

Horizons.

Connecting tomorrow's thinking to the challenges of today.

WHAT'S ON THE HORIZON FOR:

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150 years in China.

As LR celebrates 150 years in China at Marintec 2019, we look back at LR's history in the country, the current state of the market and outlooks for the future.

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Meet the team

With Marintec 2019 taking place in Shanghai this week, Head of Brand & External Relations Nicola Good speaks to LR North Asia President Mark Darley about his focus for new construction success in the region. Paul Carrett and Viv Lebbon work with LR subject matter experts for insights into decarbonisation and remote presence, whilst LR contributor Paul Bartlett looks at new ship recycling regulatory requirements. The team also takes an in-depth look at seafarer safety and wellbeing. Our designer for this issue is Kaz Kapusniak.

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

Programmed for growth.

New chapter in Chinese shipbuilding paves the way for more specialisation and diversification.



Ever since China became a member of the World Trade Organisation in 2002, global attention has focused on this leading economy, which generated 49% of the growth in trade between 2006 and 2016. Given the inextricable link between trade and maritime, there is no questioning China's role in world shipping. The numbers speak for themselves. According to data from Clarksons Research, China comes second in terms of fleet ownership, behind Greece, and it is forecast to account for 22% of expected 2019-2030 seaborne trade growth. Furthermore, Chinese shipowners account for 19% of 2019-2030 fleet growth and Shanghai itself is the world's seventh largest shipowner cluster.

Much of this activity has supported China's determination to become a dominant force in shipbuilding. In the last three decades, the China's shipyards have evolved from a production line for bulk carriers and general cargo ships to centres of excellence delivering highly specialised tonnage. With government policy supporting long-term planning, Chinese facilities have looked and learned from the challenges faced by their regional rivals and focused on differentiation and technological advancement. Chinese yards now enjoy 36% of global orderbook in CGT and lead in newbuild 2019 year to date contracting in CGT.

A long-awaited development in recent weeks heralds the beginning of a new chapter for Chinese shipbuilding. The merger of giant state-owned China State Shipbuilding Corp (CSSC) and the China Shipbuilding Industry Co (CSIC) has created a shipbuilding powerhouse with 21 percent of global sales and a combined revenue of US\$141.5 billion. The company will be the world's largest shipbuilding group, with more than 10% of the global orderbook and it is set to control more than half of China's shipbuilding capacity. With its 310,000 workers and 47 research institutes, the combined entity will have the capacity and capability to compound China's shipbuilding specialisation efforts.

China's inroads into the cruise sector are well underway. Shanghai Waigaoqiao Shipbuilding is proud to be the first yard to build the first large cruise vessel in China, a market that has been primarily dominated by European shipyards. Scheduled to be delivered in 2023, the vessel will be equipped with the latest technologies so that it complies with existing environmental regulation, showcasing our capability particularly when it comes to tackling larger ship projects as well as shipping's decarbonisation challenges.

Ambitious projects like this one, focused on high quality and technology-advanced assets, call for collaboration



The company will be the world's largest shipbuilding group, with more than 10% of the global orderbook and it is set to control more than half of China's shipbuilding capacity.

and partnerships where expertise can be developed and shared. For all of us stakeholders involved in ship construction, the decade promises to be a defining one.

Dr Wang Qi
Chairman of Shanghai Waigaoqiao Shipbuilding (SWS)

Eye on opportunity.

LR has recognised China's potential ever since its first surveyor arrived in Shanghai.

Words: Nicola Good

October 12, 1869 was a landmark day for Lloyd's Register, as Joseph John Tucker arrived in Shanghai to take up his post as LR's first surveyor in China. The office was LR's sixth overseas office, the second outside of continental Europe and the first to be established in Asia.

Tucker carried out his first survey in November 1869 on the Dora, a 379 ton barque built in Sunderland in 1863 and owned by Holding & Co, and he was quick to point out the opportunity presented by China to his leaders at the marine classification society.

On 12 April, 1870 he wrote to the General Committee that 'from six months' experience, I have no hesitation in saying that, on the arrival of instruction authorising the Agents for Lloyd's to call on my services, not only will this district pay but, I believe, it will cause the want of similar offices to be put in other parts of China, where there is a larger field and better dock accommodation'.

Fast forward 150 years and LR has eight offices in Mainland China, one in Hong Kong and two in Taiwan, employing more than 660 people. China is one of LR's seven strategic growth opportunities and forming strong partnerships has always underpinned the organisation's activity in the country which has evolved beyond its maritime origins to include business

assurance and inspection services (BA&IS) as well as energy.

"Our business in China is crucial to LR, and I believe our long history shows our strong commitment to supporting Chinese initiatives for continued economic growth and prosperity," says LR Group CEO Alastair Marsh.

"Historically 70% of our income has been from the marine industry and since 1981, 2,815 ships have been delivered from Chinese shipyards to LR class and we continue to work with our Chinese shipyard partners as they move into more specialised vessels. For example, LR will class the first cruise ship to be built in China."

During the first 100 years of its involvement with China, LR's activity in the county closely tracked the development and expansion of shipbuilding in Asia as well as the maritime industry's constant drive to build and operate safer and more efficient vessels. As much of this expertise could be applied to other sectors, in the penultimate decades of the last century the world's oldest marine classification society sought to broaden the areas of its business.

In 1994 LR opened a non-marine office to cover inspection, certification, design approval and offer advice on safety and environmental systems. Located in Beijing, this new office also provided a base for

LR's range of services to land-based and offshore industry in the region.

China has now become LR's largest market for ISO certification - today we have more than 2000 clients covering more than 25 global standards and schemes, Marsh tells Horizons.

While LR clearly has a long Chinese legacy, how does the group with three business streams – Marine & Offshore, Energy and Business Assurance and Inspection Services - expect the focus of its activity in China to change in the next 150 years?

In the marine sector, opportunities exist in the mid to long term in the decarbonisation and digitalisation of the world fleet, with much of the construction and re-fit of vessels being carried out in China, says Marsh. This will drive the rapid development of new energy sources and technologies for ship propulsion, plus a shift in how ships are operated, certified and surveyed.

Around US\$727 billion has been invested in port and infrastructure projects since the start of 2014 under the 'Belt and Road' Initiative, which involves 139 countries. With total investment under this programme likely to reach US\$10 trillion. LR has the expertise in quality assurance and inspection services to support this initiative, he adds.

Marsh also points to the "Made in China" scheme and how it is driving focus on the quality and reliability of Chinese manufactured products. This is an area where LR's expertise can support the needs of local companies. Business improvement services are in demand as new standards are introduced and there is more focus on clients being able to assess their vendors and subsidiary factories.

Furthermore, China's increasing attention on its home-grown energy needs; particularly shale gas and deep-water drilling, and eventually the supply of renewable energy, also heralds significant opportunity, he adds.

"Everything we do is rooted in our core purpose, to work together for a safer world," says Marsh. LR's safety and performance expertise combined with advanced big data analytics can support China's transition to high value more advanced industries, with products like SafetyScanner which uses AI to reduce the rate of workplace accidents.

History online

LR Foundation releases a further 150,000 documents from its ship plan and survey report collection

Project Undaunted has taken a tremendous leap forwards with the upload and release of 150,000 documents from LR's historic ship plan and survey report collection; the largest bulk upload ever undertaken. This brings the total number of digitised documents in our online Collections Management System to an impressive 167,000.

This upload also sees the release of documents for over 30 British and Irish ports, from the giants of industry at Aberdeen, Bristol, Cardiff, Dublin, Greenock, Hartlepool, Hull, Newcastle, Liverpool, and London, to rural ports at Bideford, Cowes, Weymouth, Limerick, Llanelly, Jersey and Montrose, to name but a few. Covering dates from 1834 to the end of the Second World War, this new upload sees the emergence of unique records for over 40,000 ships.

With such a large upload of material fascinating and often amusing stories are not hard to come by. Some of these finds have included records for the schooner Felix, owned by the famed Arctic explorer Captain Sir John Ross, being fitted out to venture north and rescue Franklin's ill-fated expedition a few years before. Our archive also contains those for the *Tory*, the first ship to begin the European settlement of New Zealand.

As we push on to the remaining 1.1 million documents in our ship plan and survey report collection, we look forward to unearthing even more finds, at this stage we have only scratched the surface.



Our business in China is crucial to LR, and I believe our long history shows our strong commitment to supporting Chinese initiatives for continued economic growth and prosperity.

Alastair Marsh
LR's Group CEO

LR's history in China

Some momentous milestones 1869-2019

Late 1860s

LR starts sending surveyors to China to meet demand for the survey of classed vessels trading from Europe in the late 1860s.

1865

Jiangnan first modern shipyard is established in China opens in 1865.



1869

Joseph J Tucker opens LR's first Asian office in Shanghai, and in November carries out his first survey on the Dora, a 379 ton barque built in Sunderland in 1863 and owned by Holding & Co.

1880-1890s

Survey work includes tea clippers as well as vessels built locally.

1894

First ship to be built to LR class in Shanghai was the Artillerist, a tug built by Boyd & Co. Ltd., Shanghai and completed in August 1894.

1970-1980s

As a result of its 'open door' policy of the late 1970s and 1980s, China becomes an increasingly important focus for foreign businesses. In 1978, LR signs a reciprocal survey agreement with the Register of Shipping of the People's Republic of China. LR surveyors return to the country in 1980, opening up a regional presence in Hong Kong, followed by permanent offices in Shanghai, Guangzhou and Dalian.

1960s

LR carries out statutory surveys on behalf of the Chinese government under international shipping conventions.

1930s

War between the communists and the nationalists forces departure of LR surveyors.

1930s

By the 1930s, LR had established additional permanent offices in Dalian (Darien), Hong Kong, Tianjin (Tientsin), Hangzhou (Hankow), Xiamen (Amoy), Nanjing (Nanking), Zhenjiang (Chinkiang), Wusong (Woosung) and Qingdao (Tsingtao).

1920s

By the 1920s, LR surveyors have become renowned throughout Shanghai shipping circles.



1982

LR supports the construction of the bulk carrier *Regent Tampopo* – a project that represented a major step towards China's shipbuilding industry gaining international acceptance and one that has seen it transformed into one of the world's three most important shipbuilders.

1985

In 1985, Pokan Wu becomes the first LR Country Manager to reside in China since the Second World War.

LR is the first foreign classification body invited back in to the country.



Mid-1980s

Despite international recession and fierce global competition during the mid-1980s, some 90 per cent of export ships were in the process or had been classed by LR.

1992

LR has a long involvement in China's offshore industry beginning with the Arco China Inc. Yacheng 13-1 gas project from 1992.

2010

LR receives the British Government's Company of the Year accolade at Shanghai Expo.

2009

World's first Common Structural Rule VLCC delivered from SWS for Ocean Tankers.

2006

The LR group's Board of Directors held a formal board meeting in Shanghai office. This was the first time such a meeting had been held outside of Europe and reflected the growing importance of the Chinese markets across all of the group's business sectors.

2004

The first Ropax project for foreigner owner in China was delivered to LR Class - Guangzhou Shipyard International Company for Gotland.

1998

1998 LR's opens new premises in central Shanghai.

1994

In 1994 LR opens a non-marine office in Beijing to cover inspection, certification, design approval and offer advice on safety and environmental systems. The new office provided a base for LR's range of services to land-based and offshore industry in the region.

2012

First VLGC to be built in China at Jiangnan for Frontline. LR's First LNG Carrier project in China 2012 – APLNG Project at Hudong Shipyard.

2014

The first Naval Export Ship classed by LR Algeria Frigate at Hudong shipyard. LR supports construction of first dual fuel LNG Carrier to be built in China.

2015

LR supports China first ULCS project (over 20K TEU) – 3X21K TEU CS for CSG in SWS and 6X21K ULCS in Nacks for COSCO in 2015.

2016

The world's first LNG-fuelled car carrier was delivered to LR class – Nantong COSCO KHI Ship Engineering for UECC.



2017

LR support project for Chinese icebreaking research vessel Xuelong 2.



2019

Steel cutting for first cruise ship built in China to be classed by LR SWS.

LR celebrates 150 years in China.

2018

PaxOcean delivers a 26,000m3 floating storage and regasification unit (FSRU) built to LR class to Indonesia-based Jaya Samudra Karunialas.



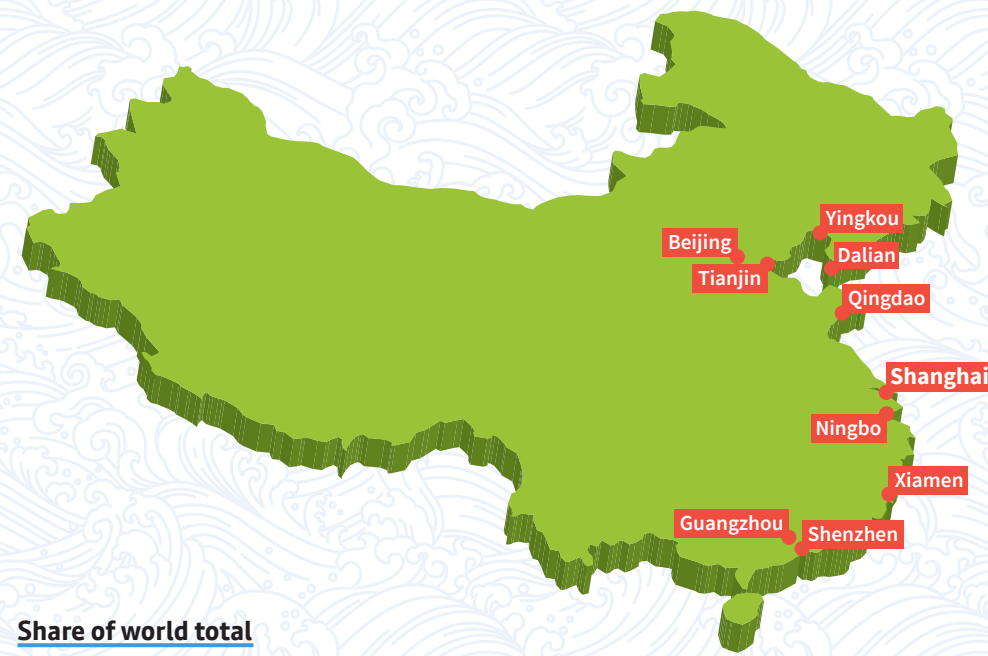
2017

The first China smart ship "Great Intelligence" presented with LR cyber-enabled ship descriptive notes.

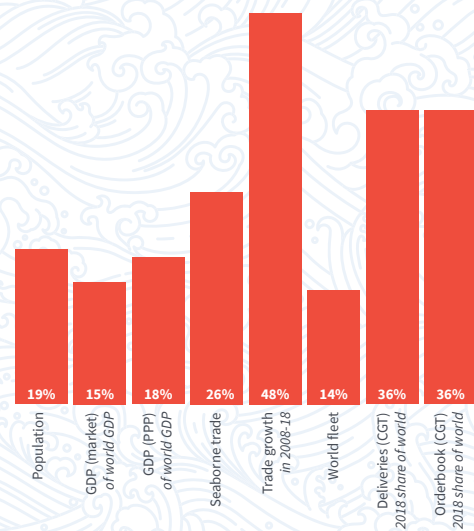


2017

LR classes world's largest civilian hospital ship in China – 36,000 dwt in Xingang SY.

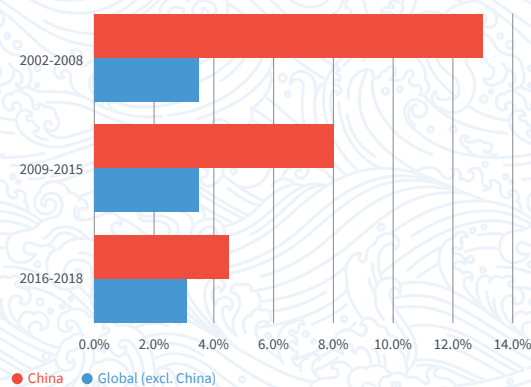


Share of world total



Average trade growth

China vs Rest of the World (CAGR Growth)

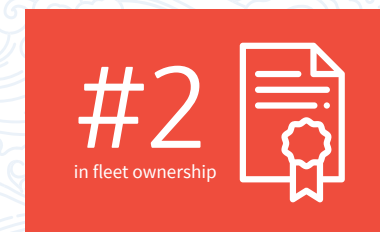


Growth centre.

