

Issue 55, October 2020

Horizons.

Connecting tomorrow's thinking to the challenges of today.





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There is no question that 2020 has been a year of challenges and one where the wellbeing of seafarers has dominated industry attentions, as referenced in Nick Brown's letter opposite, and in our next issue we will share the insights garnered from our recent survey on how the maritime industry has navigated the COVID-19 pandemic. This time around, you can learn how the commercial maritime sector takes its lead from the world's navies as Paul Bartlett assesses trends within the naval sector. You can meet Mike Holliday, new M&O president in SAMEA, as well as find out what is needed for the oil and gas industry to decarbonise. We have also collaborated with LR and industry experts for insights into alternative fuels and power sources such as hydrogen and wind power, while LR's Jennifer Riley-James answers frequently asked questions around upcoming IHM compliance. Our designer for this issue is Kaz Kapusniak.

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If you have any feedback or suggestions for upcoming issues of Horizons, we'd love to hear from you. Please get in touch with Paul Carrett at paul.carrett@lr.org



our teams around the globe.

What's happening in our world.

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Time for change.

All of us must act to protect the wellbeing of those who work at sea.

People are the lifeblood of every economy and every business. Regardless of whether you work in an office, a factory, a shipyard or at sea, it has not been an easy year for anyone. The global routine change forced by the COVID-19 pandemic has affected us all. The familiar patterns of our lives have been adjusted, the way we work has changed and sacrifices have been made along the way - particularly by the men and women onboard who tirelessly

keep the world's supply chains open.

Never has it been more important for us to look out for each other, to reach out and connect, and to offer help where we can. Many find blurring of the borders between work and home life difficult to navigate. This, coupled with anxiety about the current situation, is recipe for being tired and stressed. But with loved ones close at hand, support networks nearby and the opportunity to step away, take a walk and

clear our heads, we are almost always well positioned to persevere.

Many have been on onboard for months, far away from their families, fatigued future. Far too many crews have been at work for longer than expected. Facilitating crew change may be dominating industry headlines as well as the attentions of governments and industry bodies across the globe, but progress is slow, piecemeal and seafarers continue to suffer. In so many parts of the world, shipping lacks the public focus it deserves and the efforts of the people that move 90% of the world's good are all but invisible. This needs to change.

We all know what being underappreciated feels like. We all know how being tired



It is not that easy for the crews at sea.

can alter our outlook and our state of mind making the simplest of tasks so much more difficult. We all know how these factors can affect our ability to do our jobs as well as we would like. There is a clear link between wellbeing and and it is in the interests of us all, that we acknowledge and respect a healthy work life balance for those who work at sea. As leaders, we shouldn't sit back and allow circumstances to exploit their willingness to serve or let it box them into a corner with no other choice. And, at no time, should we overlook our responsibilities to safeguard, protect and champion the committed people who maintain our global supply chains. It is, without

Nick Brown

Marine and Offshore Director, Lloyd's Register



the long track record we already have

Unusually for a classification society, LR

Assurance providers usually stick to the

commercial shipping market since naval

vessels are exempt from conventional

regulations. Neither do they have to be

maritime regulations, including IMO

although many are these days.

has a strong presence in the naval business.

Conventions, Codes, and flag Administration

'classed' in the same way as merchant ships,

in this arena."

A naval lead.

Significant opportunities exist in this specialised arena as more nations seek to bolster their maritime defence forces.

Words: Paul Bartlett

Smuggling, piracy, border disputes and broader geopolitical issues are just some of the factors underpinning substantial naval investment around the world, estimated recently at about \$320 billion over the next three years. David Lloyd, LR's Global Naval Business Director, sees great potential. "There are significant opportunities to work even more closely with the defence sector and support our clients' evolving strategies and requirements," he says, "and build on

Class a preferred option

Lloyd reveals that many navies increasingly opt to have their vessels built to, and maintained in, class on a voluntary basis for a couple of reasons. One, they see the benefits of being able to tap into the latest technical capabilities of a class society, not only during construction but through the lifetime of an asset. And two, they see it as a means of keeping abreast of rapidly accelerating technology developments in the commercial sector, which could become valuable in a naval setting in future.

Although LR's pedigree in naval business stretches back more than 150 years, it is over the past three decades that it has become a sector of key strategic focus. It was at the UK Ministry of Defence's request that the classification society developed and published the first set of Naval Ship Rules in 2000. Since then, naval business has grown steadily and Lloyd, who joined LR in 1999 following a 16-year spell as an officer in the Canadian Navy, believes there is significant scope for further expansion. This, he explains, is because classification society assurance is now seen by many defence authorities as an essential component of establishing and operating a modern navy. Lloyd points out that support craft, auxiliaries, patrol boats and coast guard vessels are increasingly built in commercial shipyards because dedicated naval dockyards have been closed down. Plus, the latest advances in commercial technologies are assessed and assured primarily in classification society rules and flag Administration regulations, so it makes sense to use class rules as the basis for ensuring appropriate functionality and safety.

Over the past three decades, Lloyd reveals, LR has classed more than 400 naval vessels on behalf of 19 navies. Of these, 190 were built to Naval Ship Rules. Many ships are currently maintained in class, on behalf of 13 navies.

They include both combat vessels such as aircraft carriers, corvettes, destroyers and frigates, and support vessels such as auxiliary oiler/replenishment ships, landing platform dock ships, landing



LR's naval 'Grey Boat Code' goes global.

De Haas Maasslu Boat Code.

> The Interceptor DHM1050, a one-of-a-kind fast patrol boat, built by De Haas Maassluis B.V., has been awarded LR's Grey Boat Code (GBC) certificate. This is the first boat to receive this the outside of the United Kingdom and will be used as a demonstrator boat and innovation platform to showcase De Haas Maassluis design and workmanship to navies, coastguards and police forces around the world.

With a length of 10.45m and three outboard engines of 200hp each, the Interceptor DHM1050 has a speed of more than 54 knots. Classified by LR as a 'Category 2' boat, with a relatively large area of operation out to sea and up to 60 miles from a safe haven, the Interceptor DHM1050 is well suited for offshore and inshore operations. The GBC certificate confirms that this boat is suitable for onerous naval or paramilitary operations.

LR published the Grey Boat Code in 2019, the first of its kind for craft under 24-metres in length that operate in government service – typically navies, coastguards and police forces. The Code introduces a meaningful safety regime, setting standards of safety and protection for all persons on board these boat types, many of which are required to operate in hazardous environments and/or under unique conditions.

"The GBC has proved to be a great standard for our new DHM Interceptor series by offering a high standard with maximum flexibility to accommodate owner requirements on both technical and operational (mission) level. The cooperation with the LR team during the certification process was of a very high quality and has created a strong basis for future projects," a spokesperson for De Haas Maassluis said.

"We're delighted to see that the Grey Boat Code is being successfully adopted in countries around the world, particularly in the Netherlands with the De Haas Maassluis' Interceptor DHM1050. We continue to support the naval and broader governmental community with tailored solutions that provide our clients with functional and safety assurance where there are no appropriate statutory standards," LR's Global Naval Business Director, David Lloyd commented.



De Haas Maassluis – Interceptor DHM1050 is certified against LR's Grey



helicopter dock ships and air cushion vehicles. LR does not classify submarines but undertakes design reviews and provides assurance services on submarine components and systems.

Technology transfer

There are several strands to the expansion that Lloyd and his team are pursuing, but perhaps the most important is the issue of technology transfer. "For good reasons, navies tend to be risk-averse and must ensure that they have proven technology on their vessels. And since navies tend to modernise every 15-20 years, they usually start out from behind the technology curve.

"Although, for example, they are looking at new fuel technologies in a limited way, it is very unlikely navies will be taking the lead in the development of LNG, methanol, ammonia or hydrogen. There will eventually be lots of cross-over, but it will take time. As a classification society, we are already heavily engaged in these technologies and can provide continuing guidance on the latest state of play."

Independent scrutiny

Another key aspect of the value that LR brings to navies is due diligence. Lloyd reveals that, these days, many governments face a huge amount of public scrutiny over how they spend their money... more so, by far, than commercial entities. Independent advice is often required in relation to naval export construction - often of non-combatant, auxiliary vessels – but particularly on in-country naval spending.

Here, Lloyd points out, a range of factors, other than value for money, may well come into play. They include job creation, technology transfer and the protection of national infrastructure and security. "In these cases, the overall cost of building the naval ship itself becomes only one aspect to the overall policy or political objectives of the government in power," he points out. "In this case, due diligence can be demonstrated in many other ways than simply low-cost, on-time procurement – such as being able to independently demonstrate that a naval ship is fit for purpose and safe."

Lloyd also sees a growing requirement for environmental assurance in the future. He believes that navies will eventually have to demonstrate an equivalent level of environmental stewardship to that of commercial fleets, although they will not necessarily be compelled by statute to do so. "Therefore we will have an essential role to play in the transfer of technical and environmental knowledge from commercial shipping to the naval sector."

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In conclusion, Lloyd highlights the scale of global naval spend estimated from August 2019 to the end of 2023 – a total of \$319 billion (see chart opposite). Close to half of this involves construction projects in Asia, Australia and NATO countries, regions in which LR already has naval business in place.

"Growing geopolitical instability around the world is driving new naval ship construction business," Lloyd declares. "And since more navies are now realising the added value that we, as a classification society, can bring, I think there is a fantastic opportunity."

Merchant versus military shipbuilding – no easy switch.

As the world economy absorbs the aftershocks of COVID-19, shipyards face serious challenges. The orderbook is shrinking, cruise building facilities are in crisis, offshore construction has slowed, and shipbuilders are competing all-out for any routine business that's going.

At first sight, developing a naval construction capability might seem a business strategy worth examining. Many governments require a steady supply of frontline combat vessels and support ships and, as global relations become more fractious, defence spending is only likely to go one way.

There are certainly opportunities, and LR is already engaged in a broad range of naval projects across various regions including Europe, Canada, South America, the Middle East, South East Asia and China. Some of these involve shipyards with a dual capability - merchant and military construction.

But David Lloyd, LR's Global Naval Business Director, warns that it's really not as simple as it seems. And expert guidance is a precursor for any strategic move by a commercial shipbuilder into defence-related construction, he says.

"For shipyards building relatively simple commercial vessels, it's a major step to construct combat ships and supporting naval craft," he explains. "It involves a signifiant investment and I'd say it would be a formidable challenge for a traditional builder to switch to construction of complex naval ship. LR would be well-placed to help in such a transition but the approach to both design and construction are considerably different."

Lloyd explains that one of the key differentiators is that naval vessels do not have to comply with the same regulatory requirements as commercial ships. They don't have to comply with IMO Conventions or Codes, and they are not "flagged" by flag Administrations either, so in many cases there may be no regulatory authority to consult on design issues such as stability, fire safety or life-saving requirements.

"So naval vessels are built in a unique way, and some of the standard terms of reference in merchant shipbuilding do not apply," Lloyd says. "Naval ships - both combat and support vessels – may be built to far more exacting designs and





standards with which non-naval shipyards have little or no familiarity or experience.

"Unlike many commercial vessels, which are built as quickly and efficiently as possible for one task – carrying oil, bulk cargo or containers – and to maximise return on investment for their owners, naval ships are multifunctional, with front-line roles as well as routine operations including continuous surveillance and humanitarian assistance. They take years of planning and construction and their ultimate cost is often not known accurately in advance.

"Design focus is on survivability," Lloyd says. "Ship systems require robust redundancy. Multiple main engines and two separate shaft lines may be needed, as well as structural blast and shock protection, for example, considerable watertight subdivision, shielding against electromagnetic interference, main systems redundancy, and overall survivability in a conflict. Support craft are not as complex, but nevertheless must be built to function as expected and as safely as possible in a combat environment."

Lloyd emphasises one area of design and construction in which leading classification societies have a role to play. Technological innovation is gathering pace and LR, for example, is engaged in a range of development projects in the commercial sector – from new fuels and propulsion technologies to power storage, digital twins, autonomy and remote operations.

Despite the challenges, however, Lloyd believes that some commercial yards are capable of making the transition, and shipbuilders with experience in the construction of complex ship types probably head the list. He cites shipyards with experience of technologically sophisticated cable- and pipe-laying vessels, with advanced position-keeping capabilities, and multi-role offshore support vessels.

In conclusion, Lloyd says: "It is worth noting that shipyards capable of designing and delivering highly specialised commercial vessels that are technologically sophisticated are likely more able to make the transition into naval or coastguard ships than shipyards which are focused on more traditional tonnage construction. However, it is not an easy task for any commercial builder."

Navies around the world.

Looking more in detail at the global naval fleet, South Asia, the Middle East and Oceania combined has almost double the number of navies than the next largest region LR operates in. Fleet size is highly skewed due to the fact that16 countries own more than 200 vessels and 51% of the global fleet. The smallest third of navies own fewer than 10 vessels.







Composition of the in service fleet



Number of navies by vessel band

55 navies (**31%**) own fewer than 10 vessels

Total number of vessels by vessel band

There are 16 navies that have more than 200 vessels – collectively they own **51%** (6,865) of total active vessels



Crunch time for global oil and gas business.

COVID-19 has sown the seeds for fundamental change to many aspects of our lives. It has also cast a spotlight on energy consumption and the urgent need to adopt new sources of green energy. Decarbonising existing oil and gas production is a vital first step in ensuring enough time to develop the new energy technologies that are necessary in the global decarbonisation process.

Sean van der Post LR's Global Offshore Business Manager

International oil companies are at a watershed. "Big Oil has to reinvent itself if it wants to survive in a low-carbon world", the Financial Times proclaimed in a recent editorial. Chief Executive at BP, Bernard Looney, wants to produce 40% less oil over the next decade as the company believes that global demand may peak within the next few years.

One might not necessarily agree with BP's analysis, but the world's energy markets are certainly undergoing dramatic change, and consumption has been severely affected by the pandemic. But there are certain realities: oil and gas will remain key components of the global energy mix for many years to come, even as the muchvaunted "energy transition" gathers pace, because there are no other energy sources available today in sufficient quantities. This is due to a number of reasons including: economic imbalance, low adoption rates, current production capacity and infrastructure requirements.

This is where we need to clarify the terminology. Energy transition is a process that will take place over several decades. In the short and medium term, the term "energy integration" may be better because it more accurately reflects the likely course of events. Hydrocarbon demand will slow down as consumers favour various forms of green energy, which will become steadily more integrated into existing power supply systems.

Decarbonisation - essential step

Decarbonising the production of offshore oil and gas offers a fantastic opportunity to put energy integration into action. It is an essential step that energy companies must take because they no longer have a choice. Producing oil and gas is a very carbonintensive business.

Just to give an idea of scale – about 6% of energy produced in the UK is consumed during the process of oil and gas production, with huge implications for carbon emissions. The energy industry must find a means of producing hydrocarbons in a cleaner way. Its future will depend on this.

