

# Horizons

News and information for the marine industry  
A Lloyd's Register magazine

## Fireworks in Bergen

The *Viking Star* gets a spectacular send-off  
at her naming ceremony in Norway

## Heerema pioneers a world first

Netherlands group to build  
giant crane-lifting vessel

## Winning formula

Lloyd's Register leads with  
new lashings technology



Horizons is the journal for Lloyd's Register Marine clients and employees, delivering news and analysis on our global activities.

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(l-r) Lloyd's Register's Marine Director, Tom Boardley, Norden AS Senior Vice President Asger Lauritsen, Lloyd's Register's Chief Operating Officer, Nick Brown, and Lloyd's Register's Brand and External Relations Manager, Nick Brown

# GTC welcomes a work of art

Visitors to Lloyd's Register's Global Technology Centre (GTC) were greeted with a spectacular sight one sunny day in June this year.

On the main facing wall of the foyer was an eight-metre-long and three-metre-deep installation made of stitched embroidery by the Winchester artist Alice Kettle. Specially commissioned by Lloyd's Register to celebrate our move to the GTC in Southampton, its theme is "A Map for the Future".

After discussing the installation's ideas and themes with Lloyd's Register staff in Southampton and London, Alice paintstakingly stitched the embroidery together on site at the GTC. "I feel I have stitched in the stories that everyone has told me as I have gone along," says Alice

who is Professor of Textile Arts at Manchester School of Art.

A special opening ceremony at the GTC was attended by LR's Marine Director Tom Boardley, LR COO Nick Brown, Alice Kettle, and employees and clients of LR. Nick Brown, LR's Brand and External Manager and one of the originator's of the installation, said: "Alice's incredible work is a dramatic counterpoint to the streamlined minimalism of the GTC.

"You have to see it to really grasp its impact. Her techniques mirror LR's journey from being the original classification society in a pre-industrial age, to today's multi-stranded, global technology driven organisation, owned by one of Britain's biggest charities."

Front cover: The Lloyd's Register classed *Viking Star*, which was built at the Fincantieri shipyard in Marghera, Italy, is Ocean River Cruises' first-ever cruise ship. She will soon be joined by two sister ships, *Viking Sea* and *Viking Sky* (see News page 7).

# Contents

**02 COMMENT**  
Introduction by Alastair Marsh, LR's new CEO



**03 CHANGING PEOPLE**  
Key staff changes in LR Marine

**04 NEWS**  
LR's activities around the globe



**12 BOXSHIP TECHNOLOGY**  
Pioneering work by LR on lashings

**16 NOTABLE FIRSTS**  
Outstanding LR classification projects



**18 IRISH OPVS**  
Trio of vessels built by Babcock

**20 NSCV VESSEL**  
Heavy crane lift vessel to be built



**22 YACHT FOCUS**  
LR's role in two cutting-edge projects

**26 RUNNING ON BATTERIES**  
LR helps develop electric technology

## Comment

# Alastair Marsh

Lloyd's Register's new CEO  
from 1 October 2015



I am delighted and feel honoured to have been given the opportunity to lead LR through what promises to be exciting and challenging times ahead for the clients and industries we serve.

By way of introduction, I have been the Chief Financial Officer of LR since 2008, working with Richard Sadler and the executive team to grow and diversify LR into the organisation it is today.

Thanks to Richard's leadership and boundless energy, enthusiasm and commitment over the past eight years, our business is in good shape, despite turbulent market conditions. We now have strong leadership across our businesses and group functions and

the scale that we've achieved means that the role of CEO for LR has evolved.

Tom Boardley has an incredibly strong team in place to serve our marine clients, and my job is to provide them with the direction and support from the LR group to ensure we maintain our technology leadership and constantly stay relevant for our clients in today's increasingly digital world.

This technology leadership has supported our position as number one in many specialised ship types such as passenger ships, ro-paxes, oil product tankers, superyachts, LNG carriers and LPG carriers where our expertise can add the most value to our customers.

Alongside our continued success in being awarded a high share of

newbuildings and service to ships in class, LR's technology expertise in other areas is being recognised. Work started on the first newbuildings to comply with LR's provisional rules for the classification of stern-first ice class ships and we have a leading class share of the growing fleet of battery-powered vessels. We are involved in a growing range of projects for gas-fuelled ships, gas carriers and LNG bunkering projects.

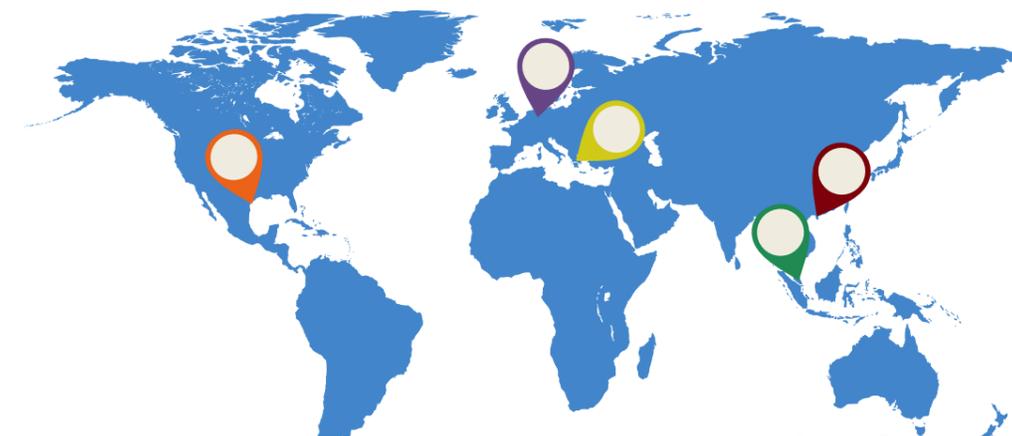
LR is also tackling the challenges and opportunities of big data – what we call data-centric engineering – through the use of nano-sensors to transmit live performance data from materials and systems.

With significant investment from the LR Foundation in fundamental research and development into areas such as technology road-mapping, 'designing for data', codes and standards and data analytics, LR is committed to being at the forefront of ensuring clients get the most value out of their vessels' data.

I am passionate and committed to LR, our history, heritage and values. We are a truly unique organisation. Our contribution to society, through our activities and the profits given to the LR Foundation, is something I am immensely proud of. I give you my commitment to lead with integrity, consistency and in line with our values.

## Richard Sadler

Richard Sadler has been LR's Chief Executive since 2007. During his tenure he has seen Lloyd's Register diversify its service portfolio and grow into a £1 billion turnover business. This period also saw the creation of the Lloyd's Register Foundation and the opening of two Global Technology Centres in Southampton and Singapore.



## Changing people

## The five regional managers



Mark Darley



Piet Mast



Dave Barrow



Jim Smith



Theodosios Stamatellos

## The appointments of Piet Mast as Regional Marine Manager for South Asia, Middle East and Africa (SAMEA) and Mark Darley as Regional Marine Manager for the Americas completes the market alignment of marine operations

Recent reorganisation has led to a new expanded North Europe region that includes France, Spain and Portugal with Dave Barrow as its Regional Marine Manager. Dave was previously Area Business Manager for for the UK and Ireland (UKI) and South West Europe (SWE).

