 to -160 degrees Celsius so must be heated for use by the engines. A cold recovery system will use this surplus cold energy to maintain the cold of the RSW in the 2,480 cubic meters in 12 cargo tanks. Meanwhile, surplus heat from the exhaust will be utilized to produce clean electricity. The Selvåg Senior will be the first newly built fishing vessel to use this technology. Additional electricity will be produced with an AMI 560L6L BSFMS 2,500 kW shaft generator. All fish pumps as well as purse seine and trawl winches are electric. The latter can also generate electrical power when paying out lines. Excess electrical energy can be stored in a large 1MWh battery pack to some extent this takes the place of a second auxiliary genset and helps flatten the load on the main engine during the voyage. It can also act as a power source in port.

Additionally, the vessel is capable of receiving power from the land power grid to recharge the battery pack. All of these power sources, combined with the SCR after treatment of the Cummins QSK60 auxiliary engine, makes for a notably green ship.

The electrical systems is integrated in such a manner that the vessel will demonstrate an overall reduction of greenhouse gas emissions by as much as 42%.

Photo courtesy Skipsteknisk and Selvåg AS

NYK: 12 LNG-Fueled PCTCs

NYK will build 12 LNG-fueled PCTCs, six at Shin Kurushima Dockyard and six at Nihon Shipyard, for delivery between 2025 to 2028.

The PCTCs will measure 200 x 38m with a car capacity between 6800 and 7000 units, and are part of the shipowner's PCTC fleet replacement plan to achieve NYK's environment management target, which is to reduce CO2 emissions per ton-kilometer of transport by 50% by 2050. The use of LNG fuel, in addition to hull modification to improve fuel economy, will contribute to a reduction of CO2 emissions by approximately 40% compared to ships using conventional heavy fuel oil.

Pictured is Sakura Leader, delivered in October 2020 and the first LNG-fueled PCTC to be built in Japan.

Photo courtesy NYK

Lindblad Launches National Geographic Endurance

Lindblad Expeditions launched National Geographic Endurance in Reykjavik, Iceland. Named to honor legendary explorer Ernest Shackleton, National Geographic Endurance is a fully stabilized vessel of the highest ice class (PC5 Category A), she will enable adventurous guests to go where few have or can. National Geographic Endurance's most striking exterior feature is her distinctive profile, the patented X-Bow, a design to ensure the smoothest, most comfortable ride in all kinds of conditions; and since it eliminates bow impact, a quieter ride, as well. An equally impressive feature may well be her capacity: she carries just 126 guests, a commitment to expedition excellence over scale.

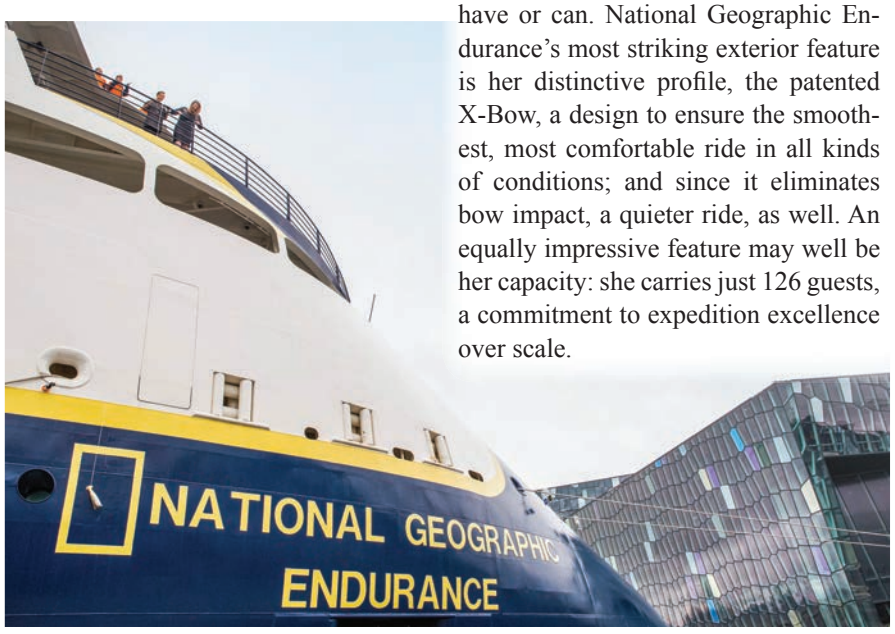
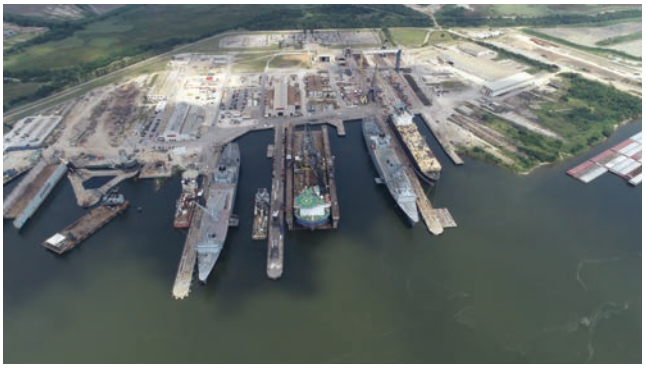


