

Horizons.

Connecting tomorrow's thinking to the challenges of today.

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Meet the team

With decarbonisation set to be the dominant topic at Nor-Shipping 2019, LR contributor Paul Bartlett speaks to Katharine Palmer about zero-emission vessels, transition pathways and funding a zero-carbon future. Head of Brand and External Relations Nicola Good seeks leadership views from LR Marine and Offshore Director Nick Brown and Viv Lebbon has worked with LR subject matter experts for more insight into digital twins and sulphur 2020.

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



Nicola Good



Paul Carrett



Viv Lebbon



Paul Bartlett

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Steering sustainability.



There is a need to make zero-carbon ships more attractive, and to direct investments towards innovative, sustainable technologies and alternative fuels.

As part of the United Nations family, IMO is actively working towards the 2030 Agenda for Sustainable Development and the associated Sustainable Development Goals (SDGs).

While SDG 14, on oceans, is central to IMO's remit, our work can be linked to all individual SDGs – addressing climate change, dealing with biodiversity, creating decent work and helping to support sustainable communities are just a few examples.

SDG 13 is all about tackling climate change, and this is a key element of IMO's strategic plan for the period 2018 to 2023. In 2013, shipping became the first global industry to be subjected to legally binding energy-efficiency requirements, when IMO regulations for both new and existing ships entered into force.

Then in 2016, IMO adopted new mandatory requirements for ships of 5,000 gt and above to collect and report data on their fuel-oil consumption in order to help Member States base future decisions on sound facts and reasoned, technical analysis. This scheme went into operation at the beginning of this year.

And in 2018 IMO adopted an initial strategy for reducing greenhouse gas (GHG) emissions from international shipping. This means Member States have now committed to a complete phase-out of GHG emissions from ships, a specific linkage to the Paris Agreement, and clear levels of ambition, including at least a 50 per cent cut in emissions from the sector by 2050.

But the targets agreed in the IMO strategy will not be met using fossil fuels, so research and development will be crucial. There is a need to make zero-carbon ships more attractive, and to direct investments towards innovative, sustainable technologies and alternative fuels.

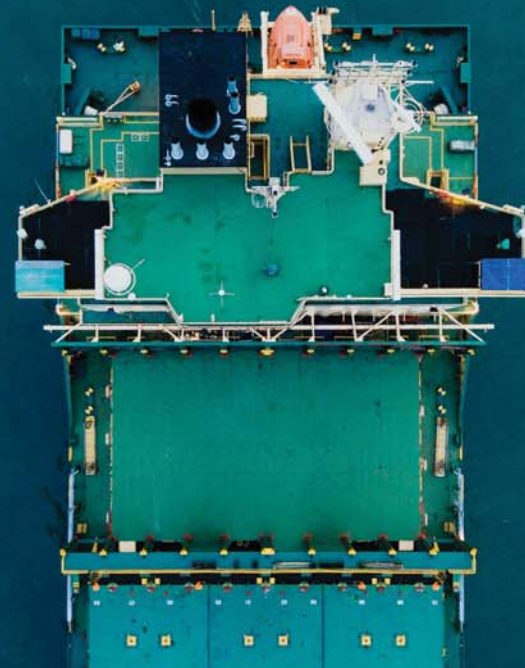
With this in mind, IMO is, as usual, backing up its regulatory initiatives with technical cooperation and capacity-building efforts. IMO's two major energy-efficiency projects – the **Global Maritime Energy Efficiency Partnerships** (GloMEEP) project and the EU-funded **Global MTCC Network project** – are already having a significant impact.

Kitack Lim
IMO Secretary-General

No time to lose.

Katharine Palmer has a strong message for the world's shipping industry. LR's Global Sustainability Manager insists that zero-emission vessels (ZEVs) need to be delivered into shipping's markets by 2030 at the latest, if there is any chance of achieving the IMO's 2050 greenhouse gas reduction ambition.

Words: Paul Bartlett



In April last year, the IMO agreed that global shipping will at least halve its greenhouse gas emissions by the middle of the century, even more if possible, compared with 2008 levels. The reduction is required if the industry is to be in line with Paris Agreement decarbonisation targets.

LR estimates that this 50% cut in absolute emissions is equivalent to a reduction of about 85% in operational CO₂ intensity (grams of CO₂ per tonne nautical mile) after taking into account seaborne trade expansion and world fleet growth over the next three decades. A daunting challenge!

A buy-in from shipping's main players is essential, Maersk's December announcement that it has adopted a plan to achieve carbon neutrality itself by 2050 is a welcome development.

Strategies for decarbonisation

Together with colleagues and experts at the UK's University Maritime Advisory Services (UMAS), Katharine has been working on a series of studies, with the latest on low carbon transition pathways, launched at the end of January this year. The study assesses ways in which shipping can address the challenges of energy development and vessel design and

operational implications relating to the IMO's ambition.

It stresses the shortage of time and identifies the 2020s as a key decade for piloting and prototyping new fuels and hybrid propulsion arrangements. If these proceed at a fair pace, it is possible that LR's vision for zero-emission ships being on the water by 2030, now with industry and government support, could be achieved.

The latest study – Zero-Emission Vessels: Transition Pathways – establishes three possible pathways relating to future fuel developments in shipping. The study's authors stress, however, that these pathways are based on today's fuel technologies and could change significantly as low or net zero-carbon fuels evolve over the next three decades.

Following release of the study, LR and its partners organised a webinar at which the complex studies and methodologies behind the study's conclusions were explained to participants. The webinar, hosted by Silje Bareksten, Head of Sustainability and Technology at Nor-Shipping, where these issues will be discussed this month, generated a number of pertinent questions and demonstrated the concern evident across a traditionally

conservative industry that faces at least three decades of major fuel disruption.