**Scott Kennedy** is LR's new UKI Marine Operations Manager based in Glasgow. He was previously Marine Business Manager for France and Monaco at LR's Marseille office. His successor is **Tariq Berdai**, who was

previously Senior Marine Surveyor at our Marseilles office. LR has created two new regions in Asia. North Asia has been led by Jim Smith since April (see May 2015 *Horizons*).

Engeljan de Boer takes over Piet Mast's previous role as Marine Area Business Development Manager for Western Europe based in Rotterdam. He will continue in his role as Yacht Segment Manager.

**Iain Wilson** is LR's new Business System Improvement Director. Iain,

who was Regional Marine Manager for Asia, has relocated from Singapore to the Southampton GTC.

**Mark Darley** replaces Tim Protheroe in the Americas. Tim will focus on his role as General Manager for the Lloyd's Register Group in the Americas. Mark who was LR's VP and Area Marine Manager for South Asia in Kuala Lumpur, is replaced by **Mike Holliday**, formerly Marine Client Manager for southern UK based in London. **Zacharias Siokouros** is LR's new Marine Business Manager for Cyprus.



Scott Kennedy



Iain Wilson



Engeljan de Boer



Tariq Berdai



Zacharias Siokouros



Tim Protheroe



Mike Holliday

## Norden to switch **entire fleet** to Lloyd's Register classification

Danish tramp ship operator Norden is moving its entire fleet and all of its externally managed vessels to Lloyd's Register class. The deal covers 57 ships in total.

Some 32 of the ships in the agreement are transfer-of-class (ToC) ships, a tally that includes nine newbuilds, which will transfer to LR upon delivery. Four Norden vessels are currently classed by LR and 16 externally managed ships are also being transferred to LR as part of the agreement.

Lloyd's Register's Copenhagen-based Marine Client Manager, Flemming Kjeldsen, said: "Our good working relationship with the client and the in-house capabilities we have here in Copenhagen consistently to support them were essential in securing the contract."



(l-r) Kim Wiese, LR's Marine Business Development Manager, Copenhagen; Tom Boardley, LR's Marine Director; Asger Lauritsen, Norden's Senior Vice President and Head of Technical Department; Flemming Kjeldsen, LR's Marine Client Manager; Nick Brown, LR's Marine COO

## World's first **gas turbine-powered LNG carrier** design wins approval in principle

South Korean shipbuilder Hyundai Heavy Industries (HHI) has received approval in principle (AIP) from Lloyd's Register for the world's first gas turbine-powered LNG carrier, developed jointly with GE Aviation and Marine (GE).

The 174,000m<sup>3</sup> IMO Tier III-compliant LNG carrier is equipped with GE's gas turbine-based combined gas turbine electric and steam system (COGES 2.0). The gas turbine-powered engine

is 60% lighter than conventional engines and will lower operating and maintenance costs accordingly, says HHI. The durability and low vibration and noise of the engine are also test-proven.

"We will continue to enhance our competitiveness through ongoing technological co-operation, including the application of the gas turbine engine to large container ships," said Shin Hyun-soo, Chief Technical Officer of HHI.



## LR first class society to certify small commercial ships in the **Caribbean**



Surveyor Umar Ali from LR's Trinidad office inspects the tugboat *Trafalgar*

As the first classification society to issue Cargo Ship Safety and Small Commercial Safety Certificates to two Trinidad & Tobago vessels, Lloyd's Register (LR) has been authorised by several Caribbean flag administrations to carry out surveys and issue certificates under new codes on their behalf.

As part of the survey and certification services, LR can undertake surveys for the following:

- Code of Safety for Caribbean Cargo Ships (CCSS Code). This applies to ships of under 500gt. The administrations authorising LR are the Bahamas, Belize, Cayman Islands, Trinidad & Tobago and St Kitts & Nevis
- Code of Safety for Small Commercial Vessels operating in the Caribbean (SCV Code). This applies to ships up to 24 metres long. The administrations authorising LR are the Bahamas, Trinidad & Tobago and St Kitts & Nevis.

Both codes were developed under the auspices of the Caribbean Memorandum of Understanding with the support of the IMO and other administrations, principally the US Coast Guard. The CCSS Code was adopted in February 1996 and the SCV Code in May 2010.

"This has been quite a significant achievement, as LR is the first class society to undertake any of this work on behalf of these flag administrations," said Wendel George, Lead Surveyor and Marine Management Systems Auditor at LR's Trinidad office. Until now, individual flag administrations' surveyors have mostly carried out the surveys that lead to these certificates being issued.

## News in brief

### First UK tall ship for 15 years built to LR class

TS *Royalist* – the first tall ship to be commissioned in the UK for 15 years – has been built and delivered to LR class.

The ship was named by the Princess Royal in honour of a previous ship of the same name and will carry sea cadets on week-long voyages throughout the year. "Aside from some improvements to the vessel's accommodation, it remains the same as its predecessor. Everything is small on the vessel, especially the tiny engine room," said LR Surveyor, Carlos Gonzalez.

### LR shines at Tokyo MoU

LR has moved up the rankings in the Tokyo MoU. In the MoU's annual report of vessel inspections by recognised organisations (ROs) in the Asia-Pacific port state control (PSC) area in 2014, LR has moved up from 5th to 4th place.

It follows our recent success at the Paris MoU where we were top-performing RO in the European PSC area in the three years from 2011 to 2013.



### Carnival launches its largest vessel

Carnival Cruise Lines has launched its largest vessel, *Carnival Vista*. The 133,500 gt ship is being built at Fincantieri's Monfalcone Yard in Italy and is due to be delivered in April 2016.

Classed by Lloyd's Register, the 5,000-passenger vessel will be Carnival's flagship and the first in its fleet to meet the statutory Safe Return to Port requirements. Among the *Carnival Vista's* green credentials are hull lines designed to minimise fuel consumption, an exhaust gas cleaning system to reduce air emissions: advanced heat recovery systems and an onshore power supply arrangement to power the ship at berth.



## LR to class two large LNG carriers for enlarged Panama Canal

A pair of 178,000m<sup>3</sup> LNG carriers, that are to be built to LR class will be two of the largest of their kind to navigate the enlarged Panama Canal, helping to revolutionise the global trade in LNG. The canal expansion project is due to be completed in 2016.

The Elcano-owned ships are powered by low-speed, dual-fuel gas injection diesel engines, driving twin propellers with high pressure gas supply systems. They also have GTT Mark III Flex storage tanks which reduce their boil-off rate (BOR) from 0.15% to 0.1%. Such features make the LNG carriers among the cleanest and most fuel-efficient in the global fleet.

As well as classification services, LR provided valuable independent consultancy services for Spanish owner Elcano, to ensure the highest safety and performance standards for these ships.

These services include risk assessments (HAZIDs and HAZOPS) for the vessels' fuel gas supply system and strength, and fatigue and vibration analysis services for the hull and pump tower structures.