Photo courtesy Julie Rowland

Photo courtesy Mitsubishi

MRRV for Philippines DOT

Mitsubishi Shipbuilding launched the first of two large multi-role response vessels (MRRVs) being built to for the Department of Transportation (DOT) in the Republic of the Philippines. The ceremony took place at the Enoura Plant at MHI's Shimonoseki Shipyard & Machinery Works in Yamaguchi Prefecture. MRRVs play an important role in severe-weather rescue missions and patrolling in offshore and coastal zones. This vessel has an overall length of approximately 96.6m, with a maximum speed of 24 knots and a cruising range of up to 4,000 nautical miles. It is equipped with secure communication systems for Exclusive Economic Zone (EEZ) surveillance, a helideck and hangar for helicopter operations, an underwater remotely operated vehicle for subsurface search and survey, high-speed rubber boats and other essential equipment for maritime domain awareness and maritime law enforcement operations.



Alabama Shipyard

Alabama Shipyard is the premier ship and rig repair facility on the Gulf Coast for vessels from 200' - 965' in length. This facility has been in operation for 105 years. Our drydock can lift up to 46,400 tons with a width of 164'. We have 5 pier locations for topside repairs. Our dismantling and decommissioning group breaks rigs and ships for re-use at local steel mills. The Shipyard is conveniently located on the East bank of the Mobile River with deep draft access and no air-draft restrictions. We are anchored in Safety, Quality, and the pursuit of Excellence.

www.alabamashipyard.com

Blount Boats Inc.

Blount Boats, Inc. of Warren, Rhode Island specializes in the construction of steel and aluminum commercial vessels. Since 1949, the shipyard has built over 372 vessels that provide our customers with dependable service and lasting value. Blount Boats has been building high quality, innovative shallow draft designs for 72 years. Blount Boats built the first U.S. flagged crew transfer vessel for Atlantic Wind Transfers for service on Deepwater's 30 megawatt Block Island Wind Farm. Blount Boats can build all designs of crew transfer vessels (CTV's) needed in this new and growing industry. Blount Boats, located on Narragansett Bay, is also ideally suited to maintain wind service vessels.

www.blountboats.com

BRIX Marine

BRIX Marine specializes in the design and construction of commercial aluminum vessels. Since the company's founding in the Pacific Northwest over two decades ago, BRIX has earned a solid reputation for pioneering and crafting the world's most rugged aluminum catamarans and workboats. BRIX closely collaborates with vessel owners/operators to create innovative solutions to unique vessel demands, giving their clients the best opportunity to succeed on the water.

BRIX Marine is a part of Bryton Marine Group, the largest builder of welded aluminum boats in North America. BRIX operates out of three main buildings at their yard in Port Angeles, WA.

www.brixmarine.com

Conrad Shipbuilding

Conrad Morgan City is the original site of the shipyard, and sits on 12-acres. It manufactures a variety of small and medium-sized vessels for commercial and government customers and comprises approximately 125,000 sq. ft. of enclosed manufacturing space. **Conrad Amelia** sits on 16-acres and specializes in small to medium-sized vessels and structures of new construction, repair and conversion projects. The yard has seven buildings totaling 67,500 sq. ft. of enclosed manufacturing space. **Conrad Orange** is located on 24-acres on the Sabine River, just north of the Gulf Intracoastal Waterway in Orange, Texas and is purpose-designed for vessel construction efficiency. The shipyard has six construction bays with approximately 115,000 sq. ft. of enclosed area.

www.conradindustries.com

Colonnas Shipyard: 140 Years of Experience

Colonna's Shipyard is located in the historic Berkley section of Norfolk, Va., and is the oldest continuous family owned and operated private shipyard in the U.S. Founded in 1875 by Charles J. Colonna, the early business was limited to pier-side repairs. Within two years, Charles had added his first marine railway powered by two horses, which had a lift capacity of about 40 tons.

Today, Colonna's Shipyard continues to modernize, making the capital investments necessary for improvements in efficiency and productivity, and is a diverse industrial company with extensive capabilities in commercial and government ship repair, machining and large steel fabrication. Colonna's maintains a positive outlook for the coming 12-24 month timeframe, and per its 140-year history will make investment and diversification of facilities and equipment a central tenet.

COLONNA'S SHIPYARD, INC.