The International Energy Agency estimates that 15% of global energyrelated greenhouse gas emissions come from producing and distributing oil and gas to consumers. It is clear that many billions of tonnes of carbon emissions could be prevented each year if a robust drive to decarbonise were put in place. And there are relatively simple steps that could be taken immediately to cut carbon emissions in oil and gas production – minimising flaring, for example, and tackling methane leaks.

In a recent report on energy integration on the UK continental shelf, the country's Oil and Gas Authority revealed that a combination of offshore renewables – wind, waves and tides – and carbon

The future of verification – how LR is working with clients.

Despite the challenges that the industry has faced with regards to the oil price, cost consideration is not always of primary concern to LR's clients – speed and efficiency are the key drivers. Remote verification has been used more frequently because it can support resource constraints and increases speed and efficiency, but it should not be seen as a replacement for physical attendance. It is just one component of the evolving surveyor's toolkit, which includes data analysis, machine learning for review of maintenance data, remote witness and physical witness all combining to develop a risk-based approach.

There are certain tests that lend themselves to remote witness and the main factor is that the surveyor is able to make a judgement on the testing to enable him to commit to the safety critical system or equipment remaining suitable for the job.

The general view in the industry is that verification can and should evolve to provide more value in what is still an extremely hazardous industry – equipment is aging and accidents still happen. LR's surveyors already have excellent technical knowledge and provide a valued service, and we want to enhance that training and expertise to be able to provide a more risk-based approach in our service delivery. As time moves on, technology will improve and facilitate changes on how we deliver verification – investing in people will be key to how LR approaches this. capture and storage (CCS) in the UK's offshore sector could provide a 60% contribution towards Britain's net-zero carbon target by 2050.

However, there are a few examples of using sustainable energy to decarbonise oil and gas production that are in the early stages of adoption, although there are many concepts on the table.There are exceptions. Norway, for example, has achieved significant carbon reductions by using its abundant renewable hydroelectric "power from shore" at offshore facilities. And the Abu Dhabi National Oil Company recently revealed plans to use shorebased renewable electricity at offshore production facilities, thereby lowering its carbon footprint by an estimated 30%.

New revenue streams

LR's involvement spans various areas. For example, we are engaged in providing independent assurance on the likely success of a particular technology under development, and we undertake safety and risk analysis relating to the environment, people and assets. We also make available our expertise in maritime environmental compliance to the oil and gas sector, supporting companies in meeting today's safety and transparency requirements.

We already work on energy integration with various international oil companies and technology providers. What is clearly evident is that there are exciting opportunities to reduce greenhouse gas emissions – opportunities that could generate new revenue streams for the energy companies of tomorrow.

The most promising sustainable technologies that could be used in decarbonising oil and gas production include:

- Blue hydrogen produced in the steam methane reforming process using natural gas and CCS;
- Green hydrogen produced from water using renewable power from wind;
- Electricity from wind.

There are also many offshore concepts relating to waves and tides. Offshore wind technology, however, is already here, developing fast and set to play a key role in the decarbonising process.

The sector is not without its own challenges, however. For example, the hydrogen and electricity that is generated from offshore wind in the future will have to come from floating wind farms "over the horizon". But floating facilities are at an early stage of development.

CCS technology has been on and off the agenda several times because of its high cost and potential risk, but it is now firmly back on. It will provide a means by which carbon generated by heavy industry ashore can be captured and stored safely under the sea.

We are therefore working with our clients to assess the potential for repurposing existing end-of-life oil and gas facilities, turning them effectively from exporters of carbon to importers. Clearly there are significant safety and environmental considerations here because injection takes place at high pressure and robust containment is essential.

Access to capital

Both international oil majors and national oil companies will need access to huge volumes of capital, both to





undertake energy integration and, in the longer term, to see themselves through the energy transition. They will also need to invest heavily merely to sustain current production levels and keep the lights on.

During the pandemic, sentiment appears to have swung against oil majors more than ever. Yet even before that, sovereign wealth funds were extracting themselves from conventional oil and gas investments; green finance initiatives such as climate bonds opted to exclude oil and gas related projects; even private investors were selling their oil and gas holdings. Without more urgency, oil and gas companies will not be able to to attract and retain investors. Energy integration, using new low or zero-carbon technologies, will become a key strategy in this process.

LR's future role will be to continue to provide first-class independent advice and to the regulatory framework, safety and the management of risk. And we must be confident that the new technologies, as they are adopted, are fit-for-purpose in delivering the intended benefits that were promised.

What role does digital twin technology play in Bluewater's digital journey?

Peter van Sloten, Bluewater's Head of Technology Management, talks through the company's digital strategy and the importance of digital twin technology.

Digitalisation, although hardly a new concept, has become a buzzword for the offshore sector over the past three or four years. Bluewater's own digital voyage started in the late 1990s when the company, as a developer, owner and operator of floating production storage and offloading (FPSO) units, began digitally connecting design, vendor-supplied and as-built documents with equipment tags. Initially, finding the information needed to operate, maintain and modify the fleet for field changes or relocation proved too time-consuming. However, the picture had changed a decade later with the emergence of new technologies that enabled physical scanning and links with maintenance logs. Health and Safety Executive and European directives also drove the connection of records and certificates for projects greenfield and brownfield - which had to be maintained for the operating asset.

In the current era of the digital twin, Bluewater, like many other companies, is striving to connect its information sources dynamically to deliver a virtual (near-real life) image of an asset. This can be used to help maximise operational performance and improve execution of offshore asset modifications, mostly topside and marine-systems oriented.

There are four main thrusts to the initiative. One is the use of 3D laser scanning to create new or revised Point Cloud models of the FPSO topsides process plant. These are converted to 3D CAD visualisation models that engineering teams can exploit for designing modifications to, for instance, piping systems or mechanical handling routes. Experience so far has been positive, with modifications consistently easier and quicker than under the previous regime of comparing photos and offshore measurements with 3D CAD design models. A second investment has been in the use of tablet computers outdoors to support construction and commissioning phases and during operations and maintenance.

Another development is the creation of a digital twin of the FPSO's integrated control and safety system to enable remote monitoring from shore. Data taken from the array of sensors onboard the vessel undergo analysis: trends identified by data analysts and (over time) by Artificial Intelligence (AI) can lead to the adoption of proactive measures such as lengthened inspection and maintenance intervals.

More recently, the programme has expanded to include the hull structures and turret mooring system via the active connection of 3D Point Cloud data. Under a two-phase project, LR is developing a Structural Digital Twin (SDT) of the hull of Bluewater's *Glas Dowr* FPSO, creating a detailed finite element (FE) model of the hull structure.

Since its first conversion in the mid-1990s from a newbuild oil tanker, Glas Dowr has been instrumented with a unique set of sensors that monitor the hull's stresses and motions caused by waves and changing load conditions. These were used by the Monitas Joint Industry Project, supported by Bluewater and various oil majors, to develop an advanced hull monitoring system, including software that identifies and explains FPSO fatigue issues. After completing its initial, two-year assignment for Amerada Hess on the Durward/Dauntless fields in the UK central North Sea, the vessel underwent further topside modifications ahead of five years of harsh-environment service on Soekor's Sable oil field in the South Atlantic, offshore South Africa. A third refit followed in Singapore in preparation for five years of production on Eni's Kitan oilfield in the typhoon-prone Timor Sea.

The SDT model of *Glas Dowr* will help Bluewater assess the vessel's redeployment options and operational readiness, taking into account the initial and subsequent redeployment upgrades and inspection data from the vessel's operational history. LR will apply its proprietary Cloud-based technology to predict the vessel's global and fatigue hull strength in various geographical settings, production conditions and development scenarios, all selected by Bluewater and drawing on Glas *Dowr's* historical design, operational and measurement data. And by continuously compiling and processing sensor data, the SDT will present a constantly evolving picture of the FPSO's health status. Understanding the remaining useful life for future scenarios would then determine the modification scope, if any is required, for the chosen field and design life.

Following the redeployment, the twin would continue to guide operational decisions in order to regularly evaluate the FPSO's structural performance and to support maintenance and inspection in-service. As the SDT is built, maintained and trained using real-time data and evolves its predictions over time, it should reduce the volume of inspection and survey activities, helping Bluewater to focus attention on critical areas. Physical inspections can be replaced down the line by remote technologies supplying data to the `twin'. By factoring inspections data



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Since its first conversion in the mid-1990s from a newbuild oil tanker, Glas Dowr has been instrumented with a unique set of sensors that monitor the hull's stresses and motions caused by waves and changing load conditions. into predictions, the SDT should attain a level of fidelity that provides assurance to surveyors on the levels of risk, reducing the need for a physical visual inspection onboard the vessel. Minimising the need for inspections would also lessen inspection costs and the risk of downtime.

Bluewater's intention at present is to extend the co-operation with LR to *Glas Dowr*'s future operations offshore, and assuming the foreseen operational cost savings take effect, potentially to other assets in its fleet.

Today the company is connecting several platforms to its virtual asset image, from design to real-life sensor data and health diagnostics delivered by original equipment manufacturers and incident command systems. While data integrity is vital, digital twin investments can easily become excessive, in terms of time and expenditure. and Bluewater's view is that not all the benefits are tangible. However, proactive, remote monitoring and data intelligence by data analysts or AI can deliver increased efficiency, uptime, lower operational costs and emissions, and the company has already seen the results in existing engineering, procurement and construction projects and during operations.

A new wave of research to support the offshore floating facilities of the future.

Leading operators, certification bodies and engineering firms are partnering with the University of Western Australia and the University of Wollongong to form a research group to blend data science techniques with engineering to transform the operation of offshore energy assets.

Launching in 2021, the Transforming energy Infrastructure through Digital Engineering (TIDE) research hub will take insight from experimental and industry-generated data to inform and improve the design and operation of offshore energy infrastructure, a critical component of the global LNG market.

TIDE will feature experts from the core engineering disciplines of oceanography, hydrodynamics, offshore structures and geotechnics, who will work collaboratively with experts from the fields of statistics, extreme value and decision making theory, as well as machine learning. Predominantly drawn from the University of Western Australia (UWA), and University of Wollongong, along with various Australian and International research teams, researchers will work with industry partners including three of Australia's largest LNG producers – Woodside, Shell and INPEX – as well as classification societies such as LR and Bureau Veritas, and solution providers Fugro and Wood.

In June, the new research hub was awarded \$5 million (AUD) through the Australian Research Council Industrial Transformation Research Program. This will be supplemented by an additional \$20 million in cash, in-kind contribution and co-investment from industry partners and universities over the next five years.

"We're excited to be part of TIDE and to work with leading operators, engineering

firms and universities to tackle the major engineering challenges facing offshore facilities today and in the future. As the market gets tougher and the risk landscape continues to evolve, the TIDE Research Hub will provide important, up-to-date insight into the offshore industry over the coming years," says Jeff Baker, LR's Offshore Business Development Manager based in Australia.

"TIDE will help operators, class societies and the wider supply chain plan for the future will produce better designs, establish efficient operational procedures to maximise opportunities, and reduce unnecessary downtime – while remaining safe and compliant at all times," Baker continued.

Director of TIDE, Prof Phil Watson of UWA said "As the Australian energy industry strives to continuously improve safety and integrity within a landscape of optimised CapEx and OpEx, the TIDE Research Hub will be positioned to lead transformational research – all with the support of key experts in both academia and industry, including LR. TIDE will focus on lowering the cost of future production in order to assist Australian companies to cost-effectively maximise production, safely manage assets and minimise environmental risk."

TIDE follows on from the success of UWA's current Research Hub for Offshore Floating Facilities (OFFshore Hub), a multi-disciplinary research group which launched in 2016. The



Industry partners for the OFFshore Hub are Shell, Woodside Energy, LR and Bureau Veritas, each of whom have been actively involved in shaping the direction of research, driving adoption of new technologies with practical outcomes, and assisting with the mentorship of researchers and PhD students. The OFFshore Hub focuses on areas such as ocean forecasting, vessel motion and offloading, riser and mooring design, novel anchors and subsea foundations, and data analysis to assist with response prediction.

Throughout the OFFshore Hub, LR assigned subject matter experts from technical support offices and technology centres around the world to support individual Hub projects, providing a third-party compliance perspective and assisting in





As the market gets tougher and the risk landscape continues to evolve, the TIDE Research Hub will provide important, up-to-date insight into the offshore industry over the coming years.

the development of solutions that can be practically implemented to meet the expectations of offshore regulators.

By being part of the project, LR aims to develop existing and establish new classification Rules, standards and guidelines, based on the latest research outcomes from projects within the OFFshore Hub. For example, the current Hub project has helped LR develop specific industry guidance for nearshore positional mooring systems, a direct output of the research conducted around geotechnical engineering and mooring. This guidance is available for the next generation of nearshore projects,

providing more durable and reliable solutions for operators when it comes to mooring in challenging environments.

"The OFFshore Hub has offered many mutual benefits, with LR providing knowledge and expertise around offshore structures, helping students and researchers understand the complexities around the practical application of research findings, thus helping to steer and focus individual projects."

"With the OFFshore Hub now in its final year of activity, LR seeks to utilise key findings to inform the latest Rules, standards and guidelines, and bring the outcomes of this initiative to the wider industry. This will ultimately support our clients and other members of the supply chain with designing and managing safer offshore facilities.

"We anticipate that the TIDE Research Hub will take offshore engineering research to the next level, where further efficiency and reliability can be gained from the application of digital technologies such as machine learning," comments Baker.



Mike on:

Most striking change in maritime in the past 20 years

There are now fewer substandard ships. When I was a young surveyor, we frequently encountered unsatisfactory bulkers and very tired container ships, which have now left the global fleet. Regulatory developments, improvements in safety management systems, concentrated inspection campaigns and an increase in surveys, audits and vetting has lifted standards generally. That said, with the development of technology, the maritime industry has become more reliant on shore support for some equipment repair and maintenance challenges and this is now evolving further with the greater appetite and acceptance of remote capability.

On leadership

For me, leadership is about enabling the team to perform well and this involves being clear on strategy and

objectives while managing performance. You also need to be honest about what you don't know, so when arriving in a new country it's vital to get the view from local colleagues on the most appropriate approach for dealing with problems as it's rarely the first thing that comes to mind.

About Mike

He may not have been born within a stone's throw of the sea, but Mike Holliday has a penchant for water and an ability to make the most of the tides. A keen scuba diver, he is married to Maria and the father of Olivia and Philippa. Rugby is another passion, but a broken collarbone put paid to him taking this talent beyond university. "I have been mostly watching ever since, although there is a local touch rugby league here in Singapore with a really good group of guys. I enjoy popping down to that and having a run around and enjoying the banter."

Riding the tide.

SAMEA president Mike Holliday is no stranger to the highs and lows of marine and offshore.

Words: Nicola Good

Shipping is a notoriously cyclical industry - one with heady highs and rock-bottom lows. Being able to ride the peaks and troughs may not be to everyone's liking but it is a skill that the maritime industry demands. It's one that Mike Holliday, LR's new M&O president for South Asia Middle East and Africa (SAMEA), has in spades.