## Naming ceremony held for Canada's longest cable ferry



BC Ferries' cable ferry *Baynes South Connector*

A naming ceremony for Canada's longest cable ferry, which will be operated by the Canadian ferry company BC Ferries, was held recently at Seaspans Vancouver Shipyards in North Vancouver.

The 78.5m-long ferry, which is named *Baynes South Connector* (after the channel it will cross) and classed by Lloyd's Register, will join Canada's coastal ferry fleet and operate on the Buckley Bay to Denman Island route after it is delivered later this year.

With a capacity for 150 passengers and 50 vehicles, the vessel is one of the longest cable ferries in the world, covering a distance of 1.9 kilometres and travelling at speeds of up to 8.5 knots.

The finishing touches were added to the vessel before she was towed to Buckley Bay on Vancouver Island where the vessel will be connected to its three cable links that were laid earlier this year.

At the naming ceremony, Mike Corrigan, BC Ferries' President and CEO, said: "Today marks a special milestone in our vessel replacement programme as we honour maritime tradition with the naming ceremony and thank the workers

at Seaspans Vancouver Shipyards who have produced a fine vessel for us. As we continue to invest in the long-term sustainability of British Columbia's ferry system, we celebrate this new ship today which will carry our passengers and their vehicles safely and efficiently for many years to come."

Ben Thompson, LR's New Construction Programme Manager for Western Canada, said: "LR Canada is very proud to be involved in this seminal project to build a cable ferry for BC Ferries at Vancouver Shipyard. It is not only the first vessel to be built at the recently upgraded Vancouver facility using the new infrastructure installed for Canada's National Shipbuilding Procurement Strategy shipbuilding programme, but it is also the first cable ferry to be classed and delegated in Canada.

"Prior to shipyard selection, LR worked closely with BC Ferries and Transport Canada to review and approve this unconventional design in order to satisfy Transport Canada's requirements ahead of any unified regulations for cable ferries in Canada. The construction has been supervised by LR's Project Manager, Richard Chern, a Senior Surveyor at LR Vancouver."

## Tom Boardley receives scale model of *Viking Star*

A scale model of Viking Ocean Cruises' first-ever vessel, *Viking Star*, was presented to Lloyd's Register's Marine Director, Tom Boardley, by Viking's Chief Naval Architect, Jon Rusten, to mark the delivery of the vessel earlier this year (see cover image of the ship's spectacular naming ceremony in Bergen).

To mark the event, LR presented Viking Ocean Cruises with a facsimile of our first register book and a copy of our official history, *Lloyd's Register: 250 Years of Service*.



(l-r) Jon Rusten, Viking Ocean Cruises' Chief Naval Architect, and Tom Boardley, LR's Marine Director

## Gobbler scoops two awards at Seawork 2015

An oil spill retrieval vessel called *Gobbler*, which has undergone surveys and design approval by Lloyd's Register, recently won two awards – the Spirit of Innovation trophy, the top prize, and the Vessel Construction & Design award – at the recent Seawork International 2015 exhibition in the UK's Port of Southampton.

A prototype of the two-man, 8.85-metre-long vessel featured in the exhibition's waterborne displays. Once in production, the vessels will use skimmers and pumps to help clear oil spills after oil rig failures, groundings, sea spillages and other forms of oil discharge until the main salvage teams arrive (see article in the January 2015 issue of LR's *Horizons* magazine).

The recovery vessel has been developed by boatbuilder Gobbler Boats Ltd of Portsmouth, UK. Lloyd's Register Surveyor Christian Olsen



A prototype of the *Gobbler* oil retrieval vessel

said: "Congratulations to the team at *Gobbler* on their recent success at Seawork which has been the result of a number of years' hard work.

The unique craft and its equipment have been designed to minimise the effects of oil spills and slicks and is an exciting new development.

"LR has worked closely with the *Gobbler* project team, approving the

design to Lloyd's Register's Special Service Craft Rules and completing surveys during the construction. We are now working closely to certify the first vessel under the MCA Small Commercial Vessel Code of Practice."

Gobbler Boats Managing Director Paul Jauncey said the company aims to produce 500 *Gobblers* a year when the project reaches the manufacturing stage.

## LR supports lifeboat design study for RNLI

The design of all-weather lifeboats is being reviewed as part of a study led by Newcastle University and the UK's Royal National Lifeboat Institution (RNLI) with support from Lloyds' Register.

The four-year project will help to improve the performance of the craft while providing the safest possible environment for the RNLI's volunteer crews.

Using computer models, small-scale experiments and full-size trials to analyse the behaviour of lifeboats at a range of speeds and in varying conditions, the findings will inform new design specifications around speed, safety and efficiency.

"When the RNLI's lifeboats travel at speed and in rough seas, they can be subject to frequent and significant slamming as the boat crashes against



One of the RNLI's lifeboats mid-operation

the waves. Measuring these forces and the resulting impact on the vessel is crucial in order to design a craft that is capable of withstanding the loads experienced during rescue operations," said Federico Prini, Project Leader and a Research Associate at Newcastle University.

Lloyd's Register is providing guidance on the practical implications of the project from both scientific and practitioners' viewpoints. Lead

Specialist Jesus Mediavilla Varas, from LR's Strategic Research and Technology Policy Group, who is supervising the project, said: "Lloyd's Register has been committed to improving the safety standards of vessels at sea for more than 250 years.

"This project will help to de-risk the operation of lifeboats by improving current knowledge, and potentially contributing to further improvement of our special craft rules."

## LR to class 3,600 teu container ships for Maersk

Lloyd's Register (LR) recently signed a significant contract with COSCO Zhoushan Shipyard in China for the classification of seven new 3,600 teu container ships. Owned by Maersk Line, the 200-metre-long vessels will be built to the Danish Flag.

This is the first time the shipyard has built container ships and it gives LR the opportunity to continue a long and successful co-operation with the yard.

The ships, which are designed by Odense Maritime Technology, will be built to ice class 1A (Finnish-Swedish

ice class) and delivery is planned for 2017. The order is the first stage in Maersk Line's recent investment programme.

LR has provided support in ECA compliance options, specification reviews and support during contract negotiations with the shipyard.

Morten A. Jensen, LR's Copenhagen-based Marine Client Manager, said: "Lloyd's Register is excited to be part of this project and it confirms the good relationship between Maersk Line and the business development department in the Copenhagen office.

"The location of LR's office in the vicinity of Maersk's headquarters was a significant advantage and our ability to respond quickly was greatly appreciated by the client."



CGI of a Maersk Line container ship

## LR partners Penn Oak to help owners find LNG solutions

Lloyd's Register North America Inc (LR) is partnering Penn Oak Energy Corp to forge a one-stop-shop solution for companies raising capital and reducing the technical risks of retrofitting LNG-fuelled ships.

Shipowners' approach to investing in LNG-fuelled ships has begun to change as more LNG facilities are built and LR's LNG Bunkering Infrastructural Survey 2014 shows that major ports are either planning for, or anticipating, the development of LNG bunkering. However the large initial capital outlay to build these ships is an inhibiting factor for owners.