Port Engineer Facilities
400 East Indian River Road
Norfolk, VA 23523
T: (757) 545-2414
E: vhull@colonnaship.com
W: www.colonnaship.com
Number of Employees: 811

An interesting recent job was an emergency drydocking on NOAA's Ron Brown, a $1.5M deal to repair leaking seals, piping, hydraulic booms, as well as rescue boat davit overhauls, cargo crane maintenance and HVAC.

Drydock 1:
Length x Width x Depth: : 620 x 87.7 x 25.7 ft.
Capacity: 15,750 Long Tons

Drydock 2:
Length x Width x Depth: 270 x 70 x 17 ft.
Capacity: 2,800 Long Tons

Drydock 3:
Length x Width x Depth: : 590 x 104.5 x 24 ft.
Capacity: 11,320 Long Tons

Shipyard Features:
Hull Shop; Paint Shop; CMMC Machine Shop; Machine & Thruster Shop; Pipe Shop.

COLONNA'S SHIPYARD, INC.

Since 1875, Colonna's Shipyard continues to expand our team, facilities, and expertise. Our commitment to education and modernization allow us to remain a leader in this ever changing industry.

www.ColonnaShip.com - Located in Norfolk, VA

Detyens Shipyards Inc.
One Stop Ship Repair & Conversion Facility

Detyens Shipyards, Inc., a family-owned and operated company located in the historic city of Charleston, South Carolina, is busy building a tradition of quality workmanship at a reasonable price. Detyens Shipyards has continually emphasized customer service, family values, and safety in the workplace since its inception in 1962. Hard work, dedication, and the goal to provide economical ship repair services are the benchmarks behind Detyens Shipyards success.

www.detyens.com

Fincantieri Bay Shipbuilding

Fincantieri Bay Shipbuilding traces its rich history of building quality vessels for more than one hundred years. The expansive 68-acre facility is equipped with climate-controlled manufacturing facilities, computer-controlled manufacturing equipment, a large graving dock, a U.S. Navy-certified floating drydock, and has lifting capacity to meet the most demanding requirement.

The shipyard is custom-designed for efficient new construction, major conversion and repair. Its portfolio reveals the diversity of products delivered—from articulated tug-barge units to fishing vessels to dredges to OSVs to LNG bunker barges to ferries to specialty barges.

www.fincantieribayshipbuilding.com

MARINE GROUP
BOAT WORKS

Marine Group Boat Works (MGBW)

MGBW is a family-owned, full-service boat construction and superyacht refit facility occupying over 15 acres of land and water. Located at the southern part of the San Diego Bay in Chula Vista and National City with a third facility in San Jose del Cabo Mexico, MGBW specializes in refits, repairs and new construction of boats up to 220 feet (91 meters) long. Featured on The History Channel's Modern Marvels, MGBW is recognized worldwide for its 665-ton travelift, making it the premiere San Diego superyacht refit facility for the West Coast. Its specialties include haul-outs, bottom paints, Lloyds' and ABS-class surveys, aluminum and steel hull extensions, engine repowers, mechanical repairs, propeller service, custom fabrications and more.

www. marinegroupbw.com

Eastern Shipbuilding

Eastern Shipbuilding has navigated its fair share of challenges over the last few years, quickly bouncing back from the damage caused by Hurricane Michael in 2018 and forging ahead through the coronavirus pandemic currently confronting all businesses globally. Eastern currently operates two shipbuilding and repair yards located in Panama City, Fla. A portfolio of more than 350 vessels makes it one of the most diverse shipyards in the U.S. Eastern has built OSVs, MPSVs, offshore construction vessels, diesel electric vessels, dredges, ATBs, offshore tugs, Z-drive harbor tugs, inland towboats, RoRo passenger ferries, barges, fire boats, research vessels, fishing vessels, military craft and more.

www. easternshipbuilding.com

Gladding-Hearn Shipbuilding, Duclos Corporation

For more than 65 years, Gladding-Hearn Shipbuilding has built steel and aluminum pilot boats (95), Incat Crowther high-speed passenger catamarans (43), and dozens of tug boats, patrol, rescue and fire boats, and research vessels. With 7 acres on the deepwater Taunton River in Somerset, Mass, the shipyard counts more than 430 vessels built as proof of its longevity and vessel reliability.

Gladding-Hearn is best known for some of the most advanced shipbuilding techniques that rival larger yards, while still providing personal customer service of a smaller yard. As a result, nearly 90% of Gladding-Hearn's business is from repeat customers.

www.gladding-Hearn.com

United States Marine, Inc.