The opportunity for maritime businesses in China will continue to command global attention in the decades ahead. Data from Clarksons shows that China is forecast to account for 22% of expected 2019-2030 seaborne trade growth and Chinese shipowners, which now come second in terms of fleet ownership behind Greece, will be responsible for 19% of 2019-2030 fleet expansion. As one of the leading shipbuilding centres, China is well-positioned to benefit when new construction activity rebounds.

China facts

Source: Clarksons Research, September 2019



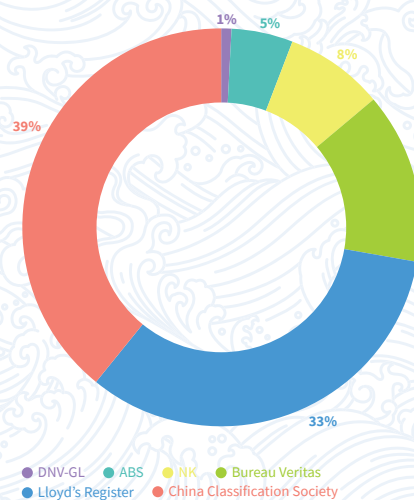
LR in China



Chinese yard marine orderbook

mGT (all vessel types)

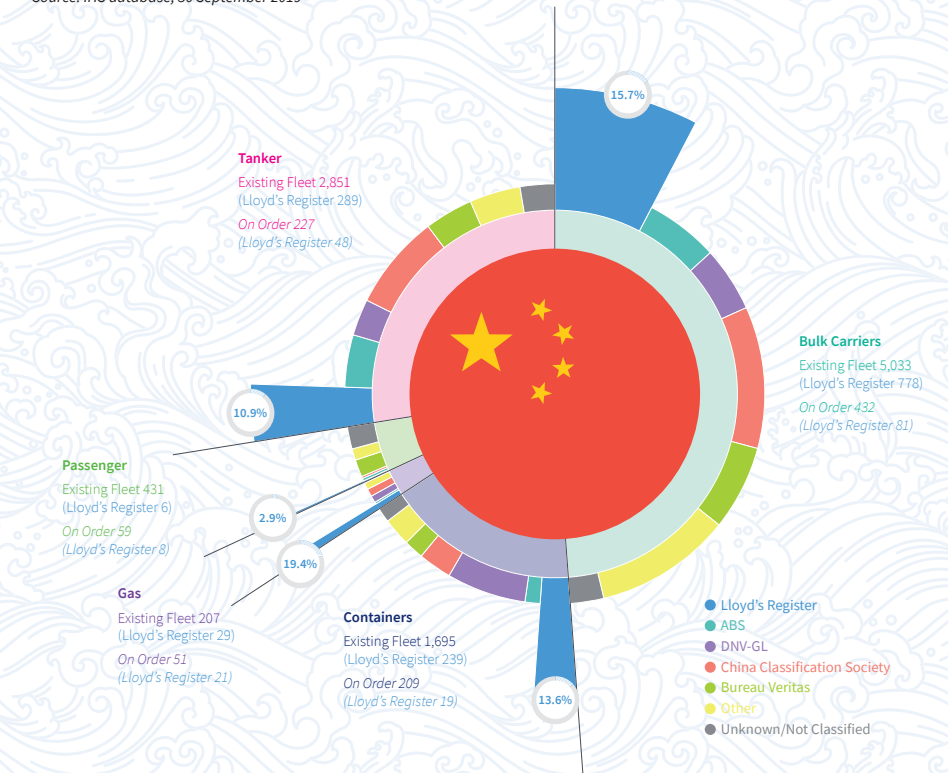
Source: IHS database, 30 September 2019



Current Greater Chinese built marine fleet

Number of ships

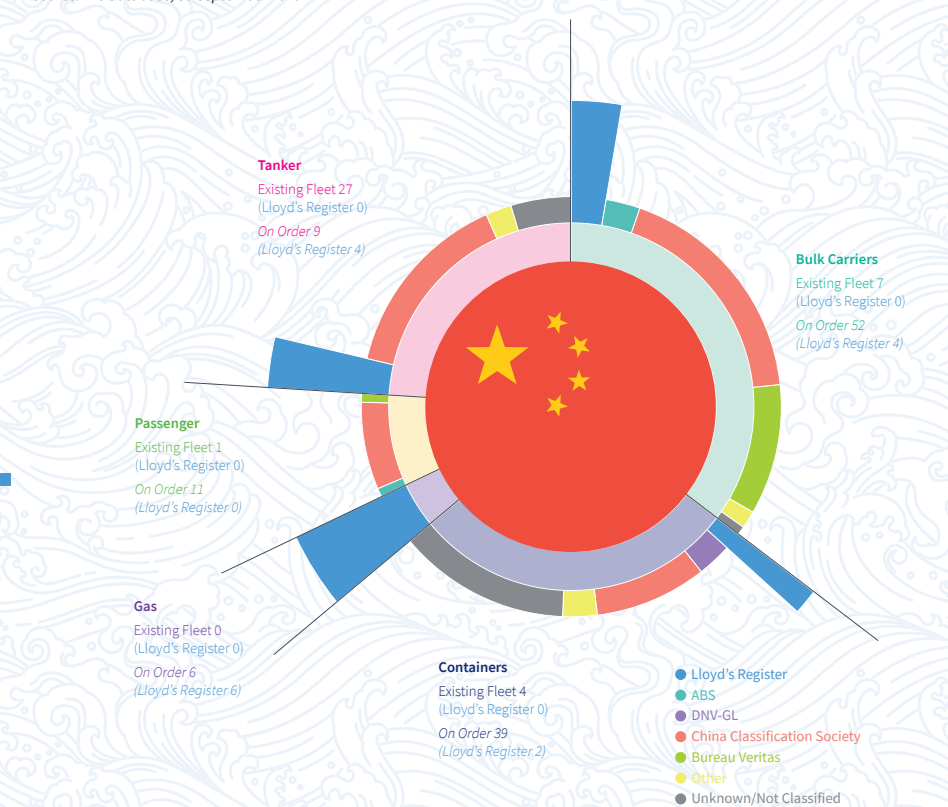
Source: IHS database, 30 September 2019



Current Greater Chinese owned marine fleet

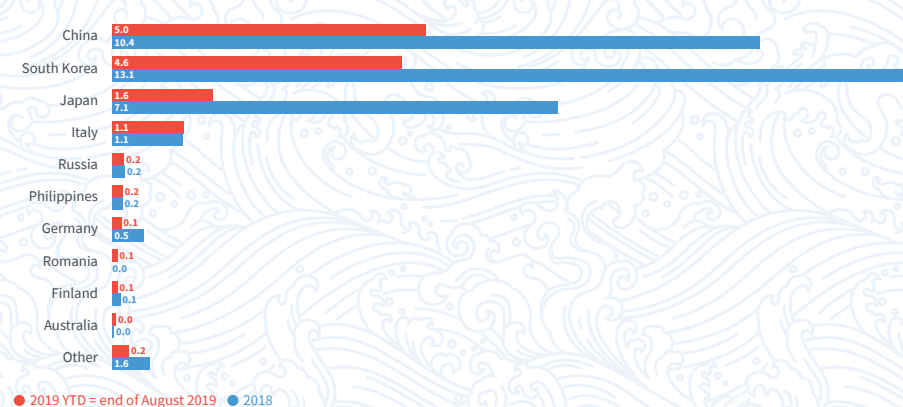
Number of ships

Source: IHS database, 30 September 2019



Newbuild contracting

By country/region (million CGT contracted)



Surveying growth.

Having worked in six countries across four continents, LR North Asia President Mark Darley is focused on new construction success.

Words: Nicola Good

We can all recount landmark days at work – most readily for reasons of personal success but sometimes because of a global event reshaping life as we know it while it's being broadcast across news channels. For Mark Darley, LR's North Asia President, being summoned to inspect a ship at the centre of an international news story was an event that had a marked influence on his career.



In October 2002, the 2000-built tanker Limburg carrying a cargo of crude oil from Iran and bound for Malaysia entered the Gulf of Aden to pick up another load of oil. While she was some distance offshore of Yemen, suicide bombers rammed a dinghy laden with explosives into the starboard side of the vessel and she caught fire. One crew member died in the blast and 12 were injured. The terrorist organisation Al Qaeda later claimed responsibility for the attack.

A few days later, the fired damaged vessel was towed to Drydocks World in Dubai and Darley was part of the team that would determine her fate. "Here I was, one of the first people onboard the vessel that I had been watching on the news, and we had to decide whether she should be saved or scrapped. For me, it was hugely impactful, especially when the master shared footage of the immediate aftermath of the attack," he tells Horizons.

At the time, freight rates were between \$180,000-\$200,000 per day, so the shipowner was determined to fix her. The repair job involved "walking down ships with a pot of paint and deciding what could be kept or discarded. We had to keep to the construction blocks. Admittedly it was a bit of patchwork but once we had decided what had to be done – we could get the job done relatively quickly," Darley explains. Renamed the Maritime Jewel, the tanker returned to service in August 2003.

The son of an engineer, Darley saw naval architecture as the perfect way to combine his love of sailing with a desire to go into mechanical engineering. "It seemed like the perfect fit. I

wanted to study hard but do something I'd enjoy," he says, and his introduction to LR came via an alumnus address at the University of Strathclyde and a number of internships and summer holiday jobs followed.

An LR man since graduation, the past two decades has seen Darley move from six countries across four different continents, enabling him to get a huge amount of experience, build strong relationships and understand the connections that underpin maritime. He readily admits that he never expected to have a job that would take him so far but believes his global exposure has given him the "ability to understand what our clients are thinking".

"LR has changed and so has our industry. Our role as a maritime advisor has had to evolve – and we need to understand the position of the yards, the owners and the charterers, especially when they are looking to differentiate themselves from their competitors or take on new projects."

The North Asia brief which Darley assumed 18 months ago is heavily centred on ship construction and when he left his position leading LR's Americas marine and offshore division "everyone told me I had an easy job as we were coming off a low in new construction. Everyone was expecting the market would rebound. This has simply not materialised, and the market is yet to come back."

Data published by Clarksons in mid-November shows that 708 contracts for new vessels have been ordered in 2019 to date, a year-on-year decline of 40% on an annualised basis, and Darley believes this is due to the industry's focus on the entry into force of the global sulphur cap on January 1, 2020.

"When I talk to the owners, it is clear that their technical teams have been

consumed with understanding the impact of IMO 2020. They simply haven't had the time to evaluate the future fuel options or consider new investments as this involves looking at new specifications and engaging with the yards," he tells Horizons.

But this has had a positive impact as it is driving the shipyards to accelerate their technology departments. "Business has been depressed but collaboration is really taking off and the yards are trying to differentiate themselves so that they are ready when the market takes off," he explains.

There is no questioning Darley's drive or his desire to move things forward. With a peloton bike in the garage as an additional outlet for his energy, the married father of two young daughters believes there are times when LR could be more customer centric as well as more vocal within the industry.

Knowledge and ability are abundant within LR, he says. We have spent the last four or so years making the internal changes necessary to give us the opportunity to lead the external digital journey. The maritime world must accelerate its adoption of technology. There will be disruption, but this will make the industry better and it will allow us all to be part of the reshaped future.

"How LR delivers its services and what the industry expects of classification is going to change," he stresses. "The industry can be slow or reluctant to change but if we don't disrupt, someone else will disrupt us."

Pointing to LR's track record of firsts, he believes the organisation is well placed to lead the digitalisation drive. For Darley, who looks after the biggest piece of LR's marine and offshore business in terms of revenue and people, leadership involves consistency and planning. Maritime relies on strong relationships and people need to know what to expect, he says, referring to customers, partners as well as colleagues.

"As someone who grew up in LR, understanding this legacy helps you as a leader because it enables you to relate to your colleagues and bring people on side. There is a common purpose within LR and it is a bit like a family – yes, we have our tiffs, but we always come together. Everything is driven by the need to help."



Solutions man

Maths may not be everyone's favourite subject but solving complex calculations happens to be a spare time pursuit for Dr Mao-Gen Xue, Greater China General Manager and Marine & Offshore Manager, whose early career was firmly rooted in academia.

Before he joined LR in 1995, Dr Xue was teaching Naval Architecture and Ocean Engineering at Shanghai Jiao Tong University, his own line of study following the suggestion of one of his middle school teachers that it would help him "find a good job in the large city. I took his advice. It was a good suggestion."

Dr Xue was the first permanent specialist that LR recruited to its technical support office (TSO) family in China. While he sees it as his best decision, he freely admits it wasn't an easy one initially given his track record as a teacher at a prestigious university.

Thankfully, he found a happy home in LR's technical department where he spent the first 17 years using his knowledge to solve customer challenges before moving in to business development in 2012 where he put his technical acumen and skill to winning projects.

Spending more than 24 years at LR, Dr Xue has witnessed a fair amount of change, in terms of China's development as a trade powerhouse, and a key shipbuilding nation as well as within LR itself. For him, one of the highlights has been the drive for a safety culture in China. "We were the first class society to hold a Safety Forum in China," he tells Horizons.

Dr Xue's passion for shipping is palpable. It is routinely noticed by his extensive industry network and has clearly rubbed off on his daughter, who also graduated from Shanghai Jiao Tong University in 2018 having majored in Naval Architecture. Xue junior is currently studying for a master's degree in Project Management at Warwick University and her father is keen for her to work for LR in the future.

How LR delivers its services and what the industry expects of classification is going to change.



China: the genesis of the modern offshore project.

LR's Offshore Technology Manager, Mark Tipping, looks at China's defining role in offshore construction.

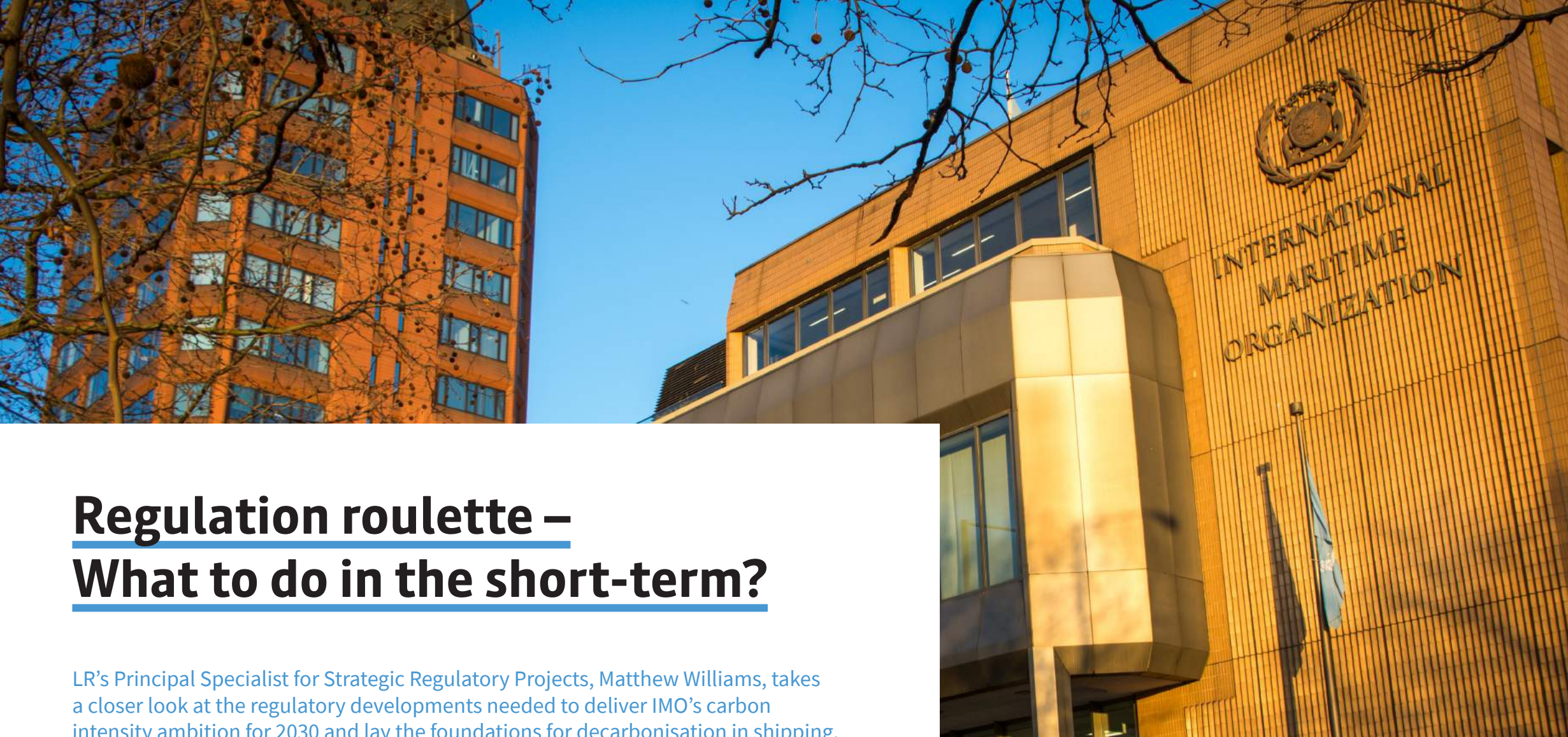
Countries such as Japan, Korea and China have all earned their place in recent history for constructing large complex ships at low cost yet have struggled to convince the global audience that they can build these complex assets to the required standard and life cycle. Now we're seeing China breaking the convention and taking a very different approach to the offshore industry. An industry renowned for operating in the most extreme environments, where the asset cannot remove itself from extreme weather and therefore must not only be rugged, but also capable of maintaining production, or at the very least have the capability to ramp up to full production quickly if a severe weather event occurs. The impact of not maintaining production can be severe, not just the millions of dollars that can be lost per day, but in financial penalties that facility operators can face if production is stopped - even for a short-time. Hence why the basis of design is key in delivering a project that meets the requirements of environmental survivability and the reliability to maintain production.

