

# Horizons



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Key changes position LR as an organisation for the challenges of the future



# New Marine leadership



Tom Boardley (left) and Nick Brown

Key changes position Lloyd's Register (LR) as an organisation for the challenges of the future – appointments reflect LR's ambition to increase its impact for the benefit of business, society and the environment

- Tom Boardley steps up to a new role as Executive VP and Global Head of Corporate and External Affairs

- Nick Brown is promoted to Marine Director

Tom Boardley, currently Marine Business Stream Director, will become Executive Vice President and Global Head of Corporate and External Affairs. Reporting to Alastair Marsh, Boardley will work across LR's global business to help ensure that LR understands and meets client needs.

Nick Brown, currently Marine Chief Operating Officer, will be LR's new Marine Business Director. Nick will join Boardley on LR's executive leadership team. He began his career with LR 20 years ago as a graduate trainee and will be responsible for managing not only LR's marine business but also LR's energy compliance business – reflecting an additional expansion in the role.

"The world is becoming more complicated and we have to be ready for the challenges we face now and those that have yet to be defined."

Alastair Marsh, CEO, Lloyd's Register

Brown, "We will continue to evolve our classification and compliance business as both regulatory and commercial pressure increase across the marine and offshore industries. Shipping and energy remain vital to society, but the challenges faced will require better connections with other sectors. This is where the broader potential of the LR Group can make a positive impact."

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Front cover image: Sreekumar Nair, LR Senior Surveyor, on the deck of the LNGC *Umm Bab*, Ras Laffan

# COP 21

## What's next for shipping?

The 21<sup>st</sup> United Nations Climate Change Conference (COP 21) was concluded in Paris with general agreement that a level of success had been realised but consensus that the hard work lies ahead. Naturally, we are asking what the implications are for shipping – not mentioned in the final text – and where shipping is in terms of the United Nations Framework Convention on Climate Change (UNFCCC) pact.

196 countries adopted the agreement, partly legally binding and partly voluntary, committing all countries to reduce carbon emissions and to keep global temperature increases below 2°C.

Before COP 21, environmental groups and the Sustainable Shipping Initiative and European Community Shipowners' Associations had been advocating for the inclusion of shipping, while others like the International Chamber of Shipping wanted the management of carbon

emissions from shipping to remain under the remit of the IMO rather than the UNFCCC. Shipping and aviation, having been included in an early draft version of an agreement text, were not included in the final agreement.

The implication is that it is more important than ever for the IMO to discuss further operational measures and the development of a data collection scheme for carbon dioxide (CO<sub>2</sub>) and fuel monitoring at its 69<sup>th</sup> Marine Environment Protection Committee meeting in April 2016.

However, the EU regulation on monitoring, reporting and verification (MRV) of CO<sub>2</sub> emissions from maritime transport entered into force in July 2015, with the first monitoring period starting on 1 January, 2018. It is going to be important to keep the two regulatory schemes aligned. Otherwise, the shipping industry could have two tiered requirements for international and European trade.



Katharine Palmer  
LR's Environmental Manager



More information on MRV, and how LR can support clients both through the process and with planning for new technologies can be found here:

[www.lr.org/mrvreadiness](http://www.lr.org/mrvreadiness)

## Ballast Water Management Convention

After weeks of anticipation, the International Maritime Organization (IMO) announced in January that the criteria for entry into force of the Ballast Water Convention had not yet been met – reporting that an additional 0.44% of global tonnage was still needed to reach the required 35% ratification threshold.

Our consultancy services and online guidance can help clients understand the regulations and support them in deciding how best to respond.



Find out more at [www.lr.org/bwm](http://www.lr.org/bwm)



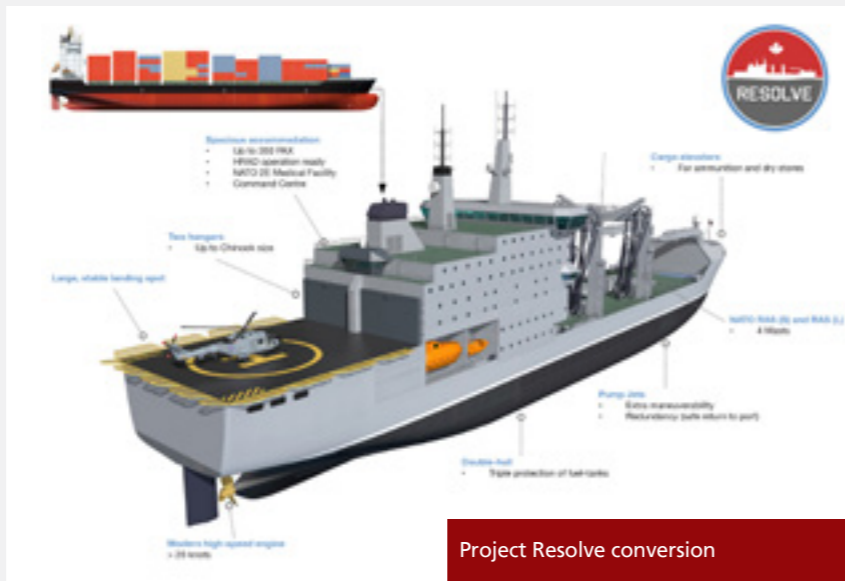
# NEWS

## LR to class Project Resolve conversion

Project Resolve is the conversion of the container vessel *M.V. Asterix* to an auxiliary oiler replenishment (AOR) ship to support the Royal Canadian Navy's (RCN) interim supply ship capability requirements. It will be converted at Chantier Davie Canada.

LR's naval technology expertise and complex conversion experience will provide key support to Project Resolve. LR will support the conversion process, from the development of a safety certification regime with the flag administration and approval of design plans through to on-site supervision at Davie and commissioning of the new AOR ship.


As the leading provider of classification services to navies, as well as to commercial shipping, and with a 160-year history in Canada, LR possesses the necessary capability to support the project.



Project Resolve conversion

This naval capability, married to deep technical experience in structural, machinery and service requirement integration, provides the technical assurance that Project Resolve requires.

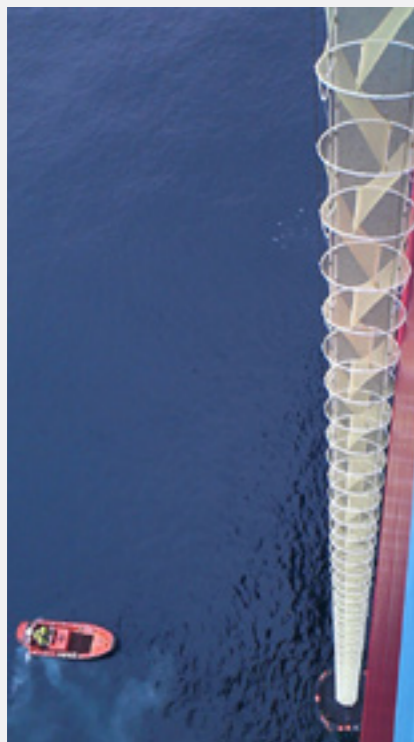
LR's Technical Support Office in Burlington, Ontario, will be responsible for design approval and an onsite team at the shipyard in Levis, Quebec will provide class supervision and support through the conversion process.

 Find out more about the project at [projectresolve.ca](http://projectresolve.ca)

## World's tallest evacuation chute gets LR approval

Leading maritime safety equipment and servicing manufacturer VIKING Life-Saving Equipment has received type approval from LR for its new offshore evacuation chute system, certified to operate at an unprecedented evacuation height of 81 metres to sea level.