Headquartered in Gulfport, Miss., with a maintenance/repair facility in Chesapeake, Va., United States Marine Inc. is a fully integrated manufacturer of military, patrol and special warfare boats available in lengths from 21 feet to 90 feet. The company is capable of designing, building, and testing all of its vessels in house. USMI has been delivering to U.S. Department of Defense and government/military customers from more than three decades with a track record that speaks for itself. "Quality is defined by the customer, and in the DoD world that is defined by a specification, scope of work and CDRLs [contract data requirements list]," says Barry Dreyfus Jr., CEO. "Our documented history of zero defects at the start and end of acceptance trials gives the government assurance we can deliver upon our obligations."

www.usmi.com

Damen-built Shoalbuster Dubbed Brutus

A ceremony was held at Damen Shipyards Hardinxveld to name the first of a new model in the Damen Shoalbuster range. The ultra-shallow, Shoalbuster 3514 SD was christened Brutus, which measures 35 x 14m with a free deck space of 150 sq. m. With a draft of 2.85m at full tank capacity and just 2.45m at 50%, she is able to access waters inaccessible to other vessels of a similar size and capability. Four Caterpillar C32 ACERT engines deliver a total of 3,876 bkW (5,280hp) to four 1900mm nozzles, an arrangement that contributes significantly to her shallow-water capability. The vessel boats 60 tons of bollard pull.

Photo courtesy Damen

Brutus is multi-functional, able to take on PLGR operations, ROV surveys and a 600 x 800mm moonpool for multibeam access, mattress installations, UXO clearance, mooring, pushing, dredging support, ocean-going towage and general offshore supply vessel duties. Other features include four-point mooring and she is also equipped for anchor handling with an open stern complete with roller. The accommodation is comprised of 12 cabins for six to seven crew plus 13-14 additional personnel.

Brutus is the first diesel-electric Shoalbuster with hybrid propulsion in the range, with a shallow draft, dynamic positioning 2 and compliant with the latest IMO Tier III requirements following installation of a treatment system to reduce its emissions.

"K" LINE's CENTURY HIGHWAY GREEN

Photo courtesy "K" Line

Earlier this year Century Highway Green, a car carrier fueled by LNG (liquefied natural gas) that had been under construction at Tadotsu Shipyard Co., Ltd., part of the Imabari Shipbuilding Group, was delivered to "K" LINE as "K" LINE's first LNG-fueled car carrier. This vessel is a next-generation environmentally friendly vessel expected to reduce emissions of carbon dioxide (CO2) by approximately 45% based on EEDI, emissions of sulfur oxides (SOx) by almost 100%, and emissions of nitrogen oxides (NOx) by 80% to 90% by means of Exhaust Gas Recirculation (EGR) in addition to the use of LNG fuel, compared to conventional vessels using heavy fuel oil.

This vessel utilizes a variety of environmental measures and digital technologies in an effort to improve safety, environment, and quality that are important issues for "K" LINE.

Environmental Specifications: This vessel has been equipped with a dual fuel main engine and auxiliary engines (generator, boiler) capable of operating on either LNG or Marine Gas Oil (MGO). The main engine type is a high-pressure MAN B&W ME-GI for low GHG emissions by negligible methane slip (unburnt gas) and reduced CO2 emissions. In order to clear NOx Tier III regulations when using either LNG or MGO fuel, the vessel is equipped with not only EGR for main engine, but also Selective Catalytic Reduction (SCR) for Generator engines. LNG fuel tank on the vessel is an independent tank of type C so that vaporized gas can be kept in the tank for a relatively long period of time.

Digital Technologies: "Kawasaki Integrated Maritime Solutions" which is Integrated vessel operation and performance management system has been installed. Wi-Fi has been installed in the cargo hold, the engine room and LNG fuel-related equipment compartments in addition to residential area for improving efficiency of operations such as remote monitoring of the vessel interior. Several web cameras have also been installed in the cargo hold and in the engine room, enabling real-time monitoring via PC or mobile phone within the vessel using the on-board Wi-Fi. Recording is also possible, and the vessel's condition can be monitored from land via internet.

EQUIPMENT LIST

Ship Name	CENTURY HIGHWAY GREEN
Ship Type	PCTC
Ship Builder	Imabari Shipbuilding Co., Ltd.
Material	Steel
Ship Operator	Kawasaki Kisen Kaisha, Ltd.
Ship Designer	Imabari Shipbuilding Co., Ltd.
Delivery Date	March 12th 2021
Classification	ClassNK, DNV-GL

Main Particulars

Length, (o.a.)	199.98m
Length, (b.p.)	192.00m
Breadth, (molded)	37.20m
Depth, (molded)	36.51m (Accommodation deck)
Draft, (designed)	9.118m
Fuel Type	Dual Fuel (LNG & MGO)
Main engines	MAN B&W 8S50ME-C9.6-GI-EGRBP
Total installed power	9,380 kW

Photo Courtesy: Malin Group

Photo courtesy "K" Line

Inside the Scienco InTank Ballast Water Treatment System

Rudy Mes and Giles Candy of Scienco/FAST discuss advantages for ship owners and shipbuilders with the Scienco InTank Ballast Water Treatment System.