Unsurprisingly, this comes with a price tag which has led to claims that the offshore industry and the associated Classification Rules are expensive, there is an obvious truth to this, at least to some extent anyway - if you want to build an asset that will survive in harsh environments there is an associated cost. But what about the locations that are more benign than normal ship operating locations - does this also hold true? No, is the simple answer. LR's Offshore Rules give the flexibility to

design for the location and its environment - meaning you can produce a design that is fit for purpose.

So, how does this relate to China? During a recent visit, I was lucky enough to have visited a number of key companies, ranging from design institutes, shipyards to process plant suppliers. I was struck by a common theme amongst them all: a clear focus on the design basis and what the client was trying to achieve with their project. This was then directly related back to the first principles engineering approach, where you look at a problem and the best way of fulfilling the goal. For most of us this might seem like a highly logical approach, however, for most floating offshore projects a common approach has been to adapt the latest project with least effort through designing, equipping and building the asset in a similar manner to a ship. Obviously, adapting ship building practice does have some merits, however this inevitably leads to compromise - usually in the ability to maintain production, require expensive onsite repairs or to stay on station for the required life of the project - all bringing with them major financial consequences for the operator.

So, what is different about China and the approaches they are using? Well, in simple terms - the facility is being designed for the task in hand rather than a previous design being reinvented to fit a compromised solution. As we've seen with other shipping industries around the world as they have developed, China is evolving rapidly especially with respect to quality which for process plants can account for more than a third of a project's cost is a prerequisite.



Regulation roulette – What to do in the short-term?

LR’s Principal Specialist for Strategic Regulatory Projects, Matthew Williams, takes a closer look at the regulatory developments needed to deliver IMO’s carbon intensity ambition for 2030 and lay the foundations for decarbonisation in shipping.

April 2018 saw the adoption, with much fanfare, of the Initial IMO Strategy for Reduction of Greenhouse Gas (GHG) Emissions from Ships. For those at Marine Environment Protection Committee (MEPC) 72, there was a huge sense of achievement and the feeling that this might just be the start of a real transformation in shipping.

Matthew Williams joined LR in 2019. His main role is to provide insight into long-term developments in regulatory systems relevant to LR’s activities, which impact its customers and their ambitions when negotiating the challenges of the future. Before this, Williams was lead advisor at International Chamber of Shipping, where he represented the interests of international shipping in negotiations at the International Maritime Organization. This followed time spent on operational appointments at sea, and as a business and risk manager within the UK Royal Navy Command Headquarters.

At MEPC 73 in October 2018 a follow-up programme of actions was agreed and is designed to guide the delivery of actions and measures needed to deliver on the intent of the Initial IMO Strategy, including measures needed to peak GHG emissions as soon as possible.

However, at MEPC 74 earlier this year, momentum was waning. It was clear that deciding what Member States would agree as the approach to reduce carbon intensity in the short-term, whilst also laying the groundwork for the radical change needed to decarbonise the shipping industry, could take some time.

As we near the end of 2019 there is one round of intersessional discussion to go before MEPC 75 in April 2020. Whilst positive progress was made at the intersessional negotiations held in November, the industry is not benefitting from the lack of certainty around what shipping will be required to do. Member States and international organisations should remember that they are not negotiating in isolation – whether bull or bear, the business of designing, building,

owning, operating and chartering ships continues.

Whilst LR has high ambitions for the decarbonisation of the shipping industry, we are acutely aware that the uncertainty around the short-term actions to reduce carbon intensity is not good for the industry and is delaying discussion on the uptake of alternative low- and zero-carbon fuels.

When it comes to procedures, there is an imperative to agree measures which reduce carbon intensity at least before 2023. The detail of the procedures is not important; the consequence is. If IMO wants to agree and adopt measures to start reducing carbon intensity before 2023 and then beyond to 2030, it needs to do this by October 2020 (MEPC 76). There is a deadline and in a strange twist to the story, it might just be the procedures so often criticised for slowing things down at the IMO that force the pace.

Short-term measures

Whilst intersessional negotiations between now and April 2020 cannot yield

decisions, they can yield an indication of the measures most likely to grace the pages of MARPOL Annex VI. The discussion to watch is the one around the most mature proposals currently on the table:

- A technical goal-based measure using an Energy Efficiency Design Index for Existing Ships (EEXI). The scope of options to achieve the goal is limited to technical efficiency measures and emphasis is placed on shaft power limitation. The simplest of the mature proposals, but not without its difficulties, including its true impact on CO2 abatement if weather continues to be more extreme because of climate change;
- A operational goal-based measure establishing a series of carbon intensity targets which can be met by technical and operational means. This would be more complex to implement but offers owners and operators greater scope to consider technical, operational and organisational ways of reducing carbon and will support IMO achieve its vision for 2050; and

- A proposal from a coalition of Member States and international organisations effectively proposing a hybrid approach, allowing owners and operators to pursue pre-certification based on the EEXI concept, or a purely goal-based approach. More interesting because of the breadth of co-sponsorship than its technical content.

Other options, including speed reduction, speed optimisation, and shaft power limitation in specific sectors, as well as, papers addressing the challenges of measuring performance against a specified target will add interest to proceedings.

As a Recognised Organisation (RO), LR is engaged in developments closely to ensure that the implementation of measures can work and deliver a globally consistent playing field for industry.

Uptake and safety of alternatives fuels

Yes, LR has a high-level of ambition for decarbonising shipping, but as a classification society we recognise that this change will need to be accompanied

by the work necessary to make the use of alternative low- and zero-carbon fuels safe.

The uptake of low- and zero-carbon fuels is also on the table for discussion before MEPC 75. This will be focused on thinking about how to incentivise the displacement of fossil fuels and is an essential starting point if zero-emission vessels are to be entering the fleet by 2030. Hopefully, the lessons of the IMO 2020 sulphur cap will be learned – early commitment and decisions are needed when compliance in-sector relies on substantial change outside of the industry.

Elsewhere in IMO, work is underway looking at the safety of alternative fuels. The Sub-Committee on Carriages of Cargoes and Containers (CCC) in September 2019 agreed guidance addressing the increasing interest in the use of ethanol or methanol as fuel. These are expected to be approved and ready for use by May 2020. Work to complete similar guidelines for ships using fuel cell power systems is also expected to be completed in September 2020 and should be available for use in 2021.

At the same meeting, the issue of hydrogen was raised in working groups considering amendments to the IGF and IGC Codes. Given the appetite for IMO to respond to the interest in hydrogen as fuel, it is expected that proposals to begin work may be made in 2020. This will be separate from existing Interim Recommendations for Carriage of Liquefied Hydrogen in Bulk.

Challenges ahead

The principal challenges ahead for IMO include: providing the industry with the certainty it needs on short-term measures; and the measures it will take to incentivise the uptake of low- and zero-carbon fuels. The latter needs to be supplemented by ongoing activity to understand the hazards of alternative fuels and provide requirements to support their safe use on ships.

The IMO has, for the first time, a strategic intent that spans at least 30 years with interest from both inside and outside of the sector. LR supports this strategic direction but also recognises that the vision and ambition it embodies needs swift but considered decisions early on – success will be determined by the choices made before the year 2023. The pressure is on the IMO to demonstrate it is in control of its own initial strategy and continues to have the vision to deliver on it.

Sulphur 2020 checkpoint for charterers.

With the imminent 1 January 2020 deadline imminent, Tim Wilson and Muhammad Usman have produced the following guide to assist charterers in assessing a ship's readiness for compliance with the new regulation.

With the clock ticking, some charterers and cargo interests are clearly seeking assurances that the right measures have been put in place to mitigate the risk of port detention due to non-compliance with MARPOL Annex VI Regulation 14.1.3. Regulation 14.3.1 of MARPOL Annex VI sets a 0.50% max limit of the sulphur content in respect of all fuel oils used by any type of combustion machinery outside Emission Control Areas (ECA-SOx) from 1 January 2020, down from 3.50% m/m currently. In emission control areas (ECAs) the limit remains, as it has been since 1 January 2015, 0.10% m/m.

In the post 2020 bunker era, it is important to ensure that the fuel supplied to the ship is within the operational quality boundaries of the ship and is compliant for sulphur emission control. Equally, the ship consuming the fuel must ensure that the ship capability and any constraints are duly communicated to the bunker purchaser.

The respective responsibilities and liabilities of the owner and charterer for complying with MARPOL 0.5% sulphur regulations are defined by the CharterParty, and it is important that existing, and new charterparty clauses are updated to reflect the new regulations. However, in this article, we will look beyond contractual obligations, at some of the critical questions a charterer, or equally a shipowner, may wish to address, to provide them with greater confidence that the ship has put in place all the necessary mitigating measures to limit the risk of the ship being detained as well as ensuring safe operation.

It covers the period of switchover from high sulphur fuel oil (HSFO) to very-low sulphur

fuel oil (VLSFO) leading up to 31 December 2019 and into 2020. The questions focus on the onboard capability and management of fuels.

1) Charter period and history

Does the charter period cover voyages outside the existing ECA?

Then 3.50% max S fuel oil would, from a statutory perspective, be OK.

Has the ship previously been detained or otherwise sanctioned by Port State Control (PSC) on MARPOL Annex VI issues?

If the ship has existing problems with compliance how will those impact on its ability to comply with the 0.50% max sulphur (S) requirements? Are those problems a result of external (i.e. poor fuel oil quality as supplied) or internal (i.e. inadequate fuel oil management onboard) factors?

2) Ship Implementation Plan status

Has the ship completed a Ship Implementation Plan (SIP) for switchover to 0.50% max S fuel oils, with consideration given to the guidance of IMO MEPC.1/ CIRC 878?

While not a statutory requirement such a plan is nevertheless essential in undertaking the switchover, plans may vary in detail and scope, but all need to have the same end point of the ship operating only on 0.50% max S fuel oil no later than 00:00 on 1 January 2020.

Has the ship included in its SIP a fuel tank 0.50% switchover capacity plan?



Regulation 14.3.1 of MARPOL Annex VI sets a 0.50% max limit of the sulphur content in respect of all fuel oils used by any type of combustion machinery outside Emission Control Areas (ECA-SOx) from 1 January 2020.

This should include tank preparation/cleaning as required and removal of remaining HSFO; all within in an agreed timeline.

Has the fuel oil switchover process, as given by that SIP, commenced?

Even if not commenced at this time, or for the duration of the charter, it may

nevertheless impact on the quantities of 3.50% max S fuel oils that the ship will accept.

Have unforeseen problems arisen in implementing that SIP?

The nature of those problems would need to be considered as to their effect on the charter. How are those being resolved and how would that affect ability to meet charter requirements? If the problems are ongoing, then this could impact on the ability to meet charter requirements.

When is the ship scheduled to complete that SIP?

This gives the date at which the ship will be operating on 0.50% max S fuel oils – many ships are applying a phased process of consuming the HSFO from one tank to the next – the important two dates to verify are:

1. When the ship will be fully operating on 0.50 fuels
2. When will they be free of any HSFO remaining on board

On completion of that SIP switchover what quantities of greater than 0.50% max S fuel oil(s) will be onboard and what is the owners planned procedure and schedule to dispose of that fuel oil?

This may cover several different types of fuel oils – gas oils, diesel oils and residual grades. Such left-over fuels must be disposed of ashore – not bled into the day-to-day usage. How does this relate to the charterparty clause(s) on bunkers at redelivery?

3) Fuel oil specifications and bunkering

What fuel oil specification(s) – ISO 8217 / year and grade(s) - does the shipowner normally require to be supplied?

All 0.50% fuels must meet the ISO 8217 specification and 'as ordered'.

For each of the grades to be supplied does the shipowner have additional parameters and/or limits over and above those given in the standard specification? This should include any operational constraints that might restrict fuel grades that can be bunkered.

If so that may limit fuel purchase options. The ship should define any operational constraints:

- Viscosity/ Density max and min
- Fuel type Residual (RM) and or Distillates (DM)
- Cold flow properties PPT, CFPP, CP.

Where bunker constraints have been identified – are these possible to address without modification or via other means?

Are these constraints due to physical limitations of the ship design, arrangement, equipment? Could the constraints be removed, or at least reduced by operational changes to build bunker grade flexibility?

Are charterer supplied fuel oils only to be loaded into essentially empty tanks (i.e. only unpumpables remaining) thus addressing the risk of incompatible fuels being commingled at the bunkering stage?

This may limit the total uptake possible to less than that which has previously been the case. This may require additional internal movements to bulk remaining quantities of each previously delivery – hence extra work for the ship but which must be insisted on. Unless fuel compatibility has been verified, loading on-top should be avoided, not only from the perspective of residual fuel oil compatibility, but also possible variations in characteristics and the risk that if the sulphur content delivered fuel was above limit that would potentially degrade any existing fuel oils to over the limit therefore this applies to all fuel oils, distillates included.



Will this bunker loading constraint affect the frequency / quantities of bunkering?

This then is part of the cost of using 0.50% max S fuel oils.

Will bunker manifold fuel samples of the charterers fuel oil supplied be sent to one of the fuel testing services?

This then potentially pre-alerts to any issues with the fuel as supplied.

In instances where the charterer supplied fuel oil differs in some significant manner from the fuel oils used to date does the ship have an instruction to trial use that fuel oil in a safe location while it still has other fuel oils onboard?

This may require a short-period of testing during which the ship would not be meeting charter party requirements in terms of speed.

Has the ship experienced and/or has the capability to use fuel oils of significantly different physical characteristics (i.e. viscosity, density, low temperature performance)?

The ability to manage the wider range of fuel oils expected to be supplied as 0.50% max S products will be largely dependent on the shipowner's investment in:

- a) Engineer training and knowledge
- b) In the physical arrangement and equipment side.

For those ships which are to use an alternative fuel inside ECA have the changeover to/from instructions been updated to cover the possible differences between the existing 3.50% max S fuel oils and the 0.50% max S fuel oils.

This should be indicative of how robust the preparations for the ship's changeover to 0.50% max S fuel have been.

Physical suppliers selected – in view of the variability of 0.50% fuels transparency of bunker characteristics being offered by the supplier should be requested. What are the ship requirements for pre-delivery?

Pre-knowledge of the typical Density, Viscosity, Pour Point, and for DM fuels CFPP and CP along with a more extended Certificate of Quality should be sought after – any reputable supplier should be able to

provide this. A ship which has recognised the value of this information will reflect on their understanding that the handling requirements may change between bunkers.

Has the supplier's Bunker Delivery Note format been updated to the current style – as given by MEPC.286(71)?