The system's certified evacuation capacity is 146 people in just 10 minutes, which comfortably beats the threshold required by maritime authorities, even from such an extreme height. The previous record for such a system, also held by VIKING, was 64 metres.



VIKING's 81-metre evacuation chute

## LR classes £7 million river maintenance vessel for PLA

The Port of London Authority (PLA) officially launched the LR classed £7 million multi-purpose river maintenance vessel, *London Titan*, in a naming ceremony at Tower Pier on the River Thames in December 2015.

*London Titan* was built to work on the Thames River: home to the UK's second biggest port, and the busiest inland waterway for passengers and freight as well as a centre for sporting and recreational activity. Her main responsibilities will include keeping the river clear of obstructions and channels clearly marked for all to use.

The vessel is the PLA's biggest single investment in over 20 years, designed by MacDuff Ship Design and built at Manor Marine's shipyard in Portland, Dorset; the largest craft of this type to be built at this shipyard.



London Titan on the Thames

## Global Marine Technology Trends 2030 (GMTT 2030) report

The report, launched in September 2015, examines the transformative impact of 18 technologies on ship design, on naval power and on the use of ocean space in 2030.



The GMTT 2030 report indicates that:

- Momentum and capability for a significant evolution in ship design and operation is now building – the report presents design scenarios for commercial ships in 2030.
- By 2030 the fastest and most radical impacts are likely to be felt in the development of naval ships and systems, where maritime autonomous systems are driving the biggest revolution in maritime security in over a century.
- Understanding the world's oceans is more essential than ever to secure the future of our planet.


GMTT 2030 is the culmination of a collaborative project between LR, QinetiQ and the University of Southampton looking at the future for: commercial shipping – without which world trade would cease; for navies – so vital for security; and for the health of the oceans – the vital resource that defines our planet's future wellbeing.

In asking 'what's next?' GMTT 2030 is an aid to business, policy makers and society in trying to understand the future for the maritime industries and the oceans.

Assessing 56 technologies and then focusing on 18 specific areas of technology, GMTT 2030 builds on the scenarios work in Global Marine Trends 2030 and Global Marine Fuel Trends 2030 to provide insight into the impact and – critically – the timescales of transformative technology.

LR was the lead partner on the commercial shipping parts of the report and focused on eight technologies that will transform commercial shipping.

As LR's Marine Marketing Director, Luis Benito explains, "The marine world in 2030 will be a connected and digital one, bringing closer integration between people, software and hardware in a way that could transform the way we operate. We know technology is changing our world and there is a great deal of overlap between technologies; how they combine will be important."

 Download the report at [www.lr.org/gmtt2030](http://www.lr.org/gmtt2030)

## LR classed LNG-powered Greenland launched

The liquefied natural gas (LNG)-powered cement tanker *Greenland* was christened and launched on 31 October, 2015, at a ceremony hosted by the shipbuilder, Ferus Smit.


The vessel will be the first dry cargo vessel ever with an LNG-fuelled propulsion system, in which a pressurised LNG tank is incorporated inside the hull.



LNG-fuelled Greenland

## LR to class nine tankers for Maersk to latest Common Structural Rules

LR has been awarded the contract for classification of nine medium range (MR)-type product tankers. Owned by Maersk Tankers, the vessels will be built at Samsung's Ningbo yard in China.

 Read the full story on page 25

## LR accredits first mass flow metering system in Hong Kong

ExxonMobil has introduced the first independently accredited mass flow metering system (MFMS) in Hong Kong, following successful introduction of the system in Singapore. The fuel delivery system can help save vessel operators up to an estimated three hours and US\$5,000 per refuelling while also providing increased transparency and efficiency to the bunkering process.



LR has accredited the Hong Kong MFMS in partnership with A\*STAR's National Metrology Centre, the national measurement institute of Singapore, and Metcore International Pte Ltd, a consultancy with expertise in MFMS for bunkering.

The technology directly measures fuel mass instead of volume, in line with industry best practice guidelines, to provide a prompt and accurate measurement reading for vessel operators. The seals used are also validated by independent parties to prevent any misuse of the system.

The MFMS provides multiple benefits for vessel operators, suppliers and regulatory bodies, including enhanced accuracy when compared to typical tank dipping (within +/- 0.5 per cent), increased efficiency by measuring fuel mass, and reduced uncertainties related to variables including density and temperature. (Continued overleaf)

It can save an estimated US\$5,000 and up to three hours per delivery, and improve transparency as measurement data is logged throughout the process.

The launch of an accredited MFMS in Hong Kong follows its introduction in Singapore, where all ExxonMobil fuel deliveries are supplied by barges equipped with the Maritime and Port Authority-certified MFMS.

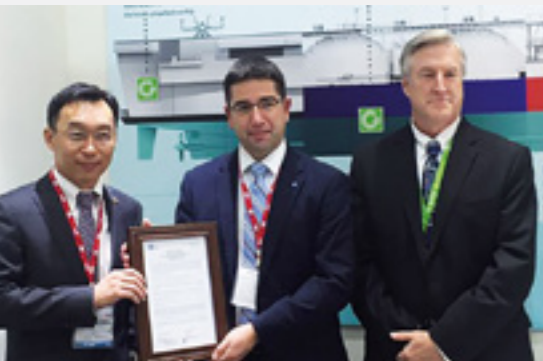
LR's Douglas Raitt, regional consultancy manager, commented, "Getting bunkering right is more important than ever.

The introduction of this technology is evidence of ExxonMobil's commitment to industry innovation.

The use of mass flow metering systems when bunkering fuel is a significant improvement, ensuring compliance. Buyers now have peace of mind that they are receiving the correct quantity of fuel for which they are paying."

### LR issues Approval in Principle for joint GE Marine and DSIC gas turbine-powered LNG carrier design

GE Marine and Dalian Shipbuilding Industry Company (DSIC) obtained LR Approval in Principle (AiP) in October 2015 for the jointly developed gas turbine-powered LNG carrier design.



(L-R) Yu Fengping of DSIC, LR's Marine COO Nick Brown and Paul Maciulewicz from GE Marine

"With the AiP in hand, customers can feel confident in procuring a COGES-powered LNG carrier through DSIC," said Brien Bolsinger, Vice President, Marine Operations, GE Marine.

"Operational benefits of gas turbines to naval architects, owners and operators include high power in a compact package and design flexibility. The gas turbine is so lightweight – fully 80% lighter and 30% smaller than comparable slow-speed diesel applications – that it can be located anywhere on the ship," Bolsinger added.


The LNG carrier design allows room for more cargo – some 4,000m<sup>3</sup> of additional space in the same size hull – along with low emissions and the flexibility to operate on LNG or liquid fuel. The LNG carrier will be built around a GE gas turbine-based COGES (COmbined Gas turbine, Electric and Steam) system that will feature one 25-megawatt gas turbine, one steam turbine generator-set and a heat recovery system including gas combustion unit.

### GTT gets double LR approval



GTT, the world leader in the design of membrane containment systems for the maritime transportation and storage of LNG, received General Approval from LR for its new Mark V containment system in October last year.

LR specialists also issued to GTT, at their request, AiP for a membrane cargo containment system (CCS) for bunker ships to allow an increase in vapour pressure of up to 2barg.

 Read more about these approvals on pages 20 and 22



Additive manufacturing is being called the next industrial revolution


### LR launches a new global certification framework to help manufacturers and users of equipment and components achieve 'best practice' in additive manufacturing

LR has launched goal-based additive manufacturing (AM) guidance notes to industry, giving operators and manufacturers in the marine and energy industries confidence in metallic equipment and components produced using AM.