Having taken over from LR stalwart Piet Mast in July, the easy-going northerner is now charged with managing 280 employees, as well as activity in key shipping centres that include Singapore and Dubai. He takes on his new role at a time when the maritime industry is grappling with the fallout from the COVID-19 pandemic.

The test of the months – possibly years - ahead is not lost on Singapore-based Holliday, who is quick to acknowledge the demands of current times. "There are challenges all around - from ensuring the team remains safe and the real uncertainties around workload and how we service our clients, as well as what business holds in terms of growth opportunities," he tells Horizons. "The weeks ahead will probably add a few more grey hairs," he adds.

It is not the first time that he has endured a taxing situation in a leadership role. In 2015 he was transferred to Malaysia as Marine & Offshore Manager for South Asia at a time when the offshore industry was badly impacted by low oil prices. Sector downturns are usually accompanied by refocusing and restructuring operations with inevitable difficult decisions. Today's demanding climate is no different. As Holliday observes: "Just as we'd started to see a recovery and an increase in new construction orders, we are now faced with an unprecedented situation."

Holliday, however, is sanguine and eager to stress that "opportunities remain" in his part of the world. They certainly do. The headline grabbing Qatar LNG tender for around 60 vessels, for instance, is commanding the attention of many in maritime and sits firmly within Holliday's area. So too do Australia, loaded with hydrocarbon potential, and

Africa, where 15% of world investment is currently focused on sub-Saharan projects. And let's not forget the dominance of India, Singapore and Malaysia and their ability to draw the focus of world shipping.

Holliday peaks in maritime, having encountered the tanker boom times before the 2008 financial crash and as an account manager with the London Business team where he found himself looking after BP Shipping and Shell in 2012. This threeyear tenure, working with "experienced clients with vast fleets during significant fleet renewal programmes", was formative, especially as Shell was innovating and moving into new areas such as LNG bunkering and floating LNG.

A more recent career highlight has been supporting India's first floating storage and regasification unit (FSRU) project that LR secured with Swan Energy; recently delivered from Hyundai Heavy Industries in South Korea.

Professing to have "always been interested in engineering', Holliday's foray into maritime came via fire-fighting systems and water cannons for the offshore industry, him first landing as development engineer for an equipment supplier in Manchester after earning a degree in Mechanical Engineering. During this time, while travelling to shipyards in Asia, he encountered marine surveyors and the prospect of a surveying career appealed to him.

"I saw marine surveyors on the ships examining the machinery and I thought that was quite an interesting job. At the

People are going to have to accept that decarbonisation is going to happen and we have to start addressing it now.

time. I felt I'd kind of learned as much as I was going to learn in the organisation I was working for and I contacted LR. It was suggested I apply for the graduate development scheme and I joined in 2002."

Early career placements took him from building submarines at Barrow-in-Furness to the Queen Mary 2 and cruise ships in St Nazaire ("where the lunches were a lot better"). He then spent eight and a half years in the Middle East, first in Dubai and later Abu Dhabi, moving up the ranks from a trainee to senior surveyor before taking on business development roles.

Maritime's changing fortunes and developments have been a constant throughout Holliday's 18-year career and decarbonisation and digitalisation two landmark transitions - will similarly test the industry in the decade ahead.

"People are going to have to accept that decarbonisation is going to happen and we have to start addressing it now," he says. "Zero-carbon ships need to enter the fleet before 2030 – it's not really that far away and some owners are still more focused on addressing their current challenges and leaving their more progressive peers to develop the solutions. There is always a worry that the followers might not like the outcome.

"As is stands, no-one knows what the answer is, but let's start exploring some of the possible solutions – getting the technical teams together and working through the challenges. It is definitely a time for collaboration."

World first for liquid hydrogen transportation.

The launch of the first LH₂ tanker heralds a new era for the bulk carrying of non-hydrocarbon gases. SIGTTO's Andrew Clifton assesses the challenges and the vital role of classification societies for the pioneering vessels to come.



Andrew Clifton General Manager and Chief Operating Officer of SIGTTO

The world is rapidly decarbonising; the process is happening a lot quicker than previously envisaged. So, it is quite likely we will see members of SITTGO (The Society of International Tanker and Terminal Operators) in the near future carrying non-hydrocarbon gases in bulk such as liquid hydrogen (LH₂) and carbon dioxide (CO₂) as cargo onboard purpose-built vessels.

We therefore noted with great interest the launch of the world's first ever H₂ tanker just before Christmas 2019 in Kobe, Japan.

The Suiso Frontier is designed to transport liquefied hydrogen (Suiso being the Japanese for hydrogen). The LH₂ cargo is cooled to -253°C; at this temperature, hydrogen is at atmospheric pressure and occupies just 1/800 of its original vapour volume. Suiso Frontier has one, 1250m³ vacuum-insulated, Type C storage tank and is on schedule for delivery in late 2020. Once operational, Suiso Frontier will transport LH₂ from Australia to Japan. For this trade, the hydrogen will be produced by a prototype brown coal gasification facility at Port of Hastings in Victoria, South Australia. The LH₂ receiving terminal is being built near Osaka in Kobe Prefecture, and the project is to prove the feasibility of bulk LH₂ shipping by sea.

When burned, hydrogen releases energy and produces only water – and no greenhouse gases. This makes it a very climate-change-friendly fuel.

From the environmental perspective, LH₂ is classified according to the production method. Brown coal gasification clearly involves fossil fuels, though in this case the Australian plant is being constructed with "carbon capture" and storage underground offshore. So, this cargo is referred to as "blue hydrogen". "Grey hydrogen" is produced directly from hydrocarbons but without carbon capture. Production involves using electrolysis by a renewable source of energy and therefore does not involve fossil fuels or greenhouse gas emissions. Green hydrogen is clearly a long-term solution option for decarbonisation. In the USA, NASA has used hydrogen as fuel for the space shuttle and other rockets for many years. NASA has three barges – pictured below – to carry bulk LH₂ between its facilities on the inland waterways of Louisiana, Mississippi and Florida. It is understood that on at least one occasion, a NASA barge fully-loaded with LH₂ was towed from the US Gulf to the European rocket launch facility in French Guyana.

As LH₂ had never before been envisaged as a regular bulk cargo to be carried at sea, hydrogen was not included in IMO's IGC code. When the *Suiso Frontier* trade was planned, SIGTTO played an integral part with the class societies in drawing up the Interim guidelines for the carriage of liquid hydrogen in bulk; this was attached to the IGC Code and agreed at MSC 97, being formally adopted by IMO on 25th November 2016.

There are many challenges to carrying liquid hydrogen at sea, not least the extremely low temperature at atmospheric pressure, the unusually high upper explosive level, the extended flammable range and the very small molecular size. The extreme cryogenic carriage temperature of -253°C for LH₂ at atmospheric temperatures presents unique challenges; after all, the cargo is only 20°C above the absolute zero of temperature (also known as "zero degrees Kelvin" and written as "0K").

Many of these challenges are not experienced even when carrying LNG at -160°C. For example, onboard LNG carriers, nitrogen is used in spaces around the cargo containment system such as barrier or annular spaces. It is not possible to use nitrogen in such places on an LH₂ carrier, as nitrogen becomes liquid at -196°C at atmospheric pressure so it would condense if in contact with a surface at LH₂ temperature. Likewise, oxygen has a boiling point of -192°C and liquid oxygen could form if oxygen (or air) came into contact with LH₂ containment. Helium is the only practical gas for inerting LH₂ system; unfortunately, this is a very expensive product, and would be very challenging to produce onboard, if possible at all.

Fortunately, there are several grades of austenitic stainless steels that are suitable for extremely low cargo temperatures. However, the hydrogen atom is the smallest of all the elements, and the molecular form (H_2) also has an extremely



↑ **Above** The NASA Liquid Hydrogen Barge fleet

→ Right
Suiso Frontier on launch day



small size compared to more common gases such as methane. So LH₂ has a very high permeability compared to LNG, which means hydrogen can leak more easily through the tiniest of cracks or gaps; this is a classic example of Graham's Law of Diffusion. Weld metal surfaces can also potentially suffer hydrogen embrittlement in LH₂ service.

Hydrogen has a very wide flammable range of 4% to 75% gas-in-air; this compares to 5-15% gas-in-air for LNG. Furthermore, the extremely low minimum ignition energy of hydrogen gas/air mixtures of 0.017mJ (compared to 0.274mJ for methane) creates additional challenges for leak prevention. leak detection and ignition protection. For example, a different standard is required for "certified safe" electrical equipment on LH₂ carriers – both fixed and portable. In addition, in the event of a cargo fire, the low luminosity of visibility of a hydrogen flame can cause problems for fire detection. The high flame velocity can lead to detonation and an associated shockwave.

In order to manage boil off onboard Suiso Frontier, the Type C cargo tank provides significant "pressure containment" capability due to the higher operating pressure. In addition, a Gas Combustion Unit (GCU) is fitted to deal with excess boil-off.

In principle, the boil-off management options are similar to an LNG vessel. One option for future designs is to use the hydrogen boil off gas as main engine fuel. However, this is not included in the design of Suiso Frontier.

The design, construction and operation of any pioneering prototype ship such as *Suiso Frontier* calls for a comprehensive risk assessment and the incorporation of suitable risk mitigation measures – in close association with classification societies, who can bring unique experience to the table. Ships like this will be designed using a major hazard risk management tool such as "Bow Tie".

Once delivered, SIGTTO will be monitoring the operation of Suiso Frontier, seeking to learn as much as possible for future guidelines for the safe carriage of this absolutely unique cargo – both for members and for the shipping industry at large. One of SIGTTO's key roles is to develop "Best Practice" for stakeholders in this fast developing "Suiso" energy frontier.

New guidance aims to advance methanol bunkering.

The LR developed Technical Reference will help shipowners, ports and bunker suppliers understand the processes and procedures required for the safe use of methanol as a marine fuel.

Douglas Raitt LR's Regional Advisory Services Manager



To meet the IMO's 2050 ambitions on halving GHG emissions from 2008 levels, zero-carbon vessels need to enter the world fleet by 2030. As Tim mentioned in the previous article, ship technology and operational efficiency will most likely run its course in terms of incremental benefits of reducing shipping's carbon intensity by 2025. For shipping to continue to be able to transition further to achieve the IMO stated goals by 2050 inevitably lower carbon and zero carbon fuels must be adopted by the industry within the new few years.

There are a variety of candidate options: fuels derived from natural gas with carbon capture systems, bio-derived fuels and electro-fuels (see table below).

LNG, methanol, ammonia and hydrogen are all low-flashpoint fuels with LNG currently well established under the IMO's IGF code (Code of Safety for Ship Using Gases or Other Low-flashpoint Fuels). Methanol, ammonia and hydrogen still have some way to go to be formally established within the IGF Code. Looking in particular at methanol, as a first step a Circular covering the Interim Guidelines on the use of such a fuel onboard ships is to be considered for approval by the IMO's Maritime Safety Committee (MSC) at its 102nd session, which is re-scheduled to take place 4-11 November 2020.

Recently, LR and the Methanol Institute worked together to facilitate methanol as a candidate fuel for decarbonisation through the development and publication of a Methanol Bunkering Technical Reference. The prescriptive guide provides checklists for shipowners, suppliers and port authorities to become more familiar with methanol bunkering and help accelerate its use.

Methanol bunkering is not that dissimilar to marine gasoil bunkering, however there are some challenges with regards to the toxicity of methanol, and in firefighting, but these can be safely navigated. The LR developed Technical Reference provides operational safety management protocols which, when applied, would significantly reduce the low-flashpoint fuel concerns, and other challenges previously mentioned, with methanol bunkering. It is already in use on product tankers, ferries and harbour craft and the Technical Reference will allow other ship type sectors to consider methanol as a candidate fuel in the transition to full decarbonisation.

Methanol, as a single carbon molecule, is currently mainly produced from natural gas but could alternatively be produced renewably from green hydrogen combined with CO₂, transitioning to, full net-zero carbon lifecycle emissions, or 'electromethanol'. If the industry starts to use methanol now with lower carbon emissions, it would then be able to transition over time to net-zero carbon emissions as we evolve from grey, to blue to green methanol in the next 10 to 20 years.

→ LR and the Methanol Institute's Bunkering Technical Reference can be downloaded at: info.lr.org/ l/12702/2020-08-28/9fb9l5

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Candidate fuel options to decarbonisation of shipping.

Energy source	Methane	Methanol	Hydrogen	Ammonia	Electricity	Diesel
Natural gas with carbon capture and storage			NG-Hydrogen	NG-Ammonia		
Biomass	Liquid Bio-Methane	Bio-Methanol				Bio-Diesel
Renewables	Liquid Synthetic Methane	e-Methanol	e-Hydrogen	e-Ammonia	Batteries	e-Diesel

Lower to zero carbon fuels



Wind power strengthens as decarbonisation drive becomes more urgent.

Creating additional thrust through the power of the wind is the focus of many pilot projects but there are signs that some wind-assisted technologies are ready for rollout.

Words: Paul Bartlett

Harnessing the power of the wind to supplement thrust developed by ships' engines is now a key focus as shipping's decarbonisation process becomes more pressing. Traditionally viewed with benign scepticism by shipping folk based on wind variance and the practical challenges of putting sails on cargo ships, today's smart wind propulsion systems are rapidly climbing the decarbonisation agenda, both for new and existing vessels. A wide range of projects are at various stages of development, and LR is involved in many of them.

There are many concepts: from soft sails to hard sails; from wings and foils to kites. And if membership of the sector's London-based trade body, the International Windship Association, is anything to go by, interest is surging forward. Over the past five years, its membership has grown from around 10 to more than 100. What has almost certainly helped to propagate this rapid development is shipping's digital transformation, enabling real-time sensoring, accurate measurement, performance monitoring, and robust shipshore connectivity.

Spectre of ETS adds urgency

Growing environmental concerns are providing another boost to the fledgling sector. Rarely a day goes by without mention of shipping's carbon footprint and the slow progress in reducing it. The latest salvo launched at the maritime sector, without which world trade would grind to a halt, is the European Plan to include the global shipping business in its Emissions Trading Scheme (ETS) from 2022. The move is a further warning of what may happen if shipping doesn't get a move on, environmentally.

Shipping economist Dr Martin Stopford pointed out recently that about half of shipping's carbon emissions between now and 2050 will be generated by cargo ships that are already on the water today. Describing shipping's 61,000-odd existing cargo vessels as a "real-time laboratory for developing and trialling new technology", he pointed out that older ships have less capital tied up in them and therefore they are more suitable candidates for experimentation. Wind power retrofits are a great example.

Sailing more slowly is less of an issue for a fully written-down ship. And, Stopford said, just as shipowners continuously retrofitted boilers, engines and other machinery in the switch from sail to steam two centuries ago, so today's owners should be testing carbon-reducing technologies, including wind power, in reverse.