Old format BDN – still in widespread use – could result in subsequent PSC inspection problems.

What information does the physical supplier have in respect of the 0.50% max S fuel oil(s) to be supplied?

If the supplier has no information, or that which is given is 'typical' or of such wide ranges, that should be viewed against that of other suppliers which offer a more detailed and narrow range product.

4) Exhaust Gas Cleaning Systems (EGCS) Considerations

Does the ship intend to use EGCS outside ECA?

The fuel oils used by combustion devices feeding into EGCS are outside this 0.50% max S review. However, for fuel oils to be used with EGCS it should be ensured that the suppliers Bunker Delivery Note format has been updated to the latest

version (MEPC.286(71)) which includes a tick-box as to whether the fuel oil supplied is for use in EGCS connected combustion devices – suppliers using older format could cause problems to the ship in case of PSC inspections.

Which combustion devices onboard will not be connected to an EGCS?

The fuel oils used by any item of combustion machinery are affected by this 0.50% max S requirement – that includes boilers, IG generators, remote small size diesel engines (all ratings) and emergency equipment – all these will need to be using only 0.50% max S fuel oils on 1 Jan 2020.

In the event of EGCS instrumentation or main component failure – or where the monitoring equipment fails to indicate compliance mode – what measures have the ship put in place to mitigate the down time of EGCS compliance state?

Every provision should be considered by the ship as to the most likely components to fail and what spares can be carried to enable the crew to bring the EGCS back on line within the IMO MEPC.1/Circ.883 prescribed time of one hour before the ship must report its failure. Alternatively, considerations to carry so many days of compliant fuel to facilitate a longer period of repairs should be considered.

Listen to our expert panel discussion.

Three years on and with a few weeks to go until the switchover, is shipping ready?

In partnership with Petrosport, LR hosted an expert panel debate with the following industry leading specialists:

- Lars-Robert Pederson, Deputy Secretary General of BIMCO
- Luca Volta, Marine Fuels Venture Manager, ExxonMobil
- Naeem Javaid, Global Operations Manager, Fuel Oil Bunker Advisory Service, LR
- Mads Bjornebye, Manager Bunker Services, Teekay Shipping
- Kristine Petrosyan, Oil Market Analyst, IEA
- Beth Bradley, Partner, Hill Dickinson

The discussion was moderated by Lesley Bankes-Hughes, Director of Publishing/ Executive Editor of Bunkerspot and Petrosport and the panel discussed a range of topics including:

- Availability of compliant fuels
- The role of ports in the switchover
- Fuel oil non-availability reports (FONARs) and the importance of proactive fuel management and training

Listen to the recording now at info.lr.org/imo-2020-panel-discussion

On trend.

What does more capacity mean for the container ship market?

LR's Product Manager for Classification and Technology, Peter Catchpole, reviews the current state of the container ship market.

Over the last few years carriers have increased capacity at a greater rate than market demand, and it seems likely that this will continue as ULCS feature prominently in the orderbooks. The overcapacity puts pressure on freight rates and hence drives carriers to focus on cost cutting and operational efficiencies. It is no co-incidence we have seen consolidation in the market over the last few years with the acquisitions of OOCL, UASC and Hamburg Sud, as well as the joint venture between K Line, MOL and NYK to form ONE. It is hard to imagine a new entrant coming into the market any time soon.

The carriers are looking to improve operational efficiencies in other ways too. Container shipping has seen the establishment TradeLens, a block chain solution that allows the various stakeholders to co-operate on populating, updating, analysing and reporting on data associated with the shipment of containers. This is intended to replace expensive manual and peer to peer solutions. While it is not clear how many containers are currently being processed on the network, the fact that Maersk, MSC, CMA CGM, Hapag Lloyd and ONE have all joined (along with a large number of other supply chain stakeholders) suggest that TradeLens may be around for some time to come.

Given the current overcapacity it is surprising that, excluding feeder ships, the total capacity of the container ships sent for demolition in the year to date is less than 75,000 teu; compared with deliveries for the year to date totalling 516,499 teu (according to IHS database September 2019). Part of the

reason is that the carriers, within the framework of the mega shipping alliances, have become very agile in managing capacity, designing their routes and schedules so that if demand on a specific route reduces temporarily then capacity can also be reduced by blanking sailings. The repurposing of older container ships as large feeder container ships has also played a part.

When it comes to the capacity of individual ships we have seen the record for the largest container ship broken several times a year for quite a few years now. Evergreen recently agreed an US\$920million deal with Samsung Heavy Industries to build six large container ships – surpassing the world's largest container ships with a capacity of 23,756 teu. However as overall ship size hasn't increased, this has been achieved through the ingenuity of designers and maybe also due to changes to classification rules for container securing. For instance, LR's cutting edge rules provide a fully non-linear assessment of each container stack to account for the increased loading of lashing rods when twist lock separation occurs; but the calculations are still fast enough to support planning teams when developing stowage plans for 23,000teu vessels.

Maybe the more interesting question is whether we will see ULCS designs with 26 rows across, certainly this is technically possible, and there would be increased operational efficiency (CO2/teu/km and \$/teu/km) however the challenge is likely to be shore side infrastructure – the current vessels are approaching the maximum size that ports can handle. Larger ships also present greater commercial risk as the value of the cargo on a 22,00 teu container ship can be worth more than \$2 billion, so if an incident occurs the consequences are much greater.

E-certs: Building for scale and growth.

Authored by Iain Wilson, LR's Chief surveyor

As of last month, LR is able to issue and verify electronic certificates in line with International Association of Classification Societies (IACS) and International Maritime Organization (IMO) requirements, cementing a key milestone in our digital journey.

While the issuing of e-certs is widely accepted within maritime, LR has focused its attention on building capability to use the technology across the business in our drive to build for scale and growth. Our customers are able access signed certificates in LR Class Direct and through a Verification Portal using a unique tracking number which is also available for third-party stakeholders, such as Port State Control, to view the certificates more easily. It also adds efficiency to the survey process. With certificates built into our reporting systems, they can be automatically endorsed so when a surveyor credits a survey and uploads his/her report no additional work is required.

Electronic certificates can be seen two ways – either as a collection of data behind certificates or as a facsimile of a paper

copy that is signed electronically and stored. A key question is whether we need the facsimile if we have all the data – at some point, it is likely that paper will become irrelevant. This transition offers us the potential to move away from individual certificates produced for each component on a vessel to a single certificate for an entire vessel, containing all the relevant data tracked through one LR number.

While the drive toward single ship certification is still an industry ambition rather than a reality, the e-certification evolution currently under way presents huge advantages.

As part of our e-certs programme, LR has laid the foundations not just for certificate for periodical work – this whole end to end process for managing and signing templates and publishing certificates, which we can use in other parts of our business.

The system has been tested and approved by the Panama flag authority and we are in talks with other flags. Leading customers have already started using it. There is no questioning the benefits, but the most exciting bit is how we are able to use the technology elsewhere.

Gearing up for the decade of decarbonisation.

2019 has been a year where decarbonisation has dominated maritime conversations, we take a look back at the key milestones.

The need for zero emission ships to enter the world fleet by 2030 has now been widely accepted. The decarbonisation drive requires collaboration and has been supported by a number of industry initiatives this year, such as the Getting to Zero Coalition and the Poseidon Principles, which sees leading names in ship finance apply climate change criteria to vessel funding.

Many see 2020 as marking the start of the decade of decarbonisation as maritime stakeholders will continue to assess what is required to achieve the International Maritime Organizations (IMO) 2050 greenhouse gas ambitions and the opportunities and challenges presented by the shift to a zero-carbon future. The transition is a long-term one and it is accepted that a variety of operational and asset investment strategies will need to be considered. Complex choices lie ahead and navigating this change will involve industry

collaboration as well as access to expert advice and insight.

Our recent joint study with A.P. Moller - Maersk found that the best-positioned fuels for research and development into achieving zero net emissions for shipping are alcohol, biomethane, and ammonia. These three fuel pathways have relatively similar cost projections but different challenges and opportunities.

Alcohols (ethanol and methanol) are not a highly toxic liquid with various possible production pathways directly from biomass and/or via renewable hydrogen combined with carbon from either biomass or carbon capture. Existing solutions for handling the low flash point and for burning alcohols are well proven. Ethanol and methanol are fully mixable in the vessel's bunker tanks, creating bunkering flexibility.

However, the transition of the industry towards alcohol-based solutions is yet to

be defined. Biomethane on the other hand has a potential smooth transition given existing technology and infrastructure. The challenge however is 'methane slip' – the emission of unburned methane along the entire supply chain.

Ammonia is truly carbon free and can be produced from renewable electricity. The energy conversion rate of this system is higher than that of biomaterial-based systems, but the production pathway cannot tap into potential energy sources as waste biomass, for example. The main challenge for ammonia is that it is highly toxic and even small accidents can create major risks to the crew and the environment. The transition from current to future applications is also a huge challenge for ammonia.

The study also concluded that batteries and fuel cells are unlikely to have an immediate role in propelling commercially viable carbon neutral deep-sea vessels.

Outcome of the Zero Emission Fuels Think Tank session at the Global Maritime Forum Summit in October.

The greater challenge is on land and within the energy sector. Zero-emission vessels (ZEVs) are technologically possible in the next two years and while they may require ships and engines to be amended, this is dwarfed by the challenges of getting the right fuel ready and the necessary supporting infrastructure on land.

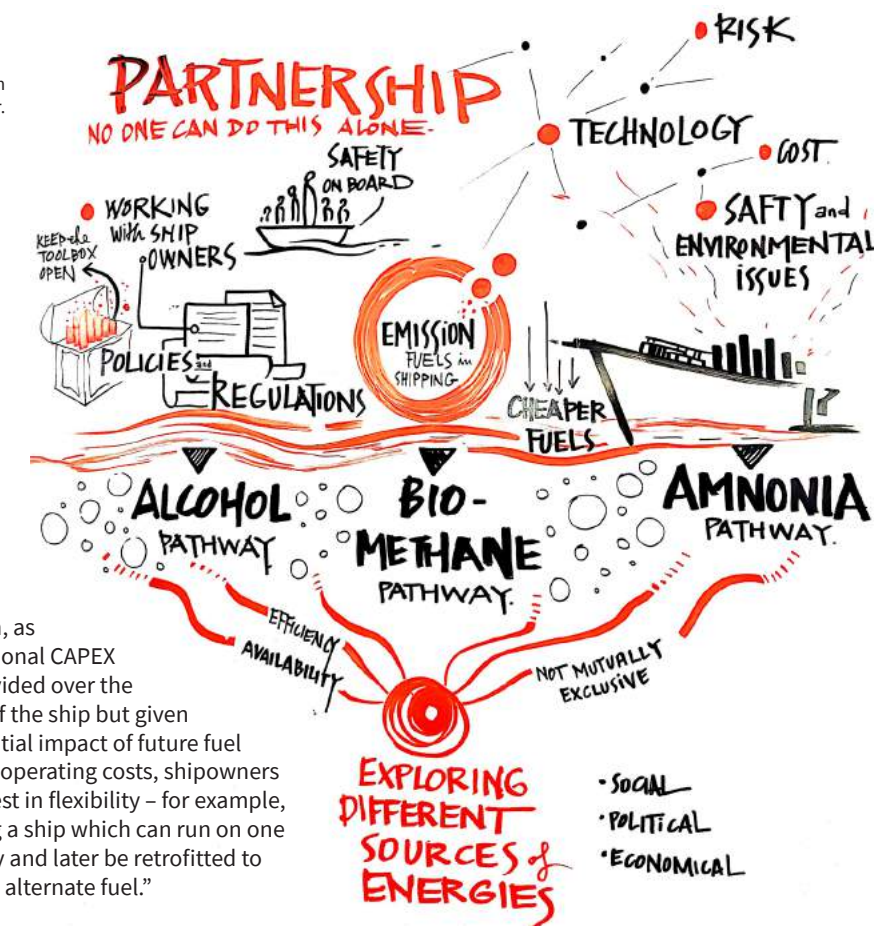
Another key takeaway from the study is that to develop zero carbon ready ships, shipowners will need to invest for fuel flexibility and that the cost of transport will rise – not because ships themselves will require greater levels of investment – but because new fuels are projected to be significantly more expensive than existing fossil solutions which will lead to increased operating costs.

Achieving net zero is therefore an operating expense (OPEX) not a capital expenditure (CAPEX) challenge. A further key conclusion of the joint exercise was the recognition that the market will not drive the transition to zero and policy interventions as well as a fundamental change to the incentives scheme for shipping are required.

Katharine Palmer, LR global head of sustainability, who led the study on behalf of LR, said: "The additional price to build a ship with new fuel tanks, modified engines and fuel supply systems is a very small

element of the total cost of operation, as the additional CAPEX cost is divided over the lifetime of the ship but given the potential impact of future fuel prices on operating costs, shipowners must invest in flexibility – for example, designing a ship which can run on one fuel today and later be retrofitted to run on an alternate fuel."

"The next decade will require industry collaboration as shipping considers its decarbonisation options and looks closely at the potential of fuels like alcohol, biomethane and ammonia," says LR CEO Alastair Marsh. "This joint modelling exercise between LR and Maersk indicates that shipowners must invest for fuel flexibility and it is also clear that this transition presents more of an operating expenditure challenge than a capital expenditure one."

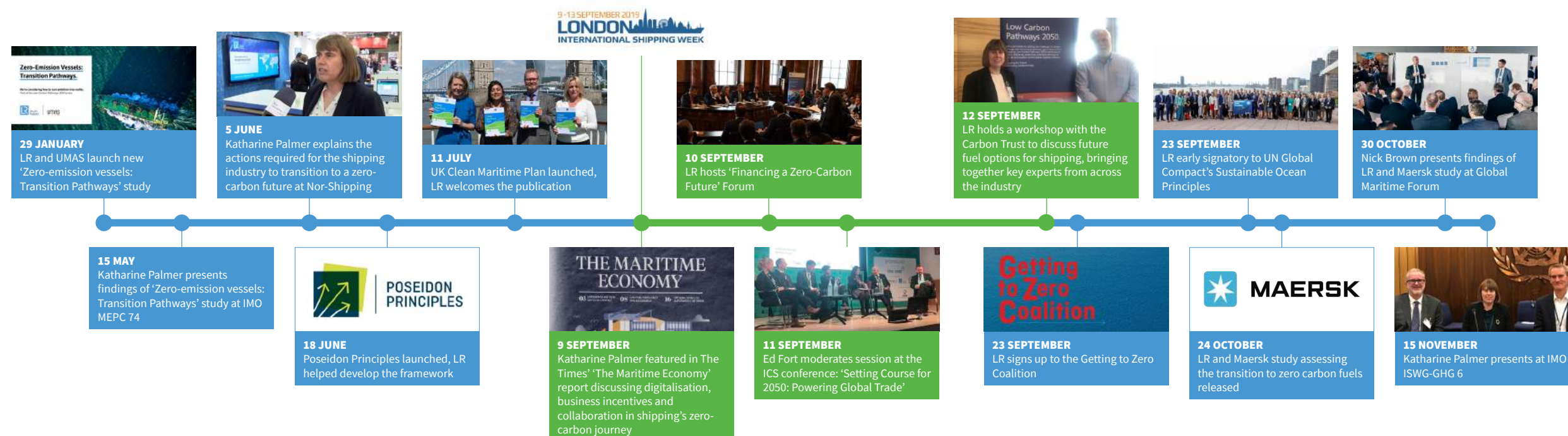


LR signs up to Getting to Zero Coalition

LR is among senior leaders within the maritime, energy, infrastructure and finance sectors that have signed up to the Getting to Zero Coalition, a partnership between the Global Maritime Forum, the Friends of Ocean Action, and the World Economic Forum.

The Coalition, which is supported by more than 70 public and private organisations, was launched before heads of state and government at the UN Climate Action Summit in New York in September.

Alastair Marsh, LR CEO, said: "The IMO's 2050 GHG ambitions require substantial and collaborative input from all maritime stakeholders and beyond. Getting to zero is about more than the delivery of zero-emissions vessels into the world fleet by 2030. As an industry we need to ensure that the infrastructure and supply chain is in place to support this change. LR is proud to be part of the coalition to collaborate on opportunities and support the sector's future achievements."