AM is being called the 'next industrial revolution' in the manufacturing mix. Once deployed, AM will enable companies to more efficiently and cost-effectively manufacture complex components and equipment.

The guidelines are part of a joint industry project with The Welding Institute (TWI), launched in September 2015, that brings together research and development efforts and real-world additive manufacturing practices to create new industry product certification guidelines.

In the marine industry there is a move to assess this new technology. Commenting on the implications of AM, Luis Benito, Marketing Director: "AM will have implications for global industry, trade and shipping as well as ship operations. It is important that we can help drive best practice as AM is adopted around the world."

 Find out more at [www.lr.org/additive-manufacturing](http://www.lr.org/additive-manufacturing)



### LR brings additional passenger ship focus to Italy

LR is expanding and strengthening its passenger ship sector capability in Italy. John Hicks will lead a Global Passenger Ship Centre in a new role as Marine Manager, Italy and Global Passenger Ship Sector Manager, based in Trieste.

John moves from the USA where, as well as working in a global passenger ship leadership role, he was Business Development Manager for the Americas and President of LR's Applied Technology Group. John brings valuable experience from the passenger ship sector – a growing area of activity for LR. One of his key priorities will be a continued focus on LR's expansion of technical support capability in this area. John will also support the overall development of LR's activities in Italy going forward across the business, operational and technical support office functions.

John commented: "LR is the global leader in the passenger cruise ship classification market. Trieste, close to key passenger ship clients and construction yards, is an ideal choice to build a global support capability."

Meanwhile Sandro Galliano retires after 34 years at LR. LR has seen continued positive growth in core operational and newbuild activities in Italy throughout his long career.

 Email: [john.hicks@lr.org](mailto:john.hicks@lr.org)




### Liz Ridgway appointed Promotional and Physical Evidence Marketing Manager, based in Southampton

Liz joined LR on 4 January, 2016, from London-based global communications company M-is, where she focused on developing strategic marketing campaigns for major corporations and worldwide governments.

Before joining M-is, Liz was employed at the Ministry of Defence, as Head of Marketing for the Royal Navy and as Director of Marketing and Fundraising for the Royal Navy and Royal Marines Charity.

Liz has worked on many award-winning and challenging projects including leading the international communications for the City of Madrid in their bid to host the Olympic Games in 2020 and for the City of Lima during their campaign for both the Pan American Games and the International Olympic Committee Session.

Joining LR, Liz is able to bring together her experiences in integrated marketing, from events planning to creating digital strategies and sharing her knowledge of many different sectors from cyber security to charity.

 Email: [liz.ridgway@lr.org](mailto:liz.ridgway@lr.org)




### Sung-Gu Park appointed Design Innovation Strategic Marketing Manager, based in Southampton

Until recently Sung-Gu was LR's Senior Hull Plan Approval Specialist for new construction in China, Korea and Europe, and since joining LR in 2007, he has had significant experience of innovative and novel ship design projects such as 22,000 teu container ship design development.

During an eight-year spell in Asia, he worked on newbuild projects in Korea and China spanning container ships, bulk carriers, multi-purpose cargo ships, ore carriers, VLCCs, PCTCs, ropax and auxiliary naval ships – projects that have given him invaluable insight into the shifts and changes of ship design and how innovative concepts influence ship design, construction and the quest for sustainable shipping.

Before joining LR, Sung-Gu worked from 1999 in the Initial Design Department at Hyundai Heavy Industries Co., Ltd (HHI) as a structural design engineer.

Sung-Gu has an MRINA in The Royal Institution of Naval Architects, a bachelor's degree in Naval Architecture & Ocean Engineering from the In-Ha University and a master's degree in Ship Design from the University of Ulsan in Korea.

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# LR's Global Technology Centre receives royal opening

The Princess Royal formally opened LR's Global Technology Centre (GTC) in Southampton as part of the official opening of the Boldrewood Innovation Campus in September 2015. The campus is also home to Southampton University's Faculty of Engineering and the Environment and the Southampton Marine and Maritime Institute (SMMI).



▶ LR's Ship Emergency Response Team ran a simulation of a ship casualty for HRH to demonstrate LR's role in providing emergency response services. Finally, the Princess Royal unveiled a plaque and formally opened the campus.

When fully completed, the Boldrewood Innovation Campus will host a world-class research infrastructure including an anechoic wind chamber, advanced fluid dynamics experimental facilities, which will be used across a range of disciplines including civil engineering and aerospace, and a 140-metre towing tank that will provide detailed research on new maritime technologies.



HRH performs the 'mixing of the waters' ceremony, a tradition for new towing tanks



Barbara Jones talks with HRH about LR's 255 years of innovation



Her Royal Highness (HRH) Princess Anne received a warm welcome from the Vice Lord-Lieutenant of Hampshire, Mrs Lindsay Fox MBE, who introduced her to LR CEO Alastair Marsh, former CEO Richard Sadler, vice-chancellor Professor Don Nutbeam, Professor William Powrie and 150 invited guests.

After viewing the commemorative embroidery created by artist Alice Kettle, Princess Anne then explored an exhibit highlighting the key role LR has played in supporting the evolution of shipping, focusing on the technology challenges today and in the future.

HRH toured the campus' towing tank facility and Centre for Complex Autonomous Systems Engineering Laboratories before arriving at the GTC building.

Historical material relating to LR's involvement with royal yachts was also presented to HRH by Barbara Jones, Curator of the Lloyd's Register Foundation's Heritage and Education Centre.

**"We were honoured to have HRH the Princess Royal opening the Boldrewood campus today. We were particularly pleased that she agreed to be here with us, due to her deep knowledge and passion for the maritime sector."**

Richard Sadler – former LR CEO



# 20,000 teu ships being built in all three major shipbuilding nations

Korean, Japanese and Chinese yards are contracted for 19, 20 and 21K teu container ships being built to LR class

The LR classed ships involved are the first 20,000 teu ships to be built in China and Japan and will be built with the option of being gas-fuelled.

"The fact that the major shipbuilding nations are all now going to be building the new generation of large container ships reflects the growing maturity of demand for these ships, as well as the capability to understand what is required to design and build them to handle the forces they will have to face," comments Tom Boardley, LR's Marine Director.

"LR has provided a wide range of supporting analysis to help ensure

that the ships will meet safety and operational requirements for all nineteen of these ships that are around the 20,000 teu capacity mark."

Today's 20,000 teu container ships need additional analysis and checks to be properly designed and built to reduce the risk of structural failure. LR has been leading the way in understanding the forces involved in building new generations of large containerships. These forces include those affecting both the hull and container lashings.

LR has provided a wide range of services in various packages of work to clients to help ensure a combination

of safety and performance benefits are best captured:

**Strength Design Assessment (SDA)** – considering one bay empty condition, analysing local and global strength;

**Fatigue Design Assessment (FDA)** – analysis of whipping and springing looking at the principal structure.

Many of the services go well beyond class requirements and these 'beyond class requirements' are being applied to help ensure safer, better, large container ships.

## LR Rule amendments promote safer, surer lashings

Part 3, Chapter 14 of LR's Rules and Regulations for the Classification of Ships have been updated to reflect the latest industry standards with regard to container stowage and securing arrangements. The updated formulae are based on LR's recent hydrodynamic and FEA research.