"We have seen great strides in companies willing to convert their existing ships to this new fuel or constructing new ships in the US emission control areas (ECAs).

Our relationship with Penn Oak Energy will help provide the private equity to shipowners to undertake these ambitious projects, and assist those shipbuilders that the US will need to expand this growing demand," said LR's Rafa Riva, Marine Business Development Manager.

LR is pioneering the global development of gas as a marine fuel. Penn Oak Energy, based in Scottsdale, Arizona, is a developer of LNG fuel solutions for industrial clients.

## LR joins LeanShips project to improve ship performance

Lloyd's Register (LR) is a key player in a EU-sponsored four-year low emissions project called LeanShips.

Co-ordinated by the Netherlands-based Damen Group, the aim of the initiative is to demonstrate how small and medium-sized commercial and leisure vessels can increase their fuel efficiency by up to 25%, reduce their CO<sub>2</sub> emissions by a quarter and cut their NO<sub>x</sub>, SO<sub>x</sub> and particulate matter emissions by as much as 100%.

Among the 46 partners are Meyer Werft, Navantia, Rolls-Royce, STX France, and Royal Wagenborg. The European Union has provided 70% of the project's €23 million funds, with the rest coming from the partners' own contributions. The project aims to develop demonstrable concepts and technologies for both newbuild and retrofit vessels in different market segments.

Reddy Devalapalli, Principal Specialist of LR's Strategic Research and Technology Policy Group, said: "Lloyd's Register's main role is to evaluate the safety and classification aspects of the different low-energy and near-to-zero emissions [lean] concepts and technologies so they can be demonstrated on an LNG carrier, a general cargo ship, an

ice-going vessel and a leisure/passenger ship."

One of LeanShips' key concepts is a demonstrator led by Rolls-Royce to study the operating risks posed by using large-diameter propellers (LDP) on a 25,000 dwt, ice-classed general cargo vessel.

It builds on the knowledge gained from a previous EU-funded project called Streamline, a Rolls-Royce-led research enterprise into innovative marine propulsion concepts.

The other concepts LR is contributing to include:

- development of a waste treatment system (WTS) for converting dry and wet wastes to solid substitute fuel on board a passenger ship, led by Meyer Werft and STX France
- the reduction of an LNG carrier's lightweight using optimal structural design led by Navantia
- applying a sulphur emission control area (SECA) strategy to a fleet of general cargo vessels, led by Royal Wagenborg.



# LeanShips

Low Energy And  
Near to zero emissions Ships

# Royal Canadian Navy awards Lloyd's Register classification

After a long collaboration with the Royal Canadian Navy, LR has been contracted as the sole provider of Naval Material Regulatory services for its combatant vessels.

As naval vessels and administrations are generally self-regulated, they develop their own naval safety assurance programmes. The Royal Canadian Navy has elected to use all eight safety areas of its Naval Ship Code as a foundation for its safety programme and LR classification is supporting all these areas.

The multi-million dollar, 15-year contract will enable LR to facilitate increased co-operation between Canada and the UK Ministry of Defence (MoD).



Representatives of LR and the Royal Canadian Navy at the contract signing ceremony

"This is a milestone for both Lloyd's Register and the Royal Canadian Navy. It's the result of a great deal of vision and determination."

Lloyd's Register's David Lloyd

LR will provide classification services to all current and future combatants in the naval fleet, including 12 modernised Halifax class frigates and up to 15 future Canadian surface combatant frigates/destroyers, which are all unique to Canada.

LR will support the Royal Canadian Navy with these complex vessels from concept design all the way through to 15 years in service. We are the sole classification society chosen to provide this service in a highly competitive market.

Lloyd's Register's Government Operations Manager for Canada, Jason Organ, commented: "We were able to

win this contract both because of our close relationship with the UK MoD, which gives us an edge on technical expertise, and because we already have a robust set of naval ship rules through our work with other navies."

David Lloyd, Lloyd's Register's Deputy Marine Manager for Canada, said: "This is obviously a milestone for both Lloyd's Register and the Royal Canadian Navy. It's the result of a great deal of vision and determination on the part of key individuals in the navy, as well as a tremendous amount of hard work by Lloyd's Register staff in Canada and the UK over many years to establish the credibility of LR to be able to deliver these services."

# LR's cutting-edge technology highlighted at Nor-Shipping

Lloyd's Register was able to engage with industry stakeholders, discuss day-to-day service delivery and opportunities and demonstrate the development of new technologies at the Nor-Shipping 2015 exhibition and conference in Oslo.

In an increasingly complex world, solutions are ever more complex. Lloyd's Register is addressing the challenges of an ever-larger shipping industry that needs to reduce its environmental impact, and also to find performance gains while maintaining or increasing safety margins.

At Nor-Shipping, LR demonstrated its activities in all areas of future fuel, propulsion and initiatives to improve efficiency. Our team discussed a wide variety of issues and development areas with clients. One of the leading issues was the importance of polar shipping

and its role as a valuable part of our technology portfolio and a driving force in our innovation projects.

The evolving structure of the ice cap means shipping in the Arctic Circle will need to change, and LR is ahead of the curve in the technology relevant to this huge environmental and market shift. No challenge is too big or too small for LR, and we will always welcome our Northern and Nordic clients to partner with us to deliver world "firsts". Recent ones include classification for:

- The world's first LNG-powered icebreaker
- The first ship to hold a stern-first ice class notation
- The first ship to hold the class notation Icebreaker(+)
- The first ever ice-breaking superyacht.

Our latest *Marine Technology Report* was launched at the event and shared

with our clients and stakeholders. Available online, it contains reports, with the voices of our experts, and describes how LR is driving the development of new technologies.

We look at five key areas of activity and news:

- Computational fluid dynamics
- Battery technology
- Polar technology
- Wind-powered shipping
- The Applied Technology Group in Halifax, Nova Scotia.

Elsewhere at Nor-Shipping 2015, LR speakers were on various speaking platform including the innovative Ocean Industry Podiums where one of the highlights was Professor Richard Clegg, Managing Director of the Lloyd's Register Foundation, talking about Lloyd's Register's Big Data Classification firsts.



Speakers and topics featured at the Ocean Industry Podiums at Nor-Shipping 2015

# LR develops new technology for container ships

Lloyd's Register's lashings specialists have been using state-of-the-art analysis techniques that will enable owners of ultra-large container ships to extend their vessels' cargo-carrying capabilities

Lloyd's Register is classing the world's largest-ever container ships – led by a recent contract to oversee the building of six ultra-large container ships (ULCS) of more than 20,000 teu.

Four ULCS vessels of 20,150 teu will be built for the Japanese company Mitsui O.S.K. Lines (MOL) at Samsung Heavy Industries' (SHI) shipyard at Geoje Island, South Korea, while two 20,050 teu ships will be built for Shoei Kisen Kaisha on long charter to MOL at Shoei's affiliate company Imabari Shipbuilding at Saijo shipyard, Japan (see article in the May 2015 *Horizons*).



*Most of the world's goods are transported by container*



The height of container stacks is growing every year



“By introducing an innovative approach to container stowage, shipowners who class their container ships with LR will achieve world-leading container carriage capability – without increasing the risk of container loss or damage.”