Ship recycling – new regulatory requirements for owners.

Paul Bartlett examines the current status of ship recycling in maritime.

Little more than a year from now, all ships entering a European Union port or anchorage will require a valid and certificated Inventory of Hazardous Materials (IHM) on board, according to the requirements of the 2013 EU Ship Recycling Regulation (EU SRR). Also, a requirement under the Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships 2009, which is yet to enter into force, is a necessity for the IHM requirements to be fulfilled has been hastened by the EU SRR.

LR's Jennifer Riley, Senior Ship Recycling Specialist, explains how this works. Under the EU SRR, all new ships delivered under an EU flag after December 31, 2018, must carry valid IHM certification on board. All existing vessels, regardless of flag, will need IHM certification from December 31, 2020, if calling at an EU port or anchorage. Furthermore, all EU-flagged ships sold for recycling after December 31, 2018, require a Ready for Recycling Certificate, ensuring that they can only be processed at a recycling yard that is included on the European List of Ship Recycling Facilities.

Riley points out that the EU SRR has brought forward the IMO Hong Kong Convention IHM requirement by a number of years. Even after the Hong Kong Convention has been ratified, which is probably still some years away, the requirement for new ships to have valid IHM certification will not become mandatory for two years thereafter; and for existing ships, compulsory IHMs won't be required for seven years from ratification.

Dr Nikos Mikelis, a leading ship recycling expert and a principal architect of the Hong Kong Convention, believes the IMO's recycling regulations could still be at least four years from ratification. "With German's accession [in July], seven countries have acceded to the Convention in the last six months, which is one more than those that acceded in the previous nine years.

"The acceleration in the recognition of the need for the Convention to enter force the soonest possible probably reflects growing concerns over the enforcement of the regional EU SRR since the beginning of this year," Dr Mikelis continued. "What remains now is for two of the major ship recycling nations to also accede to the Convention before the ship recycling industry can start operating under a uniform global regulatory platform."

Dr Mikelis, who is also a non-executive director of GMS, the world's largest cash buyer of ships sold for recycling, believes that India now "holds the key to the Convention's entry into force". Recycling yards there have invested in infrastructure, training, working procedures, and have been certificated by IACS classification societies working as independent third party consultants, he points out. But India is not yet a signatory to the Convention.

One problem, however, is that although these many Indian recycling yards have undergone the appropriate independent third party audits – LR has completed a number of these – and shown that they satisfy the standards of the Hong Kong Convention and the EU SRR, the

European Commission manages its own audit procedure and does not rely solely on the guidance of such independent third parties. Although a number of Indian facilities have gained independent certification against the requirements of the Hong Kong Convention and the EU SRR, they have not yet been approved for inclusion on the EU's list of approved recycling facilities.

Recycling volumes down as markets surge

Even before earnings climbed sharply in the tanker and bulk carrier markets recently, 2019 recycling volumes were down sharply on recent levels and are forecast to reach a total of only about 22m dwt over the full year, the lowest volume since the financial crisis. Executives at GMS, the world's largest cash buyer of end-of-life ships, stress that the recycling market is driven fundamentally by the demand and price of steel. This, in turn, depends on the global economy which faces a very uncertain geopolitical outlook.

Meanwhile, those same geopolitics also have an impact on the shipping markets and, as mid-October came and went, tanker earnings had surged upwards in a way not seen so far this century. This, together with a less spectacular but still

significant rise in the dry bulk market, may well generate more resistance to recycling amongst owners as they seek to make the most out of stronger markets. A reduction in the supply of potential ships for recycling could help to stop the recent decline in prices – from typical levels of well over \$400 per light displacement ton in India to the mid \$300s.

GMS executives also point to imminent IMO fuel and ballast water regulations as important factors in owners' recycling strategies. "Currently, despite IMO 2020 being just around the corner, we see no supply of tonnage as it would have been anticipated a year or so earlier. At the end of the day, market forces are the ones that are going to define the time when an asset will have to be disposed," said Mr Evangelos Chatzigiannis, a Senior Trader at GMS.

"Good chartering earnings are encouraging shipowners to evaluate options in order to have their vessels operating as long as possible," he continued, "or even encouraging [them] to consider investing in assets that a few years back would have been recycled. The moment that these dynamics are affected in a negative way, the supply of tonnage for recycling is definitely going to increase and I would not be surprised to see units

over 15 years evaluating recycling options the moment that operating expenses or the cost of investment on such assets is not justified any longer."

LR handles a diverse client base

There is, of course, a diverse range of potential clients for which classification societies can provide valuable guidance in the complex ship recycling arena. Ehud Bar-Lev is LR's Principal Service Delivery Manager. He reveals a significant number of enquiries from recycling yards preparing for a tougher regulatory environment. And he says that business models are changing as facility owners implement more progressive environmental and human resource management strategies.

Indian yards in Alang and Gujarat are amongst the front-runners, he says, and it is often the second, third or even fourth generation of facility owners who see the writing on the wall and wish to implement modernisation programmes, both in terms of facilities and hardware in their yards, but also in the human systems which make so much difference in this once primitive activity. Worker motivation is a key factor, Mr Bar-Lev says, and that is often more clearly recognised by the latest generation of recycling yard executives than their forbears.

With a shortage of certificated recycling capacity worldwide evident already today, and a world fleet that has increased in size by more 150% since 2000 according to Clarkson Research statistics, the safe disposal of ships in the future will become a growing challenge. Riley believes there is much to be done both by yard owners and ship operators, particularly in view of shipping's greening process and initiatives such as the Ship Recycling Transparency Initiative and the implementation of the banking initiative, responsible ship recycling principles, such as those championed by lenders.

Although these initiatives are voluntary, Riley points to a clear direction of travel. The issues are complex both for ship recyclers and ship operators, she says, but taking advice and guidance from organisations such as LR is a wise precaution as the European deadline for IHM Certificates approaches and ship recycling facilities require the necessary upgrades and certification. Without these, they will not be able to continue unrestricted operation.

Both Riley and Bar-Lev agree that 'beaching', a practice that certain lobby groups have campaigned to stop, can be perfectly acceptable, but only if carried out properly, at upgraded facilities,





invested in continual improvements and review of health, safety and environmental practices.

The verification process

LR has a deep involvement in the ship recycling sector and is therefore well-placed to provide first-rate advisory services to shipowners, operators and ship recycling facilities. The classification society has overseen the upgrade and certification of recycling facilities in India and Turkey, assuring that they meet the requirements of both the Hong Kong Convention and the EU SPR at the point of certification.

LR has assisted a number of recycling facilities in Turkey, including the certification of one of the largest yards – LEYAL Gemi Söküm – in Izmir. As a result, the facility became the first non-EU recycling yard to join the EU’s list of approved facilities. Dismantling ships on a slipway, the yard has no limit on ship length or tonnage, has a maximum breadth of 100 metres, a maximum depth of 15 metres and an annual capacity of up to 80,000 light displacement tons.

However, there are many challenges ahead, not least because the number of certified recycling facilities, complying with the EU Ship Recycling Regulation, falls far short of the capacity required to dismantle and recycle end-of-life vessels safely in the future. Capacity is particularly constrained for large ships including VLCCs and capesize bulk carriers.

Seven countries have ratified the Hong Kong Convention this year and meeting the three entry-into-force criteria will come sooner than appeared likely at the beginning of 2019. However, the Convention will only enter force 24 months after fulfilling the criteria. These are:

- when 15 states become signatories;
- when these 15 states represent 40% of world gross tonnage;
- when the combined annual recycling volume of those states is not less than 3% of their combined merchant shipping tonnage.

So far, of the world’s principal recycling nations, only Turkey is a signatory. India, Bangladesh and Pakistan have not ratified the Convention although sources indicate there are signs that India is intending to do so. China is not a signatory either, although is no longer accepting non-Chinese flagged vessels for recycling.

Apart from India, yards in these regions have been relatively slow to invest in the necessary upgrades and verification procedures required for Hong Kong and EU regulatory compliance. Those that have done so, however, comment on the beneficial outcomes for business.

One example is Y.S. Investments, LR’s first recycling facility in India which underwent the necessary yard and procedural upgrades to meeting Hong Kong Convention and EU SRR requirements earlier this year. Mr Naeem Massani, Managing Director, said the upgrade has transformed activity at the yard and is hoping that the facility will soon receive confirmation of EU SRR compliance and be accepted onto the EU List of recycling facilities. This, he believes, will lead to more enquiries and new clients.

Modifications at the facility involved investment in new equipment, the introduction of QHSE systems and a complete social and cultural change in the mindset of employees, he explained. The physical changes involved:

- the installation of a completely impermeable surface to the dismantling areas with appropriate drainage systems;
- a completely traceable downstream waste disposal system;
- heavy duty cranes to lift entire blocks directly from the ship to the impermeable floor;
- metal slag collectors to catch material falling within the inter-tidal zone when dismantling side shells;
- PPE equipment meeting international standards.

Meanwhile, workers at the yard have benefited from external training courses, a modern well-equipped accommodation block and professional guidance on health and safety. The results have been clear to see, Mr Naeem said. For example, there is far more awareness amongst all workers in the yard regarding basic health and safety. And there is now far more employee engagement, a sharp contrast to the traditional culture which focused exclusively on individual actions.

‘We have observed a significant improvement in our key performance indicators,’ Mr Naeem revealed. ‘It has not only benefited our organisation, but the change has spread like wild-fire in the whole of Alang, bringing a cultural change throughout the industry. Workers have become more aware, not only on an industrial level, but also on social levels – passing it on to the next generation through more emphasis towards education of their kids and their personal lives.’

A regulatory hotch-potch

Shipowners face an increasingly complex regulatory backdrop over recycling that has

major implications for the environment, the market, and emerging nations for which ship recycling and ready access to scrap steel is important business. Since the past dire safety record of the world’s ship dismantling business came to light in the 1990s, a range of regulatory initiatives have been adopted to raise safety standards and bring some order to what was an unregulated and dangerous industrial activity.

Dr Nikos Mikelis, a principal architect of the Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships 2009, will soon release the second edition of his book, The Recycling of Ships. In it, he describes the twists and turns of ship recycling regulatory development so far this century.

First, it was thought that the Basel Convention, which entered into force in 1992, controls the international movement of hazardous wastes and their environmentally sound management, could be applied to the ship dismantling business. For a variety of complex legal reasons, however, this proved not to be the case and, at COP 7 of the Basel Convention in 2004, the IMO was invited to establish a mandatory framework for ships to be dismantled. As a result, the Hong Kong Convention was developed and adopted ten years ago but has still not met its entry-into-force criteria.

However, the EU had already implemented and adopted into law the Basel Convention and its Ban Amendment, and then subsequently the Waste Shipment Regulation of 2006, preventing the export of hazardous wastes from EU member states to non-OECD countries. These regulations effectively made illegal the recycling of ships in Bangladesh, China, India or Pakistan if the ship’s last voyage began from a European port.

Yet, as Dr Mikelis points out, these four countries consistently recycle more than 90% of the world’s tonnage. Most shipowners therefore found a way to circumvent the European regulations, such as ensuring that a ship’s last voyage did not start in Europe.

Frustrated by this, and the fact that no country appeared keen to sign the Hong Kong Convention, the European Commission published its Proposal for a Regulation of the European Parliament and of the Council on ship recycling in 2012 and subsequently the EU SRR entered force at the end of 2013. The aim was bringing

The Hong Kong Convention – ten years after.

Authored by John Stawpert, Manager (Environment and Trade) at International Chamber of Shipping

Since 2009, we have witnessed phenomenal progress in ship recycling practices, and ratification by a steady flow of flag States which have now got the Convention to a point where the power for its entry into force lies squarely in the hands of the major recycling States.

At the adoption of the Convention ten years ago, the more cynical observers claimed that the practices would remain as they were, and that business would continue as usual. Yet the Convention has been practically realised even without entering into force. Inventories of Hazardous Materials (IHM) proliferate through the world fleet, products continue to be developed by class and service providers to assist owners toward green recycling. Most significantly, yards in South Asia have worked with class and shipowners to reach compliance with, and in some cases, exceed the requirements of the Convention. In one remarkable instance a New Zealand warship was recycled in accordance with the Basel Convention, in another, the Rainbow Warrior was safely dismantled in a Bangladeshi yard, achievements unthinkable a decade ago at the adoption of the Convention.

More remains to be done. The European regime needs serious clarification, and the European List in particular needs to be an honest reflection of compliant capacity worldwide. That global capacity also needs to grow, and efforts should be directed to those States which have shown the willingness to meet the Convention standard. But more than anything, major recycling States now need to ratify the Convention as a priority, pushing it over the entry into force threshold. Encouragingly, India and China have indicated that they are taking strides towards this, and it is therefore to be hoped that we will see the industry regulated by a common global regime in the very near future.

into force “an early implementation of the requirements of the Hong Kong Convention, therefore hastening its entry into force globally.”

The EU SRR is broadly similar to the Hong Kong Convention but differs in two key aspects. One, yards located in countries outside of the EU’s jurisdiction must apply to be included in “the European list of approved facilities” and accept possible site inspections by the European Commission or its agents. Two, the EU SRR includes two additional hazardous materials to be included in the inventory of hazardous materials (IHM). and considered at end of life – perfluorooctane sulfonic acid used in fire-fighting foams, and brominated flame retardant used in cryogenic insulation and refrigerated spaces.

Furthermore, the EU SRR tightens the Hong Kong Convention requirements on hazardous materials. From December 2020, all ships visiting EU ports, regardless of flag, will have to carry an IHM.

While the EU’s strategy may have helped, on the one hand, to hasten the sector’s badly needed regulation, observers also

point out that it may be leading to a two-tier market. Recycling facilities must now not only gain certification under Hong Kong Convention requirements to demonstrate compliance ahead of entry into force, but also gain separate approval from the EU to be included on its list of approved facilities.

Meanwhile, the Hong Kong Convention is still some way off. Although 13 of the 15 countries required to sign it have now done so, neither the tonnage requirement nor the ship recycling capacity criteria are close to being met. So far, the only recycling nation to have signed is Turkey. India is thought to be considering signing; one more recycling state would be needed after that.

On tonnage, sources suggest that one large open registry may be considering signing, satisfying that criterion. Meanwhile, following a ban on the import of foreign ships for scrap in China and the end of subsidies for Chinese owners recycling ships domestically in December 2017, Chinese recycling facilities have taken only a few ships. However, if China were to sign the Convention, both the recycling capacity and the tonnage requirement would be met in one go.

Time to rethink safety: Do we have tunnel vision when it comes to confined spaces?

Fatalities due to casualties in confined spaces are increasing. LR's James Pomeroy examines the factors that contribute to them and what could be done differently to protect crew.

James Pomeroy
LR's Group Health, Safety, Environment and Security Director



During a recent incident in China, 10 individuals died and 17 were seriously injured in a single confined space casualty, a tragic reminder of the risk crews face when entering confined spaces. The nature of shipping cargo and the asphyxiant gases that can be produced means the risks created within a marine environment are often underestimated. Despite the regularity of confined space work, the number of people being seriously or fatally injured in confined spaces is increasing, as a recent IMO paper highlighted.

This lack of progress prompts us to consider if the industry is doing enough to tackle the issue or if tunnel vision is stopping us from introducing more effective solutions. The reasons behind the lack of improvement are not truly understood. What we do know, however, is that unlike other high-risk work, confined space working has not seen any significant change in the approach or technologies used to keep crews safe for many years. Meaning that workers are losing their lives in confined spaces the same way they did 30-40 years ago.

Why do casualties occur?

Many hazards cannot be seen, such as toxic or flammable gases, making confined space work particularly challenging. Another complication is the dynamic nature of the risk, many spaces can become confined when the atmosphere within them changes,

so the risks associated with confined spaces are frequently underestimated. Critical control measures including thorough risk assessment, control of entry, gas testing and emergency response are often incomplete or not done at all.

Learning from failure

Confined space accidents are complex and typically involve a range of factors which provide insight into the nature of the challenge. Reviewing the causes of past incidents can help identify where we need to improve.