The goal of this Rule amendment is to keep pace with the rapidly developing technologies being implemented within the container shipping industry, to maximise cargo carrying capabilities and to adapt systems to benefit most effectively from the opportunities associated with increased vessel size.

As ship configurations and operating requirements change, the design of new securing arrangements needs to be assured accordingly in a prescriptive manner as confidence in analysis permits.

### Vanishing point

Thousands of pink detergent bottles washed up at Poldhu beach in West Cornwall in January, after a container was lost at sea during stormy weather.



Photo credit: National Trust / Steve Haywood

# Understanding the risks associated with large container ship design

Modern container ships have very large deck openings, long hull forms, a large bow flare (the projection of the forward deck outwards above the waterline) and operate at fairly high operational speeds (roughly 18 knots or over).

They must, of course, meet the structural strength and fatigue requirements imposed by all sea conditions.

While the basic rules that underpin containership structural strength are well established, as ship sizes increase, new challenges emerge, making continued research into the implications

essential. To some extent, the scales now possible mean we may be moving beyond the gradual evolution of ship rules to a revolution in rule development.

The principal elements of the design challenge are:

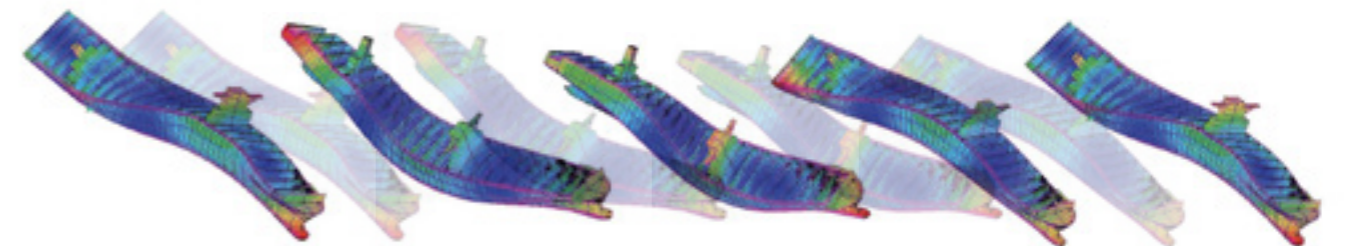
- effects of whipping
- effects of springing
- effects of warping / distortion of hatch openings.

Our capability is based on pure research and deep analysis of both

full-scale actual in-service data and theoretical modelling. Note that research must often be conducted in the absence of in-service experience, since the ship sizes under investigation have not yet been realised.

The sea state effects on ship structures can be detrimental to the structural integrity and fatigue life (the time before cracking caused by fatigue becomes important) of the ships at risk.

Whipping actions increase extreme wave bending moments and shear forces; springing actions reduce the fatigue life.



### Whipping and springing describe different effects of waves on the hull girder

**Whipping** is the rapid flexing of the girder due to waves hitting the hull. It has been compared to a violin string being plucked, producing an initial note which dies away. **Springing** is the continual vibration of the hull girder due to waves exciting the girder's resonant frequencies. It has been compared to a bow being drawn over a violin string, producing a constant note.

Above: Response of a container ship in an oblique wave showing combined bending and twisting deformation of the hull girder

# Ready for a big world driven by data and digitisation



"The world is changing fast – this we know. It will change shipping just as it is changing our daily lives."

Nial McCollam,  
Chief Technology Officer, Lloyd's Register

Big data, connected devices and cloud applications are increasingly a part of your life – whether it's a fitness monitoring device on your wrist connected to your phone and computer; social media apps; or the remote control you have over banking and travel arrangements. Big, connected data is here today and it's only going to get bigger.

It will affect business and it will affect shipping. At LR we know that our stakeholders need us to help them find the right solutions for the future of data. We are keeping our

stakeholders up-to-date with our plans, objectives and progress as we provide advice and solutions, as well as on the impact of our own internal programmes in the LR Group's technology, software, data and digital strategy.

Connecting our capabilities with our markets and harnessing the power of the LR Foundation will place us in a strong position to provide solutions and inspire the data and digital innovation ideas of others. We are starting to lead a broad collective dialogue on the topic of technology

as part of shaping and influencing LR's technology strategy.

If the smart tracker on your wrist can give you instant feedback and data showing performance over time, there is no reason why connected ships won't be providing data to their operators to make better, safer, operational and performance decisions.

We need to make sure that there is confidence in these systems, that they are secure and that we are able to help stakeholders make the most of the opportunities that are emerging.



## LR involved in China's first smart ship design

China State Shipbuilding Corporation (CSSC) has signed a joint industry Project with LR Asia to design the next level of cyber ship. LR will develop classification rules for the 38,800 dwt innovative 'I-Dolphin' design.

The smart ship will apply up-to-date information technology, including real-time data transmission and collection, large-capacity calculations, digital modelling and remote control. All of this is designed into the ship to better guarantee navigational safety and improve operational efficiency of the vessel.

By working together with CSSC and other I-Dolphin project partners, LR will look to develop the rule content, to understand what is the most efficient, safe and environmentally friendly route to take in the design, operation, survey and maintenance of smart ships.

The ship will be dual-classed by LR and China Classification Society (CCS), with LR taking the lead class for the ship.

## Our GMTT 2030 report explored transformational technologies and how they will make the smart ships of the future a reality

### The tools are here

The components required for a smart ship revolution already exist and are cost-effective. Commercial aircraft fly autonomously without pilot interference. At the size of a wallet and for less than US\$200, a smartphone is a fully connected computer containing any conceivable sensor: including an accelerometer, gyroscope, magnetic compass, proximity, light, GPS, barometer, thermometer, hydrometer, infrared and more.

### Increasing shortage of maritime skills and resources

There are over 104,000 ocean-going merchant ships. The shortage of highly qualified sea-going staff is an increasing concern, especially as ships become more complex due to environmental requirements. The lack of gas engineers is quoted as a major barrier for the gas-fuelled shipping transition. Smart shipping is not necessarily about removing

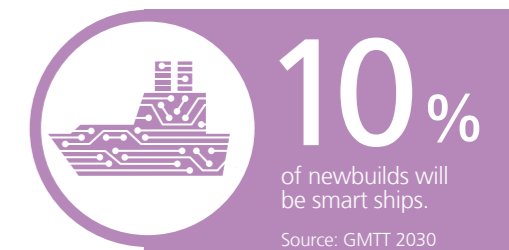
people from ships, but about better connecting ships and their crews with specialised onshore resources.

### Physical shipping technology has peaked

It is possible that we have already approached the limits of what physical technology (engines, hull, propulsion) can deliver in terms of absolute efficiency (tonnes per day).

Smart ship technologies will provide an opportunity to deliver higher efficiency gains.

Download the full report at [www.lr.org/gmtt2030](http://www.lr.org/gmtt2030)



# Updated battery guidance from Lloyd's Register

LR is increasingly involved in supporting the development of battery and hybrid power solutions across a range of vessel types

Working with industry experts and academia, including research work with chemical experts at the University of Southampton (UoS), LR is helping to support the safe introduction of this clean power technology. In-depth understanding of the science is crucial in helping the LR team and the UoS assess the risks of new technologies before they are applied on board vessels.

The second edition of our guidance for clients on battery installations is now available. The guidance covers the hazards associated with battery installations and LR's approach to approving them. The guidance is generic and applies to all electric and hybrid configurations, since batteries can be used in many marine applications. It is based on our extensive experience of battery installations on board ships and yachts.