Luis Benito,  
LR's Marine Marketing Director

These huge vessels are due to be delivered in 2017 and they have been earmarked to operate on the Asia-to-Europe service.

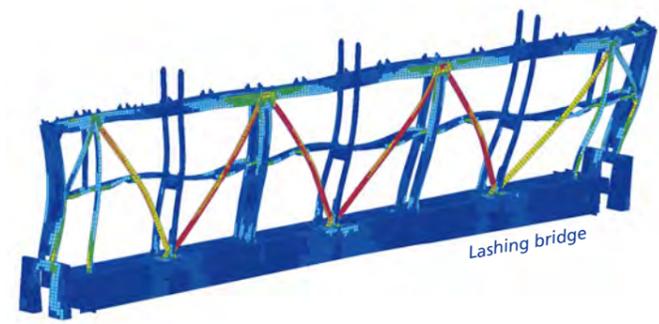
This significant order heads a growing cluster of potential contracts we are currently discussing with leading global shipowners and operators for approving and classing vessels of over 20,000 teu.

LR's experience and expertise in container ship technology and the current market has enabled us to produce a series of proposals and guidelines on the safest, most cost-effective methods of stowing and lashing container cargoes.

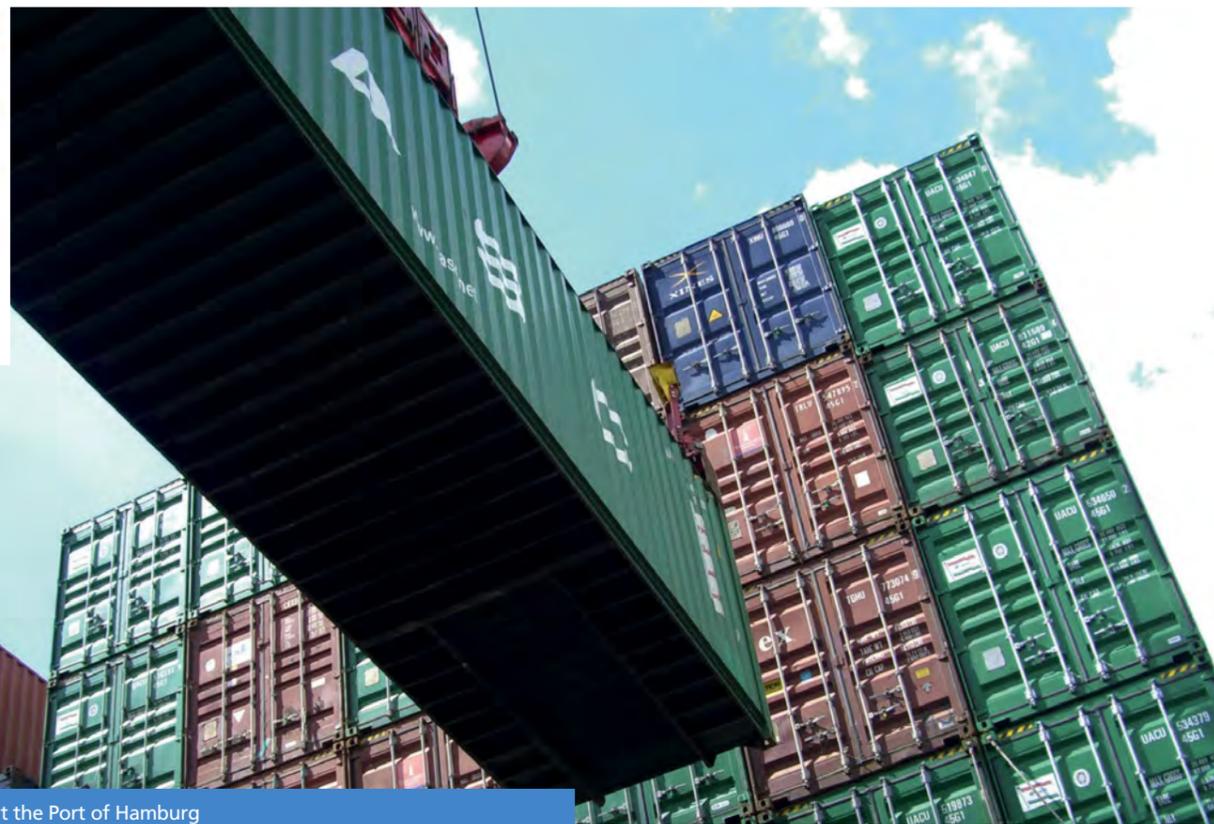
Our technical teams have investigated the rising heights and weights of the container stacks that today's ULCSs can



David Tozer, LR's Business Manager for Container Ships, said: "Secure, efficient and ergonomic lashings are an overriding priority for owners as the sizes and capacities of ships increase. At Lloyd's Register we are constantly developing and revising our rules and their technical application for these giants of the sea."



Finite element analysis of the deformation of a lashing bridge due to the forces from lashing rods



Containers being loaded at the Port of Hamburg

carry and produced new rule proposals to help designers, owners and masters handle these ever-expanding cargoes.

One of the key findings of the work, led by Nigel White, Technical Manager for Hydrodynamics with LR's Structural Analysis and Hydrodynamics Group, is based on vessel speed. Our research demonstrates that the speed at which a ship sails has a significant and predictable effect on its rolling

motions – this is a crucial factor in cargo-carrying. So instead of designing container stows as if a ship is sailing at full speed in the harshest seas of the Atlantic or Pacific oceans we have produced a methodology based on a combination of ship speed and stability and the height and direction of the prevailing waves.

Another significant finding is based on the development of lashing twistlocks



Nigel White, LR's Technical Manager for Hydrodynamics, said: "For such a simple concept, the technical problems involved in the safe assessment of container stowage arrangements are very complex. Lloyd's Register has been undertaking vast amounts of non-linear finite element analysis and ship motion analysis as well as linking this to experience in order to ensure the safe passage of containers."

## Twistlock technology



Container lashing equipment has to survive the rigours of the marine environment

A key area of investigation by LR has been the performance of fully automatic twistlocks (FATs) compared with semi-automatic twistlocks (SATLs).

When a vessel arrives in port, SATLs must be unlocked manually. However, it is often impossible for stevedores to reach the highest tiers, so designers developed a fully automatic version of the twistlocks which enable the containers to be unloaded from the ship without prior intervention by the stevedores.

While both types of twistlock allow for a small degree of vertical

movement before they take up the slack as the containers lift when the ship rolls, some early models of FATs had clearances which were on the large side.

However the latest FATs have a smaller clearance and, crucially, LR's latest research shows that container stacks are less sensitive to this clearance than was previously believed.

The commercial benefit to owners and operators of this new knowledge is that ships can now carry more loaded containers than was previously believed possible.

(see box). Operators who use the latest fully automatic twistlocks (FATs) will have the advantage of securing their cargoes safely and effectively with minimum intervention from the stevedores.

Combined with the introduction of high lashing bridges (see image above left), they will be able to safely carry stacks of 10 or more tiers of containers on deck.