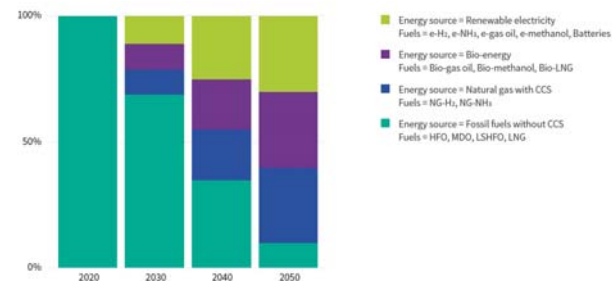
Looking beyond 'clean' hydrocarbons

As things stand today, however, the study is clear. There is absolutely no time to lose in examining the options and embracing fuel change. Whilst 'clean' hydrocarbons – liquefied natural gas (LNG) and methanol produced from fossil fuels, for example – provide significant air quality benefits and gains in energy efficiency, they will not make the IMO's 2050 ambition possible.

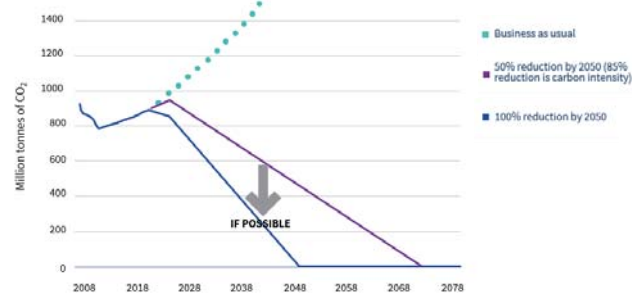
The study's authors note that until now, global shipping has pursued its own independent fuel strategy, as one of the only major users of high sulphur heavy fuel oil. But the IMO's decarbonisation ambition means that this must change.

Marine fuels of the future will be developed alongside broader decarbonisation initiatives across all energy-consuming sectors. A portfolio of new fuels is likely and will require a 'holistic' approach – one to which shipping is perhaps not traditionally accustomed.

Energy source and marine fuels mix assumed in equal mix pathway



Pathways for international shipping's CO₂ emissions



Global collaboration on sustainability

LR is proud to be a founding member of UN Global Compact Sustainable Ocean Business Action Platform. As part of this commitment, we are encouraging leading businesses and organisations to take action now with regards to our ocean's health. We strongly support the 17 UN Sustainable Development Goals and believe that this platform will help get us further to creating the future that we want.

Three pathways

The study identifies three possible pathways to meet the IMO's 2050 ambition. The first is based on one in which renewables dominate the supply of marine fuel. Hydrogen and ammonia produced from renewable electricity, used possibly in fuel cells or combustion engines respectively, could well form a basis for new research and development.

A second approach is based on the development of biofuels. The challenge here, as the study points out, is that the price and viability of biofuels will be driven by the availability of worldwide bio-energy capacity. This, in turn, will require a fundamental change in huge areas of land, which comes with its own challenges.

A third pathway sets out an 'equal mix pathway' made up of fuels produced from renewable electricity, including hydrogen, ammonia, methanol and batteries; fuels produced from bio-energy such as gas oil, methanol and LNG; and fuels produced from natural gas with Carbon Capture and Storage (CCS). However, the report warns that hydrogen and ammonia produced in this way depends both on a supply of competitively priced natural gas alongside the development of affordable carbon capture and storage technology. Fossil fuels would have to provide a small percentage of the outstanding requirement in this pathway.

Overall, as Carlo Ruacci at UMAS says: "These pathways have given us the opportunity to reflect on the actions needed to achieve a desirable future with zero-emission vessels dominating the shipping industry. There are different paths to reach this goal and every turn of a path has its seduction and promises attached. A path may hold so many possibilities for shipping stakeholders but what is clear though is that the era of emitting fossil fuels must be left behind."

Download the Zero-Emission Vessels: Transition Pathways study at www.lr.org/zev

Many dynamics in play

The lively webinar stimulated a range of considerations:

Could today's LNG bunkering facilities be converted in the future to supply feedstock for a hydrogen production plant, located nearby?

The conclusion here was that the difference in the boiling points of natural gas and hydrogen makes them directly incompatible.

Could LNG infrastructure constructed today be 'over-built' to make it suitable for handling hydrogen in the future?

The webinar participants thought this is unlikely because, without substantial grants, there would be no payback on the extra investment for an unknown period of time.

Katharine stressed that new fuels were only one part of the picture which, she conceded, has many variables. However, vessel performance, efficiency, automation and how we use the marine fuels of tomorrow more effectively could be equally as important as the fuels themselves.

There are also challenges specific to ocean-going vessels. Where lower density fuels in the future may require different operating profiles and more frequent bunkering for certain vessel types, including ferries and coastal vessels, this may not be appropriate for ships deployed on long-haul trades.

One conclusion that must be drawn from the webinar, whichever way the fuel mix turns out, is that fuel change must be embraced and there is no time to lose. There are big economic challenges that need to be addressed and an urgent need to invest in research and development of new fuels and hybrid propulsion arrangements.



CASE STUDY

Leading assurance for the safe deployment of alternative fuel sources for shipping.

How LR can champion sustainable oceans and a decarbonisation breakthrough in shipping.

Preventing and significantly reducing marine pollution of all kinds by 2025 is a key objective of the United Nations' Sustainable Development Goal 14, and shipping leaders will need to play a crucial role in contributing to this goal through decarbonisation of the industry.

We estimate that zero-emission vessels need to be delivered into shipping markets by 2030 at the latest, if there is any chance of achieving the IMO's 2050 GHG reduction ambition; a goal that has the full support of Lloyd's Register.

The maritime industry needs the confidence to invest in ships and infrastructure that utilise low or zero-carbon fuels, as well as the confidence in their design, operation and in the fuel supply chain to facilitate global trade. Similarly, energy companies are still uncertain about the demand from maritime for new fuels, when it will emerge and how big it will be.

To find a path through this uncertainty, parties that sometimes compete will need to convene and collaborate to address these challenges. The United Nations and the UN Global Compact provide a perfect

platform for constructive dialogue between energy and maritime, along with the ocean industry, to resolve this catch-22 situation.