*Svitzer Euro*, one of four new LR classed ECOtugs – these hybrid vessels can operate exclusively on battery power, while maintaining full manoeuvrability.

Using batteries to supply ships' power systems can improve efficiency, save fuel and reduce emissions.

Battery installations also give a significant reduction in noise and vibration compared to traditional power systems. There are currently no international standards for marine battery installations.

However, the International Electrotechnical Commission (IEC) is

developing two standards: 62619 and 62620. There are also requirements for transportation of batteries such as the UN 38.3 Recommendations on the Transport of Dangerous Goods – Manual of Tests and Criteria.

A significant number of vessels have already been classed under LR's novel design Rules and the interest in battery installations from shipbuilders and battery manufacturers is continuing to increase.

It is important to note that the range of available cell chemistries makes it unfeasible to have a prescriptive set of rules for batteries. LR recognises that lithium-ion is the most commonly-used type of cell at present, but even within the lithium-ion family there is no standard cell. At the same time, research into battery technology is moving rapidly, so developments in cell chemistry can be expected in the near future.

"Whatever system is being proposed, LR will take a considered technical and business approach to approval of the system."

Bernard Twomey,  
Global Technology Leader –  
Electrotechnical, Lloyd's Register

## Benefits of battery systems

- Potential for optimised engine operation
- Reduced fuel consumption
- Safety and reliability
- Agility



Download the guidance now at [www.lr.org/batteries](http://www.lr.org/batteries)





# Another great day in dock

September 2015

Location:

Nakilat Keppel Offshore & Marine Ltd (N-KOM) ship repair and fabrication yard, Ras Laffan, Qatar – on board the LNG carrier *Umm Bab*

Temperature:

Day time high, 42°C, high humidity



Nakilat-Keppel Offshore & Marine (N-KOM) offers a wide range of repair, conversion and fabrication services to the marine and offshore industry. The world-class shipyard has successfully undertaken the world's first main engine gas injection (MEGI) conversion of a Q-Max liquefied natural gas carrier (LNGC) to run on LNG as fuel and completed more than 100 gas carrier repairs over the past four years in operation.



Sreekumar Nair, LR's Senior Surveyor in Qatar briefing the *Umm Bab's* crew



Of great importance during the docking is checking the cargo tanks. *Umm Bab* was constructed at DSME in 2005. This is only the second time since then that the tanks have been opened

The 145,700 cbm LNG carrier *Umm Bab*, named for a city in southern Qatar, is at N-KOM for routine drydocking, maintenance and completion of its second special survey. While the docking programme is routine it is highly significant and requires effective planning to get all the required tasks ticked off so that the ship can get back into operation as fast as possible.

N-KOM's location could hardly be more convenient for gas carriers regularly loading at the Ras Laffan facility. At any time at least three to four LNG carriers can be seen to the north-west

at the loading jetties. And the turnover is regular as ships complete cargo operations while empty ships arrive. As soon as *Umm Bab* has completed her docking programme she will cool down and proceed to load.

Her last port was Taichung, Taiwan. When not trading to Asia she is mostly discharging at North European ports such as Zeebrugge. She always loads at Ras Laffan.

Operated by Maran Gas Maritime Inc. (MGM), *Umm Bab* is one of Maran's sixteen LNGCs in operation, with fourteen LNGCs currently on order. Thirteen out of the total thirty are joint ventures with Qatar Gas Transport Co. Ltd – known as 'Nakilat' which means carrier in Arabic. Greek flagged, *Umm Bab* is like a Greek island in the Arabian Gulf. Hospitality means a frappedaki (iced coffee) and Greek cakes are offered.

In charge of the docking is Maran veteran, Costas Stavropoulos. Through 2015 he has spent more than three months in Qatar overseeing three of the Maran ships docking at N-KOM. He has long days working with the crew, yard and contractors – as well as the LR surveyor. The ship has now left the drydock and is alongside the docking quay, freshly coated in the distinctive deep maroon red of the Qatari national flag, for final jobs.



**Invar®**

Invar®, also known generically as FeNi36 (64FeNi in the US), is a nickel-iron alloy notable for its uniquely low coefficient of thermal expansion (CTE or  $\alpha$ ). The name Invar® comes from the word invariable, referring to its relative lack of expansion or contraction with temperature changes.

It was invented in 1896 by Swiss scientist Charles Édouard Guillaume. He received the Nobel Prize in Physics in 1920 for this discovery, which enabled improvements in scientific instruments and is also used by GTT's NO96 series of containment systems.



Inside cargo tank No. 4: Mark Haskell, LR's Senior Surveyor in Charge – GCC with Sreekumar Nair, Senior Surveyor, Qatar



The ship's cargo containment tanks are the GTT membrane NO96 system. Great care has to be taken when accessing the tanks as the membrane is both strong and fragile to be able to efficiently and securely contain LNG at -163°C.

Ventilated by dehumidified air being blown in at the bottom of the cargo tower, the atmosphere is considerably more comfortable than the midday Qatari summer conditions outside.

But great care has to be taken when accessing the tanks. Not only is it a good climb down the ladders, the primary concern is protecting the containment membrane surface: a 0.7mm layer of Invar®. Invar®, an alloy of iron and nickel, with a negligible coefficient of thermodynamic expansion, is used in the making of clocks, scientific instruments – and gas carrier membrane tanks (see box above). Laid in 500 mm wide strakes, the Invar® covers the surface of the

entire primary barrier and is also used in the secondary barrier.

Because the layer of Invar® is so thin, nothing can be carried down into the tanks. Pockets, unless secure and zipped, need to be emptied. Tools must be lowered into the tank, down to the carefully secured wooden boarding at the bottom of the pump tower, and then secured by a leash when in use. Safety boots must be covered with cotton felt over-boots. The docking

is the first time that the tanks have been accessible for five years and after completion of work they will be closed until 2020. Everything going in must be accounted for. Foreign objects are not wanted in the LNG discharge system and cannot be retrieved after cool down.

The final step before sealing will be a careful inspection and cleaning of the tanks. In the meantime the LR surveyor assigned to *Umm Bab* will carefully

survey the tanks, checking for damage and deformation. But the tanks are looking very good and he is not expecting to find anything significant – the inside of the cargo tanks look just like they did when delivered from the shipyard in Korea in 2005.

Maran has a strong track record in minimising down time – known as off-hire. In the last five years, since the last docking, only five maintenance days have been required. Getting back to

business fast is what the docking is all about. Soon *Umm Bab* will sail across to the loading jetty. After a 30 hour 'cool down' she'll be ready to load a full cargo of LNG and be back at sea, southbound in the Gulf, leaving behind the clamour, heat and dust of the dockyard days.

# Mark V technology approved by LR

GTT, the world leader in the design of membrane containment systems for the maritime transportation and storage of LNG, received General Approval from LR for its new Mark V containment system on 1 October, 2015

The validation by LR of the Mark V technology is the culmination of a work programme following LR's issuance of AiP in 2013 and is a further major step towards its rapid commercialisation following two co-operation agreements GTT signed during the first half of 2015 with the shipbuilders Hyundai Heavy Industries and Samsung Heavy Industries to confirm the industrialisation of the system.

After some years of research and development, the Mark V technology is an optimised version of the Mark III system and its sister Mark III Flex.

As with the Mark III and Mark III Flex, the Mark V technology is composed of a double insulation with reinforced polyurethane foam. The new system also includes an innovative nickel-steel alloy corrugated secondary membrane and offers significant improvement of the warranted daily boil-off rate.