• Competency

Industry figures show that in 92% of fatalities recorded, the victims were not adequately trained. If workers are not competent to recognise a confined space or taught the safety precautions to follow, they will not understand the risks involved, recognise dangerous situations and know how to respond. Training plays a key role in managing confined space work, ensuring that everyone involved understands the hazards and the precautions that they need to follow. For safety training to be effective, it's not enough to simply 'train' people, it must be engaging and focus on a 'head, heart and hands' approach to help them appreciate the consequences of not following the right procedures. The best training is a two-way process, where the workers share their experiences and feedback

on problems or variations within the safety procedures in their organisations. Using examples of incidents and openly discussing experiences is great way of achieving this.

• Safety management systems

A common finding following a confined space incident is the failure to follow procedures. A National Institute for Occupational Safety and Health (NIOSH) report states that from the fatalities recorded, 31% of organisations involved had written a confined space procedure and yet not one of these was followed during these instances. When a safety procedure is not followed, it's common to focus on the individual failures. However, if we want to learn from incidents and prevent repeats, we need to consider if the process itself may be the problem. The complexity and length of many safety procedures can be the problem and contribute to mistakes being made. We need to learn from high-risk sectors how to simplify procedures, write them for the worker and introduce 'error-proofing' in the layout. Another key component for any confined space safety procedure is the need for an emergency process which should detail how a rescue will be performed, but sadly this is often overlooked.

• Assessing the risks

Many confined space fatalities involve inadequate testing of the atmosphere,

often due to a lack of testing equipment, limited awareness of the safe testing processes or incorrect use of equipment. Robust testing processes and how these results are acted upon is critical. It is essential that organisations conducting confined space work have effective detection and response equipment for toxic gases to identify the changing situation, such as personal gas detectors and atmospheric testing, and effective emergency evacuation equipment. One of the factors that makes confined space work so deadly is the speed at which things can go wrong. When we assess risks of confined space work, we tend to focus on the severity and probability of harm, but the speed of environmental changes is often overlooked. Within a tight and enclosed space, fluids, materials and toxic gases can enter quickly and overcome those inside.

• Leadership

A robust Stop Work Authority (SWA) programme provides workers with the obligation and responsibility to stop work when a perceived unsafe condition or behaviour may result in an unwanted event. Yet written policies alone are not enough. Managers need to recognise, praise and promote examples where workers raise safety concerns and back them, even when their decisions may have been incorrect. A true culture of empowerment takes time and requires the organisation to identify and address

the reasons an individual needed to stop work.

• Complacency

Nearly three quarters of all fatal incidents in confined spaces involved regular and routine work. This supports the theory that the more we undertake a task, the more we become over-familiar with the task and become complacent. Over time, workers become normalised to the risk and this results in a decrease in attention, risks being underestimated, and shortcuts being taken, tragically with fatal consequences. Organisations need to consider this within their inspection and auditing programmes, ensuring that they are monitoring the effectiveness of the critical controls and actively seeking employee feedback on potential improvements through near miss programs.

• Psychology

A significant number of fatalities involve attempted rescues and it's common for individuals outside the confined space to enter the space and be overcome by the hazards. To prevent this, rescuers need to be properly trained, sufficiently fit to carry out their task, ready at hand, and capable of using any equipment provided for rescue, such as breathing apparatus and lifelines. Regular emergency drills involving real-life retrieval from confined spaces help rescuers build the 'muscle memory' so that they respond safely when the need arises.





Seafarer wellbeing: Why do people do what they do?

Shell’s Vice President, Shell Shipping & Maritime, Dr Grahaeme Henderson discusses the connections between human error and safety, and what the industry can do differently.

Global trade has transformed life as we know it today and shipping has been the backbone. More than 50,000 ships sail our oceans every day, transporting goods from all corners of the earth. Shipping is vital for the world to function, from the food that we eat, the goods that we use every day and the energy that we need. Yet, shipping has one of the poorest safety records of any industry in the world.

A UK study showed that the shipping industry has a safety performance 20 times worse than for the average onshore worker and 5 times worse than the construction industry. During the last 10 years, an average of 113 ships around the world have been lost each year, and many thousands of people killed and seriously injured. In addition, research has shown that almost 6% of deaths at sea are attributable to suicide and this increases dramatically if suspicious cases when seafarers go missing are considered. This is at least six times higher than the suicide rate for the UK population.

Seafarer wellbeing...a subject that has huge importance to us all. I want to focus on why wellbeing is so important and the impact that it has on safety, and to start asking the question and understand “why do people do what they do?”

Along with many of my fellow shipping leaders, I have the vision of a zero-incident industry and we are making good progress. Businesses have recognised that improving their safety performance is not just fundamental to their licence to operate, but also good business.

Human error is the cause of more than 75% of accidents in shipping. Tiredness, inadequate procedures and improper supervision can increase the risk of human mistakes by up to 50%. So, we urgently need to look at the seafarer wellbeing behind those statistics. We need to ask ourselves “why do people do what they do?” and how we can positively influence them.

During the past year, working together with my Shell Shipping & Maritime team and the Shell Health group, we have carried out extensive research into the link between seafarer wellbeing and human error. We reviewed nearly 700 academic papers and more than 60 industry publications, conducted over 30 hours of interviews and analysed 340 pages of feedback from industry experts. Our research demonstrated clear links between health-related aspects and adverse incidents at sea.

The results showed five key areas of influence on wellbeing:

1. **Fatigue**...this might be the result of different shift patterns, long hours, or insufficient rest.
2. The **environment** that the seafarers are working in...the physical aspects, and separation from home, and healthy living.
3. The **nature of the role** the seafarer is conducting...the individual’s responsibility and workload, the personal fulfilment and job security, job satisfaction, reward and recognition.
4. Then there is the **leadership** on the ship and in the office...taking personal accountability for wellbeing, setting the right culture and tone, and having the right skills to recognise issues and knowing how to act.
5. And finally, the **networks** that surround the individual...family, friends, and work colleagues on the ship...and effective communication, as well as the cohesion and social interaction of the team.

Golden Safety Rules: to ensure zero accidents and healthy work.

The best results in safety are reached through a combination of several elements including leadership, accountability and rules. In October 2019, the Global Maritime Forum (GMF) launched nine fundamental high-level rules to prevent loss of life or life changing injuries. The rules were developed by a number of organisations such as the International association of Oil & Gas Producers (IOGP), LR and several oil majors, including Dr Grahaeme Henderson at Shell.

1.
Enclosed space entry
Only enter an enclosed space if it has been ventilated and the atmosphere confirmed safe.

2.
Fall prevention
Always protect yourself from falling when working at height or during personnel transfer.

3.
Invisible hazards
Verify isolation before working with stored energy and invisible hazards (e.g. electrical; pressure).

4.
Working over water / access to vessels
When outside of ships rails always wear a Personal Flotation Device.

5.
Line of fire
Ensure yourself and others are positioned away from suspended loads, stored pressure, moving machinery and snap-back areas.

6.
Navigation
Obey the collision regulations, supplement nav aids with visual / manual checks plan, execute plan, and avoid distractions and fatigue.

7.
Lifeboats
Ensure own and others safety during maintenance and testing of lifeboats.

8.
Hotwork
Ensure spaces are free of flammable materials and gases before working where flame is used or sparks may be produced.

9.
Stop
Ensure all staff are empowered to STOP WORK and intervene where uncomfortable.

After identifying these five strategic areas and the key contributing factors, we were able to build a model of how these areas influence safety. For example, if we take fatigue which strongly influences wellbeing, this leads to a human response, being stressed, tired, disengaged, leading to a behavioural outcome, the decisions and the resulting errors that an individual makes.

The more that people have had insufficient rest, are stressed, under time pressure, or poorly trained or have personal issues, bad news from home, the more likely that there are human errors. This raises the risk of catastrophic accidents occurring.

Two years ago, we (Shell) launched HiLo, focussing on high impact, low frequency safety events which may result in serious injury or death. It is a mathematical risk-

analysis model that uses near-miss data to highlight a pattern of events that, if left unchecked, could lead to a major incident. In essence, HiLo assesses the risk of serious accidents before they happen. We have seen some very impressive results from those companies using HiLo, including reducing the risk of lifeboat accidents by 72% and the risk of engine room fires by 65%. Now, we are combining HiLo with our research into seafarer wellbeing, to develop the first ever human error model, launched this year during this year’s London International Shipping Week.

This new model will allow shipping companies to better understand the wellbeing of the crew on their ships and highlight the human errors that cause more than 75% of accidents at sea. If we can understand the wellbeing of the crew,

we can make proactive interventions to address their needs and make improvements. HiLo provides important data for us to make decisions - but training also plays a critical role. This is making life onboard safer. It is also good for the business too, as there are fewer incidents and a more motivated crew who want to do a great job for the company.

As an industry, we can do much more about caring for our own and other people’s wellbeing. We can become a leading industry in the challenging area of mental health and become flagbearers. Working together, we can improve the shipping industry the world over - for every ship, every company, every crew member. We have a vision of a zero-incident industry where everyone gets home safely to their families and children.

The impact of technology on crew welfare, with a focus on mental health.

To what extent does technology play a role improving seafarer wellbeing? LR's Marine & Offshore Director, Nick Brown investigates.

Nick Brown
LR Marine & Offshore Director



There can be no underestimating the importance of seafarer health and wellbeing, particularly when it comes to safety within the maritime industry. Technology needs to assist, and support crew rather than making them feel more stressed or anxious. Data collected by the UK's Health and Safety Executive in 2017 shows that some 15 million working days were lost to work-related stress, depression or anxiety. The impact of employee wellbeing can be easily seen across all sectors so it's important to look at how other sectors are using technology to address mental wellbeing and how this could be adopted for seafarers' mental health and welfare.

In January 2018, the World Economic Forum estimated around 8.4 billion connected devices were in use with many crew members using Facetime, Skype and WhatsApp to connect with family members across the world – yet these apps can also be a vehicle of bullying and isolation. The number one seafarer need nowadays is internet access for email, social networks, access to information and for keeping on top of their finances. The same applies for anyone working away from home for extended periods – whether they are on oil rigs or in remote research facilities. Internet access is no longer optional, it's essential.

Technological advances aren't just affecting the way we live – they can affect the way we perform our tasks and the time it can take to do them. This can be

can be easily witnessed in maritime; with the move from manual operations to the number of automated systems, and fewer processes now relying on physical ability, with brain power being more important. These positives and negatives should be considered when assessing how some technology can be used to address health and wellbeing at work. Firstly, it can help us avoid problems, for example mechanical and software technologies (including advanced automation), and can reduce workload and stress by removing difficult or dangerous work. The downside however is that there can be a danger and/or fear of more technology being imposed for the sake of it. LR funded work at the Seafarers International Research Centre found that sometimes those onboard can feel those onshore are “meddling” in the work of the ship through email and enterprise resource planning (ERP), whilst being unaware of ship location, time zone or weather.

How do you know if crew are fit, well rested and ready to perform? Technology can be used to sound the alarm when people are tired, and their performance could create risk. Using data on fatigue and eye-hand co-ordination can pull people out of dangerous situations and help employers identify patterns of performance and isolate risk hotspots. It can also be used to minimise administrative tasks, allowing for work to be more flexible and create a margin of safety/comfort. However, when we must contend with multiple sets of data from several devices - it is easy to overlook

what really matters and there are times when we all struggle to stay focused on the job and the critical tasks in hand.

Technology can also be used to detect problems either with health and wellbeing or activities that may compromise safety. From fatigue and alertness monitoring to keeping track of body temperature or the location of impending hazards. This is becoming more routine in the workplace, across many industries including mining, logistics and construction. Canaries, which were once widely used for detecting noxious gases in mines, were replaced by wearable gas detection devices in 1986. Maritime is all too familiar of the hazards of confined spaces and this technology is becoming more widely used.

Tracking the emotional state of workers can also be completed through technology. Visual tracking, whether its facial recognition, iris recognition or voice analytics, can assess whether we or our customers are happy, stressed or sad. This has found a place in the finance industry, using voice and text analytics to determine state of mind characteristics to ensure high risk clients are receiving the right level of attention. However, data protection and privacy mean there is a need to assure confidentiality both for reporting of things that concern people and for seeking assistance. We must also factor in cyber security.

At LR, safety plays a central role in what we do. We care about employee wellbeing and seek to share our expertise and do the right thing. LR's Safety Accelerator programme has been developing technology using vision analytics for mental capacity, assessing fatigue monitoring and MLC compliance as well as equipment alarm fatigue. We are working on another project to reduce the mental needs from staff, using analytics to digest the slew of alarms a crew member encounters in high stress scenarios.

As with all of challenges and opportunities presented by technology in maritime today, this is not something to be addressed solely by shipowners, charterers or classification societies. Only by working together to share experiences, solutions and ideas can we ensure that the impact of technology on seafarers can lead to positive change.



Discover the safetytech solution that can assess if a crew is fit for duty.

The challenge

Marine and offshore jobs are some of the most stressful in the world, with psychological and emotional factors, including fatigue, not only affecting the safety and health of the concerned seafarer, but also the immediate safety of others onboard, safety of the vessels and the marine environment.

There is a lack of feasible objective means to determine the psychological and emotional status of a seafarer before he or she is assigned to an important task or scheduled watches, which could lead to injury, death or damage to property or the environment, if the seafarer is not psychologically sound.

This LR Safety Accelerator challenge, set in partnership with one of the world's largest containership operators, Pacific International Lines (PIL), sought innovative methods to assess the psychological and emotional wellbeing of individual crew members in real-time, whilst they are onboard and before they are about to go on duty, with their consent and protecting their privacy.

The solution

The Safety Accelerator worked with PIL to define the parameters of the challenge, and along with Accelerator partners Plug and Play sourced 15 best-in-class startups with cutting-edge and new approaches, to solve the challenge. Through a competitive selection process, the Austin-based startup Senseye.co was selected to trial their solution with PIL, during a three-month pilot.

Senseye is a computational neuroscience company based in Austin, Texas that uses high-resolution video footage of the eye to quantify previously inaccessible cognitive insights. During the pilot, Senseye drew upon their experience working with US military training fighter jet pilots, applying their expertise in cognitive psychology, computer vision and machine learning technology.

In collaboration with PIL, Senseye built and deployed an Operational Risk Management (ORM) solution on top of its existing Emotional Intelligence Engine and camera, modifying the hardware to allow for the system to run from a ship.

The solution involves a camera and computer vision-based pattern recognition, scanning a crew member's eyes and assessing in real-time if they're 'fit for duty' or not, based on the following criteria:

1. Impairment from alcohol or drugs
2. Fatigue
3. Psychological risk factors such as depression or stress

The pilot

The Senseye ORM solution was deployed on a PIL container ship that travelled between two US ports, to China, then back to the US, over a six-week period.

During this time, most of the 23 PIL crew members used the system twice daily and provided extensive amounts of detailed feedback to Senseye.

LR, PIL and Senseye are now exploring further development of the solution, beyond the initial pilot period, to improve assessment test time, pass/fail accuracy and auto stabilisation enhancements, to account for the ship's movement at sea.

Powerful results

Senseye's solution added value to the crew and ship master in that they could get a quantified fitness for duty before any given shift.

“This has been an exciting journey for us in the management office ashore and for our colleagues on board, we truly appreciate the amazing technologies Senseye had developed, and in given time, will be perfected to address the pain point of the industry.” ChuXing Peng, Asst GM, QSSD, Fleet Division, Pacific International Lines.



The changing face of risk mitigation in shipping.

How does technology play a part in risk mitigation's evolving business model? James Forsdyke, LR's Head of Product Management, puts a spotlight on LR's journey to remote presence.

Business models for risk mitigation through third party and second party inspection are evolving, moving towards partnership-based relationships with our customers, also known as 'remote presence'. Risk mitigation and inspection has always involved physical proof (a visit from a surveyor) to ensure compliance and verify any issues that occur either onboard our customer's assets or on land-based facilities, partially because technology has not always been able to verify the data or evidence as authentic. LR is now moving towards a different business model in which technology readiness gives us the opportunity to strengthen our confidence in the documents, imagery and data we review, which in turn helps reduce the number of physical visits our surveyors need to complete.

Historically, risk mitigation has often been a separate process, whereby the customer and classification society work separately when it comes to inspection and as a delegated regulator – LR is required to have rigorous inspection techniques to ensure the safety of the ship and any accompanying machinery and equipment. In previous times, it was hard for classification societies to have confidence in the imagery and documents, with regards to validity and authenticity, as technology could not always determine if it's the correct ship, the exact location, or if it's the specific equipment and machinery in question – making it easy for some to falsify data or manipulate imagery.