Wind is free... except it's not

Of course, the wind doesn't blow all the time, but when it does, it's free, and provides spectacular results. On some sea routes, wind is very reliable and potentially large energy savings are possible. But systems are expensive and the question of who foots the up-front bill is a constant constraint. However, creative thinking and new business models are making the upfront investment more affordable.

Some proactive charterers have shown a willingness to support projects with

post-installation charter contracts, but as in other decarbonisation initiatives, more collaboration is necessary. Wind propulsion experts point out that proven technologies could face a rapidly expanding retrofit market as the IMO prepares to introduce its Energy Efficiency Existing Ship Index (EEXI) in 2023. Efficiency gains will be essential to to meet this requirement and with potential carbon levies on the horizon as well, the return on investment will improve.

One possible impact of the pandemic, according to LR's Ship Performance Manager, Dr Chris Craddock, is that newbuilding plans are postponed or cancelled, existing ships are kept for longer, and more capital is freed up for performance improvements and carbon emission reductions. This process must, in any case, become a feature of shipping if there is any chance of meeting the IMO's 2030 carbon reduction target and later its 2050 ambitions.

Only some of the concepts are likely to gain traction, but sails of one kind or another have already been installed on various cargo vessels. Modern-day development of the Flettner rotor, a cylindrical "spinning" sail developed by German engineer Anton Flettner, is being pursued by at least two companies, including Helsinki-based Norsepower and London-based Anemoi (see box).

LR verifies post-installation fuel savings

The wind propulsion sector was given a high-profile boost when Denmark's Maersk Tankers decided to install two Norsepower Rotor Sails on its 109,647dwt Aframax products tanker, *Maersk Pelican*. The beforeand-after results of the two-sail installation were independently tested and verified by LR and savings of 8.2% were clocked over the 12 months following the 2018 installation.

The two 30m-high, 5m-diameter Rotor Sails are types of Flettner rotors and use the Magnus effect to create forward thrust. LR's Ship Performance team is continuing to monitor the tanker's performance.

Helsinki-based Norsepower is a frontrunner, with installations on four vessels: Viking Lines' LNG-powered Viking Grace (Stockholm – Turku), Scandlines' MV Copenhagen (Rostock – Gedser) and MV Estraden, a roro vessel owned by Finland's Bore Line. Later this year, Norsepower will be retrofitting two 35m by 5m tiltable Rotor Sails on board the *SC Connector*, a ro-ro operating in the North Sea, which could achieve fuel savings of up to 25%, it is claimed. These will be the first tiltable Rotor Sail installations, a design initiative to counter air draught constraints.

Despite such installations, Norsepower CEO Tuomas Riski remains a realist. "Our technology is clever, but it's not cheap," he says. "Although our Rotor Sails were successfully installed on board the *MV Copenhagen* in just a few hours, this followed months of meticulous planning and, of course, design and manufacture of the sails themselves. Even before this, we knew we had to find a way of helping owners to fund the capital expense.

New pricing model

"Now, we can offer our Rotor Sails under the 'Technology as a Service' banner. This means that the upfront cost of the kit is replaced by a monthly fee based on the actual fuel that is saved. We believe this is a fair and equitable arrangement and should prove popular with ship operators who pay for their own fuel."

Since the wind blows more steadily and strongly in some regions than others, the savings possible from shipboard installations vary widely. This was one of the factors that has led to the development of **LR's Flettner rotor simulator**, a means by which the relative benefits for a certain ship type on a particular route can be estimated.

A recent project supported by the Wind Assisted Ship Propulsion (WASP) project and European funding has involved the installation of eConowind's Ventifoil system on the 3,600dwt general cargo ship, *MV Ankie*, at Royal Niestern Sander shipyard in the Netherlands. The LR-classed vessel completed her first wind-assisted voyage this year, sailing from Delfzijl to Hamburg, then to Norway and back to Rotterdam. Fuel savings were projected to be about one tonne per day on the small cargo vessel.

In another initiative, LR has carried out computational fluid dynamics analysis for Windship Technology, of which ex-Concordia Maritime Managing Director and Chairman of Intertanko, Lars Carlsson, is a director. The widely patented Windship system creates additional forward thrust with a vertical rig comprising a three-wing set of foils 35-45 metres high.



Anemoi's spinning sail.

London-based Anemoi, a specialist in harnessing wind power for commercial ships, has developed a range of patented Deployment Systems based on the Flettner rotor concept, which uses the Magnus effect to generate forward thrust from cylindrical sails that spin. Supported by LR in design services and plan approvals, the Anemoi Rotor Sails have been developed for all vessel sectors and wide-ranging operational conditions.

A first Anemoi system was installed at the company's shore-based facility in 2014. This prototype Rotor Sail is used continuously in a coordinated test programme, providing data to optimise the technology. Research and development has involved scale model and wind tunnel tests.

The sails are based on three distinct arrangements and can yield fuel and emission savings of 5%-30%, the company claims. The first arrangement is a fixed installation, attached to the ship's deck in one position. The second version is a folding system, allowing the sails to be lowered from vertical to horizontal for vessels with operational constraints, including port operations and air draught restrictions. A third, rail-mounted set-up allows the sails to be moved horizontally or longitudinally about the deck on arrival in port so there is no impact on cargo-handling operations.

The rail-mounted system, which consists of four rotors, was installed on the geared 64,000 dwt ultramax bulk carrier, mv Afros, in 2018. The vessel, owned by Piraeus-based Blue Planet Shipping, has since won a range of awards, including the 'Ship of the Year' at Lloyd's List's Greek Shipping Awards in 2018, and the 2019 Green4Sea 'Dry Bulk Operator Award'.

Kim Diederichsen, Anemoi CEO, says: "This is a truly green technology which requires very little input from the crew. Maintenance costs are low, despite the Rotor Sails having a life span of 20+ years. We believe the technology will be integral in the shift towards sustainable shipping, a process which is accelerating as the maritime industry tackles the decarbonisation challenge.

Windship's technology is targeting the tanker, bulk carrier and ferry sectors. It has been tested in Southampton University's wind tunnel and has had aerodynamic performance optimisation undertaken by flow analysis experts Cape Horn Engineering, in Portsmouth, UK. Windship claims that its windpower system is the most powerful setup so far. Combined with other energy saving initiatives and slow steaming, the company says it has the potential to cut fuel consumption and emissions by up to 80%.

"Over the past few months Windship Technology have taken a holistic view to a complete ship solution and have further enhanced their Windship rig system to include a new drive train and hull form. This has resulted in an 80% reduction in fuel consumption and the world's first 100% net zero carbon vessel." Simon Rogers, Director, Windship.

Superyacht owners show their sustainability streak.

LR Yacht Segment Manager Engel-Jan de Boer says eco-efficiency a key consideration in sector where many new technologies are trialled.

Words: Paul Bartlett

If you're lucky enough and sufficiently rich to have a superyacht of your own, it's more than likely that you'll already have a relationship with LR. The classification society, which has been working with the owners of high-end private yachts for longer than most, has a market share of 62% of vessels on the water in the 500gt-plus category, and more than 70% of today's 83-ship orderbook in this segment.

LR provides a comprehensive startto-finish service ranging from design validation through construction assurance, commissioning, the oversight of through-life care, maintenance and periodic surveys, upgrades and refits, and eventually, decommissioning and recycling. The process involves a deep involvement and appraisal of the many new technologies which the owners of these vessels increasingly want to install. Some of these find their way through to commercial vessels, albeit in a scaledback and more utilitarian form.

According to Engel-Jan de Boer, LR's Yacht Segment Manager, the yacht industry is "the Formula 1 of the shipping industry" where many of the latest technologies are trialled.

"It is a huge fertile ground with owners wanting to participate in exciting new projects, which can then be upscaled to the commercial shipping world. For far too long, the industry has had an image of tycoons and villains owning and operating yachts for their own entertainment. But the opposite is evident in the projects we have been involved with recently in this sector."

Focus on eco-efficiency

In fact, de Boer reveals that the high-networth individuals who own these luxury superyachts are a fascinating bunch. They have sharp minds, a close attention to detail, and a desire to understand and pioneer new technologies whenever possible. Today, many of them are closely focused on eco-efficiency and sustainability.

A key differentiator of this sector, de Boer explains, is the fact that steady growth rarely falters and there are always plenty of new vessels at design, construction, and commissioning stages. And LR's existing market share – 42% of the 5,567 vessels of all sizes currently in service – means that the class society is well-placed to track latest technology developments and win more superyacht business.

The orderbook provides compelling evidence. Although RINA is classing 43% of yachts currently under construction in numbers, most of these are relatively small, in the sub-500gt category. In terms of gross tonnage, LR has a 47% share compared with RINA's 20%, at number two.

So why is demand for luxury yachts so inelastic? De Boer says that it's partly because the number of very rich individuals in the world continues to rise, almost regardless of the state of the world economy. But there are other factors too. Superyacht owners want to be able to go to places where others have not been before, such as the Arctic and Antarctic, and they want to sample and offer to privileged friends the unique experiences made possible onboard some of the most luxurious vessels afloat.

De Boer notes that across the environmental considerations that are

climbing the agendas of yacht owners, interest in wind is strengthening. More are now interested in sailing vessels, he reveals, such as the three-masted 106.7m *Black Pearl*, delivered in 2018 (see box) whilst many are adopting hybrid power systems with batteries, including the recently delivered *MY Dreamboat* and the *MY Bravo Eugenia*.

A trailblazer here was the 2012-built sailing vessel *Rainbow*, a J-Class vessel based on the lines of the original 1934 America's Cup winner, designed by William Starling Burgess. The LR-classed vessel has a classic interior true to the 1930s, but a modern hybrid propulsion and power system specially designed and engineered for the vessel.

Technology transfer

Solar power and other sources of energy are hot topics. De Boer highlights sails with solar panels and comments on the pressing need to keep abreast of the latest developments. "We published Rules and Regulations for Sail-Assisted Ships last year," he explains, "and this July, we launched Requirements for Wind Propulsion Systems, a development from the experience and know-how we have with sailing yachts now being extended and transferred to commercial ships."

A range of other sustainability features are now also found on owners' shopping lists. "Cyber security, data analytics, glass constructions, 3D plan approval techniques, and environmentally friendly solutions such as hydrogen and battery propulsion are amongst developments that are catching the eyes of more environmentally conscious and forwardlooking owners," de Boer says. Bound by non-disclosure agreements, he cannot reveal details of the hybrid systems under development involving hydrogen and other fossil-free fuels of the future.

"Since many yachts are used both for their owners' pleasure and business, top-notch connectivity is essential," he continues. "Therefore, the very latest communications technologies are to be found on these vessels. The availability and use of data are also changing the way we work with yachts and their owners in this sector. Systems and components are becoming more autonomous, allowing for remote condition monitoring and predictive maintenance.

"This is already having an impact on the way class societies operate. Remote inspection techniques are often used now for smaller tasks such as verifying that a repair has been undertaken and completed, and ensuring that minor damage has been rectified." "The environmental footprint of construction, operation and maintenance has become, and will remain, a hot topic," he predicts. "And the industry is developing a Yacht Environmental Transparency Index (YETI) to make owners even more aware of their environmental profile. The drive for owners to reduce their eco-footprint is good news for us – it generates significant demand for our core classification and consultancy services."

Power of the wind

As to the future, de Boer is convinced that wind power will play an important part in the sector's propulsion developments. These are also likely to have a bearing on wind propulsions in the commercial sector, an area he thinks has great potential.

"If slower steaming becomes the norm and global economies are less reliant on the



'just-in-time' principle, of which COVID-19 has demonstrated the dangers, Rotor Sails and Ventifoils will probably become more common. I doubt that there will be a push towards fully sail-operated vessels, but on some trade routes and liner services, these could be possible.

"Actual propulsion systems using wind vary in configuration and we have been involved in a range of different technologies. Our rules and regulations apply to the rig insofar as this structure is used for propulsion purposes. The actual propulsion force may be generated by sails that are hoisted on the mast (a fore-andaft rig, for example), rotation of the mast structure itself as in the Flettner rotor concept, or other ways of capturing wind force and transferring it to the hull.

"In a way," he muses, "we are going back to our roots in 1760 when wind power was the only source of propulsion."



Jewel of the sea.

The LR-classed *Black Pearl*, owned by Russian billionaire oil and gas magnate Oleg Burlakov, is almost 107m long and the largest sailing yacht in the world. Bought by her owner for about \$200m in 2018, the tri-deck vessel is instantly recognisable and is the result of a string of distinguished yacht design outfits, including Dykstra Naval Architects, Ken Freivokh, Nuvolari Lenard, BMT Nigel Gee and Gerard P Villate. She has a steel hull and an aluminium superstructure.

Her most distinctive features relate to her wind propulsion. She has three DynaRig carbon masts supporting a sail area of 2,900 sq m, all of which can be set at the push of a button in seven minutes. Supporting her sail power, the yacht also has a hybrid propulsion system comprising two 1,080kW and two 400kW MTU electric propulsion motors, and a waste heat recovery system.

Accommodation available on board includes a master suite, two VIP suites and two double cabins. The yacht has a beach club extending across her 15m beam that can also be used as a cinema.

Documents, Digitisation and Data: A look at digitising our Ship Plan and Survey Report Collection.

Since 2016, the Lloyd's Register Foundation, Heritage & Education Centre has embarked on an extensive digitisation project to conserve, catalogue and digitise its historic Ship Plan and Survey Report Collection.

The Collection, which dates from the 1830s-1970s, holds over 1.25 million documents and details the design, construction and maintenance of ships classed by LR. Through survey reports, ship plans and handwritten correspondence, the collection highlights the important role LR has played in the development of marine safety.

Deep in an archive storage facility in Woolwich, London, sits a treasure trove of 1,133 port boxes, from Aberdeen to Yokohama. The contents of each box can vary. Most of them will hold a selection of survey reports; periodical surveys carried out by Lloyd's Register surveyors that include information on a ship's build, dimensions, owner, classification and voyage. But a plethora of other document types are often found. Telegrams, memos, forms, certificates, photographs and ship plans also reside in the collection; highlighting the sheer diversity of the collection's holdings and educational value. As the Ship Plan and Survey Report Collection has never been catalogued before, the Heritage & Education Centre are frequently uncovering never before seen documents.

Many famed ships are included in the collection such as Cutty Sark, Mauretania and Dunedin, as well as ships that were the first of their kind, including Fullagar (the world's first fully-welded ocean-going ship) and Bakuin (one of the first modern tankers ever built). The remarkable documents held within the archive also depict the work and life of LR surveyors and their frequent dealings with shipbuilders and shipowners.

Currently more than 238,000 documents covering 45,000 ships are available to view and download, for free, on the Centre's website. With a global audience spanning over 190 countries worldwide, the digitised collection is a unique resource that is being used by maritime historians, economists, linguists, ship model enthusiasts and family historians.