By Greg Trauthwein

How doest the InTank system stand out?

Rudy Mes We found that most vessels have issues (when) treatment is being done during the intake of ballast water or during de-ballasting, as it puts a strain on power consumption and pump capacity. So we decided we're not going to treat the water while we're in port, we're going to treat it during the voyage. (By treating the ballast water during the voyage) it doesn't put any restraints on the cargo operations and the crew is less busy, so it's also less stressful on them, too.

How do you treat ballast water during the voyage?

Rudy Mes Rudy Mes We take water on with the full capacity of the ballast pumps. And then during the voyage, we treat the ballast water with sodium hypochlorite that is generated in an electro-chlorination cell, or stored on board. We bring that into the ballast tanks and with nozzles we make sure that there is a circulation created in that tank to get the full ballast tank treated with the sodium hypochlorite. Then we have a 24 hour hold time. So the total minimum treatment time to treat an entire vessel is about 36 hours. When you come to port, all tanks are treated and neutralized so while in port, you can use the full capacity of the ballast pumps to unload your ballast water. That's a big benefit.

Can you give a full rundown of the advantages of the InTank system as you see it?

Giles Candy The reason I got involved with InTank in 2016 was it was a fundamentally different way of approaching ballast water treatment, a much more elegant, a more simple solution to the problem. As Rudy said, we're treating in the tank during the voyage. Why does that bring specific advantages? Well, as Rudy said, all of the ballasting operations that a vessel would normally complete in port are done completely as normal. You have no filters, you have no care what type of ballast you are ballasting, whether it's fresh, high turbidity, low turbidity, high biological load, low biological load, hot or cold: it really doesn't matter.

So that's a fundamental difference to every other ballast water treatment system on the market. Now, InTank does not remove the work of ballast water treatment. You still have do it. But it displaces that work from the port to the voyage, and we're probably around 36 hours voyage time required to complete treatment on most vessels.

It will start dosing the sodium hypochlorite and the circulation will go to the tank, and the water in the tank will use a certain amount of TRO. In different waters; clean Caribbean water will barely use any. Mississippi water might chew through that TRO at a higher rate. One of the major advantages of InTank is that this system has control over the degree of treatment it offers. With InTank, after a certain number of hours, the system revisits the tank and has a look at the TRO level. Now, if it was Mississippi mud that chewed through the TRO, we can add more. So you're controlling your treatment.

MARITIME REPORTER TV **Watch the interview with Rudy Mes & Giles Candy @ Bit.ly/3fq6c1V**

All photos courtesy Scienco/Fast

Inset photos above [L to R]: InTank Dosing Module and Circulation Pump; InTank Bulk Chemical and DeChlor Modules; InTank Dosing Module in existing Deckhouse; and InTank EC Module and DeChlor Unit.

Once treatment is complete, you then control your neutralization. So you have neutralized the water before discharge. If there is an issue (with the system), you're at sea, so hopefully you can fix that issue and complete treatment without impacting the commercial operation of the vessel. It gives so much more control to the operation of the vessel.

Ship owners want to spend as little time as possible in the shipyard, and the retrofit of BWMS on existing ships can be an engineering headache. What is a typical timeframe and process to get the InTank system installed?

Rudy Mes From the first contact we ask a lot of questions about the vessel specifics: ballast water capacity, number of tanks, etc., and then we start calculating three different options of the system that we could offer, options to consider different treatment times, different operational costs and initial investment costs. Based on the readiness of the vessel owner to share information, this process can be finished in a couple of days. When we sign a project contract with the owner, then we start the application engineering, which is determining (things like) how big the circulation pumps are going to be, how big the feed pumps are going to be, how many nozzles are in each tank to get good circulation. That process takes about two weeks. After that, we have integration engineering, looking at the tying points to the existing ballast system, integration with the existing automated valves on board (and pipe runs throughout the ship). That's a process that normally takes about eight weeks.

Normally, when we have a signed contract, the minimum time we need to send it out is about 16 weeks. Our production capacity is not an issue; it's more the third party (ie. pump and valve manufacturers) that puts a limitation on the availability of the system for the vessel owner.

Looking at the system holistically, are there any advantages for the shipyard?

Rudy Mes Our system is relatively small, about a 7 sq. m.

footprint (and it comes in smaller models), so normally it's easy for the shipyard to bring the equipment into the pump room or the engine room; they don't have to cut holes in the deck or inside the ship. During our integration engineering we can provide isometrics for all the piping, so the shipyard can prefabricate the spools so that when the vessel comes in the yard it's a relatively easy effort to install all that piping. If the vessel owner wants to keep the time they spent at the ship yard as short as possible, a large part of the installation can be done during voyage.