# LR scores some notable firsts

A review of novel Lloyd's Register classification projects



## Pioneering Spirit

**i**

Allseas *Pioneering Spirit* weighs 403,342 gt. This is equivalent to 32,000 London buses



- equal to -



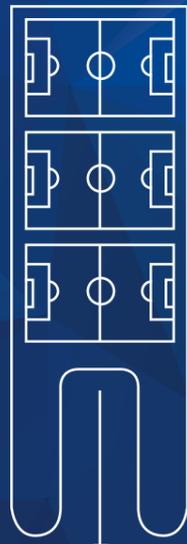
**Allseas**  
Pioneering Spirit

**32,000**  
London buses

**i**

Allseas *Pioneering Spirit* is 382m-long and can fit three football pitches end to end

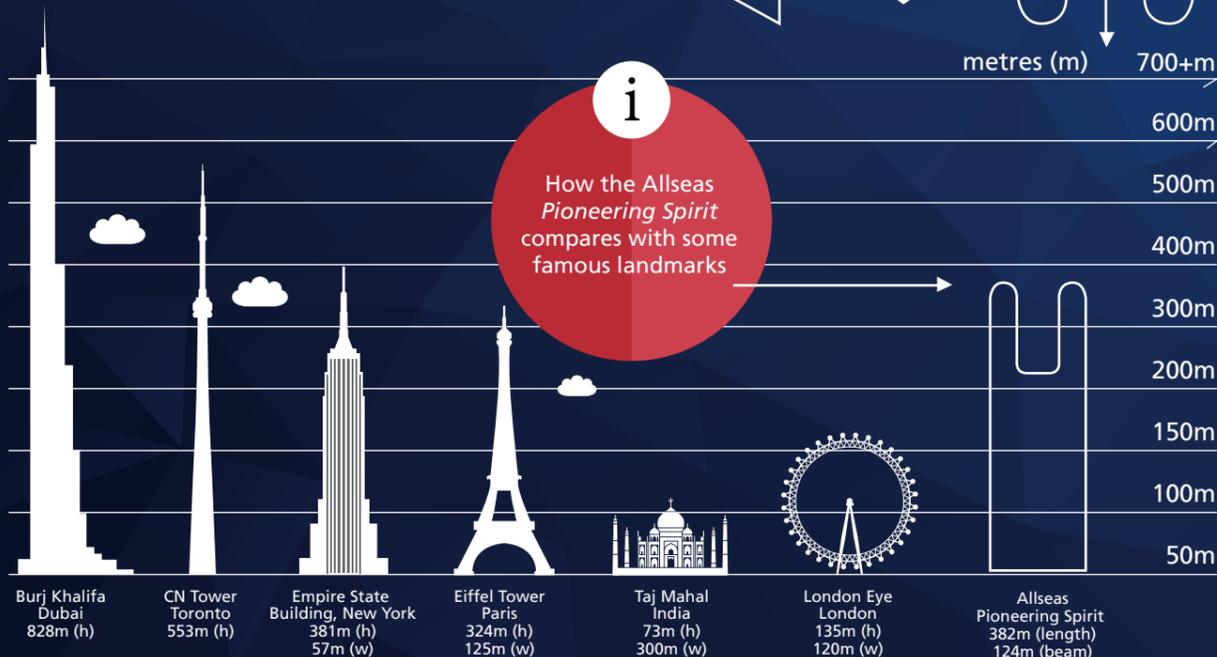
**382**  
metres long



metres (m) 700+m

**i**

How the Allseas *Pioneering Spirit* compares with some famous landmarks



**i**

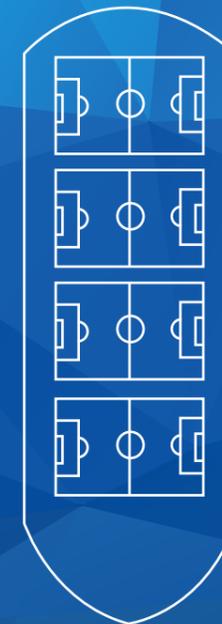
The 488-metre-long *Shell Prelude* is the world's first FLNG plant and the largest offshore facility ever created

**488**  
metres long



**105**  
metres high

## Shell Prelude



**Shell**  
Prelude



**7,500**  
Blue whales

**i**

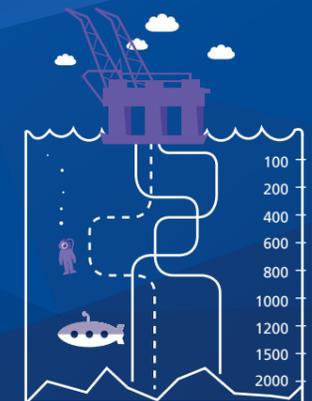
Heerema's *Aegir* deepwater construction vessel was named after a sea giant known as 'Hier' in Norse mythology.

## Heerema Aegir

**211**  
metres long



**305**  
crew members



**i**

The conversion of the ropax *Stena Germanica* to methanol fuel is a world first

**240**  
metres long



**105**  
metres high

## Stena Germanica



Methanol drives light aircraft...



and for heavy truck racing



including several types of modern racing car

**i**

World's first LNG-fuelled icebreaker is being built for the Finnish Transport Agency and classed by Lloyd's Register

## LNG Icebreaker

**110**  
metres long



Can travel at **6 knots** in 1.2m-thick ice

# Babcock builds three OPVs for the Irish Naval Service

A project to build a new generation of offshore patrol vessels (OPVs) – approved and classed by Lloyd’s Register – has helped to rejuvenate the UK-based shipyard of Appledore

The second of three 90-metre-long offshore patrol vessels (OPVs), built by Babcock International and classed by Lloyd’s Register, was recently delivered to the Irish Naval Service.

The OPV is called LE *James Joyce* and follows the 2014 delivery of her sister vessel LE *Samuel Beckett*, which is the same name as the vessels’ class. The third vessel, LE *William Butler Yeats*, which is being built at the same Babcock International shipbuilding facility at Appledore, Devon, UK, is due to be delivered in July 2016.

The three OPVs, which have been designed by Vard Marine, are replacing three earlier OPVs, the Deirdre Class LE Emer, LE Aoife and LE Ashling Aisling, which were commissioned with the Irish Naval Service from 1978 to 1984.

The vessels are designed to carry remotely operated submersibles plus a decompression chamber for divers – to

enable search and rescue, search and recovery, undersea exploration and increased sea area surveillance.

Among their other features are dynamic positioning (DP) systems and power take-in systems to enable the main engines to shut down and power to be sourced from shipboard electricity generated by three 630kW alternators – with emergency power provided by a 320kW generator.

The OPVs are built with extended monohulls incorporating fin stabilisers and anti-heel tanks for roll and pitch reduction. They have 450kW bow thrusters and rudders for high manoeuvrability in close quarter positions. They are also equipped to carry two 8m-long RHIBs on either side of the hull with a third housed over the stern deck.

The extra flexibility provided by electric propulsion provides both fuel savings and an increase to OPV range.