The digitised collection reinforces the Centre's commitment to open access for the Heritage & Education Centre's resources while also enhancing public understanding in marine and engineering science and history.

Ahead of the next digitised document upload, the Heritage & Education Centre team have selected three interesting items from the collection.

ightarrow To view the digitised Ship Plan and Survey Report Collection, visit hec.lrfoundation.org.uk

[↑] Built in 1912 by the Craig Shipbuilding Co, of Long Beach California, Camino was a steamer capable of carrying 5,500 tons of freight and travelling at 12 knots. This outboard profile shows her cutting through the water, steam billowing from her funnel, and flags flying.







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[↑] The *Magdalena* was a refrigerated passenger liner, built in 1948 by Harland & Wolff, their first to be constructed after the end of the Second World War. Intended for service between the UK and east coast of South America, Magdalena was wrecked off Brazil on her maiden voyage. All passengers and crew were saved; her insurance payout (£2,295,000) became the largest for any marine casualty in British history at the time.

Health standards in the passenger market: How do we manage risks in the new normal?

We take a closer look at existing health management standards onboard passenger ships and what LR is doing to help operators strengthen their approach against the spread of illness when operations resume.

Words: Viv Lebbon

Ships are a confined space where crew live and work closely together for extended periods of time with occasional visitors and crew changes. Passenger ships can be particularly prone to outbreaks of infectious diseases because cruise ships and ferries often include a large number of crew and passengers from different places, sharing accommodations such as public spaces, recreational facilities and common food outlets/buffets. These factors increase the risk of viral/bacterial transmission.

The introduction of an infectious disease can have a detrimental effect on the vessel's operational status. When the industry experienced outbreaks of COVID-19 onboard cruise ships from February 2020 onwards, with 13 reported by March (Ship Technology), this has halted cruise line operations for the time-being, in line with the US Centers for Disease Control and Prevention (CDC) no-sail order. This has caused up to 95% of global cruise fleet to be in lay-up, with ferry operators also seeing a slowdown in demand with most operating a reduced service.

The passenger ship sector remains one of the hardest hit by the pandemic, but when local lockdowns ease and travel restrictions are lifted, we anticipate the return of cruise and ferry travel but not as we previously knew them. A serious outbreak of COVID-19 or any other infectious diseases onboard will likely damage passenger, crew and stakeholder confidence regarding health safety standards on passenger ships. This means risk mitigation around health management is central to the reintroduction of cruise ship travel and ferry services when the time comes.

More is needed to restore confidence of passengers and crew alike, going above and beyond existing standards and guidance.

Yet what does this mean specifically for passenger ship operators? We take a closer look at existing standards onboard passenger ships and what LR is doing to strengthen our approach against the spread of infectious disease when operations resume.

Health management

Protecting the safety, health and wellness of passengers and crew is at the core of each cruise line and ferry operator. Measures are aligning with guidance from medical agencies such as the CDC and American College of Emergency Physicians (ACEP), and trade-specific organisations – including the Cruise Lines International Association (CLIA) regarding medical facilities and infectious disease management to help mitigate

against and manage any potential outbreak onboard, focusing on early detection, prevention and control.

To prevent further spread of COVID-19, CLIA members agreed a voluntary suspension of all US cruise operations until 31 October 2020 for some ports and cruise lines and even further for most ports in the US. This proactive suspension beyond the CDC's no-sail order is a positive sign for the industry, although CDC has now extended its no-sail order until 31 October (announced 1 October).

Moving towards establishing a "new normal", CLIA continues to work closely with its members to draw up a set of guidelines for future embarkations, which may see changes to vessel operation. For example, operators may introduce different luggage handling systems and crowd management and boarding procedures. There could also be a temperature scanner in every cruise terminal and 100% COVID-19 testing requirements prior to boarding.

"More is needed to restore confidence of passengers and crew alike, going above and beyond existing standards and guidance," states Joep Bollerman, LR's Global Manager at Passenger Ship Support Centre in Miami.

LR's approach

To support clients with this journey, focusing on crew and passenger safety, LR has developed a tailored and flexible framework of solutions with the introduction of its new products - Marine



↑ Stay Safe and SHIELD cover these six core areas for enhanced controls where higher health risks exist

Stay Safe and SHIELD. These provide increased levels of verification and assurance to help maintain the highest health standards at sea.

SHIELD and SHIELD+ are voluntary ShipRight descriptive notations that provide a detailed survey and inspection of the key areas where health risks are elevated, as well as against the six categories (highlighted in the graphic above). SHIELD offers additional standards for health assurance onboard a ship, while SHIELD+ offers the highest standards for extensive levels of health assurance.

LR's SHIELD aligns with existing ship management measures and exceeds the requirements set by regulatory compliance bodies, helping operators demonstrate heightened safety policies to crew and passengers through additional certification.

LR's Marine Stay Safe is a tailored health verification programme that can help determine if vessels and marine-based structures are maintaining high levels of safety, cleanliness, quality and good hygiene. Stay Safe also provides a consistent review of policies against any of the six categories to highlight enhanced risk areas so that operators can make the necessary improvements related to operational efficiency and processes,

especially for passenger and crew safety.

Depending on the preferred client requirements, Marine Stay Safe, SHIELD and SHIELD+ can be either delivered onboard or remotely by LR specialists.

"Our new health safety solutions provide an independent route for the assessment, prevention, control and reduction of risk against the introduction and spread of infectious diseases onboard cruise ships, ferries and other ships and assets," says Bollerman. "This voluntary measure

How is SHIELD being applied?

"Saga voluntarily paused cruising operations due to the COVID-19 pandemic. Our vessels are currently in lay-up whilst we prepare for our return to service. When operations resume - there will be a new way of operating, with vessel modifications, revised and enhanced procedures and strict protocols, and we need to be ready to welcome our passengers back onboard safely. We've been working with Lloyd's Register's to act as our third party verification experts through their new SHIELD product, they've listened and helped create the right solution for us. We want to ensure we have covered all bases, can demonstrate and verify our additional voluntary measures as well as statutory compliance, and importantly are to demonstrate an enhanced level of health safety to our passengers, crew and other stakeholders.

James Langley, Director of Marine and Technical Operations at Saga Cruises

will help our customers go beyond core compliance, to establish even greater confidence in the health safety of their marine vessels and structures."

Above and beyond existing standards

LR's new standards are based on medical science from the global health industry, including guidance from the World Health Organisation (WHO), CDC and other relevant national and local medical experts. We are also working towards partnerships with leading health organisations, including the Institute of Cruise Ship Medicine (ICSM), which provides practical training for medical personnel working on cruise ships, to ensure continued alignment and that our standards comply to its stringent guidelines.

LR has offered health risk mitigation services within the land-based hospitality industry for many years. By extending what we do into the maritime world. LR can provide operators with trusted knowledge, expertise and support around health management to tackle health risks associated with COVID-19 and other illnesses.

"Looking long-term, LR Stay Safe and SHIELD standards will help ensure that best practices continue to be implemented and integrated into ongoing health and safety measures," says Bollerman. "It's not just a one-off certification - we work with our clients to put in place the right immediate and long-term medical health solutions to improve health safety policies. This provides further assurance against the potential spread of health risks, demonstrating to passengers, crew and other stakeholders how our clients are 'going above and beyond'."



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Cyber security – a technical inconvenience or a critical strategic risk?

Our increasing online presence means challenges for board members grappling with risk and mitigation. A new programme is here to help.

Simon Reeve Commercial Engagement Director, Lloyd's Register Foundation



As the world adapts to new ways of digital working, conducting much of its business remotely, supported by newly discovered web tools, many of us may feel we have stepped up a gear in our ability and competence operating in cyberspace. It is no longer purely the domain of the Instagram generation.

However, with this increased access and online presence comes increased exposure and increased risk to cyber threats. We are used to regular reminders to update security software and protocols from our home and/or work network

providers, but have we really stopped to consider 'What if?'

What if... the smart interconnected system I have at home that enables me to communicate with the outside world, order food for home delivery, order gifts for family members that I am unable to visit at present, and lets me watch any number of films and documentaries for my sanity, education and relaxation... what if all of that stops? What if nothing works? What if by hacking my system, someone sends spurious unpleasant emails to all my contacts? What if they

redirect my groceries or family gifts elsewhere? What if I don't receive the important medical report from my Doctor on my pre-existing condition? Or the track and trace message, highlighting I am now at enhanced risk of COVID?

In the maritime world, we have seen recent examples where the business equivalent of the above domestic situations has put whole fleets of ships at risk, disrupted communications and supply chains, and increased the risk to the safety and well-being of crew members.

We are familiar with the technical solutions to reduce the risk and we rely on our information system or operational technology system providers to keep us advised and protected. However in our role as executives and board leaders responsible for the safety and operations of large shipping fleets or port operations, the questions are more strategic:

How do I assess the cyber risk alongside other risks I need to form a judgement on?

How can I make a decision on something on which I have little experience to fall back on, given the exponential rise in this issue in recent years?

I am comfortable with the majority of risks presented by the risk committee as I have direct experience in most of these areas. In cyber, other than avoiding clicking on a link that may or may not look suspicious or remembering to change my personal passwords with ever increasing frequency, these issues seem to have escalated exponentially in recent years.

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As a CEO, board chair or risk committee chair, I am inundated with offers of technical assistance. I am aware of the IMO and IACS guidelines and BIMCO risk framework, but am I really comfortable that we would know how to react if we were the subject of a malicious attack?

These are the questions that a programme, co-sponsored by the Lloyd's Register Foundation and the UK National Cyber Security Centre, are currently addressing. Cyber Readiness for Boards is a two-year programme, led by the Research Institute for Sociotechnical Cyber Security at University College London and supported by an international team of business specialists in cyber security and board-level operations.

The programme takes a number of inputs into account in its work. These include capturing the current experience and practices of board members and nonexecutive directors through confidential and anonymised one-on-one interviews with senior specialists, research on the



We are used to regular reminders to update security software and protocols from our home and/or work network providers, but have we really stopped to consider 'What if?'.

effectiveness of current guidelines and training methods, and analysis of boardlevel roles, responsibilities and decisionmaking practice on cyber security topics.

The outputs of the programme will include recommendations for future updates of guidelines, a revised best practice toolkit for board members to access. This is also an option for board members to undertake a training exercise whereby a situation relevant to your specific board will be role-played to investigate thinking and decision-making when presented with a cyber threat to your business.

If you are a board member or nonexecutive director interested in participating, please get in touch. The more engagement we have, the more value will be added to the updated guidelines and training exercises helping us all in engineering a safer world.

 \rightarrow <u>Get in touch to find out more.</u> Email Simon.Reeve@lr.org

A closer look at remote surveys: what's involved and what's next.

Yiannis Fytilis discusses what's on the horizon for remote techniques and provides a step-by-step walkthrough of a remote inspection of a crack in the superstructure deck.

Yiannis Fytilis Lead Surveyor and Remote Survey Champion in LR's Southampton office



In the June issue of Horizons, LR's Head of Product Management, James Forsdyke, looked at how the COVID-19 pandemic has significantly broadened the range of use cases where remote support is considered appropriate and provided the industry with the impetus needed to embrace what technology has been able to offer for a number of years. But as lockdowns ease, travel restrictions lift and physical attendance slowly returns, what does this mean for remote surveys?

When used in appropriate scenarios, remote surveys still hold great value for LR and our clients by advancing periodical inspections where practical, streamlining decision-making through real-time livestreams with surveyors and other stakeholders including flag States, enabling immediate feedback and transparency.

LR envisages that traditional physical attendance surveys will become enhanced and supplemented by remote surveys and data, through the use of digital technology such as digital twins. This would build our confidence that safety levels and availability of ships can be maintained during periods when we are unable to get on board.

However, this does not negate the importance of people. Technology is an enabler, but the value continues to be the human expertise and experience – there are still experts reviewing inputs

and making decisions based on their experience. Remote surveys are just a subset of technology-enabled working, and as we all become more comfortable working differently because of the changes imposed on us, we will find new ways to deliver value to those we serve centred on our core skills and expertise.

As a remote survey champion, I am responsible for leading many of the remote inspections that LR performs, establishing best practice and ensuring that the remote surveys are performed to the highest technical standard and importantly, that the crew's safety is protected and maintained at all times.

Through our experience, we've found that the interaction between hardware, software and remote survey experts can offer the right combination that complements and enhances the traditional approach based on physical attendance only. LR remains committed to applying remote only in situations where there is clear value and our experts have validated that the remote service is equivalent to physical attendance.

As you can imagine, static data has its limitations. Therefore, the introduction of LR's new live-streaming video-audio tool, LR Remote, is a real step forward by providing an improved perspective onboard the vessel and enabling a broader range of surveys to be completed remotely. This has been absolutely essential during the period of disruption, and invaluable to a number of stakeholders throughout the industry – not just vessel operators, but also flag Administrations and other regulators.

In one particular instance, a vessel operator reported the development of a crack in the superstructure deck. This had been identified during the last sea passage and the operator requested LR undertake a remote inspection in conjunction with surveys for Special Survey postponement. Utilising its well-established governance structure to support this type of request, LR was able to identify the items to focus on to enable the postponement using its remote survey methodology.

The through-thickness crack that had developed was a substantial length from the side of the vessel to the inboard termination, following an erection seam from new build. The gap that had formed between the plates was also significant.

The LR Remote app, which was easy for the ship's crew to download and set up on either the vessel's V-sat enabled LAN network or the domestic 4G coverage, provided a much more thorough examination of the defect than would have been achievable using static photos. It was possible to identify the start and termination points, and explore above and below deck, to identify distortion in other structural members that would need to be rectified as part of the permanent repair.

This process of planning for permanent repair was particularly important to the operator – not only to identify the steps to be followed, but also to understand the classification requirements. Indeed, when this type of conversation is facilitated remotely, it is significantly enhanced by having a live video-audio stream – so you can talk through the repair in detail while viewing the damage and marking up the steel as you go. All of which helps ensure repairs can be undertaken as efficiently and effectively as possible, minimising any further downtime for the vessel.

At this point it is important to mention the safety considerations. LR provides clear recommendations to our clients on performing remote surveys in a safe manner, and always discusses this with the client in the kick-off meeting before inspections have commenced.

We were able to continue the survey using the LR Remote app for the general examination of items on exposed and partially-exposed decks. Again, the ability to direct the crew member onboard was key to enhancing the survey. Where previously static photos would have been provided to indicate overall condition, the live videoaudio stream now enabled instructions to be relayed in real-time, focusing in on specific areas of interest. For example, by gaining detailed views of windlass chocking arrangements or coaming, packing and cleat condition for hatches, a true "general examination" equivalent to physical attendance can be supported - which is, of course, a pre-requisite for remote survey method acceptability.