What about compliance?

Giles Candy Compliance is not talked about all that much at the moment. From the IMO's point of view, we're in the experience building phase. So it's no harm, no foul really at the moment. In the U.S. it is much more a paperwork exercise. There is very little biological analysis being completed. And in times of COVID, I think as long as there's not gross non-compliance, things are relatively relaxed. This is odd for a convention that was final in 2004, as here we are in 2021, and we still don't actually know how compliance is going to be assessed. It is on the agenda for MEPC.

And I would think by '24, maybe '25, there will be some hard guidelines for assessing compliance, but there are really two forms of compliance. One is technical and the second is biological. We don't have any real biological metrics or enforcement at the moment.

There is some technical enforcement. You've got to have a type-approved system on board and it should be working and operated correctly.

The next step is biological compliance and SGS recently issued a study completed with the Australian authorities showing more than 30% of discharges were non-compliant, non-compliance by over an order of magnitude for zooplankton. There is an army of compliance monitoring device companies proffering all sorts of solutions for quick analysis of biological load on the discharge and the standards are very high. This is something that's underestimated and you can be starting with a million zooplankton per cubic meter, quite regularly, a hundred thousand zooplankton per cubic meter. And you have to get down to less than 10. So this is a very high-performance treatment in order to succeed. And if you're just relying on filters for that, those filters have to perform really well all the time. InTank is designed to be robust enough to work without a filter. Whatever the water quality, the operator has complete control over compliance, both technical (TRO discharge) and biological (D2 performance standard)

Elastomeric Repair and Protective Coatings

By Peter Senger

No other means of transport are as exposed to the forces of nature as a ship. The word 'safety' takes on a special sense: safety for people, goods and the environment. Elastomeric protective coatings can help to keep the operational safety of the parts of the huge mechanism secured.

In terms of protection against wear caused by the destructive energy of cavitation, erosion and abrasion, there are still two physical schemes available: energy reflection through very hard surfaces, such as those achievable through plasma treatment, manganese steel, Hardox, tungsten carbide and similar alloys. And energy absorption by elastic substrates that absorb, store and release the energy when the energetic impact ends, as it is the case with natural rubber and synthetic MetaLine elastomers.

On the market since 1960 as a manufacturer of epoxy ceramic repair materials, MetaLine Surface Protection GmbH introduced in 1990 a range of elastomeric repair and protective coatings and opted for energy absorption.

"Thirty years ago we began developing a material that incorporates the primary technical characteristics of completely different materials," said Peter Schramm, Managing Director, MetaLine. "The application process is as straight-forward as with an epoxy-ceramic composite, but the compound itself functions like rubber, and finally possesses erosion qualities equal or greater than Duplex Steel (AISI316). The result is a hydrodynamic resistant castable and sprayable protective coating that provides unparalleled erosion/cavitation resistance."

This fundamental step was based on experience and knowledge from the epoxy ceramics business. While MetaLine covers the market with only three products, epoxy ceramic suppliers exchange their fillers creating numerous of similar compounds with identical limitations. They do not offer variations of their binder as this would negatively influence the easy do-it-yourself character of their products.

Epoxy ceramic materials try to fight wear with a low hardness which is far less than ordinary mild steel. The epoxy binder is not hard enough to become wear resistant by energy deflection and not soft enough for energy absorption. The ceramic content in these products cannot overtake that role, as composites always fail with their weakest element: the epoxy binder.

The most important maritime applications of epoxy ceramics are the rebuilding of worn surfaces, which are then coated with a protective layer, and quick repairs as an emergency solution until a spare part can be used.

The market demands more wear-resistant materials for professional applications with long service lives. The ongoing development of ultra-wear-resistant elastomeric protective coatings (cannot be removed by sandblasting) has led to today's MetaLine Series 700 supplied in three different degrees of hardness:

- **MetaLine 760** (60 Shore A) serves to repair soft rubber linings and worn fenders as well as optimizing the performance of hatchcover seals.
- **MetaLine 785** (85 Shore A) is the first choice for the protection of components subjected to erosion, cavitation, corrosion and wear: rudder blades and horns, kort nozzles, seawater/scrubber pipes, strainers, BWT reactors and installations, heat exchangers, pump impellers and casings, thrusters, jet propulsion drives, ropes, fenders, floating hoses etc.
- **MetaLine 795** (95 Shore A) develops non-stick properties. It offers an ultra low coefficient of static friction improving material and fouling release. Applications: cargo gates, off-loading chutes, hopper and bunker installations.