To read more about GTT's containment technology and LR's role, read our Gas Shipping Report at [www.lr.org/gas](http://www.lr.org/gas)

Philippe Berterottière, Chairman and CEO of GTT commented: "This new milestone in the development of the

Mark V system demonstrates the quality of GTT innovation as well as the close relationship established with class and particularly with Lloyd's Register."

Tom Boardley, LR's Marine Director said: "This is important news and we are very pleased to have been working with GTT in the ongoing development of their innovative gas containments systems.



" This new milestone in the development of the Mark V system demonstrates the quality of GTT innovation as well as the close relationship established with class and particularly with Lloyd's Register."

Philippe Berterottière  
Chairman and CEO of GTT

# New low-flashpoint fuels (LFPF) notation from LR

With the development of gas as a marine fuel going beyond LNG, LR developed a notation that came into effect on 1 January, 2016, that provides clarity and helps to ensure technology can be adopted effectively

LR has developed a new notation for low-flashpoint fuels (LFPF), allowing owners and shipyards to demonstrate that their ship design and construction meet requirements. The notation came into effect on 1 January, 2016, as part of LR's Rules and Regulations.

In the last 12 months, the industry experienced two major changes in legislation with the adoption of the revised International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code) and the International Code of Safety for Ships using Gases or other Low-flashpoint Fuels (IGF Code). The codes have broadened the horizons for gas applications, encompassing the use

of low-flashpoint fuels for gas carriers and non-gas carriers, but it is the classification society's role to ensure clear standards, requirements and methodology are put in place, to help ensure the required levels of safety and reliability are achieved.

LFPF is assigned where the main propelling and/or auxiliary machinery is designed to operate using a low-flashpoint fuel in accordance with the applicable LR Rules and Regulations. LR's approach to this developing market is through Rules and Regulations applicable to all ships using LFPF under an overarching notation that is clearly structured, scalable and can evolve as the industry's knowledge matures.

The LFPF notation is to be appended by the associated characters GC or GF:

- GC: Assigned to gas carriers indicating that the gas-fuelled machinery has been constructed, arranged, installed and tested in accordance with the relevant requirements of Chapter 16 of LR's Rules for Ships for liquefied gases, or is equivalent there to.

- GF: Assigned to ships other than gas carriers indicating that the low-flashpoint-fuelled machinery has been constructed, arranged, installed and tested in accordance with the LR Rules and Regulations applicable to the fuel(s) used.

The low-flashpoint fuel (or fuels) that the ship is designed to use is indicated in the notation using a two letter identifier:

- NG: Natural Gas
- EG: Ethane Gas
- PG: Liquid Petroleum Gas
- ML: Methanol



LNG Carrier using BOG as fuel - LFPF (GC, NG)



LFPF (GF, NG) or LFPF (GF, ML)



LPG Carrier using BOG as fuel - LFPF (GC, PG)



LFPF (GF, NG) or LFPF (GF, ML)



LPG or VLEC using LNG as fuel - LFPF (GC, NG)



LFPF (GF, NG) or LFPF (GF, ML)

Development of a new class notation pertaining to low-flashpoint fuels

# A new application for GTT membrane cargo containment systems

LR specialists have concluded and issued to GTT, at their request, AiP for a membrane cargo containment system (CCS) for bunker ships to allow an increase in vapour pressure of up to 2barg.

A joint GTT and LR research and innovation programme has been investigating cargo containment behaviour from strength aspects in various applications, sizes and pressures.

The close collaboration between LR's Southampton GTC specialists and GTT experts, through workshops using experimental and analytical results and data on internal pressures occurring in LNG tanks, studied the maximum compressive strength of the containment system on LNG carriers. Using a 4,000 cbm LNG bunker as a reference case, with two Mark III Flex membrane tanks and structural analysis – while considering navigation and operating conditions – in October 2015 LR issued AiP for a GTT Membrane CCS

system for use in bunker ships with an increase in vapour pressure up to 2barg.

The project required a clear engineering understanding of the membrane technology as well as the fundamental principles of applicable rules and regulations in order that the required safety and reliability levels are maintained, when implementation of membrane containment systems goes beyond atmospheric pressure applications.

## Why pressurise?

Higher vapour pressures in CCS are relevant for gas-fuelled ships and small-scale LNGs – especially for LNG bunkering, to help manage boil-off gas. Strengthening the hull offers additional safety within the tank to withstand the boil-off gas generated.

Dariusz Boryszewski, Senior Specialist, Ship Structures said: "The potential use of such applications in the gas as fuel

and small-scale LNG market are many. This AiP opens the route to progress further with GTT towards project specific applications.

"This study carried out by our specialists and GTT's was an effective marriage of our organisations' capabilities. Getting to Approval in Principle with the novel idea of pressurised membrane tanks is a real achievement. Our review identified areas that can be engineered to help ensure the ship's structure effectively supports the CCS."

David Colson, Commercial Vice-President of GTT commented: "Thanks to our extensive knowledge and experience, GTT, together with Lloyds Register, has been able to demonstrate the feasibility of operating membrane tanks at higher pressures.

"This is a significant step in increasing the use of membrane tanks in the LNG as fuel chain for fuel tanks and bunker vessels."



Studies performed by GTT during this LNG bunkering project, taking into consideration operation envelopes, port facilities, environmental conditions and structural details, enabled LR to perform a rigorous review for the purpose of Approval in Principle – issued on 9 October, 2015.

"GTT, together with Lloyd's Register, has been able to demonstrate the feasibility of operating membrane tanks at higher pressure."

# Poseidon Med II works towards the adoption of LNG in the Eastern Mediterranean area

LR is a key player in €13.1 billion project, now approved by EU Member States, to advance to Poseidon Med II.

EU Member States, represented in the Connecting Europe Facility (CEF) Co-ordination Committee, approved the allocation of €13.1 billion to support a total of 276 projects – the largest investment plan ever made by the EU in the transport area.

Poseidon Med was the first cross-European border project which aims to introduce LNG as the main fuel for the shipping industry in the eastern Mediterranean region. Hellenic Lloyd's, the subsidiary of LR in Greece, was one of the main partners that initiated the Poseidon Med Project. The LR project management team is based in Piraeus.



Thanos Koliopoulos, standing, moderates the technical panel of the conference at Zappeion in Athens

Over 200 attendees recently attended a stakeholders conference at Zappeion in Athens where the second phase of the project, Poseidon Med II, was announced. It detailed further work towards the adoption of LNG as a marine fuel in the Eastern Mediterranean area, supporting substantial benefits to the society, the environment and the economy.

Poseidon Med II involves 26 beneficiaries and three member states – Greece, Cyprus, Italy. The focus of the project includes safety and HAZID studies for LNG bunkering in five ports, Approval in Principle for 10 or more vessel retrofits to LNG, and detailed review including newbuild designs, gap analysis in current legislation and proposal of the regulatory framework for vessels and ports and financial assessments and business reports for the selected onshore and offshore installations.

Speaking at the conference Thanos Koliopoulos, LR's Global Special Projects Manager, emphasised the safety aspects of the adoption of LNG as marine fuel, "Risk assessment methodology and tools applied leave no doubt that there are high safety standards across the LNG supply chain, from LNG transportation and bunkering to LNG-fuelled ship operation."



Jose Laranjeira Anselmo, Principal Administrator Motorways of the Sea (MoS). MoS strives to establish a trans-European network which concentrates on viable, regular, and reliable sea-based transport services that are integrated in logistic chains and cover all types of maritime freight operations.