This example, and the many others before and since, have proved the significant value of remote survey tools when used in a safe manner and in the right application. This is a real watershed moment for the industry. All stakeholders now recognise that investment in solutions to enable remote surveys throughout vessels, from the bilges to the fore mast, will be key to keeping trade moving in the future, whatever challenges the industry faces. With our new LR Remote solution, we are preparing for that future, and are continually investing in, and adopting, advanced technologies to keep vessels trading around the world.



What are the key takeaways from the IMO's latest GHG study?

Matthew Williams highlights key findings from the Fourth IMO GHG Study and what this might mean for maritime and the measures to reduce GHG emissions from ships.

Matthew Williams LR's Principal Specialist for Strategic Regulatory Projects



The Fourth IMO GHG Study is now available and due to be considered by the IMO Marine Environment Protection Committee (MEPC) in November. But what does it say, and what does it mean for measures to reduce GHG emissions from ships?

This latest study provides inventories for CO_2e (or carbon dioxide equivalent) emissions from international shipping from 2012 to 2018, a revised baseline for 2008 and projections to 2050. This is vital management information that should feed into the work to agree short-term measures to reduce carbon intensity by 2030 (Energy Efficiency Existing Ship Index (EEXI) and inservice carbon intensity management) and it provides a timely reminder of the scale of the energy transition required if greenhouse gas (GHG) emissions are to be halved by 2050 (uptake of low- and zero-carbon fuels).

The study shows that little progress has been made since 2015 in terms of organic reductions in carbon intensity and trade demand continues to outstrip that progress. The result is that CO₂e emissions from international shipping have increased by 6% between 2012 and 2018. Most carbon intensity reductions achieved since 2008 are considered to have been delivered before 2012 in response to economic conditions, which have promoted reductions in speed. The Energy Efficiency Design Index (EEDI) has influenced some change, but generally this is limited to an increase in deadweight for new ships with no significant impact at fleet level.

On average, the global fleet is operating at between 40% and 60% of main engine load, according to the new study, but individual ships are operating with substantial variability in key determinants of carbon intensity. As such there is scope for measures that influence operational behaviours to ensure that all ships achieve in-service carbon intensity performance which matches the best performing ships of the same type. On the other hand, measures focused on simply locking-in already delivered carbonintensity reductions offer little in terms of an effective regulatory response. This outcome supports the direction the IMO is most likely to go in November, which will be using in-service carbon intensity management to augment a minimum technical standard (EEDI and EEXI).

The study shows that little progress has been made since 2015 in terms of organic reductions in carbon intensity and trade demand continues to outstrip that progress, with the result that CO₂e emissions from international shipping have increased by 6% between 2012 and 2018.

An interesting question is whether the current fleet-level trend in main engine loads translates into a need to increase the use of sustainable alternative lowcarbon energy carriers earlier than previously thought. Currently, we do not tend to think of alternative low-carbon energy carriers in the context of IMO's ambition for 2030. We might need to.

As carbon intensity continues to rise, so too do CO₂e emissions. The forecast growth in those emissions has been refined, and the scale of potential future growth has been moderated to represent 90% to 130% of CO_2e emissions in 2008, rather than the 50% to 250% found in the third IMO GHG Study. However, none of the forecasts are compatible with the Initial IMO Strategy, or the Paris Agreement temperature goals. Work on revising the marginal abatement cost curves for various abatement technologies highlights the significance and cost uncertainties associated with zero-carbon energy carriers in achieving reductions in CO₂e emissions compatible with the 2050 level of ambition. Such fuels may unlock 64% of CO₂ abatement potential, but that is a serious and complex energy transition by any measure. Early and persistent signals to de-risk capital investment at sea and ashore are needed.

While CO_2 remains the dominant source of shipping's climate impact, the growth in methane emissions (155%, 2012 – 2018) and

the new inventories for climate forcing black carbon cannot be ignored. It is difficult to interpret the study as anything other than making the case to regulate these two shortlived climate pollutants (a big impact on the heat energy equilibrium relative to CO₂, but over a much shorter timeframe), at least on a tank-to-wake basis. But care needs to be taken to avoid unintended consequences of black carbon-related regulations, such as pilot fuels, which are still needed.

The change in method in the study to better define the relative contributions of domestic and international shipping has transferred emissions previously attributed to international shipping to the domestic fleet. The result is a 130% increase in domestic shipping's inventory. This will hit nationally defined contributions and will have knock-on effects for international shipping if domestic shipping is strictly regulated.

There is no doubt that the work to operationalise the Initial IMO Strategy needs to keep pace with what the data is saying about carbon intensity and tank-to-wake GHG emissions to bring forward work on the latter. There are different ways of interpreting some of the results of the study, but let's not pretend anyone has got GHG emissions under control. There remains the potential for substantial growth, both new and latent. An urgent move to operationalise the intent to increase the uptake of low- and zero-carbon energy carriers is needed.

A revised EU MRV Regulation and potential implications for charterers.

Matthew Williams explains the proposed revisions and what they could mean in the short and long term.

In 2019, the European Commission proposed that the EU Monitoring, Reporting and Verification (EU MRV) Regulation should be revised to further align with the IMO Data Collection System (IMO DCS). Their aim was to reduce the administrative burden on companies who submit data to both systems, while still preserving the EU MRV's ability to support the EU policy objectives.

Earlier this month, the European Parliament adopted a substantial number of modifications to the European Commission's proposed revisions to further strengthen the Regulation's ability to support the EU Green Deal and ambitions for climate-neutrality in 2050. These modifications will be the European Parliament's negotiating position when the final text of the revised Regulation is developed later this year.

Included within the text adopted by the European Parliament is an extension of responsibility for compliance with the Regulation to time charterers. In particular the definition of "company" has been updated to read "company' means the shipowner or any other organisation or person such as the manager; the time charterer, the bareboat charterer, which has assumed the responsibility for the commercial operation of the ship from the shipowner and is responsible for paying for fuel consumed by the ship." Further relevant elements of the European Parliament's position include:

- A 40% carbon intensity reduction by 2030 for ships subject to the Regulation, with failure to meet in-year targets resulting in dissuasive financial penalties. The baseline is expected to be derived from the emissions reports data in the THETIS MRV database;
- Introduction of a performance rating system for ships from 2022;
- A requirement for all ships to be zeroemissions at berth by 2030;
- Expansion of the potential scope of monitoring, reporting and verification to methane (from 2022) and an intent to further increase the scope to other emissions and discharges;
- Greater transparency in the information available about ships and the companies operating them; and
- Amendments to the EU Emissions Trading Scheme Directive (EU ETS) to include shipping in the EU ETS from 2022. The European Commission has already indicated its willingness to include shipping in a revised EU ETS, both from the perspectives of climate neutrality and an EU recovery from COVID-19. This is subject to separate impact assessment work right now.



In the long term, time charterers would need to ensure that ships that they charter for European port calls are capable of being zero emissions at berth.

In the short-term, these revisions could result in time charterers becoming responsible for both the monitoring, reporting and verification of emissions from ships they hire and the compliance of those ships with carbon intensity reduction targets. This would be a new regulatory risk for time charterers, particularly in the presence of dissuasive financial penalties. If the proposed definition of "company" also translates into a revised EU ETS Directive that includes shipping, then time charterers would likely become responsible for obtaining emissions allowances for ships they hire, which are flagged in an EU member State, or call at a European port.

In the long term, time charterers would need to ensure that ships they charter for European port calls are capable of being zero emissions at berth, and could also



incur increasing monitoring, reporting and verification obligations beyond carbon dioxide and methane.

The final text of a revised EU MRV Regulation remains subject to negotiation, but is expected to be finalised in Q4 2020 or Q1 2021 and is expected to take effect from 1 January 2022. Work to assess the impacts of a revision of the EU ETS Directive by the European Commission is expected to be finalised shortly, but if shipping is to be included, work on the implementing details will follow at pace.

→ If you require further information about these proposed revisions, please get in touch with Matthew Williams, our Principal Specialist for Strategic Regulatory Projects, at MatthewJ.Williams@lr.org

Countdown to IHM compliance – are you prepared?

Jennifer Riley-James answers questions around the upcoming regulation to help owners and operators prepare for the upcoming deadline for IHM compliance.

Jennifer Riley-James LR's Senior Ship Recycling Specialist and Product Manager



The final EU Ship Recycling Regulation (EU SRR) deadline for Inventory of Hazardous Materials (IHM) requirements is getting ever closer. This should not be breaking news for most shipowners and operators given the formal adoption of the IMO Hong Kong Convention for the Safe and **Environmentally Sound Recycling of** Ships (HKC) in 2009, and the phased entry of the EU SRR since 2018. EU SRR is a regional regulation that requires commercial in-service vessels over 500gt which are either EU-flagged (including the UK, Norway, Iceland and Liechtenstein) or non-EU flagged, calling at EU ports and anchorages to compile and maintain a certified IHM.

An IHM is an inventory of any materials present in a ship's structure, systems and fitted equipment that may be hazardous to human health and the environment. EU-flagged ships will require an Inventory Certificate and non-EU flagged ships will need a Statement of Compliance (SoC) against the regulation. Both must be issued on behalf of the Flag (either by the Flag itself or a Recognised Organisation (RO) the Flag has authorised to do on their behalf). The requirement for non-EU ships ("third country") is full compliance with IMO HKC as a minimum.

Shipowners and operators should have already started this process in order to ensure compliance before 31 December deadline. However, for those who have not started we would advise you to start as soon as possible.

To support industry stakeholders with preparing for this change, we have put together a summary of the most frequently asked questions:

1. Do I have to have an IHM and certification ahead of legislation entering into force?

Yes. In our experience, shipowners and operators need at least six weeks to compile a new IHM for an existing ship. However, this is typically longer if the services of an expert company are employed to undertake hazardous material sampling on board (which LR recommends). It then takes a month or so for ROs to carry out approval, verification and certification work.

For third country vessels not planning to call into the EU until later in 2021, certification only needs to be in place before this date. However, we still strongly recommend aiming to achieve this before the end of 2020 because:

- Trading routes are ever more likely to change, which could make the requirement more urgent
- The time it can take to achieve compliance, especially due to COVID travel restrictions

2. What is the likelihood of the EU SRR deadline being extended, in light of COVID-19?

Based on current feedback from the European Commission (EC), the likelihood of the EU SRR being extended is small.

Members of the industry, such as the International Chamber of Shipping and BIMCO, formally requested consideration of a grace period based on the argument that COVID-19 is an event shipowners or operators could not have been prepared for and will lead many to miss the deadline.

The EC has advised that it is not empowered to extend the legal deadline. Nevertheless, Member States may exercise certain discretion when it comes to enforcing the regulation, for example where a shipowner has endeavoured to achieve certification within the deadline but has been unable due to factors outside their control.

Although the previous duration of time (between the regulations, entry into force and onset of COVID-19) available to achieve compliance may prompt a stricter approach, at the time of writing, there is not yet any specific, formal guidance from the EC on how to exercise discretion. It is therefore difficult to envisage what such discretion might look like or the likelihood that it will be consistent from port to port. We recommend that shipowners and operators concentrate on the elements within their control and ensure as a minimum that they have: (i) contracted a HAZMAT specialist in good time to compile the sampling and IHM and make every effort to get the work completed, and (ii) contracted with the relevant Flag or RO to conduct the approval and verification work required for certification.

3. What information is needed to be provided to LR in order to get IHM certification?

For existing ships, LR will request the following documentation be provided as a minimum, ahead of the desktop approval, on-board IHM verification survey and ultimate certification:

- a completed IHM on the LR template;
- a Hazardous Materials Expert Sampling report for all hazardous materials within the structure, systems and fitted equipment of the vessel (if compiling the IHM initially for full HKC and EU SRR compliance)

- OR -

 the collected paperwork from build and ongoing maintenance where the IHM was compiled at build against the HKC or EU standards (note, where the IHM is against HKC standards and the ship is EU flagged, we will also require an expert sampling report for the additional applicable EU required hazards).

The following documents will also be requested and should be provided if available:

- Asbestos-free certificate from build;
- PCB-free certificate;
- International Air Pollution Prevention (IAPP) Certificate and Supplement to IAPP Certificate (recording machinery and equipment containing Ozone Depleting Substances (ODS)) as required by MARPOL Annex VI;
- Antifouling certificate;
- Evidence of a procurement policy in place (restricting the hazards identified in the legislation from being brought on board).

For existing ships, LR strongly recommends that, in the absence of complete paperwork from build, a hazardous materials expert is employed to undertake sampling onboard to determine presence and extent of hazards. This is in-line with both the HKC MEPC.269(68) and EU SRR EMSA Guidance.

4. How long after IHM approval does the on-board verification and certification have to be completed?

Upon satisfactory completion of the IHM approval, the IHM must be verified on board before a statement/certificate can be issued. While there is no limit of time stated in legislation between approval and onboard verification, it is recommended to complete the verification survey as soon as possible after the approval. This minimises the likelihood of any repairs or modifications being made to the structure, equipment and fittings, which would then result in potential updates to/maintenance of the IHM.

"Maintaining the IHM" is mandatory in the legislation. If, for example, the IHM is approved two years before verification, the likelihood of the IHM having been updated is greater, thus the need to repeat IHM approval. Up to six months between completion of approval and



onboard verification surveys is considered a "reasonable period", beyond which the owner should submit suitable declarations and statements as evidence that from the date of compiling the IHM (and visual/ sampling check plan) there were no changes with regards to existence of hazardous materials in the structure and/or equipment.

5. Will non-EU flagged vessels need a Statement of Compliance (SoC) issued on behalf of the Flag?

Current EMSA guidance for IHM states that non-EU flagged ships must have an SoC issued on behalf of the Flag in order to be compliant. To LR's best knowledge, EU Port State Controls are expected to enforce this specific requirement, and an SoC on behalf of the RO providing approval/verification will not be sufficient.

This is a challenge for many shipowners with vessels flying third country Flags – as many of these Flags have not yet authorised ROs to issue an EU SoC in their name. LR continues to work with third country Flags to obtain this authorisation for both LR classed and non-LR classed ships. Shipowners can check which Flags have already authorised LR at <u>Ir.org/en/</u> resources/ihm-authorities. We would strongly recommend that shipowners check these details with their IHM provider(s) and contact their Flag directly if their selected RO has not yet been authorised to provide certification for their IHM. In most cases, the Flag will have authorised all or none of its ROs.

We recommend that shipowners who are yet to start the certification process do not delay this while awaiting their Flag to authorise ROs for this work (unless the Flag itself can commit to completing all work before the

deadline). By using a RO such as LR, this ensures all of the groundwork is completed before the deadline. Where LR has issued an SoC on its own behalf and subsequently receives authorisation to issue on behalf of the Flag, we will do this free of charge.

6. How should the IHM be maintained?

In order to uphold IHM certification, the IHM itself must be maintained and updated during vessel operation using the official IHM template provided by LR.