LR is supporting this drive with thought leadership, innovation and dedicated research. We are a strategic partner and Advisory Council member of the Global Maritime Forum, a founding member of the UN Global Compact Sustainable Business Action Platform and a World Economic Forum Friend of Ocean Action. Our Zero-Emission Vessels: Transition

Pathways study, highlighted the possible transition pathways for achieving the IMO's 2050 ambitions. We will now work with early adopters of future fuels to ensure that those pathways are safe and sustainable.

One such example of this work is the launch of Compagnie Maritime Belge's hydrogen-powered passenger vessel, *Hydroville*, classed by LR (see case study below).



Climate change is one of the greatest challenges for the safety of our world. All participants in the maritime value chain must collaborate to accelerate the transition to low, or no, carbon operating models.

Alastair Marsh
CEO, Lloyd's Register

In December 2017, Antwerp maritime group Compagnie Maritime Belge (CMB) launched its new hydrogen-powered passenger vessel, *Hydroville*, classed by LR.

The catamaran crew boat was the first LR classed vessel to use hydrogen to power a diesel engine. The advantage of hydrogen is that no CO₂, particulate matter or sulphur oxides are released during combustion.

Hydroville is a showcase for the use of clean fuels and is primarily a project to

test hydrogen technology for applications on larger vessels. It will serve as a shuttle on the river Scheldt to provide CMB employees with environmentally friendly transport to their office.

The project is also a showcase for services related to the vessel. For example, LR's class approval of this vessel shows a way forward in hydrogen risk assessment and is a stepping stone towards the wider use of hydrogen as a fuel for combustion engines and alternative power generation technologies such as fuel cells. LR is taking a leading role in assuring the safe

deployment of alternative fuel sources for shipping.

LR is also working with H2-Industries to develop standards for all-electric vessels powered by emission-free Liquid Organic Hydrogen Carrier (LOHC) technology. Furthermore, LR signed a project agreement in September 2018 with Viareggio Super Yachts (VSY) and Siemens for the application of hydrogen fuel cells technology on a special version of the VSY 65m Waterecho yacht.

Funding a zero-carbon future.

Urgent action is needed to incentivise a global shipping industry that's reluctant to fund energy-saving technologies that support the IMO's targets to reduce carbon emissions, writes Paul Bartlett. New contractual initiatives and innovative funding channels may provide fresh incentives for a zero-carbon future.



If we are to meet the 2030 ambition, we must embrace a change in the way ships are operated, including a wide range of carbon-reducing practices and technologies for existing ships. There is no time to waste.

“History has shown that cost remains the best driver of change,” declared Noah Silberschmidt, CEO of Silverstream Technologies. He is referring to what many expect to be a major hike in bunker bills when the IMO’s sulphur cap kicks in next January and the fact that more than a year has elapsed since the UN agency agreed ambitious carbon-reduction targets. Yet much of the global shipping business continues as though nothing has changed.

In line with the so-called Paris Agreement, the IMO agreed on carbon reduction targets in April 2018. By 2050, its ambition is to reduce shipping’s carbon emissions by at least 50% compared with 2008 levels.

LR estimates that this is equivalent to a reduction of about 80% in carbon intensity, taking into account growth in trade over the next three decades.

The IMO also set out an aim that, as a waypoint, global shipping should aim to cut its carbon intensity by between 40% and 70% by 2030. Nearly a tenth of that 12-year time frame has now elapsed and carbon-cutting initiatives – particularly on existing ships – have been lamentably few.

Katharine Palmer is a principal architect of LR’s zero-carbon transition strategy. She is adamant that achieving the IMO’s ambitions will rely on an industry-wide approach to decarbonisation – in fact, she says, it will require substantial and collaborative input from other industrial sectors too, some of which are already well ahead of shipping in terms of transitioning to low/zero carbon. Palmer stresses that the involvement of the financial sector is essential.

No time to waste

“New marine fuels with a low-to-zero carbon content are the way forward,” Palmer told Horizons. “And several new low- or zero-carbon fuels are under development. But these are still years away from becoming full-scale and commercially available. If we are to meet the 2030 ambition, we must embrace a change in the way ships are operated, including a wide range of carbon-reducing practices and technologies for existing ships. There is no time to waste.”

Palmer shares the views of others who believe that access to finance is currently a stumbling block, particularly for energy-saving retrofits on existing ships and incentivising the transition to zero-carbon. However, she says that several recent initiatives could potentially open up new financing channels for ‘green’ initiatives in shipping.

One of these is the Climate Bonds Initiative. It describes itself as an international, investor-focused, not for profit organisation working solely on mobilising the \$100 trillion bond market for climate change initiatives. Projects across the transport sector generally, including those in shipping, are likely to feature in its work in the future.

However, traditional maritime lenders are often reluctant to provide funding for green initiatives in shipping, particularly since some have scaled back their exposure to the sector or left it completely. Energy-saving retrofits may well benefit the environment immediately whilst also contributing to the IMO’s long-term decarbonisation ambitions. Yet they do not fit conveniently into traditional bank-lending models and many

ship operators face a challenge in funding such initiatives out of cash flow.

Mark Clintworth has a responsibility for shipping at the European Investment Bank, the lending arm of the European Union which is also the world’s largest multilateral lender and the biggest provider of climate-related finance. He insists that funds are potentially available for the right project provided it is eligible under bank lending rules; that it is a proven technology and has a strong business case.

This last point constitutes another hurdle, however. Bankers obviously want certainty over payback, but many new energy-saving technologies have no significant track record. It’s not a good start, from a financing point of view.

Progress is also hampered by shipping’s complex contractual relationships and who pays the bunker bill. In the dry and liquid bulk trades, time charters are widely used as the contract between charterer and owner. In such arrangements, charterers foot the fuel bill. Owners, therefore, have little incentive to invest in vessel efficiency gains.

“The split incentive between charterers and owners is arguably the most pressing and difficult question to answer when it comes to shipping’s sustainability drive,” observes Silverstream’s Silberschmidt. “Whilst we are beginning to see some contractual changes in the market, further changes are needed.”