For third party inspection, we are a delegated regulator on behalf of a flag State through our RO (Recognised Organisation) statuses for various countries and are subject to audits by those authorities to ensure robust and correct techniques for risk mitigation. If authorities don't have a high enough level of assurance in our techniques, we could risk losing our status to perform verification activities, a core part of our business. Therefore, this change has taken time, yes – some technology has been around for a while, which we have spent time testing, but the regulatory freedom and the culture to adopt them has taken time. We need to ensure that the technology is reliable and can properly assist us in safely verifying our customers' ships.

Over the last few years, we've spent time piloting and testing technologies and now we need to phase-in technology adoption

across the scope of services we offer and consider all stakeholders in this cycle – the wider industry, technology providers and regulators – and take them on this journey. We've fully understood and embraced that these technologies are at a much more advanced state of readiness and the time is now to phase-in their adoption, whilst also fully recognising that we work in a regulated space and we are still fully responsible in ensuring that specific vessels, machinery and equipment are safe – giving our customers a license to operate. It must be said that during the implementation of these technologies, each stage will need to be validated and proven and cannot be taken for granted. 'Remote surveys' will not be promoted as the answer to every issue our customer experiences, instead we will recognise that they have a place in the suite of customer experiences and will be offered when deemed appropriate and safe.

New partnership with our customers

Part of this move towards 'remote presence' means there is a change in the way we work and collaborate with our customers, a more partner-based relationship is needed. Look at some of our typical customers and their responsibilities – consider a captain of a Very Large Crude Carrier (VLCC), for example, they have the lives of the entire crew, the environment in which they operate and a considerable amount of crude oil – all within their accountability. This indicates the high level of responsibility that sits on the shoulders of our customers – so when minor, non-critical issues occur, and we still require further proof than what the captain is showing us – there is a problem. We must respect our customers and provide an avenue where we can trust the information they are submitting, which could be through technology, keeping in mind that some could still falsify documents or data, so transparency and diligence is still required.

At LR, we take a criticality-based approach – determining how critical each case is and if it's low or medium critical there's a smaller consequence of it going wrong so we're less likely to send a surveyor out, helping our customers mitigate risk and avoid downtime. On the other hand, if the case is critical then a surveyor will need to go on board. Our 260-year experience and knowledge are utilised each time a surveyor goes on board a ship, which is why there is value in sending our people out at the right time and at a



We must respect our customers and provide an avenue where we can trust the information they are submitting, which could be through technology, keeping in mind that some could still falsify documents or data, so transparency and diligence is still required.

REMOTE PRESENCE

right level of criticality. So, if an incident is minor, or circumstances dictate that a remote intervention is most appropriate as a short-term solution, we'll conduct a remote survey and if it's major, the customer and LR both understand that a physical inspection is needed. Part of 'remote presence' will involve rounding out our service offering to be appropriate in all scenarios, to make sure safety is paramount at every stage, but also avoiding any unnecessary downtime.

How does technology support this business change and help evaluate risk?

Technology now provides high fidelity assurance, meaning we can be far more confident that what we're seeing is an accurate representation of the situation. We didn't have this technology to start with and needed this level of technology readiness to have this sense of trust that what we're seeing is right. Now you can get high definition images with metadata which has the GPS location, so our surveyors know where that picture was taken, along with data integrity checks and the necessary audit trail, so we are confident that it's authentic and wasn't taken onboard another ship at a different time or location.

In most cases, if an issue occurs - surveyors are required to assess the integrity of the wider system, not just the item in question. For example, if you were to assess what kind of repair a small structural defect needs, our surveyors would look at the overall structure to assess its global and local strength. A potential reason as to why remote survey uptake has been slower than expected. However, modern techniques such as drone technology and livestreaming software has meant that we are now able to access this information easily and therefore make better, more informed judgements faster than before, helping us improve the risk mitigation process for our customers.

Different technologies under 'remote presence' can prevent business disruption, saving time and operational costs. If we take special surveys as an example, particularly on Enhanced Survey Programme (ESP) ships, such as bulk carriers and oil tankers. These ships have a rigorous requirement whereby surveyors must inspect the structure and measure the thickness of the steel, often through ultrasound techniques which can inform the surveyor of how thick the steel is. This can be expensive for owners – as the vessel

needs to go in drydock and scaffolding needs to be erected by the shipyard, which can be expensive. Rope-access, an early form of remote surveyance, is when a specialist team of climbers rappel down the structure with a harness and take live footage of the structure. A surveyor is sat at the bottom of the ship reviewing this footage whilst also having the thickness measurement relayed as the specialists travel down the structure. Scaffolding is not required, and in some cases, rope access can be performed in a safe anchorage whereby a drydock is not required. This has a significant cost saving and reduces downtime for our customers. Seeing the value for special surveys, we have been authorising specialists to perform rope access verification for years and will continue to do so with our 'remote presence' approach to risk mitigation.

Collaboration between each stakeholder of the risk mitigation process could be enhanced through 'remote presence' as it could be an avenue of aligning stakeholder expectations during an incident and offer efficiencies such as getting real-time information sooner rather than later, which impacts the flag State, Port State, salvage company, P&I Club, charterer and the classification society. With older technology it was hard to get common understanding, but advanced technology can provide a level of transparency which helps get each stakeholder on the same page at a faster pace, offering a community approach to risk mitigation and management.

Technology pilots

As part of this changing face of risk mitigation and move towards a partnership-based business model, LR has been involved with various technology pilots to validate and test technology readiness and applicability for the marine industry. A recent example of this was with Wärtsilä where we tested the company's Remote Guidance software and Augmented Reality hardware to use during an inspection onboard a ship during its voyage on the Baltic Sea. The software had livestreaming capabilities, allowing someone on board – either members of the crew or a surveyor - to show a real picture of the situation on board and relay schematics back to Wärtsilä and LR experts at the command centre in the UK for review. By seeing the ship's name, immediate surroundings and its GPS position, experts at the command centre could verify its exact location and relay instructions back to the crew to

investigate certain parts of the ship and use live coverage to determine if an object or area is compliant and safe for operation. Doing this in real-time within seconds and without travelling to the ship, will save time, resources and will help to improve environmental footprint.

Surveys without attendance

In certain scenarios, surveys without attendance (often referred to as remote surveys), can offer great efficiency to our customers as it allows for quick responses on smaller, less critical tasks, helping customers reduce the level of unnecessary downtime and resume operations in a safe and timely manner. In other words, our customers don't always have to wait for our surveyors to physically attend their vessel before continuing their operations. A recent example of this was with an operator of a hybrid vessel, powered by a mixture of diesel and electric batteries, who found that its automatic battery-charging system was not working, a defect that needed to be fixed for safe and efficient operation. The repairs were completed by the equipment supplier and verified by the ship's staff who then

provided information to our surveyors, such as the servicing report and evidence from the engine control systems, to demonstrate that the fix had been done and the system was functioning correctly. The surveyor verified the functioning of the system remotely and was satisfied that the system was working correctly, without having to physically inspect the system in person onboard.

We also supported an interisland ferry operator in a remote area who struck a quay side and needed repairs to continue safe operation. The customer worked with the surveyors to assess the damage and agree a temporary repair plan without needing to arrange for the surveyor to travel to the location of the damaged ferry. The completion of the repairs was also confirmed remotely, enabling the ship to return to service quickly. As this issue was handled efficiently through a remote survey, the customer did not have to take the ferry off-hire for a long period of time.

Another example was a tanker at a remote terminal where the Port State Control (PSC) identified minor damage to the casing of

the inert gas blower, which prevented the vessel from discharging its cargo until the defect was fixed and confirmed. Normally, this would require a surveyor onboard to examine the reported defect and assess if repairs are necessary. The vessel operators were able to provide detailed photographs and information of the damage and how it had been patched and tested. After verifying the information provided, the surveyors then issued a short-term certificate remotely which was sent to PSC as evidence of LR's acceptance of the temporary repair. The vessel was then able to use the system and safely discharge the cargo, without having to wait for the surveyor to come onboard, which minimised disruption to the tanker's operation.

We must emphasise, however, that a survey without attendance has benefits for both our customers and surveyors in appropriate circumstances, however, safety must always be and remain the first consideration.

Drone technology

Drone technology is another tool of 'remote presence'; we have been working

with drone operators for many years, helping us utilise available technology to prevent unnecessary downtime, whilst also ensuring safe and compliant practice. On a recent case, we worked with bulk cargo carrier operator, CSL, when one of its self-unloading bulk carriers was due a close-up survey as part of its intermediate survey. It was not due to go to dry dock until 2021 but our surveyors needed access to the cargo holds, often requiring a cherry-picker or scaffolding and staging, which can be quite expensive and disrupt business operations. Instead, we conducted a close-up survey using an LR-approved drone operator, utilising the drone's accessibility to examine hard to reach areas of the vessel whilst still retaining the arm's length requirement of a close-up survey. The drone was able to capture high-quality imagery to complete the visual inspection without the need to set foot off the deck. This drone-assisted survey was quick and avoided the need for expensive scaffolding and staging, so CSL's self-unloader was back in operation in record time. It also enabled our surveyor to assess the asset's condition from a safe distance.



2019: a year to remember.

LR celebrates more than 50 years of service in Mexico and a significant milestone in Italy.

LR's hard work recognised in Italy

In May, LR was awarded RO status by the Italian flag Administration and is authorised to issue statutory certification on its behalf to all seagoing ships sailing with the Italian flag. To celebrate this significant achievement, LR hosted a range of local customers, both old and new, alongside government officials in the prestigious British Embassy in Rome in September.

LR's South Europe Marine & Offshore Manager, Theodosios Stamatellos said during the festivities: "This is a significant milestone in LR's history of classification. The modern Italian shipbuilding industry started in the 19th century and the fleet has continued to grow significantly during the last century and is now one of the most important in the world in many different sectors. Our new RO status demonstrates our wide range of classification, consultancy and technical services to owners who have Italian-flagged ships. LR is now in a stronger position to support existing and potential Italian-flagged shipowner customers."

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 our extensive technical expertise.



During the event, LR signed a Marine Management System (MMS) contract with Sea World Management which allows us to carry out MMS audits on behalf of the Italian Flag. Pictured above: Guglielmo Ruggeri, QMS & Marine Department and Chief Engineer Pasquale Meschino, Technical Director of Sea World Management and Sea World Shipping. With Fabio Canesi, LR's Italian flag account manager; LR's Marco Novarino, Genoa fleet manager; Elina Papageorgiou, LR's area sales marketing manager, and Paolo Izzo, LR's sales marketing manager.



British Ambassador to Italy, Jill Morris, during her speech.



From left to right: Ezio Mesini, Italian Offshore Authority as defined by the EU Offshore Directive, Gianpaolo Dalla Vedova, LR's Business Development Manager, and Aldo Scopetti, QA/QC Corporate Manager (Rosetti Yard) speaking to Jill Morris.



Pictured: Theodosios Stamatellos, LR's South Europe Marine & Offshore Manager, during his speech.



Pictured: LR's Americas team during the celebration.



Pictured: Amy Clemitchaw, Deputy Head of Mission at the British Embassy in Mexico City.



Pictured: LR's Energy Director, David Clark, during his speech.



Pictured speaking during the event: Sergio Garza, Business Development Manager, Business Assurance at LR.



Photo above, right to left: John Hicks (LR's Americas M&O), British Ambassador to Mexico Corin Robertson, David Clark (LR's Energy Director) and Cliff Muckleroy (LR's BA&IS Operations Manager, Americas).

What does this 50-year anniversary in Mexico mean for LR?

LR has been operating in Mexico since 1969, providing added-value solutions to our local customers. We have been growing and had a strong local presence in the main cities of Mexico for many years, including Veracruz, Coatzacoalcos, Ciudad del Carmen, Monterrey, Tampico and more recently, we opened a new office right in the heart of Mexico City. Our 50-year celebration represents a long history of successes and relationships built through the years, specifically where we have adapted to new changes and market trends in the local marine and offshore industries.

Luis Alcalá, Business Development Manager for Strategic Offshore Projects and Assets in Mexico



Assurance beyond Class.

A selection of case studies that investigate assurance beyond Class.

Supporting life extension with predictive fatigue assessment

Following a mid-life fleet refit, a naval client needed increased assurance that vessels would maintain high availability while planned replacement vessels are being built.

LR's Applied Technology Group (ATG) has developed a system that provides the client with up to date information on the state of the vessel structure to guide in-service inspection and repairs. The team then developed vessel specific models for each of twelve in-service warships. LR's naval fatigue assessment, FDA2, was being applied to each of these models to establish a baseline fatigue life for each vessel. This process also identified locations susceptible to fatigue damage so that inspection efforts can focus on these locations.



The models were updated with results from planned inspections that reflect the actual condition of the vessel as it passes through its service life. This database of the vessels' conditions will also allow for informed repair decisions if defects are discovered outside of the planned maintenance periods.

Naval vessels have unique inspection challenges. Insulation coverings and equipment congestion limit access to many structures. This can make inspection an expensive and time intensive proposition. The ability to prioritise enables maintenance personnel to make informed decisions about where to deploy inspection resources, contributing to ensuring high availability of the vessels during their remaining service life.

This approach gives the client tools and information to focus inspection efforts on early fatigue damage and repair. This contributes to ensuring vessel availability during the critical period before replacement vessels enter service.

Evaluating autonomous technologies

Naval clients need to comprehensively assess new autonomous underwater technologies that are rapidly becoming available for deployment in real world operations. LR's ATG worked with defence clients to evaluate three different autonomous underwater vehicles (AUV) in conditions matching real world operations.

The evaluation focused on a four-day exercise and covered software and hardware from two manufacturers. The team worked with the stakeholders to define exercise parameters, acquire equipment and arrange for technical support from the equipment suppliers. The on-water exercise was executed by naval personnel who, prior to this project, had no experience working

with the software or hardware being evaluated.

During the exercise, ATG staff worked alongside the navy personnel, noting how well these new users were able to execute the mission with this novel hardware.

The customer received a comprehensive report on the evaluation exercise including results from performance tests, lessons learned and recommendations for planned future operations and acquisition requirements.

LR has the experience and expertise to help clients reduce the risks associated with acquiring and integrating autonomous systems into their operations.



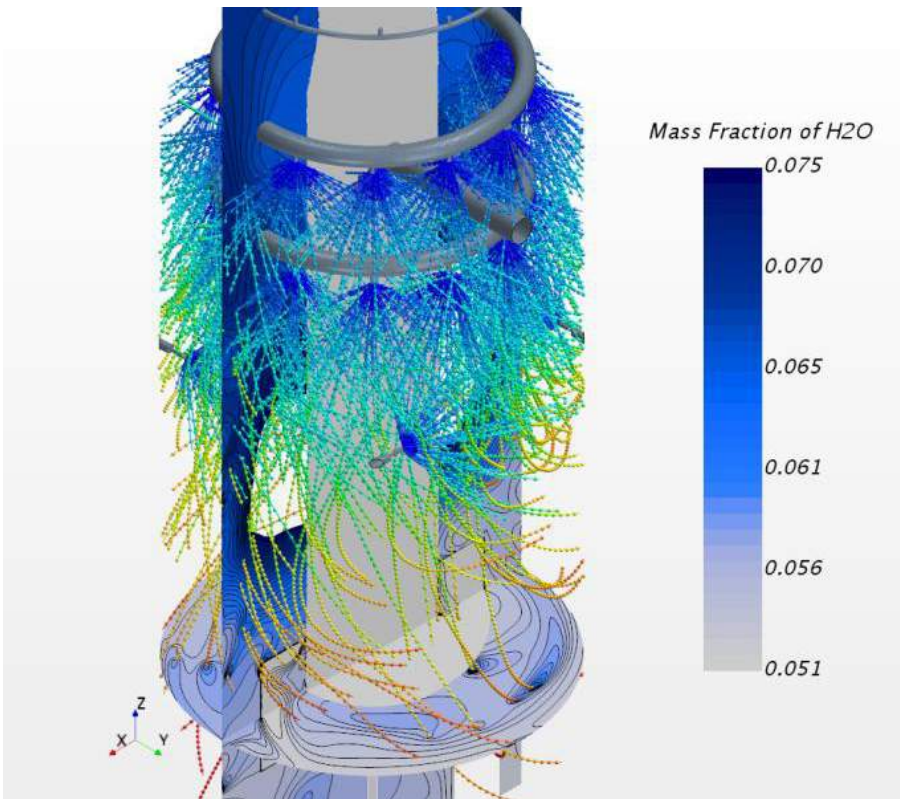
Scrubber analysis

A client requested support from LR's Technical Investigations department (TID) to analyse one of their marine scrubbers using Computational Fluid Dynamics (CFD). The analysis was required to determine the pressure drop across the scrubber and to provide an insight into the flow through it in order to improve the design.