If any items recorded in the IHM are added to, removed or replaced, or the hull coating is renewed, the IHM should be updated using information obtained from Material Declarations (MD) and Supplier Declarations of Conformity (SDoC) forms. The requirement for MD and SDoC forms should therefore be included in the shipowner's internal procurement policy at the time of the initial IHM compilation. MD and SDoC must be collected for every item brought onboard the ship.



Ship recycling facility certifications: beyond legislative compliance.

Why is a certified industry not the same as a compliant industry?

For LR, the certification of a ship recycling facility is one part of a picture which overall must show a robust commitment to ongoing compliance against the highest legislative standards.

Certification alone simply demonstrates that on the day the facility was certified it was deemed to be compliant with the required legislative standards. Without ongoing audits for the duration of the certificate validity, the guarantee of ongoing compliance is difficult. At LR, our certification is always conditional on the provisions and results of periodical verification audits. Where deficiencies are observed, as required, we will not hesitate to stop works and ultimately remove certification should the deficiency not be swiftly and comprehensively rectified.

As such, compliance can only be truly demonstrated through the longer-term journey that a recycling facility embarks upon to demonstrate their ongoing commitment to innovate and improve health, safety and environmental standards. Through our work at LR, we have invested time and knowledge in recycling facilities to help establish a culture of change. Our audit approach ensures we can witness every aspect of the ship recycling process, procedure and methodology, both in the facility itself (when a ship is actively being recycled) and wherever possible beyond the facility, for example the downstream waste management. Without this comprehensive on-the-ground review and understanding of the recycling processes, we would not be able to provide certification to recycling facilities.

The statements of compliance that LR issues are delivered as part of our advisory services portfolio. Certification of a ship recycling facility is not related to the class of a vessel, but is a building block to demonstrate the statutory compliance of the facility with either the IMO Hong Kong Convention (HKC) or the EU Ship Recycling Regulation (EU SRR), or both. Certification does not mean that a government will ratify the HKC, nor that a facility will be EU Listed (the decision for inclusion on the EU List ultimately lies with the EU Member states). It simply provides independent third party evidence of the ability to comply with the statutory requirements. However, the certification must be fully and regularly assessed to demonstrate ongoing conformity.

Through our work we have witnessed a genuine commitment to change and process improvements, facilitating and demonstrating safe and environmentally sound ship recycling. This is particularly true of the recycling facilities of South East Asia that we have worked closely with over the past five years. Certification and the subsequent ongoing monitoring of compliance is part of a much bigger picture, documenting industry change and a ground-up commitment to improve standards, and make safe and environmentally sound ship recycling as the industry norm. As such, the relevance of certification and ongoing demonstrations of compliance is clear – when it is provided following comprehensive methodologies it complements the legislative topdown approach to drive change.

According to MEPC.269(68), shipowners should 'implement the following measures in order to ensure the conformity of Part I of the Inventory:

- to designate a person as responsible for maintaining and updating the Inventory (the designated person may be employed ashore or on board);
- · the designated person should establish and supervise a system to ensure the necessary updating of the Inventory in the event of new installation;
- to maintain the Inventory, including dates of changes or new deleted entries and the signature of the designated person;
- · to provide related documents as required for the survey or sale of the ship.

The following points should be considered as best practice advice when considering developing or reviewing current procurement policies to restrict hazards being brought onboard ships after the initial compilation of the IHM:

- Request that any items supplied to the ship are accompanied by a completed MD and SDoC as per the guidance in MEPC.269(68) and the EMSA best practice guidance.
- The procurement policy should make explicit reference to the up-to-date IMO Resolution MEPC.269(68), which replaced MEPC.197(62) in 2015 to cover HKC.
- The procurement policy should make explicit reference to Regulation (EU) no 1257/2013 if coverage of EU SRR hazards is required.
- The policy should preferably cover the hazards listed in both Appendix I and II of HKC and Annex I and II of EU SRR.

7. Will one Material Declaration per supplier covering multiple different products be enough?

The Material Declaration (MD) requested from the supply chain is designed for use on a per product basis - therefore, a singular MD per supplier which covers multiple items is unlikely to be enough or acceptable. (Note: according to Section 2.5 of MEPC.269(68) a product is defined as "machinery, equipment, materials and applied coatings onboard a ship".)

If a single MD is provided by a supplier, covering multiple items, the maintenance

of the MD will become much more difficult. As an example, if there is a change on one product (replacing a computer with a new one, for example), the whole document, covering all listed products will have to be revised. As such, practically speaking, maintaining such declaration on a product by product basis is much more manageable.

Ongoing maintenance is reliant on suppliers having the correct paperwork to provide completed MD and SDoC. Going forward, this will become one of the next big challenges that shipowners and operators and suppliers to the industry face after 31 December deadline. Correct, complete and comprehensive paperwork is required by ROs, such as LR, for re-certification of the IHM in the fifth year. Incomplete or insufficient paperwork may lead to LR being unable to provide recertification without additional sampling being undertaken again.

8. What does the UK's exit from the **European Union mean for EU SRR?**

There is still ambiguity around the UK's exit from the European Union; the one thing we do know is that EU SRR has already been mirrored to UK law. The following expectations are based on what we currently know and are not certain/subject to change:

- IHM Requirements at UK Port State Control: We recommend working on the assumption that any ships calling at a UK port will still require the same documentation as would be required at an EU port and non-compliance would be subject to the same penalties.
- IHM Requirements at an EU Port State Control: The UK will become a 'third country' and as such any UK-flagged ships may need to have onboard both an Inventory Certificate (issued in accordance with UK regulations) and a SoC issued on behalf of Flag to demonstrate IHM compliance at an EU port. It is not yet confirmed whether existing statutory certificates issued by

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Part of the discussion Last month, LR's Jennifer Riley-James spoke at Ship Recycling Transparency Initiative's roundtable, which concluded a webinar series that explored data and transparency, circular economy and financial stakeholders' role in responsible ship recycling. Watch on demand: www.shiprecyclingtransparency.org/road-to-the-roundtablesrtis-journey-through-2020/

the UK flag Administration will be valid until expiry or whether they will need to be reissued as an SoC beforehand.

• Up until the end of the transition period, or until informed otherwise, the UK should be considered an EU Member State.

If further clarification is needed, we would also recommend shipowners and operators contact their respective flag Administration.

9. How does IHM compliance fit with wider ship recycling initiatives?

The objective of the EU SRR is to reduce the negative impacts linked to the recycling of ships. The IHM is the link between the ship's operational phase and its end of life. So, although the IHM may be compiled at build and is used for keeping the crew onboard safe from exposure to unnecessary hazards, its primary use comes when a ship is being recycled. The up-to-date information contained in the IHM helps recyclers make critical decisions about methodologies and best practices to employ in order to keep the recycling process as safe and environmentally sound as possible. The EU SRR has brought forward all requirements from HKC, as well as setting additional stringent standards around working from an impermeable surface and controlling the downstream management of hazardous wastes beyond the recycling facility, all EU-flagged ships to use an approved ship recycling facility included in the European list (effective from 31 December 2018).

At LR, we are committed to supporting safe and environmentally sound ship recycling. IHM compliance is one part of our wider ship recycling services. We have in-depth knowledge of ship recycling legislation, standards and practices through our work at IMO, IACS and the International Ship Recycling Association (ISRA). We have also represented IACS on Ship Recycling legislation at the IMO and have made significant and ongoing contributions to the EU Regulation.

The clock is ticking for compliance with IMO's 2021 cyber security regulations.

The 1 January 2021 deadline is fast approaching for marine and offshore organisations to implement the necessary cyber security measures required by the IMO. Karen Bolton explains what actions need to be taken.

Karen Bolton CEO, Nettitude (a Lloyd's Register company) Karen was appointed CEO of Nettitude in July

Maritime organisations have long focused on safety and the management of risks, however, bringing cyber threats into play can often be challenging as these are usually harder to quantify, understand and relate to the physical world. Some lessons can be brought across from other industries and frameworks, including that of the National Institute of Standards and Technology (NIST), which can be very helpful in aligning thinking and practice to cyber risks. But there are unique considerations that need to be factored in when applying a robust risk management process to cyber risks within marine and offshore organisations.

In 2017, the IMO issued MSC-FAL.1/ Circ.3 'Guidelines on maritime cyber risk management'. These guidelines provide high-level recommendations to safeguard shipping from current and emerging cyber threats and vulnerabilities, including functional elements that support effective cyber risk management. The IMO's Maritime Safety Committee then adopted these guidelines through Resolution MSC.428(98) 'Maritime Cyber Risk Management in Safety Management Systems'. This resolution encourages administrations to ensure that cyber risks are appropriately addressed in existing

safety management systems (as defined in the International Safety Management (ISM) Code) no later than the first annual verification of the company's Document of Compliance (DOC) after 1 January 2021.

The following five points summarise the goal and the approach from the IMO:

- 1. Effective cyber risk management should start at senior management level and should embed a culture of cyber risk awareness into all levels of the organisation.
- 2. A risk-based approach should be adopted with a comprehensive assessment to compare an organisation's current, and desired, cyber risk management postures. Such a comparison may reveal gaps that can be addressed to achieve risk management objectives through a prioritised cyber risk management plan.
- 3. The 5 NIST Cyber Security Framework domains should be considered as part of the response to the Risk Management Review (Identify, Protect, Detect, Respond and Recover).
- 4. All operational systems should be included, and the process and effectiveness reviewed regularly.

5. A plan to communicate awareness throughout the organisation should be implemented.

The IMO resolution is not just about completing a risk register or risk management plan. Organisations will need to be able to demonstrate over time that they can execute that plan and address the risks in a way that improves the security of their operations. Currently, shipowners and operators are looking for assurance that what they are doing will meet the intent of the IMO's resolution and be accepted when the time of audit comes. As the guidance allows for many ways for organisations to meet this resolution, it can be hard to know what will be accepted at an audit. Consistency in governance over time will be important.

There are some tactical actions required before 1 January 2021:

1. Prepare and ensure cyber risks are identified and understood within your operations.

For example, what would a ransomware attack on your business do to you? How would you recover? What business impacts would this cause? Or, what would the introduction of malware on a contractor's USB stick into key

Recent cyber attacks on CMA CGM and the IMO have been a sobering reminder for the shipping industry that protecting against breaches, such as ransomware attacks, must be a fundamental component in a company's cyber security strategy. We take a look at some of the reasons why attacks occur and what can be done to lesson the risk:

Ransomware attacks are more likely to occur where there is a combination of an attractive target with weak defences. Organisations with large amounts of personal data, payment information, large supply chains, or with critical operations (such as infrastructure providers) are attractive targets because the greater impact of an attack means the company is more likely to 'pay up'. Ransomware groups always need a 'way-in' to the organisation they are targeting, for example through phishing emails or by targeting weaknesses in a company's infrastructure. Therefore, organisations who do not have a way of staying on top of the latest cyber security risks are more likely to be either targeted or susceptible to untargeted attacks.

What steps can shipowners and operators take to lessen the risk of ransomware attack?

The key step is to ensure that there is a clear cyber security strategy with boardlevel ownership which allows for everyone to work together towards a common goal. This should take into account the whole organisation, third parties and Cloud services, notably the organisation's supply chain – not just the vessels themselves. A key aspect of this strategy is to expect, plan and test for such attacks. Knowing how you will both manage and recover from a ransomware attack is vital in being prepared for when it occurs.

This needs to be put into action – which means having skilled employees who are empowered to make changes to the way things are done. The exact actions will depend on the identified risks but could include having a clear incident detection and recovery plan, vulnerability management process, secure remote access, as well as cyber security awareness and training for staff and operators.

Finally, third-party dependencies within the supply chain should be clearly understood and tested to ensure that they don't provide an easier way into the target organisation to create disruption, or provide easy ways to access to sensitive information that customers may have provided.

How can LR help support companies that have fallen victim to cyber attack?

To conclude, complying with the IMO's 2021 cyber security regulations is not just about defining an initial management plan - organisations will need to ensure that the plan is executed, risks are addressed, and their governance strategy is evolved. LR and Nettitude are working hard to support our clients on this journey.

operational technology equipment

onboard a vessel do to your ship or

management plan for these risks.

can introduce to your business. This

will enable you to implement and

prioritise actions and controls that

directly affect the most significant

cyber risks you are facing.

3. Prepare and demonstrate this

January 2021).

matured over time.

at the next ISM DOC Audit (post

The IMO guidance is comprehensive, so

your response needs to be in proportion

to the size of your organisation, the

scale of your operations and the cyber

will be the start of a journey in which

cyber risks become better known and

appropriate actions and controls are

risks your business faces. This first audit

Understand the risks that cyber events

fleets ability to operate?

2. Document a risk treatment and





Through Nettitude, LR can provide Incident Response services. These are delivered using leading industry-standard technology deployed by independent security professionals, to help tp report and resolve security incidents rapidly and effectively. On top of this, Nettitude's recommendation is to proactively assess the status of the cyber security incident response capability so that criticalities in the contingency plan become visible and can be promptly addressed. This is done through regular penetration testing, red teaming and other assurance activities all of which LR and Nettitude can advise on and deliver.

Assurance beyond Class.

A selection of case studies that investigate assurance beyond Class.

Quick reference guides for naval personnel.

In the naval sector, equipment and software generally arrive with comprehensive technical manuals. These manufacturer documents are important, but are difficult to use as learning resources or for on-the-job support. Take for example the REMUS 100, a modern Autonomous Underwater Vehicle (AUV) used by navies. The first guide produced for AUV equipment focused on typical operator needs (mission preparation and execution) and is laid out based on what a user will do upon arriving at the mission site.

With many naval personnel rotating periodically every two to three years, this approach can pose challenges with new staff quickly getting up to speed with the vessel's equipment and software while maintaining operational continuity.

Quick refence documents can supplement the manufacturer manuals and provide key information in a readily accessible form. To support naval personnel, LR's Applied Technology Group (ATG) developed a series of quick reference guides to help new or infrequent users get up to speed with their new roles in a timely manner. Guides related to navigation/chart software, SeaBotix vLBV950, REMUS 100, Side Scan Sonar and Bathymetry can be viewed or downloaded from a secure client website.

The guides are designed to be used in the field where personnel face operational

pressures. On a naval vessel, commanders issue tasks and expect them to be executed immediately. The performance of the task affects the mission objectives and impacts other personnel. Quick reference material has proven to be a key resource to ensure safe and efficient field operation.

New staff can access this material on a secure website, learn at their own pace and use the material in the field as needed. LR ATG also provides on-demand support and continuity of knowledge retention as staff periodically transfer to new naval groups.

Quick use equipment guides can be developed and made available by LR ATG to clients introducing new technology to their operations.

Evacuation simulations for cruise ships

A cruise operator wanted to increase the passenger and Life-Saving Appliance (LSA) capacity of its fleet and undertake alternative design arrangements (ADA) for LSA on a number of ships. To do this, the operator needed to demonstrate that the evacuation/ embarkation times remain within acceptable limits as defined in IMO guidelines (MSC.1/ Circ. 1533) with an increased number of people or ADA of LSA.