Norwegians and Japanese front runners

The Norwegians have pioneered some of these contractual initiatives. State energy company Equinor, for example, has worked closely with owners to share the benefits of fuel-saving technologies. New time charter clauses set out how any financial upside from fuel savings should be split. Meanwhile, the country’s unique NOx Fund has supported a broad range of energy-saving initiatives across the marine and offshore sectors, underpinning an array of new environmentally favourable technologies.



Japan’s NYK group also broke new ground when it recently secured a 2 billion yen (\$18m) ‘green loan’ from the country’s Taiyo Life Insurance Company to finance a 49,000 dwt methanol-fuelled chemical tanker. The 10-year deal, running from December 2018, was assessed by the Japan Credit Rating Agency and achieved the highest green credit rating.

However, NYK is one of only a few shipping groups that carry investment grade ratings. Whereas the bond market may be potentially available for investment-grade energy companies engaged in the development of offshore renewables, for example, or for sustainable real estate or organic farms, it is not available, so far at least, to shipping companies with a handful of bulk carriers or tankers.

These are some of the reasons why Tuomas Riski, CEO of Norsepower Oy, a Finnish clean technology company that has developed a rotor sail system to supplement power from ships’ main engines, is offering ship operators a ‘technology as a service’ financing model. Rather than face a capital cost up-front, clients can install Norsepower rotor sails

and pay a monthly fee based on actual fuel savings.

“This approach guarantees that the owner will not pay out unless the technology functions as promised,” says Riski. “Norsepower is essentially de-risking the installation of Flettner rotors for applicable vessels.” Three installations have been made so far – on the 109,647 dwt products tanker *Maersk Pelican*, the 57,565 gt cruise ferry *Viking Grace* and the 18,205 gt *Estraden*, a ro-ro cargo vessel.

LR’s Palmer has already highlighted the need for a cross-industry collaborative approach to global shipping’s decarbonisation. Traditional maritime lenders and non-shipping finance institutions have an essential role to play if there is to be any hope of meeting the IMO’s targets.

There is no time to lose, sources say. Financiers must bring their expertise to the table and assist the shipping industry with some urgently needed creative financial thinking.

Taking advantage of digitalisation: Why use a digital twin in the offshore world?

Vaibhav Parsoya explains how LR is pioneering digital twin technology for FPSOs and other offshore structures.



Vaibhav Parsoya
Our voice on digital twins

For the last decade, the offshore industry has been leveraging digital technologies with some specific applications, including defining geo-characteristics of oil fields, to improve the quality of extraction processing.

In recent times we have seen this interest extend into new technologies, such as digital twins, with more industry players realising the benefits digitalisation can bring to their business and the impact it can have on performance, specifically when it comes to maintenance, reliable utilisation and asset designs to tackle bespoke challenges. We are seeing success and failure stories throughout the industry. This emphasises the need to define digital twin technology and investigate its true benefits and opportunities for our customers and establish trust, as we believe the technology has a lot more to offer beyond the hype it has created so far.

Digital health management and digital twin technology

Digital health management (DHM) is the term used by LR to describe digital technologies and systems that are used to gather data and insights on an asset's health, which incorporates digital twin technology. Furthermore, we define a digital twin as a 'multi-physics, data-driven representation of a physical asset,

often residing in a cloud-based environment using data streamed from the physical asset' and has applications varying from designers and operators to autonomy. In other words, a digital twin is a dynamic digital representation of a physical piece of equipment or asset used in a business environment. It is helping operators improve aspects of their operational performance and maintenance regimes through insights generated by the twins as part of the DHM.

Digital twins for the offshore industry

The offshore market has a number of technical and commercial challenges including the reduction of operating costs, a growing knowledge and experience gap, competition for talent, as well as trying to prioritise and achieve superior returns on investments. The economic value and environmental stability derived from digital twin technology will be evident from improved productivity, utilisation and efficiency, as well as the increased level of safety, transparency and confidence to users and their clients, which potentially provides an opportunity to co-create and collaborate.

Digital twins can mitigate the talent and experience gap given its ability to provide prescriptive actions to the maintenance and optimal operation of an asset. Accurate insights on the health of the asset, specifically its electrical,

mechanical and structural systems, can improve operational expenditures such as life extension, which can positively influence capital allocation at the business level.

To realise a digital twin's true value at a business level, digital twin applications would need to integrate business, economic and technical needs, as the technology has the potential to generate economic value out of different facets of an asset in operation. This is achieved through managing operational performance with digital twin technology, helping operators avoid costly and unexpected downtime.

Digital twins for FPSO operators

If used as an integral part of the decision-making process, digital twin technology can improve a floating production storage and offloading (FPSO) unit operator's competitive advantage when it comes to traditional ways of working. This can include revenue protection, increased operational efficiency and better customer experience as the technology gives the operator's client increased confidence and transparency on the asset's ability to stay productive. FPSO operators can use digital twins to gather and integrate existing and new data, whilst correlating with physics-based simulation models, to diagnose and predict structural performance. This in



time can provide operational savings when it comes to unplanned downtime and maintenance, and in some cases can extend the life of an asset.

Digital twin technology can assist operators with establishing safer operations by embracing recommendations taken from insights learnt from past behaviour across the fleet. This gives operators more confidence in human-based operations as it can potentially reduce human errors from occurring.

To sum up, we have realised through working with industry partners that digital twins, specifically for FPSOs, can offer great opportunities through improved productivity, better utilisation of assets and increased efficiency. This leads to a better level of safety, transparency and confidence, whilst also helping to diagnose and predict structural performance, which can prolong the life expectancy of an asset. It helps customers to make the most of their FPSO.

Our work with digital twin technology

In addition to our Digital Compliance Framework, which delivers assurance of digital twins against DHM targets (you can read more about this in the [previous issue of Horizons](#)), we are also a digital twin solution provider. We are working with leaders in the industry to create bespoke twins, suited to the business solutions of our customers, giving them the ability to understand, manage and optimise their whole asset.