Based on the information provided by the client, a 3D computational model was generated by TID, to be used in the analysis. The model accounted for the evolution of the exhaust gases from the engine through the scrubber, including the injection of water and heat transfer through the heat exchanger and scrubber steel walls.

All thirty injectors were explicitly modelled. The model accounted for both the evaporation and condensation of the spray, representing both heat and mass exchange in between the liquid and gaseous phases.

The client was supplied with both the pressure drop across the scrubber and a detailed analysis of the flow and heat transfer inside the scrubber. Design recommendations were also provided in order to reduce the system pressure drop by reducing the backpressure and



increasing the scrubber efficiency by improving the mixing.

TID can apply the same technique to predict the pressure distribution of scrubbers and provide a set of

recommendations to improve the efficiency and reduce the pressure drop. The same techniques can also be applied to other marine applications, such as ballast water treatment systems or non-marine industrial processes.

Vessel tank sloshing

A shipbuilder needed to quickly perform required sloshing assessments before the vessel delivery date. This threatened to delay a high-profile project to convert a commercial container ship to a naval replenishment role.

LR's ATG performed sloshing assessments following the ShipRight SDA guidance and scantling assessment. The assessment used the LR developed Aquarius software; a two-dimensional sloshing analysis system that applies CFD methodologies. Aquarius was originally developed to assess large LNG carrier tanks. The naval resupply vessel had a novel arrangement of 12 fuel and cargo tanks at different positions between decks.

The analyses started with a simplified Level 1 screening assessment. This screening identified tanks with potential problems



that required the more detailed, Level 3, analysis. Level 3 assessments were performed using Aquarius to calculate wall pressures in partially filled tanks. This approach captures representative motion of the vessel and tank boundaries, along with the dynamic response of the fluid in the tank. The tank wall pressures are then used in a separate strength assessment of the affected panels and stiffeners to

evaluate structural integrity.

The Level 3 analysis confirmed that the factors of safety used for the initial design were acceptable. The customer was able to assure the designs were acceptable and proceeded with the tank modifications. The timely completion of this work contributed to successfully delivering the vessel on time.

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.

Markus Büsig to join LR.

LR has appointed Markus Büsig as its President Marine & Offshore (M&O) for North Europe commencing on January 1, 2020.

Markus Büsig, 52, joins from MPC Münchmeyer Petersen & Co. Group, Hamburg, an international firm focussed on the finance and management of maritime assets, where he led MPC Marine, a provider of marine technical and commercial services to the shipping and shipbuilding industry.

In his decade at MPC Group, Markus Büsig has successfully supported and restructured a number of companies during demanding market cycles, returning them to profitable and sustainable growth.

“Driving efficiencies has always been a key focus of my career and I have been exposed to a broad range of experience in different sectors of the shipping industry. This ties in extremely well with my keen interest in the new technologies and I look forward to working with my new colleagues to continue to grow LR’s service offering,” said Markus Büsig, adding: “Lloyd’s Register is an icon of the industry and I am honoured and humbled to have been appointed to this role.”

LR Marine and Offshore Director Nick Brown said: “I am delighted that Markus has agreed to lead the North Europe area for M&O. He has a wealth of experience across the shipping, offshore and naval sectors and will work closely with Thomas



Aschert and the M&O leadership team.”

Markus Büsig has more than 30 years’ experience in the maritime industry. In addition to his tenure at MPC, he has worked at other leading companies including E.R. Schiffahrt and Reederei Nord. He will be based in Hamburg.

IntelliTug Project – autonomous harbour tug takes a big step towards reality.

Wärtsilä, in collaboration with PSA Marine, has achieved a breakthrough in its IntelliTug project. Following the successful installation of a first-of-its-kind Dynamic Positioning (DP) system onboard the harbour tug ‘PSA Polaris’, trials are now being carried out in the Port of Singapore under real-world conditions. This phase of the project implementation, which has been approved by LR, moves the bar higher on safety standards for vessel automation and autonomy. The Wärtsilä and PSA Marine IntelliTug project is also supported by the Maritime and Port Authority of Singapore.

The new DP system, also known as the Joystick Maneuvering System (JMS), enables easier and more intuitive control of the tug’s movement. With the push of a button, the tug master can achieve ‘virtual anchoring’ to hold position and/or maintain the tug’s heading. The DP system



also forms the foundational technology layer for the IntelliTug project, enabling digital navigation instructions to be passed to the vessel’s propulsion systems. The system has received a Statement of Compliance from LR for the DP notation, thereby endorsing its safety, reliability and performance.

“With the growing interest in repurposing existing vessel systems for autonomous

navigation, LR is taking the lead in making sure that control systems are safe and compliant as both a human-machine interface for vessel control, as well as the foundational layer for digital navigation instructions. We are delighted to advise that Wärtsilä’s DP system has met the requirements of our DP notation,” said Andrew Watt, LR’s Centre of Excellence Manager for South Asia, the Middle East and Africa.



LR and Nettitude release new procedure for assessment of cyber security controls for ships and ship systems.

The procedure was developed to provide an independent assessment of the effectiveness of cyber security controls within connected, integrated and internet-enabled systems and environments.

With the rise of cyber threats in the marine industry, the ShipRight procedures extend beyond the structural design aspects. Such procedures offer ship builders, ship managers and shipowners a link to cyber security assurance services aimed at enhancing the security of a ship; their purpose is to verify that the optimum level of safety is being sought and applied.

“The cyber security ShipRight procedure can be considered as a ‘route to cyber security compliance’ in relation to the relevant rule criteria. The LR cyber security ShipRight procedures have been designed as relevant and pragmatic controls that educate and enable baseline standards and mature roadmaps to be implemented whilst demonstrating compliance to IACS and IMO requirements,” said Ben Densham, CTO, Nettitude.

The four levels of cyber security maturity have also been mapped to existing industry standards, where relevant, such as IEC 62443, ISO 27002, IACS Cyber Security Guidelines and NIST.

LR transforms its approach to Machinery Surveys.

LR has significantly updated its ShipRight procedures for Machinery Planned Maintenance and Condition Monitoring and the corresponding Rules, in order to embrace industry technological advances and owner operational needs.

Key changes include the introduction of Risk Based Maintenance (RBM) to complement the existing Reliability Centred Maintenance (RCM), and the introduction of new Predictive Technique (PT) approvals to meet a perceived shift towards digital twins, advanced data analytics and machine learning. The corresponding Rule changes include a re-formatting of the relevant Descriptive Notes.

LR’s procedure enables operators to apply the most appropriate maintenance

methodologies to each of their machinery items in order to suit their specific needs. With support and approval from LR, operators can now use a combination of traditional prescriptive, condition-based, risk-based, and predictive-based strategies across their machinery items.

James Henton, LR’s Global Head of Survey and Inspection, said: “Our role is to ensure our Rules and Procedures are robust, meeting existing industry demands and challenges across the entire spectrum of maintenance activities. We take pride in adopting an advanced range of techniques to align with all recognised maintenance schemes. The introduction of Predictive Techniques (PT) and Risk Based Maintenance (RBM) in line with our recent Digital Compliance procedures ensure we remain at the forefront, in line with customer requirements.”

LR’s Naval Rules turn twenty.

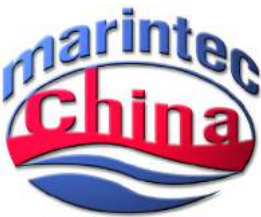
This year marks the twentieth anniversary of the first Naval Ship Technical Committee meeting, where a group from LR, different navies from around the world and the defence industry set out to develop a unique set of Rules for navies and the naval shipbuilding industry. Following the first meeting in May 1999, there was a period of intense collaboration which resulted in the release of a provisional set of Naval Ship Rules later that year, which are now

applied to a variety of different ships in the fleets of several navies. This includes the latest addition to the UK Navy, the 65,000-tonne aircraft carrier HMS Queen Elizabeth, a project LR has been involved in since its inception in 2006.

LR’s Naval Ship Rules have been a game-changer for the industry and are now used by shipyards around the world and classification Rules are now required in nearly all naval ship specifications.

LR at Marintec 2019

This December, LR will mark 150 years’ presence in China. This momentous milestone will be celebrated with a series of events during Marintec China.



Date	Time	LR stand event
3 Dec	12:00	150 years in China celebration
4 Dec	11:30-12:30	Cruise conversation with our expert Joep Bollerman
4 Dec	12:30-13:00	Digitalisation: the future of fleet management YiChenn Liu
4 Dec	13:00-13:30	Digitalisation: the changing face of cyber risks Fan Zhang
4 Dec	15:00-15:30	Snack and Gas: meet our gas experts
5 Dec	11:00-11:30	Innovation in safety: introducing Safety Accelerator
5 Dec	13:00-13:30	Innovation in safety: introducing LR Aurora and SafetyScanner
5 Dec	15:00-15:30	Innovation in safety: introducing Safety Accelerator



Houston, Texas. 17-19 September 2019

Joint development project to design LNG-fuelled VLCC.

LR signed an agreement at Gastech 2019 for a joint development project (JDP) with China Merchants Energy Shipping Co., Ltd. (CMES), CNOOC Gas and Power Group, Dalian Shipbuilding Industry Co., Ltd. (DSIC), and GazTransport and Technigaz SA (GTT) to design an LNG-fuelled Very Large Crude Carrier (VLCC).

The JDP will evaluate design options for an LNG-fuelled VLCC that uses a prismatic GTT Mark III membrane LNG tank. The scope of the JDP includes reviewing solutions to minimise construction costs for LNG-fuelled ships, while ensuring operational flexibility and efficiency, with the location of tanks as well as tank sizes

to allow for round trip voyages under consideration.

LR will conduct a risk assessment and review the design in accordance with the latest regulatory requirements and will ensure it meets LR's Rules to issue an Approval in Principle.

Mark Darley, LR's North Asia President, said: "With the global marine industry looking towards carbon reduction and ultimately decarbonisation, this JDP marks an important milestone in the journey that the industry is now taking. Through this JDP we look forward to jointly working with the key stakeholders in this innovative development



proposed to bring technological advancements to the industry."

LR awards DSME AiP for 98,000 m3 VLEC design with High MnA steel tank.

LR awarded Approval in Principle (AiP) to Daewoo Shipbuilding & Marine Engineering Co., Ltd (DSME) at Gastech 2019 for its 98,000 m3 Very Large Ethane Carrier (VLEC) design with new cryogenic material High Manganese Austenitic steel (High MnA) and sloshing-free tank, the first VLEC design to use this type of material.

DSME's 98,000 m3 VLEC design is made of DSME-patented 'Type B' tank so it

can operate with partial loading due to a sloshing-free tank design making vessel operations flexible and efficient, and facilitating multi-port loading/unloading requirements. The newly developed VLEC design also has the potential to carry a variety of different gases such as LNG, commercial ethane/ethylene, pure propane, commercial butane, commercial propane, mixture of propane and butane in any proportion, and propylene.

In December 2018, the IMO's Maritime Safety Committee (MSC) at its 100th session approved the Draft Interim Guidelines regarding the application of High MnA, making this steel more visible and feasible as a competitive cryogenic material. Currently, the application of High MnA steel is only defined for the use of LNG cargo and/or fuel tank, however the material could be expanded as a tank for other cargoes with higher design temperatures than LNG, such as ethane (-90 degree C) and ethylene (-104 degree C) and other specified cargoes as above with same manner as for 9% nickel steel case.

Odin Kwon, DSME Executive Vice President and CTO, said: "This is a significant milestone for DSME towards an unexplored market and demonstrates our commitment to taking a step forward to help meet the challenge of the diversity and flexibility as featured in the new market. We are excited to be collaborating with LR on this initiative who have an excellent technical and commercial insight."



LR approves innovative ethane transportation solution by Babcock.

LR awarded Babcock LGE with an AiP for its ecoETHN® solution, an innovative solution designed to maximise the economic transportation of ethane in VLECs, by combining the reliquefaction and ethane fuel supply systems. This is the first time such an application has been developed by the maritime industry.

Babcock's ecoETHN® separates excess methane from within the cargo boil-off gas (BOG) and feeds this into an ethane-fuelled VLEC engine, thereby reusing the incondensable methane gas as fuel. With no venting to the atmosphere, the industry-first design also minimises greenhouse gas emissions and as a result, the reliquefaction plant can optimise the operation whereby the system only condenses ethane boil-off gas.

LR carried out the appraisal of the system ensuring compliance with LR Rules and IGC Regulations, assessing the technical feasibility of the combined solution for the use of an enriched-methane ethane fuel supply system and maintaining cargo tank temperature/pressure control intended



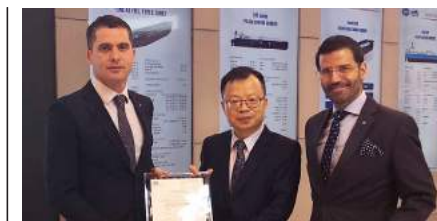
for the new generation of innovative VLECs.

Andrew McKeran, LR's Commercial Director, Marine & Offshore, awarding the AiP said: "ecoETHN® is a first for the industry and we're incredibly proud to issue an AiP to Babcock LGE for their design. ecoETHN® offers clear benefits to a variety of stakeholders, from power saving within the reliquefaction plant for owners, liquefaction terminals reducing costs by producing a higher content of methane in ethane, to terminals which can produce a high-quality ethane for their suppliers. ecoETHN® also offers a greener alternative by preventing venting occurring into the atmosphere, reinforcing LR's commitment to shipping's transition to decarbonisation. We see this a great step in ethane's journey as a marine fuel."

LR awards Jiangnan AiP for 91,000 m3 VLGC Panda 91T design.

LR also awarded Jiangnan Shipyard (Group) Co., Ltd with AiP for its 91,000 m3 Very Large Gas Carrier (VLGC) at Gastech 2019. The design, named 'Panda 91T', includes an LPG dual-fuelled main engine and relevant fuel gas system, as well as an optional air lubrication system and the Energy Efficiency Design Index (EEDI) is approximately 40% lower than the base value, improving the efficiency of the VLGC design.

LR facilitated a basic-level hazard identification (HAZID) workshop for the LPG fuel supply system and associated technology in accordance with LR's ShipRight Procedure for Risk-Based designs, confirming that the design meets international regulations and LR classification Rules, specifically the construction and classification of ships for the carriage of liquefied gases in bulk and for gases or other low-flashpoints fuels.



Mark Darley, LR's LR North Asia President, awarding the AiP commented: "This is a great milestone of our longstanding relationship with Jiangnan, demonstrating the shipyard's strong design capability in VLGCs and its clear understanding of our Rules and Regulations which we have rewarded with this AiP. We are proud to be part of the 'new' generation of such VLGCs, offering unique expertise to this gas ship market, and continue to support our customers in the delivery of safe, efficient and sustainable operations across the entire gas supply chain."

Class News

Mitigating Lithium battery system fires

The Norwegian Maritime Authority (NMA) has alerted shipowners and operators to hazards associated with lithium battery systems. This follows a fire and subsequent explosion in the battery room of the car and passenger ferry Ytterøyningen, which took place in Norway on 10 and 11 October. An investigation has yet to determine the causes.

The NMA circular SM3-2019, issued on 14 October and clarified on 18 October 2019, recommends that shipowners using battery systems review their risk assessments and emergency procedures related to possible accumulations of explosive gases during unwanted incidents in the battery systems. Corvus Energy, which supplied the ferry's battery system, has issued its own recommendations.

LR has put together a list of considerations related to the mitigation of risk in case of fire adjacent to, or within, a lithium battery system space which you can read in the full Class News at [info. lr.org/l/12702/2019-11-18/86xwml](https://www.lr.org/l/12702/2019-11-18/86xwml)

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