Poseidon Med is the LNG bunkering initiative from EU countries in the Eastern Mediterranean and Adriatic Sea led by QEnergy Europe and organised by top experts, including LR, in marine energy, gas and finance sectors. Its ultimate objective is to prepare in detail a global solution of infrastructure development in the Mediterranean area so that LNG can be embraced as the marine fuel of the future.

# Common Structural Rules first for Chandris Hellas, COSCO Dalian and LR

Chandris's 114,000 dwt Aframax tankers are the first ships ordered to be built to the latest common structural rules following the July entry into force of the new IACS requirement

**Two 114,000 dwt double hull oil tankers ordered by Chandris (Hellas) Inc. are to be built at COSCO Shipyard's facility in Dalian.**

The ships will be built to the new Common Structural Rules (CSR) that have been in force since July 1, 2015, following the adoption by the International Association of Classification Societies (IACS) of the CSR in December 2013. Plan approval will be carried out by LR's Shanghai Technical Support Office. Dr. Xue Maogen, LR's Marine Manager for Greater China, said that this order "is a major milestone for the industry."

Tom Boardley, LR's Marine Director commented: "The introduction of the Common Structural Rules – a shared, integrated set of class rules – is a significant achievement for the classification sector. Their entry into force gives all industry stakeholders the required confidence in the Common Structural Rules."

Speaking for Chandris (Hellas), Mr John G. Skordias, President and Managing Director, said: "We want



the best ships for our seafarers, for our cargoes and to protect the environment. So we are very proud that our company may be one of the very first to have ordered ships to the new common structural rules and to be working with LR and COSCO Dalian."

COSCO Dalian said: "We are arriving here along a consolidating journey, of efforts on innovation, devoting ourselves in delivering international recognised products with safety, quality, and added values to the customers. This 114,000 dwt product and crude oil tanker project is a typical example, she is the world's first contracted newbuild tanker to the latest CSR. We have confidence to make success steps upon the constructive cooperation from the ship owner, Lloyd's Register, and other key stake holders."

**"The introduction of the common structural rules – a shared, integrated set of class rules – is a significant achievement for the classification sector."**

Tom Boardley,  
LR's Marine Director



## About the Common Structural Rules

Adopted by IACS on 18 December, 2013, these new rules entered into force on 1 July, 2015 and supersede the Common Structural Rules for double hull oil tankers, July 2012 and Common Structural Rules for bulk carriers, July 2012. The Common Structural Rules are in two parts. Part one provides requirements common to both double hull oil tankers and bulk carriers. Part two provides additional requirements applied to either double hull oil tankers or bulk carriers.

# Navantia to build large tankers



First steel cut at Navantia

## LR to class Suezmax tankers under construction in Spain

The new vessels will be constructed at Navantia's Puerto Real yard near Cadiz. On delivery they will be operated by Maritime Transport Ondimar LDA, a shipping division of Ibaizabal Group.

DSEC Co. Ltd, a subsidiary of Daewoo Shipbuilding & Marine Engineering (DSME), will provide ship design and procurement services. Navantia, a Spanish state-owned

company, is the fifth largest shipbuilder in Europe, and the ninth largest in the world, with shipyards all over Spain.

Navantia's history dates back to 1730, with the creation of the Ferrol, Cartagena and San Fernando arsenals, dedicated to the construction and repair of Spanish Navy vessels.



## LR to class nine tankers for Maersk to latest Common Structural Rules

LR has been awarded the contract for classification of nine medium range (MR) type product tankers. Owned by Maersk Tankers, the vessels will be built at Samsung's Ningbo yard in China.

These are the first ever vessels ordered by a Danish shipowner to the latest Common Structural Rules for Bulk Carriers and Oil Tankers, which came into force in July 2015 for tankers and bulk carriers. The new rules provide a consistent approach for all IACS members to evaluate the structural strength of these ship types. Construction of the first vessels is due to start in the near future, with deliveries due in 2017/18.

LR's Copenhagen Marine Client Manager, Morten A. Jensen, commented: "I'm very pleased that LR has been chosen for this newbuild programme and proud that Maersk Tankers has expressed its confidence in LR by classing these ships with us."

LR holds a leading position in the adoption of the latest CSRs and is currently working on a Joint Industry Project to develop software to simplify the application of the CSRs.



# Hellenic focus: events in Greece and China

## Lloyd's List Greek Shipping Awards, Hellenic Advisory Committee and Greek Day in China

**Committee Chairman, Theodore Veniamis, noted the high level of input classification needs to provide to new technology before politics and regulators influence the developments.**

"IMO will always face political pressure, so that is why IACS needs to stand up and strongly input in the formulation of regulations," said Veniamis, and called upon continuing LR support to this approach.

Greece and the Eastern Mediterranean and Adriatic (GEMA) region is a very important area that will play a leading role in the growth of LR in the future. 23% of the total gross tonnage classed by LR in the entire world comes from this area. Of LR classed newbuilds contracted in China, 24% stem from the region, a share that rises to 31% for Korean-made newbuilds.

**"Our large and extremely active Piraeus office endeavours to provide the constant support that the local market needs. We also have Greek surveyors and managers working around the world – most notably in China and Korea supporting new construction."**

Tom Boardley, LR's Marine Director

In his opening comments, Alastair Marsh, LR CEO, took the opportunity to confirm that he would continue LR's strong commitment to the Greek community. Tom Boardley LR's Marine Director, outlined LR's new regional structure and emphasised the importance of GEMA as a consolidated region with the head office in Piraeus. "Greece has always been seen as a home market for LR," said Boardley.

"Our large and extremely active Piraeus office endeavours to provide the constant support that the local market needs. We also have Greek surveyors and managers working around the world – most notably in China and Korea supporting new construction. While in our Marine head office, in Southampton – at our brand new Global Technology Centre – there is a strong Greek contingent of naval architects, engineers and support staff.



Notably, LR's Operations Managers in both China and the Middle East are Greek nationals. In total we have around 200 Greek nationals working for us worldwide."

Advancing the theme of technology focus, Nick Brown, Marine COO, LR, made reference to the recently published Global Marine Technology Trends 2030 and provided an overview spanning from advanced applications to practical design and efficiency measures. He also highlighted LR's leadership in the adoption of Common Structural Rules and guiding owners through the compliance challenges of ballast water treatment and measurement, reporting and verification.

Brown was pleased to report that LR continues to build on its PSC performance further to its recognition as top-performing recognised organisation (RO) at the Paris MoU for 2013. Furthermore, he pinpointed LR's strong performance in the US Coast Guard inspections with no detentions during the period 2012-2014.

Luis Benito, LR's Marine Marketing Director, underlined that helping the market adopt and understand relevant, useful technology is critical. "It is important to provide Greek clients with the support that is needed for understanding the maturity of novel technology to generate the desired impact when implemented on board ships."

Theodosios Stamatellos, LR Regional Marine Manager GEMA, focused on

the activities of the Lloyd's Register Foundation and its aim to connect science, safety and society by supporting research and promoting education. Stamatellos made specific reference to the long standing commitment of the Foundation to the Greek shipping community and the collaboration with Greek educational and industry bodies.

Facilitated by George Maglaras, LR's Marine Client Support Manager for Greece, the Committee also reviewed

the workings of LR's Hellenic Technical Committee and Environmental Subcommittee during 2015, covering a wide range of themes, from the Ballast Water Management Convention and monitoring, reporting and verification of CO<sub>2</sub> to environmentally acceptable lubricants and barred speed range and light running margin.