In terms of approach, we believe it's important to deliver digital solutions that are well-balanced between the technical solution and its business application for our customers. We understand the challenges around data sharing and data ethics in this collaborative digital eco-system and address the value of the data and its contributions to not only our customers, but also their partners.

For LR, our work is about supporting the industry's digitalisation journey to realise new value. More importantly, we support our clients to build confidence in these technologies so that they can be trusted within the industry to make better, more informed decisions safely.

Want to find out more? Contact innovationmo@lr.org

Engineered for growth.

Strong relationships are vital to help clients achieve their strategic ambitions, says Nick Brown, LR Marine and Offshore Director.

Words: Nicola Good

It's the dilemma that many leaders in the classification sector face – anticipating maritime's future needs and supporting clients to deliver on their commercial ambitions. It's a situation made even more complex by the rate of technological change and an ever-evolving regulatory landscape. For Nick Brown, LR Marine and Offshore Director, the most effective way to deal with this challenge is to foster strong customer relationships.

"There are so many horses we could back when it comes to the development of our products and services, particularly around decarbonisation and digitalisation," Brown tells Horizons, adding that "it is hugely important that we pace our investment correctly. If one goes in too early, there is the risk of there being no market appetite or capacity from the industry to buy or benefit from these services."

According to Brown, one of the best ways to mitigate against this happening is for LR's people to develop a stronger understanding of their client's strategies by working closely with them to better understand their ambitions.

"It's vital that our customers see the value of involving LR at the earliest stage," he says. "Some 80%-85% of what we deliver remains our core classification or certification 'licence to operate' services. Everything we do is all about trying to provide assurance, but how do classification societies differ? Assurance is often the reason why people select Lloyd's Register, but to take this to the next level, we need to play a role in supporting their business performance. This is where it all comes together."

"We always have a positive chance of being considered integral to a customer's strategy and if they're planning something major, they should be able to think of LR as a trusted advisor who can give impartial

advice. They need to know that they can rely on our opinion before they go to their boards for sign-off."

There is no doubting that Brown, who joined LR following engineering studies, has a solid track record of understanding how market and customer needs can rapidly evolve, particularly from his time in China during the mid-2000s.

Having been parachuted into China in November 2006, a year when LR had contracted around 60 vessels, he suddenly found himself running a sales team that won 427 ships in 2007. There was even a day when he and Dr Xue, the China country manager, secured 30 newbuilding orders in a single road trip from five shipyard visits. "We kept looking at each other and thinking, 'Well, that was a good meeting', and that was the day we always wanted to beat, but never could," Brown recalls.

In the summer of 2008, he was chosen to take charge of operations in China because "now you have won it all, you must deliver it all". The LR headcount in the country swelled from 200 people to around 900 at the peak. While the pace of growth presented numerous challenges, it was accompanied with unwavering support from the LR CEO at the time, who was adamant that safety and quality had to come first.

"I was constantly being reminded by my CEO that the biggest risk to the LR brand was being associated with a ship that had quality concerns, so he was committed to supporting me with the resource and skills I required in China to deliver to LR's standards," he explains.

However, Brown's time in China was not always plain sailing. No economy was untouched by the meltdown in financial markets in late 2008 and this forced some of the most difficult decisions of his career.

"One of the most challenging situations I have ever faced was driven by the boom and bust of China. There was a lot of conversion activity at the time – very large crude carriers to very large ore carriers and single hulls to double hull. LR took the bull by the horns and opted to move a dedicated conversion consulting team to Shanghai. I spent months convincing several approval specialists from Europe to relocate and then, six months later, the market collapsed and I had to send them home."

There were a number of hard conversations – families had been uprooted and spouses were incredibly unhappy about the too-ing and fro-ing – but the decision for staff to come to China and then leave was right for the business and our clients at the time. However, it was tough, he admits.

A farmer's son from Lincoln, who joined the LR graduate trainee scheme in September 1996, Brown is no stranger to hard work and colleagues across LR attest to his work ethic. He readily admits that he has workaholic tendencies and, as a husband and father of two, he has to be mindful about his work-life balance.

While he does marathon training to clear his head and find solutions to some of his daily dilemmas, Brown has no intention of running away from LR.

"The reason I've stayed at LR is because I've been allowed to have several different careers within the same organisation. I was a surveyor in very busy dry-docks in the Middle East for eight years, I moved into product development and marketing in London for three years and then went to China and it felt like I was running a start-up company. My fourth career started when I came back to Southampton in 2013. It's all been very dynamic, even though I have only ever been with one company."



So why Lloyd's Register?

"For many people, LR's history and legacy is a key attraction. For me, it is because LR is a company that is motivated to do the right thing, not just the profitable thing. I am by no means unique. A lot of people work with LR and stay with LR because the LR Foundation makes you feel like you are working for a higher purpose."

Views on surveyors

"Anybody can be an inspector, but if you don't understand why the rules exist and you can't take in everything else that you have seen, then you won't be a surveyor. No two surveyors will ever do the job the same way – that's the beauty of running a human organisation. With remote surveying, we will still use surveyors to make the decisions but the way they will collect the information on which to base their decisions will be totally different."

Career low that became a high

"I have only ever applied for one job in LR and I didn't get it. I had hoped to go to Singapore as country head but didn't get the job. Instead, I was told I was going to China. As a father of a 15-month-old baby at the time, I objected and then I was told the Singapore role didn't exist anymore. I have no doubt that I wouldn't be in this position now if I hadn't gone to China. I try to recall this experience to my colleagues when we hold our regular talent development discussions. "Have faith in your coaches and mentors as they often know what's best for your career and your family." As it turned out my family loved our 7 years in China."

Nick in the news

The Interview – Lloyd's List
[Click here](#) to view

A view from the front lines of ocean shipping's technological evolution – FreightWaves
[Click here](#) to view

Shipowner and operator guide: How will the 2020 sulphur limit affect you?

Muhammad Usman, our voice on marine fuels, answers your questions around the upcoming regulation.