LR ATG conducted advanced evacuation simulations using maritimeEXODUS evacuation software, which has been validated against MSC.1/Circ. 1533 requirements. The simulations provided estimates of the response time (R); travel time (T) for the persons onboard to travel from their initial locations to assigned muster stations; embarkation time (time for persons to embark the assigned LSA (E); and the launching time (T)).

Standard IMO benchmark scenarios as well as selected incident scenarios



derived from risk assessments were considered. Approximately 50 – 500 simulations were carried out for each scenario in order to incorporate uncertainties of passenger distributions and attributes. The simulated evacuation/ embarkation times were assessed against the performance standard defined in MSC.1/Circ. 1533 and results confirmed the adequacy of the operator's processes and physical arrangements and provided information on areas of congestion to further improve the escape arrangements. Through the help of LR's ATG, the client was able to demonstrate compliance of escape arrangements and processes with regulation and rules established by international organisations and regulatory authorities/societies.

LR's advanced evacuation simulations can provide cruise operators with a robust means of estimating evacuation times and offers information about congestion and delays which can then be used to demonstrate compliance and enhance ship escape processes.

Support with meeting specific military and strength requirements.

A ship designer needed to demonstrate its naval vessel design's ability to withstand various military threats and strength capabilities in order to acquire the LR-recognised notations required by its client's navy.

LR ATG performed assessments of the ship design using LR Naval Structural Rules (NSR), notations and various specialised software tools. Notations included underwater shock (SH), whipping (WH), external air blast (EB), extreme strength (ESA), residual strength (RSA) and fatigue (FDA).

The ESA and RSA are assessed using the LR NSR software, which utilises a twodimensional representation of a vessel section to determine the ultimate strength under various conditions. For each section, the user generates the combined panel and stiffening member properties based on load-shortening curves to predict stiffener buckling/tripping and stiffener and plate yielding.

The analysis for SH was performed using a 3D model and the Fluid Structure Interaction (FSI) procedure in ATG's Trident system for

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UNDEX analysis. The Doubly Asymptotic Approximation (DAA) method with cavitation was used to carry out this assessment.

For the WH analysis, again using a 3D model, a Whipping Index (WI) was developed using the methodology implemented in the Trident system. The index provides a measure of susceptibility to panel buckling when subjected to compressive loads and material yield associated with tensile loads. Panel buckling was determined based on LR NSR WH criteria per LR's Naval Ship Rules.

3D virtual globe to identify flooding, evacuation routes and safety zones.

Our client needed to incorporate information from its existing geo-spatial urban databases in modelling and analysis efforts that support its planning activities.

LR ATG developed a 3D virtual globe platform that helps users to virtually view and execute a range of analyses at urban settings around the world. The globe is fast, flexible and interactive, and can be embedded in standalone Windows applications.

The tool is based on the open source Chromium browser and CesiumJS, a Java Script 3D visualisation engine for creating globe and maps from Cesium. It uses WebGL for hardware-accelerated graphics and supports static and time-dynamic contents. It accepts data formats, including footprint buildings (.SHP), detailed geographical or engineering formats (.STL, .KML, .KMZ, .GML, .DAE, .OBJ, .DYN), raster terrain data, LiDAR point clouds (.LAS, .LAZ) and imagery (.TIF, .KML, .SHP).

As part of the software tool set delivered to our clients, LR ATG also developed a 3D geometry data processing pipeline that provides data cleaning, data fusion, geospatial transformation and data conversion to Cesium compatible formats.

Using the 3D virtual globe, our clients were able to quickly navigate to the urban region of interest, set up location specific geometric model and analysis parameters, execute calculations, and display results on the virtual globe. The platform also enabled our clients to demonstrate the value of investment in large-scale digitalisation of urban environments.

LR ATG can develop the same or similar tool that can be embedded in client software



The ship designer was therefore able to deliver a design with the required notations. These met its naval customer's requirements to demonstrate the ability of the design to meet the intended military and strength demands.

LR's advisory services used to support/ demonstrate design requirements for achieving the desired military vessel notations can be applied to others designing naval vessels in accordance with specific military and strength requirements.





where 3D geometric data processing, geospatial modelling, and visualisation are required to predict flooding, evacuation routes and safety zones.

What's happening in our world.

The world doesn't stand still and neither do we. Catch up on the latest developments at LR from our teams around the globe.

BeHydro dual-fuel hydrogen engine awarded Approval in Principle by LR.





LR has awarded Approval in Principle (AiP) to BeHydro for its hydrogenpowered dual-fuel engine with a capacity of 1 megawatt (MW). BeHydro is a joint venture between Compagnie Maritime Belge (CMB) and Anglo Belgian Corporation (ABC).

The new engine was unveiled in a ceremony in September and offers the potential to reduce CO₂ emissions by up to 85%. Thanks to the dual-fuel technology, the engine can continue to supply power even if no renewable energy or hydrogen is available. Based on this development, BeHydro is now planning to develop larger engines of up to 10 MW.

Andy McKeran, LR's M&O Commercial Director, said: "This collaboration with CMB and ABC is an important development in demonstrating the potential of hydrogen as a fuel for shipping. This Approval in Principle demonstrates LR's commitment to helping the industry to adopt safe, reliable and economic new technologies and processes to meet decarbonisation ambitions."

Alexander Saverys, CEO of CMB, commented: "We are very happy with the recognition by Lloyd's Register. The Approval in Principle is an important milestone in the launch of the BeHydro medium speed engines. It confirms that the built-in safety systems are solid proof. We now feel confident to start working on the first applications with these clean and powerful engines."

Tim Berckmoes, CEO of ABC, said: "LR has supported the ABC medium speed engines for many years. We value this Approval in Principle from LR very much because it shows the quality of our engineering and the safety level of our dual-fuel BeHydro engines. These engines are the ideal future proof solution for all marine applications, as well as rail traction and electrical generator sets."

← Pictured (left to right): Tim Berckmoes, ABC CEO, Alexander Saverys, CMB CEO, Peter Van de Graaf, Senior Surveyor in Charge, Lloyds Register, Roy Campe, CMB. TECH Managing Director.

LR awards AiP to ammonia-fuelled 23,000 TEU ultra-large container ship.

LR has granted Approval in Principle to Daewoo Shipbuilding & Marine Engineering (DSME) and MAN Energy Solutions for its ammonia (NH3) fuelled 23,000 TEU ultra-large container ship design, a key result from a Joint Development Project launched earlier this year focused on developing ammonia propulsion ships. It is the first AiP to be awarded in Korea for an ammonia-fuelled ultra-large container ship design.

As part of the JDP, DSME generated the basic design of the ammonia propulsion system and MAN Energy Solutions was responsible for the development and specifications of the ammonia dual fuel propulsion engine. As the only classification society involved in the project, LR's role was to review the suitability and risks of the design which involved a hazard identification (HAZID) workshop, a hazard & operability analysis (HAZOP) workshop and a design review in accordance with the Approval of Risk-Based Design (ARBD) process, which led to Approval in Principle.

LR's AiP certification is the first phase of the JDP. The second phase will involve further development of the design for meeting market demand in terms of commercial viability as well as technical and safety maturity.

LR and the National Physical Laboratory partner on marine autonomy assurance.

LR and the UK's National Physical Laboratory (NPL) have teamed up to collaborate on marine autonomy projects to ensure that appropriate levels of service and competence can be achieved within the maritime industry.

As part of the framework agreement, the two organisations will collectively establish and enhance the current body of knowledge for marine autonomy. This combination of skills, expertise and experience will be built on to bring clarity to the requirements for the assurance of autonomy and assist stakeholders in realising the potential of these systems in the market.

This will allow standards to be set and consistently applied and will therefore bring surety to risk management and certification for autonomous and unmanned systems and vessels. By partnering with NPL, LR will enhance the delivery of its services and assurance in marine autonomy and gain access to a wide range of knowledge and expertise developed in other aligned domains.

LR and NPL are currently working together to deliver a scope of services to the THEMIS Project, to demonstrate the feasibility for the world's largest ocean-going autonomous vessel. This is part-funded by the Maritime and Port Authority of Singapore's (MPA) Maritime Innovation and Technology (MINT) fund.

Neil Stansfield, NPL's Head of Digital, said: "NPL is excited by the opportunities presented in this collaboration with LR, where the two organisations complementary capabilities are well

Expert Voice

LR's Expert Voice podcast series – driving the debate in marine and offshore. Each of our podcasts features leaders and influencers from across our industry, in frank conversation with one another, focusing on trending topics and challenging discussion points.

Listen to the latest podcast: info.lr.org/podcast/expert-voice



The ammonia-fuelled 23,000 TEU ultralarge container ship is expected to be commercialised by 2025.

suited to addressing the challenge of assuring marine autonomous systems. This work represents an important part of the UK's national programme to deliver confidence in the intelligent and effective use of data, which is being conducted with a range of partners across sectors and with a specific focus on autonomous systems. NPL is applying a combination of measurement skills, expertise and experience, in areas as diverse as sensor characterisation, data quality and AI validation, to support partners in the development of new tests, standards and regulations for the safety of autonomous systems. This collaboration with LR will help ensure the UK maintains its global leadership in the marine services sector, where the autonomous shipping sector is expected to represent a global \$52bn market opportunity by 2050."



LR awards Digital Safe Security certification to Evergreen for its new 12k TEU container ship.

Evergreen Marine Corp. Ltd. (Evergreen) has been awarded Digital Safe Security certification from LR for its latest 12,000 TEU ultra-large container ship, Ever Forward, which was built and delivered by Samsung Heavy Industries Co., Ltd. (SHI) on 28 September 2020.

This solution provides operators and shorebased staff with instant access to operating data from onboard systems for monitoring and diagnostics through the cloud, which they can use to make more informed operational decisions and respond to issues faster and more efficiently.

Ever Forward has been built to class in line with LR Digital Ship notations with elements of SVESSEL certified against LR's Digital Safe Security notation, demonstrating that access for autonomous and remote monitoring of the ship's systems has been provided and assessed. LR also provided independent



assurance services to Evergreen and SHI, applying the Digital Ship descriptive notation to the vessel in recognition of the work and certifying the digital ship system as safe.

Young-Doo Kim, LR's North East Asia TSO Manager, said: "By working closely with Evergreen and Samsung Heavy Industries,

we were successful in assessing the system's functionality through LR's Digital Safety Security notation. We are excited to see digital ship technologies grow and comprise more and more functions and reach higher levels of autonomy, helped by LR's Digital Ships procedures that enable digital systems to be installed safely and fully functional as intended."

LR awards Samsung Heavy Industries AiP for its ammonia-fuelled tanker.

LR has granted AiP to Samsung Heavy Industries (SHI) for its ammonia-fuelled tanker design, a key progress milestone in the joint development project LR and SHI announced with industry leading partners MISC Berhad and MAN Energy Solutions in January 2020.

Ammonia is among the zero-carbon fuels

that is being considered by maritime

stakeholders and with the award of this AiP, SHI will forge ahead with its exclusive development of a relevant fuel gas supply system and detailed ship design. It aims to commercialise these developments by 2024.

Nick Brown, LR Group CEO designate and Marine and Offshore Director, said: "LR is working with leading industry partners to make deep-sea zero-carbon vessels a reality within this decade. Shipping needs action not words to deliver on the IMO's 2050 GHG ambitions and this challenge calls for collective action and industry collaboration. Following the announcement of the ammonia-fuelled tanker joint development project in January, we are delighted that SHI has made steady progress on the fuel gas supply system and detailed ship design."



Technical Matters

LR's Technical Matters series brings you regular opinion and insight from technical experts on a wide range of topics, from enhancing safety to improving asset performance. In each issue, we will consider how new regulations, technologies and innovations can be pragmatically and safely applied, weighing up the pros and cons in each case, and focusing on practical, efficient application.

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Digital Twin Ready certification awarded to Furuno.

Furuno Hellas has been awarded Digital Twin Ready certification from LR for HermAce, a smart onboard system that collects and monitors data on bridge navigation and communication equipment, actively supporting remote troubleshooting and problem rectifications.

HermAce, developed by the Hellas team of the Japan-headquartered marine equipment manufacturer, uses a digital twin as a virtual replica of bridge equipment based on data streamed directly from the vessel that offers real-time identification, diagnosis and resolution of problems.

Using HermAce, Furuno can remotely monitor, maintain and test their onboard equipment and this capability will deliver cost reductions to their ship operator clients as maintenance will be more predictable with testing requirements satisfied digitally.

It is the first time that the Digital Twin Ready certification has been granted for a Digital Health Management (DHM) developer in the marine and offshore industry. LR has previously awarded Digital Twin Ready Approval in Principles to GE, SERI and HHI (below) for completing the life-cycle engineering review of the processes and software tools in developing digital twins.

In granting the approval to Furuno Hellas, LR evaluated the engineering life cycle processes, the workflow involved in the HermAce model, algorithm

LR awards Digital Twin Ready AiP to HHI for gas containment tank.

LR has awarded AiP to Hyundai Heavy Industries (HHI) for its DHM System for a Type B gas containment tank, following a Joint Development Project (JDP) between the two parties launched in November 2019.

The system, Hyundai Prismatic Independent IMO Type B Tank eXcellence (HiPIX), has been assessed by LR's digital experts against LR's ShipRight Procedure for Digital Compliance, resulting in Digital Twin Ready AiP. It offers the possibility to operate and maintain ships' Type B gas containment tanks in an optimal cost-effective way while complying with classification and statutory requirements.

HHI is aiming to develop a complete structural DHM system for its LNG Fuel Type B Tanks fitted onboard the world first dualfuelled ultra-large container ships that are currently under construction at Hyundai Samho Yard.

HHI's HiPIX is a suite of software and service solutions designed to assure the structural safety of Type B tanks and enhance the performance of assets by obtaining survey credit through accurate insights on the condition of tank components, using digital twin technology and data as an alternative to a physical survey.

This will provide shipowners with an advantage when securing charterer contracts by lowering the through-life costs of the containment tank while maintaining a high level of safety and reliability. The digital twin's ability to process real-time data and generate insights on the health condition of the gas



↑ Pictured: Luis Benito, LR's Marine & Offshore Innovation and Co-creation Director (right) presents the Digital Twin Ready AiP to Seung-Ho Jeon, Executive Vice President of HHI Initial Design Division.



development, software conformity and practices concerning information security, in accordance with LR's Digital Twin Ready requirements.

"It is now more critical than ever to build trust in new technologies by applying practical, effective assurance techniques, which will help in operating vessels safely. reliably and remotely in the future," said Luis Benito, LR's Innovation and Co-creation Director.

containment tank improves maintenance effectiveness through the ability to make just-in-time, specific maintenance advisories. Furthermore, its ability to estimate and localise incipient fault conditions allows accurate tracking and progression of faults, prior to becoming costly failures.



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