For surface prep, metal substrates are coated with MetaLine 924. This electrochemically active corrosion protection prevents borderline penetration on coating edges and protects damaged areas from rusting. After drying, a double coat of MetaLine 900 Universal Primer on solid surfaces or MetaLine 910 on rubber surfaces is applied. Finally, MetaLine Series 700 protective coating

Photos (from left to right)
1: One of the key safety-relevant aspects of ship operation is maneuverability. MetaLine 785 coating for long-term protection.

2: Tugs work hard. The high-revving propeller carries a huge flow of water, which leaves cavitation and erosion marks, especially on the suction-side edge and on the supports of the nozzle.

3: Seawater pipe before repair and coating and 5 years later. Only rust particles from unprotected areas have settled.

Photos courtesy of MetaLine Surface Protection GmbH

with required film thickness and color is sprayed on. For the purpose of visual wear control indication, the coating can be executed with color changes during application. MetaLine Series 700 can be recoated and repaired at anytime.

MetaLine Series 700 adheres to various substrates including steel, alloys, aluminium, rubber, concrete, wood and different plastics. The coating thickness ranges between 1 mm (40 mils) and 20 mm (.75 inch) and can be achieved on vertical surfaces without material sagging. It can be used in many climatic conditions. The solvent-free, two-component elastomer can be applied by spraying, injecting or casting by a low-pressure cartridge applicator (about 5 bar). After 5 minutes the coating is dry to touch and most parts can go back in service after 24 hours (at 20 °C / 68 °F). The temperature resistance is between -50 °C / -58 °F and +120 °C / +248 °F, depending on the relevant application.

The coating cures without any shrinkage or swelling. In addition to its chemical bonding process, a mechanical memory effect is developed. This permanently ties the coating to the substrate, thus counteracting any separation tendency that is normally associated with conventional rubber sheets. With strict adherence to all processing steps an adhesion/bond strength of at least 15 N/mm2 (2,175 psi) is achieved.

The low pressure spray mode creates an extraordinary smooth surface improving any fluid-flow dynamic. Efficiency increases of up to 3.5 % have been proven.

A coating of this surface quality cannot be achieved by common composite trowel applications.

The MetaLine technology allows seamless coating of the most complicated surface shapes.

With a density of just 1.05 g/cm3, it is a lightweight duroplastic wear protection tool. The material has practically no influence on the dynamic behavior of moving parts, with a dynamic abrasion of 55 mm3 according to DIN ISO 4649.

The material is non-toxic, safe to use and have been assessed by US & EU authorities as drug and food-safe according to FDA standards and relevant EEC regulations. MetaLine Series 700 has been used in civil and military shipping since 2012. In the meantime, a wide variety of marine equipment has been repaired or protected using MetaLine´s elastomer materials on more than 500 ships.

Profile: Anna Galoni CEO, Thordon Bearings

MARITIME REPORTER TV **Watch the interview with Anna Galoni @ bit.ly/3x7tsrx**

Photo Courtesy Thordon Bearings

While new to the CEO seat, Anna Galoni is long-tenured at Thordon Bearings, having worked in the company for more than 15 years, joining the Burlington, Ontario-company in 2007 after graduating from Queens University with a Masters' Degree in Epidemiology. The new leader of this family-owned company, Galoni shares her insights on the business and technology.

Thordon Bearings is a, global business which designs and manufactures a range of non-polluting, oil and grease-free bearing systems, seals and other shaft line products for the global marine, clean power, pump and industrial markets with more than 75 distributors in 90 countries. But the tech and the international reach are only part of the story, as Thordon Bearings is a Thomson-Gordon Group company, a business founded in 1911 by Major George J. Thomson.

Recently the company named Galoni as its fourth-generation leader, her appointment following the retirement of Terry McGowan, who stepped down after almost 14 years in the CEO role. Galoni shared with Maritime Reporter TV her insights on the future pace and direction of the company.

It is Easy being Green

"We are the pioneer in inventing the water lubricated bearings in polymer," said Galoni. "My father, Sandy Thompson, had a vision" to design and manufacture a bearing that does not need oil, thus eliminating the potential for water pollution. "Thordon has a very strong reputation with ship owners, and they return to Thordon for oil- and grease-free products" again and again. Galoni takes the top spot at an interesting time in business history, with the lingering impact of COVID-19 and all of the challenges that entails, as well as the marine industry's push for 'green' solutions.

Thordon's polymer bearing technologies have achieved worldwide renown as grease- and maintenance-free, environmentally safe alternatives to traditional bearings.

"My vision is to obviously grow the company; entering new markets, like aviation, forestry, mining, as well as growing our existing markets," said Galoni. "But to do that, we have to make sure that we have the right people to do it. We are a very complex business. We are very technical business."

Directly ahead she sees growing opportunities in the shallow-draft, workboat markets, as well as "a huge potential" in expanding its reference list of navies using Thordon solutions.