Muhammad Usman
Our voice on marine fuels



The 1 January 2020 deadline for MARPOL Annex VI regulation 14.1.3 is fast approaching which will mandate ships to burn fuel with sulphur content less than 0.50% outside Emission Control Areas (ECA-SOx). We know from conversations with customers that many ship operators have already put the preparatory plans in place and are busy working on their Ship Implementation Plans (SIPs), ready for the deadline.

On the regulatory side, some important decisions are being made by the IMO that are shaping the discussions and impacting the choices being made by various stakeholders. The supply industry is also preparing itself for this change by announcing the availability of 0.50% sulphur fuels in various ports around the world. Based on this information, several market surveys indicate that the majority of shipowners and operators intend to comply with the MARPOL Annex VI regulation 14.1.3 by burning 0.50% Very Low Sulphur Fuel Oil (VLSFO).

To support those preparing for this change, specifically shipowners and operators, we have put together a summary of the most frequently asked questions:

Is a Ship Implementation Plan (SIP) mandatory?

As per MEPC.1-Circ.878, a SIP is not mandatory, though it is ship-specific and owners and operators are recommended to prepare one as it provides an opportunity for technical staff on board to review the ship's fuel management procedures in view of the expected

variability in quality of 0.50% sulphur fuels. Moreover, this exercise will help technical staff set timelines for the vessel when taking necessary operational, design, and system amendments in the run-up to 1 January 2020. LR continues to support customers with fuel change management procedures before this regulation comes into force, and is helping customers prepare ship-specific SIPs for when they transition from HSFO to VLSFO. Contact your local LR office for more information.

Should there be a comprehensive tank cleaning before 1 January 2020?

Each ship is different with regards to their machinery management procedures, bunker tank design, and the quality of Heavy Fuel Oil (HFO) they have consumed. Hence an assessment should be performed on the condition of each HFO bunker tank and a decision needs to be made on the appropriate course of action. There are a few options being considered by the ship operators such as:

- Flushing tanks with distillate ultra-low sulphur fuels to naturally flush the tanks, piping and fuel system components of high sulphur fuel oil and sediment
- Using one or more bunkerings of 0.50% fuels well before the enforcement date, again having a flushing effect
- Use of a specialist additive dosed over several bunker loads before the first 0.50% is loaded to clean the tanks. (Note: this approach may require at least six months, if not more, to be effective)

- Manual / physical cleaning
- A combination of any of the above

The effectiveness of these approaches would depend on the final condition of the tank and how well it is executed. When first using 0.50% fuels, crews are also recommended to carry out sulphur sample checks from the system periodically to provide indications of the tank's compliance condition.

What are the major quality concerns with 0.50% fuels?

Some of the main challenges and risks with the new 0.50% fuels are:

- Compatibility between fuels from different sources
- Long-term stability of the blends
- Significant variability of certain physical parameters from different sources such as viscosity and density
- Compliance (sulphur – blending to the limit)
- Cold flow properties (high pour point fuels and/or waxy fuels potentially causing blocked filters/sludging if handled at inappropriate temperatures)
- Combustion performance of new blends

Handling of these 0.50% sulphur fuels will become a bigger challenge if there is a lack of preparation and planning, which includes understanding the fuel properties

and making necessary operational adjustments to ensure seamless operation. Crew training will be important because they are on the frontline handling various technical challenges and ensuring resilient ship operations. It is well recognised, however, that there are many thousands of ships that have not yet truly experienced the occasional switch to distillates, this would suggest that the lessons learnt by some from the switch in 2015 will have to be learnt by many more for 2020 and the same technical and operational warnings will need to be reinforced.

We expect that an increasing number of vessels will start trialling these 0.50% fuels in the second half of 2019. LR's Fuel Oil Bunkering Analysis Advisory Service (FOBAS) team is monitoring the situation closely and, as soon as there is significant take up, we will build the 0.50% sulphur fuel characterisation matrix.

What is the update from ISO?

The work on the ISO/PAS 23263:2019 guidelines for fuel suppliers and users regarding marine fuel quality, considering the implementation of maximum 0.50% sulphur in 2020, is currently undergoing a balloting process as per ISO procedures. It is expected that the ISO/PAS 23263 will be finalised and available as reference for ship operators and suppliers by the end of September this year.

The ISO working group's primary focus has been to address the 0.50% sulphur fuels' stability and compatibility, for example being able to protect against unstable fuels and providing better indicators as to the compatibility between one fuel and another. Informative Annexes include additional guidance on the composition, general requirement, stability and commingling of fuels. Furthermore, CIMAC WG7 for fuels will be coming out with a more detailed technical document covering fuel stability and compatibility.

How are discussions shaping up at IMO?

Most discussions are revolving around the consistent implementation of MARPOL Annex VI regulation 14.1.3. At MEPC 74, held recently at IMO's headquarters in London, draft guidelines for the consistent implementation of the MARPOL Annex VI Regulation 14.1.3 were completed and a revision of the Annex for approval and adoption was proposed. The consistent implementation guidelines will be released as a resolution in due course and include the committee's understanding of the matters relating to the safety and management concerns expressed on the use of 0.50% fuels. The guidelines will also address areas such as key technical preparatory considerations, control measures by port states, control on fuel oil suppliers, and fuel oil non-availability, including a FONAR template and handling non-compliant fuel scenarios.

Draft amendments to the MARPOL Annex VI have been approved by MEPC 74 to be adopted later by MEPC 75. The terms 'in-use sample' and 'on-board sample' have been defined. One of the major changes has been the amendments to the Sulphur Verification Procedure (Appendix VI) to handle accuracy and precision of test results of both the current MARPOL sample, as well as 'in-use' and 'on-board' sample. The MARPOL Annex VI (as delivered) sample test result would be considered as having 'not met the requirement' above 0.50% after following the verification procedure. However for the 'in-use' and 'on-board' samples the fuel will not have met the requirement if the test result exceeds 0.53%. These final results will then be evaluated by the competent authority.