James Joyce OPV which was delivered in July 2015

"The extra flexibility provided by electric propulsion provides both fuel savings and an increase to OPV range."

This enables operations for longer periods without needing to refuel. The diesel-electric propulsion system includes two 5,440kW Wärtsilä medium-speed diesel engines.

The OPVs’ dual-power propulsion system ensures a maximum speed of 23 knots and the vessels have a range of 6,000 nautical miles at a cruising speed of 15kt. They are capable of carrying out missions of up to 21 days. Richard McLoughlin, LR’s Senior Surveyor on the project, said:

"This project has seen a rejuvenation of shipbuilding in Appledore and it has been exciting to be part of this process through to vessel completion. LR has assisted in ensuring deliveries have met contract specification for both classification and requested statutory compliance.

"Project challenges have involved resolving the application of a commercial rule set and statutory requirements in contrast to naval service operational requirements.



Ship’s plaque: (l-r) Lieutenant Padraig Reaney and Lieutenant Commander Brian Dempsey from the Irish Naval Service, Mike Reynolds, Commercial Manager for Babcock International, and Richard McLoughlin, Lloyd’s Register Senior Surveyor, in front of the OPV James Joyce at the vessel’s plaque presentation

It is clear the open environment created at Appledore combined with the strong build heritage has again produced successful deliveries."

Babcock International's Head of Project and Acting Site Director, Nick Plows, said that the working relationship with Lloyd’s Register, the Irish Naval Service and the equipment suppliers has been excellent throughout the programme and goes a long way in delivering an excellent vessel that will serve our customer, the Irish Naval Service, for decades to come.

# LR to class world's largest heavy lift crane vessel

A partnership between Heerema Group, Jurong Shipyard and Lloyd's Register will build the new semi-submersible crane vessel (NSCV) in Singapore

Lloyds Register has won a contract to class the world's largest heavy lift crane vessel (NSCV) for the Netherlands-based Heerema Group. The semi-submersible vessel (NSCV) will be constructed at the newly opened Sembcorp 'Mega yard' in Singapore.

The dual-fuel LNG and MGO vessel is due to be delivered in the fourth

quarter of 2018 and will be a key asset in the offshore market and a leading player in the installation and decommissioning of offshore facilities. It follows another significant Heerema project, the delivery of the LR-classed *Aegir* deepwater construction vessel (DCV) in 2013 (see article in the January 2014 *Horizons*).

The NSCV project, which has a contract value of around \$1 billion, is further

strengthened by the involvement of the Dutch crane specialist Huisman Equipment Ltd, which will fabricate two tub-mounted 10,000-tonne cranes for the vessel in her Chinese production facility.

The Sembcorp Tuas Boulevard yard, where the vessel will be built, has been constructed in two phases. Phase I is 73.3 hectares and is equipped with four VLCC dry docks. Phase II spans 34.5

▶ hectares and includes a steel fabrication facility, another three docks and a capacious offshore dock measuring 255m by 100m where the NSCV will be constructed.

While the vessel is impressive in scale, Heerema are committed to the protection of the environment and will include an Inventory of Hazardous Materials (IHM) and boast a full complement of LR's ECO notations including NOx Tier III compliance, LNG propulsion and compliance with the ballast water management convention (BWMC) to ensure efficient operation in some of the world's most sensitive environmental areas.

The state-of-the-art vessel will also have dynamic positioning capabilities in excess of the DP (AAA) standard along with compliance with a range of coastal state requirements including Norwegian Maritime Authority (NMA), UK and USCG requirements which means it will be capable of deep and ultra-deep sea operations on a truly global scale.

Jan-Pieter Klaver, CEO of Heerema Marine Contractors, said: "Our contract with Jurong Shipyard represents the next critical step in our plans to introduce the NSCV to the market. The fact that we decided to press on with our plans in these times of low oil prices shows our belief in the offshore oil and gas industry and demonstrates our continued commitment to offer unparalleled installation services to the industry."

Piet Mast, Lloyd's Register's Regional Marine Manager for South Asia, Middle East and Africa, said that this is the exciting next step in the long-running partnership between the Heerema Group and Lloyd's Register. "The Heerema Group is demonstrating its commitment to the marine and offshore industry. With the opening of Lloyd's Register's new Global Technology Centre in Southampton this complex project is a good fit for LR and is an exciting challenge for the LR team in Singapore who are supported by a range of global experts," he said.

## Profile of Heerema Marine Contractors

HMC is a world-leading marine contractor in the global offshore oil and gas industry, excelling at transporting, installing and removing offshore facilities. These include fixed and floating structures, subsea pipelines and infrastructures in shallow waters, deep and ultra-deep waters. The company's headquarters are in Leiden, the Netherlands.

## NSCV's main particulars

- Length: 220m
- Breadth: 102m
- Lifting capacity: 2 x 10,000t
- Displacement: 273,700t
- Flag: Panama

"The dual-fuel LNG and MGO vessel will be a key asset in the offshore market and a leading player in the installation and decommissioning of offshore facilities."



Signing the contract: Weng Sun Wong, Chairman and Managing Director of Jurong Shipyard Pte Ltd (left), and Jan-Pieter Klaver, CEO of Heerema



A CGI of Heerema's giant heavy lift crane vessel (NSCV)

# LR supports a craft revival

Lloyd's Register is the leading class society for yachts and has overseen 75 of the world's 100 largest vessels. In this issue of *Horizons* we feature two significant projects – the restoring and refitting of a classic motor yacht dating from 1937 and our pioneering work on masts and rigging with newly produced guidelines for owners, operators, designers and builders

► You can read more about these and other LR projects in the September *Yacht Focus* [www.lr.org/yachtfocus](http://www.lr.org/yachtfocus) which is produced specially for the Monaco Yacht Show.

*Malahne* after her major conversion

# A yacht transformed

A classic yacht built in the 1930s has been restored back to her original design after a long, intricate and fruitful collaboration

One of the largest and most significant projects Pendennis Shipyard and Lloyd's Register (LR) have been involved with is the two-and-a-half year rebuild of the 1937-built motor yacht *Malahne*.

The classic yacht, which was originally classed by LR was, to use the candid words of Richard Cooper, LR's Project Manager for the *Malahne* rebuild, "at risk of an ignominious end when found languishing in a dilapidated condition following a series of poorly executed alterations."

During a long and chequered early history – including active service during the Second World War – the 50-metre-long *Malahne* had several changes of owner and the indignity of having her class suspended for two years. In 1960 she was bought by a company owned by the flamboyant Hollywood film producer Sam Spiegel. And, in what was referred to as a "never-ending Spiegel production", she had frequent changes of captain and attracted famous film stars and royalty such as Prince Rainier of Monaco and Grace Kelly.

During this eventful spell, the maintenance of the vessel was neglected and in 1978 her class had to be suspended once again.

Five years later, Spiegel sold the yacht to a Saudi Arabian sheikh. The new owner made various modifications in an attempt to superimpose a more modern profile and superstructure on to the vessel. Even her name was changed, to *Adel XII*. After a further refit in 1999, the vessel was sold at least twice before she was bought through Edmiston Yacht Management by her current owner, who had the passion and enthusiasm to restore her to her original design. "It was a challenge that many organisations would be reluctant to attempt," said Cooper.