Thordon's penchant for investing in the latest tech will manifest itself again shortly, with the introduction of The Blue Water Seal, a complement to the company's COMPAC Open Seawater Lubricated Propeller Shaft System. While details are scant at the moment, Galoni said to stay tuned for more. "The main feature (of the Blue Water Seal) is its the safe return to port feature," said Galoni, noting that the seal should be on the market "in the next month or two."

– Greg Trauthwein

SNAME

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Tech Files

Shipyard Tools

SubArc Digital Converter Part of a Complete Digital Solution

Miller Electric expanded its digital capabilities for submerged arc welding (SAW) with the new SubArc Digital Converter. Designed for field applications including above-ground storage tank construction, as well as shipbuilding and bridge construction, the SubArc Digital Converter enables the use of digital SAW accessories, such as the 3-Wheel Tractor and digital control, with expanded equipment — including Big Blue welder/generators and Dimension 650 welding power sources.

www.MillerWelds.com

Norton BlueFire Abrasives

Saint-Gobain Abrasives introduced upgraded Norton BlueFire Abrasives including Belts, Cloth Quick-Change and Flap Discs, and Mini Flap Discs. Featuring a new, proprietary self-sharpening zirconia alumina grain shape and chemistry, and an upgraded resin bond for faster cut rates and durability, the new BlueFire R860 and R887D abrasive products are designed to give exceptional performance on a wide range of materials in light to heavy-pressure applications.

www.saint-gobain-abrasives.com

ICR Technowrap, Quickflange

ICR Integrity (ICR) won a three-year contract with Shell UK, with extension options, for the provision of Technowrap engineered composite repairs, as well as Quickflange weldless connectors, for all its UKCS assets. Scott Byers, Technowrap Key Account Manager, ICR said: “Both Technowrap and Quickflange are industry approved and qualified to several type standards and are proven in improving pipeline integrity and flow assurance, which is imperative to Shell.”

https://icr-world.com/

Starrett Reciprocating Saw Blades

The L.S. Starrett Company launched its new series of “3X Power” Bi-Metal Reciprocating Saw Blades featuring teeth that cut more efficiently, enabling users to make up to three times the number of cuts than conventional blades, and are engineered for use on corded and cordless saws. Starrett 3X Power blades are also highly resistant to breakage and feature a reinforced shank. King Cut 3X Heavy-Duty blades feature heat-treated teeth with a super-aggressive pitch set designed to slice through virtually any material.

www.starrett.com/3xpower

Ace Control Line Clamp

Ace Oil Tools, known for its proprietary ‘ratcheting technology’, has launched its new Ace Control Line Clamp (ACLC) to the well construction market. The ACLC has been designed to improve safety in offshore operations by enabling automation during the installation of control line clamps. Its innovative, revolutionary design ensures the ACLC semi-automates the control line process, reducing the need for workers in the red zone by 50%, and reduces the time spent in the red zone by 30%.

www.aceoiltools.com

Viega Fittings Earn Navy Approval

Viega MegaPress CuNi and ProPress copper fittings are the first press fittings approved for use in Navy combat ships. NAVSEA approved the use of MegaPress CuNi mechanically attached fittings in sizes ½-in. to 2-in. in surface combatants for a variety of systems, including chilled water, potable water, electronic freshwater cooling, seawater cooling, washdown countermeasures, drainage and others. ProPress copper ½” fittings were also approved for potable water and various drains.

www.viega.com

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SHIPPING 2025:
TODAY'S ACTIONS FOR TOMORROW'S BUSINESS

12-15 October 2021

Hamburg, Germany

BUYER'S DIRECTORY

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

ANCHORS & CHAINS

Anchor Marine & Supply, INC., 6545 Lindbergh Houston, Texas 77087 , tel:(713) 644-1183, fax:(713) 644-1185, david@anchormarinehouston.com

APPROVED U.S. COAST GUARD MARINE SANITATION DEVICES

Environmental Marine, Inc., 711 Colyer Rd., Bronson, KY , USA , tel:(606) 561-4697, bobkenison@aol.com contact: Bob Kenison, www.envmar.com

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

EXHAUST

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

INERTIAL SENSING SYSTEMS

Silicon Sensing Systems Ltd, Clittaford Road Southway, Plymouth, Devon PL6 6DE United Kingdom , UK , tel:+44 (0) 1752 723330, sales@siliconsensing.com

MEMS MOTION SENSING

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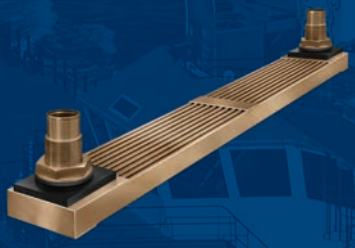

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