The guidelines for port state control are developed to handle scenarios such as when there is discrepancy between the Bunker Delivery Note (BDN) and independent ship results indicating non-compliant fuel has been loaded despite the declaration on the BDN stating otherwise. Moreover, it was recognised that there will be a wide range of scenarios to address

resulting in non-compliant fuel being on board, such as after application of a FONAR, including by port and ship; the discretion ultimately remains with the inspection authority on a final decision. The emphasis is on the ship making every attempt to avoid putting itself into such a position. The guidance on best practice for member states/coastal states adds to the previously completed guidance for fuel purchaser/users and suppliers, mainly providing guidance for contingency measures for addressing non-compliant fuel oils. The guidance also focuses on the expectations on suppliers to ensure fuel quality is acceptable for the receiving ship. MEPC 74 also worked on the guidance document in case of failure of a single monitoring instrument and recommended actions to take if the exhaust gas cleaning system fails to meet the provision of the guidelines.

To facilitate the consistent implementation, MEPC 73 agreed a carriage ban of high sulphur fuels that exceed 0.50% on ships not fitted with an exhaust gas cleaning system (EGCS), often referred to as scrubbers, from 1 March 2020.



How can LR's FOBAS team help?

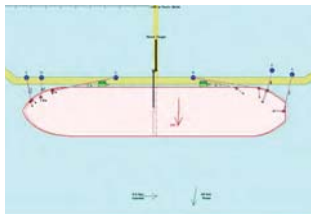
We are actively participating in IMO 2020 discussions at various industry forums to highlight ship operator concerns and provide guidance and technical input where possible. Apart from fuel oil testing, which will be increasingly important moving forwards, our experts are here to help ship operators in their sulphur 2020 implementation planning.

To find out more, please contact us at fobas@lr.org.

Assurance beyond Class.

A selection of case studies that investigate assurance beyond Class.

Mooring arrangement review.



The Oil Companies International Marine Forum (OCIMF) published the 4th edition of their Mooring Equipment Guidelines in 2018. New terminology to describe the strength of mooring lines and equipment has been introduced to avoid confusion with the term Minimum

Breaking Load, and drag coefficients have been updated. As a result of these changes, a tanker operator wanted to re-assess and verify the mooring lines' strength of 22 classes of their chemical tankers.

Using both analytical calculations and the Optimoor mooring software, LR's Technical Investigation Department (TID) carried out an assessment of the existing mooring arrangement. The wind and current forces acting on the ship were calculated based on the updated OCIMF drag coefficients. The required line strength using the new terminology (ship design minimum breaking load and line design breaking strength) was

determined and communicated to the client. The assessment was carried out for a standard mooring arrangement as defined by OCIMF for a 'site specific' mooring arrangement.

The client benefited from a swift turnaround for getting updated line specification requirements. The requirements comply with the OCIMF recommendations and the client can specify mooring lines using the new terminology and therefore avoid any confusion. Additionally, as a result of the study, a mooring rope manufacturer was approached to renew some of the ships' mooring lines.

Autonomous marine systems risk assessment.



Defence Research and Development Canada wanted to reduce the risks of using autonomous marine systems (AMS).

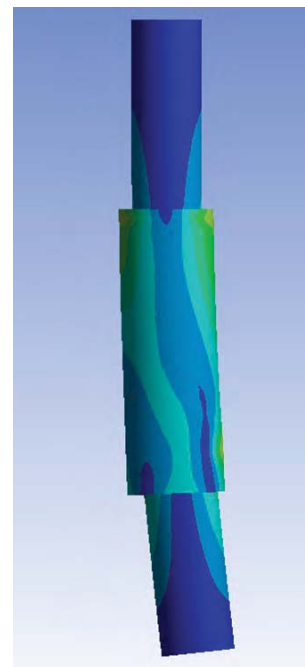
LR's Applied Technology Group (ATG) participated in the Unmanned Warrior sea trials in 2016. Under planning for four years, a major objective of the trial was to demonstrate that AMS, enabled with SeeByte's SeeTrack NEPTUNE planning tool and WHOI micro-modems, are capable of communicating and inter-operating regardless of the AMS unit, robotic control middleware and payload.

Prior to and during the trials LR ATG, assessed the performance and expectations of state-of-the-art automated systems commonly used in Naval Mine Countermeasure (NMC) operations. During the trials, LR ATG collected information on the local environment, autonomous vehicle condition, mission complexity, performance/issues, variables (plus

linkage to other variables) and their associated risks to performing NMC missions. With this information, LR ATG developed the first iteration of a mission risk assessment.

Considering the harsh marine environment that AMS operate in, the impact of the environment on their performance and their onboard sensors and sub-systems, LR ATG developed a concept plan for implementing a fault detection, identification and recovery system into a Robotic Operating System (ROS) based tool, like NEPTUNE.

The client was able to extract additional value from these trials and provide naval planners with additional insights that will support effective implementation of AMS into naval operations.



Machinery failure investigations.

A number of vessels fitted with balanced spade-type rudders had suffered problems with the rudders' neck bearings. Made from a polyester resin fibre reinforced material, the bearings had shifted down in the housing of the rudder trunk extension and were now resting on top of the rudder blade. Rudder blades were also found to have construction defects with numerous absent welds. It was noted that all of the affected vessels were constructed at the same shipyard. LR TID was requested to investigate the cause of the neck bearing movement.

LR TID generated a finite element model of the assembly with the rudder stock, neck bearing, (having an interference fit) and the rudder trunk extension. The rudder stock neck bearing journal included a tapered diameter decreasing from the axial centre to the lower end. The rudder trunk was constrained at the top to represent being cantilevered out the bottom of the hull. A transverse rudder load of 80 tonnes was simulated at the bottom of the rudder stock.

The analysis found the maximum hoop and radial direction stresses in the neck bearing occurred in way of the knuckle on the rudder stock journal, as would be intuitively assessed. The radial direction stresses would generate a Poisson's response in the axial/vertical direction. The axial elongation would be sufficient to overcome the frictional resistance due to the as-fitted interface pressure at the lower area of the bearing, resulting in local movement of the bearing in the rudder trunk housing. Repetition of the action would result in the bearing being ratcheted out of the housing.