### Lloyd's List Greek Shipping Awards

Tom Boardley, LR's Marine Director, (left) presenting the LR-sponsored Award for Achievement in Safety or Environmental Protection to Georgios Bourekas of Frontex (middle) and Vice Admiral Athanasios Athanasopoulos Commandant of the Hellenic Coast Guard (right).

### Fifth LR Greek Day in China

The fifth LR Greek Day in China took place in Shanghai in December 2015 and was attended by 60 representatives of the Greek shipping community in China.

The event was honoured by the Greek Consul General, Mr. Vassilios Xiros, together with the Consul for Economic & Commercial Affairs and the Maritime Attaché.



Top left: Theodosios Stamatellos, LR's Regional Marine Manager for Greece, East Mediterranean and Adriatic.

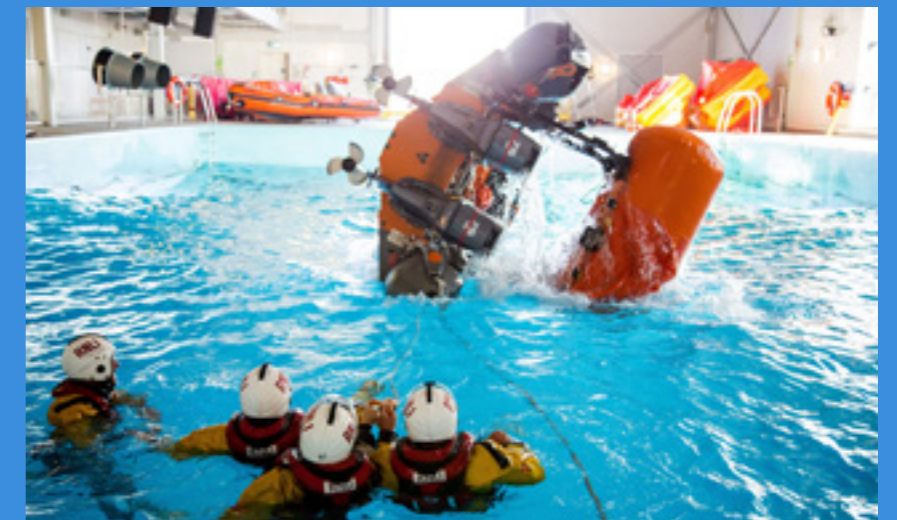
Above: Theodosios with Lazaros Skoularikos, Technical Manager at Eletson Corp. Left: Nikos Skaribas, LR's Greater China Operations Manager, Marine.



The RNLB trainee crew undertakes a series of lifeboat capsize simulation and self-right exercises in the sea survival pool.



All photos credit RNLB / Nathan Williams



The crew have to get out from under the lifeboat and operate the self-inflating bag built into the lifeboat

# RNLB sea survival training funded by the Lloyd's Register Foundation

For the past five years the Lloyd's Register Foundation has funded the RNLB's sea survival training for lifeboat volunteers, training 1,600 crew to date.

In 2014, RNLB lifeboats launched 8,462 times. They rescued 8,727 people and saved the lives of 368 people who would have died had the RNLB crew not been on hand to rescue them.

New funding from the Foundation will support training of 1,800 volunteer crew for 2016-2021.

Every RNLB crew member must undertake a structured training programme, and trainee crew members start on a 12-month probationary period, working through a crew development plan. With only one in ten volunteers joining the RNLB from a professional maritime occupation, training is extremely important. After 6

months of regular training and getting to know and work with the coxswain/helmsman and crew, trainees are then able to attend a trainee crew course at the RNLB College in Poole, as pictured here.

This course trains them in their responsibilities as a crew member and provides them with the essential personal survival and firefighting techniques they will need, as well as an understanding of the equipment

used when assisting to save lives at sea. Generic seamanship skills and inshore and/or all-weather lifeboat-specific skills are also taught.

Theoretical and practical sessions help build the crews' confidence and awareness of the lifeboat's equipment and capabilities when at sea. For practical sessions, crew use training lifeboats and casualty vessels, a sea survival pool, a fire simulator and a flare ground.





RNLi volunteers on board *Mudford Servant* lifeboat during a casualty care training exercise

## Foundation's focus for the future

The Lloyd's Register Foundation is a UK charity established in 2012 that helps to protect life and property by supporting engineering related education, public engagement and the application of research.

Over 60% of these grants support excellent scientific research and over 25% advances skills and education. In 2015 researchers funded by the charity won over 20 academic awards.

The charity's aim is to be known worldwide as a leading supporter of engineering-related research, training and education that makes a real difference in improving the safety of the critical infrastructure that is vital to modern society.

Find out more about the work the Foundation is doing and its vision for the future in the Foundation Review 2015 (pictured right); this document reflects on the Foundation's second full year of operation and the progress it has made to become a leading engineering research and education charity.

The Foundation currently has over 70 live grants, with the original value of these totalling over £60m.

 Download now [www.lrfoundation.org.uk](http://www.lrfoundation.org.uk)



" We're proud to be supporting RNLi in their mission to save lives at sea. We share a mutual purpose because part of the mission of the Lloyd's Register Foundation is to enhance the safety of life and property. We're proud to be supporting RNLi and the front line volunteer crews in this way."

Professor Richard Clegg,  
Managing Director, Lloyd's Register Foundation



## Marine Technology Report

May 2015

Our Marine Technology Report focuses on technological developments that are changing the face of modern shipping. Four crucial areas of research and development are explored – CFD, battery technology, polar technology and wind-powered shipping.



Download now at [www.lr.org/technologyreport](http://www.lr.org/technologyreport)

## Global Marine Technology Trends 2030

September 2015

Global Marine Technology Trends 2030 is the culmination of a collaborative project between LR, QinetiQ and the University of Southampton. The report examines the transformative impact of 18 technologies on ship design, naval power and the use of ocean space in 2030.



Read more on page 3

## Yacht Focus

September 2015

Read the latest news from the yacht industry in our Yacht Focus magazine. Find out about two leading European shipyards building superyachts, LR's new guidance notes on masts, spars and rigging, NOx and SOx emissions, and a 1930s yacht that has been restored to her original design.



Download now at [www.lr.org/yachts](http://www.lr.org/yachts)

## Gas Shipping Report

October 2015

Our Gas Shipping Report looks at innovation: new cargo containment systems from GTT; new trades, such as ethane; and how LR surveyors, standards and insight are supporting the evolution of gas shipping.



Download now at [www.lr.org/gas](http://www.lr.org/gas)

## Lloyd's Register Foundation Review 2015

November 2015

The Lloyd's Register Foundation's Annual Review 2015 reflects on the Foundation's second full year of operation and the progress it has made to become a leading engineering research and education charity.



Download now at [www.lrfoundation.org.uk/](http://www.lrfoundation.org.uk/)

## Battery Installations Guidance

January 2016

The second edition of our guidance on battery installations covers the hazards associated with battery installations and LR's approach to approving them.



Read more on pages 12-13



Launch of the LR classed, LNG-powered *Greenland*

[www.lr.org](http://www.lr.org)

From our origins in a London coffee house in 1760, Lloyd's Register now has 9,000 employees throughout the world. We are engineers, and more: we've evolved from the original classification society supporting the shipping industry to a multi-industry compliance, assurance, risk and technical consultancy services organisation. With a truly global reach we can adapt our service offerings to suit businesses wherever needed.

Our only shareholder is the Lloyd's Register Foundation, but our stakeholders are many.

We exist to help make the world a safer place.

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