Further, as bending of the rudder trunk results in compressive axial strain in way of the contact area on the bearing, then rudder trunk bending may also be a contributory factor, in the movement of the neck bearing.

The client was informed of the likely failure scenario and contributory factors, as well as mitigating actions. Non-metallic bearings should have substantial retaining rings. In this case, the non-metallic neck bearings were replaced with items of bronze.

Noise attenuation of scrubbers.



The installation of scrubbers in exhaust systems often requires a reduction or even removal of the existing silencers, due to space limitations. Therefore, a reliable evaluation of the scrubber noise attenuation is necessary before it is installed in the exhaust system. Often only limited information on the noise attenuation of the scrubber is available, as this is a complex parameter to determine. Based on LR's experience, noise attenuation provided by scrubbers varies substantially.

LR has developed in-house software called EXHAUST, which accurately predicts the noise attenuation provided by marine exhaust systems, including scrubbers. This is linked to the use of finite element modelling of the noise, and the simulation of the flow inside the scrubbers. LR has also

developed a new method based on wave decomposition techniques for on-site measurements of the noise attenuation by scrubbers, thereby separating the attenuation by the scrubber from other exhaust elements.

LR has successfully helped scrubber manufacturers with optimising scrubber designs for noise attenuation and flow, as well as supported shipowners with meeting noise emission requirements from exhaust systems with scrubbers and catalytic filters. We can provide assistance to shipowners, shipyards and scrubber manufacturers for optimising the acoustic performance of scrubbers, provide assistance into understanding the impact of its installation, and perform troubleshooting of underperforming systems.

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.



Developing the first ocean-going autonomous navigation system.

During Singapore Maritime Week in April, LR announced a Memorandum of Understanding (MoU) with ST Engineering, a leading Information Communications Technologies provider, and co-creator of Smart City Solutions, and Mitsui and Co., Ltd, the second largest trading house in Japan.

The partners will collaborate on the 'Development of Ocean-Going Autonomous Navigation System on a Marine Asset'. The MoU forms the foundation of the MPA-funded 'World's Largest Ocean-Going Autonomous Vessel Programme'.

"LR's involvement in this project builds on the capability and experience already gained from our partnership in other industry-leading and world-first autonomous projects," said Andrew

McKeran, LR Commercial Director, Marine and Offshore. "However, this project, a world-first for the deployment of autonomous navigational technology to an ocean-going vessel for commercial operations, pushes the boundaries of autonomous technology and moves the industry towards deployment of autonomous navigation systems on board vessels for enhanced performance and, critically, safety."

"Increasing interest in maritime autonomy and remote access/control technologies is a specific example of larger technological changes we are currently seeing in the maritime industry. Essential to the successful and safe adoption of these technologies is that robust use-cases are established, for example to improve navigational safety, supply chain efficiency or operational costs of marine assets.

"Autonomous systems will also provide opportunities for skilled seafarers to focus on what they do best, and the safe and sustainable integration of autonomous systems relies on the appropriate engagement with seafaring professionals."

He continued: "Working with ST Engineering, who have already developed and proven this capability and are now looking to work to scale in the commercial marine market, is what sets this project apart. ST Engineering provide world-class technical expertise, technology and advanced learnings on autonomous systems in the marine environment. We will support with expertise on assurance, certification and regulation for the application of autonomy in the maritime environment, as well as approval of systems where appropriate."



HMD receives approval for LNG-fuelled MR tanker design.

Hyundai Mipo Dockyard (HMD) has received approval in principle (AiP) from LR for an LNG-fuelled 50,000 dwt Class MR tanker design. This development is the result of close collaboration between HMD and LR.

HMD has incorporated an LNG-fuelled propulsion system into its most successful design, following technical cooperation with LR, ensuring that the design complies with the new IGF code, as well as LR's Gas Fuelled Rules, covering other applicable requirements.

LR adopted a risk-based approach to review the novel design and facilitated a high-level hazard identification (HAZID)

workshop for the LNG fuel supply system (and associated ancillaries) in accordance with the LR ShipRight Procedure for Risk Based Designs. The concept design was reviewed in conjunction with the result of the HAZID workshop, requiring several actions and recommendations, before receiving AiP.

HMD has been focusing its efforts on LNG-fuelled ships as part of its plans to meet the market's needs with environmentally friendly, commercially viable and innovative designs. HMD is now reviewing various other types of vessels for LNG-fuelled application, such as bulk carriers and container ships.

LR awarded RO status by the Italian flag Administration.

LR has been awarded RO (Recognised Organisation) status by the Italian flag Administration and is now authorised to issue statutory certification on its behalf to all seagoing ships sailing with the Italian flag.

In line with its new RO status, LR will establish an Italy branch of LR Group Ltd to fully support Italy and the country's shipowners. As LR will be authorised to work on behalf of the Italian flag Administration, owners of Italian-flagged ships will have the opportunity to work with LR for classification and consultancy services and benefit from LR's extensive technical expertise.

By having RO status, LR will also support the Italian Shipping Community, linked associations such as the Confitarma, Atena, Port Authorities and the Italian Coast Guard as the technical branch of the Italian Ministry of Transportation.



Virus-hit boxship takes centre stage at Singapore cyber wargame.

A container ship whose power management system had been shut down by a long dormant virus was the focus of a UK maritime industry cyber wargame hosted during Singapore Maritime Week in April.

Sensors in containers warning of issues with storage temperatures on board made for a truly uncomfortable situation for the cargo owners. More than 40 delegates were invited to discuss this cyber security scenario and work out solutions for

immediate action, as well as longer-term plans to mitigate such a security breach.

The Singapore event, which followed on from a successful Athens cyber wargame in March, was facilitated by the Society of Maritime Industries and the UK's Department for International Trade. The event was hosted by Nettitude (a member of the LR group), NCC Group, CyberOwl and Inmarsat.



Get in touch

Please visit www.lr.org for more information



Lloyd's Register Group
71 Fenchurch Street
London
EC3M 4BS
UK