A project team to restore the vessel at Pendennis's shipyard in Falmouth, UK, was led by Edmiston and the classic yacht experts G. L. Watson with naval architecture partner BMT Nigel Gee and approval and classification by Lloyd's Register. In the words of interior designer Guy Oliver, "Our brief was to make *Malahne* look as if she had been in continuous ownership since she was built."

Cooper explained: "The major challenge was to survey the original structure and specify the criteria for retaining it, to make sure such original techniques as riveting and lapped joints were applied and to use the vessel's original equipment.

"We also needed to make sure the vessel was compliant with the latest regulations and to install additional equipment to satisfy the latest operational requirements such as air conditioning and sewage treatment and to address structural issues relating to the fabrication in steel, aluminium and wood.

"Finally, we needed to make sure the vessel met the latest requirements for the UK flag and to satisfy the Large Yacht Code (LY3) and other relevant conventions."

So after keeping everything faithful to the original from lighting, anchors, the bridge telecom and the *Malahne's* hand-painted surfaces to its period styling, the vessel was relaunched in March this year. As one of the project team remarked as the yacht emerged from the Pendennis build shed: "It is like seeing a beautiful butterfly emerge into the sunlight!"

Mike Carr, Managing Director of Pendennis Yachts, said: "Over the past two-and-a-half years the team here has worked incredibly hard to bring *Malahne* back to life. Seeing the final transformation from her 1980s form back to her original design, her launch marks a proud moment for everyone involved."

"Our brief was to make *Malahne* look as if she had been in continuous ownership since she was built."

Interior Designer Guy Oliver

# Raising the bar on masts and rigging

The changing shapes of sailing yachts and the cutting-edge technology they incorporate mean the need for safety compliance and specialist knowledge in such key sectors as masts and rigging has never been greater.

The evolution of yacht design and the use of new materials have prompted Lloyd's Register to produce new guidelines on the building and compliance of vessels' masts and rigging.

Called *Guidance Notes for the Certification of Masts, Spars and Standing Rigging*, the document helps designers, builders and owners to develop virtually any rig configuration within the remit of the Large Yacht Code (LY3).

What makes the LR guidelines unique is that they are goal-based and not prescriptive and have been devised to give owners and designers stage-by-stage, one-to-one matches with each of the legal requirements of the Code.

They also give all the parties involved in newbuild projects – from owners, designers and manufacturers to builders and authorities – a transparent view of their status in auditable trails and clear responsibilities at every stage of a vessel's construction.

In the document, the certification process is modular and covers the following areas:



*Shabab Oman III* was certified by Lloyd's Register

"The new guidelines enable LR to be involved with the project from initial conception to completion of the vessel"

- concept design
- structural design
- manufacture and materials
- stepping and verification of behaviour.

## How Lloyd's Register can help

As the leading classification society in the superyacht sector, LR has the knowledge and troubleshooting abilities to foresee problems and snags during the design and manufacture of a newbuild project. The flexibility of these new guidelines also enables us to be involved with the project from initial conception right through to the vessel's completion, assisting the builder and owner through every stage of certification.

## Oman clipper project



*Shabab Oman II*

Lloyd's Register was recently involved in the certification of a three-mast, full-square rigger.

Called *Shabab Oman II*, the vessel was built by Damen Schelde Naval Shipbuilding for the Royal Navy of Oman to design principles based on the iconic tea clippers of the 19th century. The certification included the design appraisal and

survey of the masts, the assembly of the standing and running rigging and certification of all associated components.

"This work gave Lloyd's Register a good grounding on which to base our new guidelines including the internal and external feedback we received from this project," said LR Specialist Surveyor, Tom Wolodarsky.

Our guidelines are explicitly based on first principles and therefore apply to all types of mast. While the examples we have included in the document are based on fore and aft type rigs (Bermuda), because they are the most common type used in the industry, the guidelines can also be applied to lateen sails and A-frame type masts.

Put simply, any rig configuration can be examined and certified – subject to early involvement in the design by Lloyd's Register.

Finally, throughout the lifecycle of new or existing vessels we can help owners and operators improve and maintain the safety of their masts and rigging.

## Definition of the Large Yacht Code

Although we use the short name Large Yacht Code, it does not give the full picture of the code.

The name means Large Commercial Yacht Code with an emphasis on the 'commercial'.

Any yacht certified to this code is entitled to offer services on a commercial basis, making it subject to the requirements needed for other types of commercial vessel.



# Running on batteries

The ongoing quest to find alternative sources of power that avoid the high cost of HFO and comply with emission control area (ECA) regulations has prompted rapid advances in battery technology

**What percentage of the world's fleet will be driven by some form of battery technology in 20 years' time? Five per cent, 10%, 15% even? Your guess is as good as mine.**

More stringent emissions regulations, high oil prices and the search for alternative fuels mean that new battery projects are being developed all the time as the shipping industry follows the lead of the aviation and motoring industries in turning to low-emission and emission-free sources of power.

Batteries have a range of advantages such as emission-free travel, accessibility, reductions in noise and vibration and

low cost. Batteries are an ideal power alternative for vessels travelling in coastal areas or manoeuvring in port. However, unlike the small batteries we use in our daily lives for everything from TV remotes to kitchen utilities, those needed to drive a ship have to be very large and capable of remaining in situ – and not simply taken in and out of a small battery compartment.

“The batteries used in shipping [must be] big enough to fill a large compartment, because ultimately the physical size of a battery directly relates to the power it can produce,” said Louise Dunsby, Electrotechnical Specialist in Lloyd's Register's Marine Technical Policy Group.

A variety of chemical processes are available for these batteries, the two most common being lead-acid and lithium-ion, with the latter type favoured for its energy intensity.

Early tests revealed that lead-acid batteries would have to be unfeasibly large to propel vessels because of the significant electrical load involved.

## LR battery guide

As a global technology leader, Lloyd's Register has been working with designers, owners and operators to find the most effective ways of applying battery technology to today's vessels. ▶

▶ The result of this work is a unique guide to battery technology called *Large battery installations*. The guide takes a risk-based approach to battery use – from the start of the battery's life, when its cells are being manufactured, to installation and the consequent effects on the vessel's power system.

The aim of the guide is to help ship designers and builders identify specific risks in the design of a battery-driven system as early as possible so that hazards can be mitigated early instead of reacting to them later. The guide advises owners and operators about the hazards associated with fitting batteries to vessels and summarises LR's non-prescriptive approach to approval.

The key factors that need to be considered are:

1. The positioning of the batteries on board the vessel
2. The impact of the battery system on nearby equipment
3. The need for temperature control of the space where the batteries are installed and prevention of overheating
4. Development of software for the battery system using robust and auditable processes;
5. Fire prevention
6. Protection of the batteries' electrical management system
7. Regular maintenance.

## Batteries at work

Currently, batteries are being used on vessels as auxiliary or short-term power sources, because they do not last long

enough to act as sole power sources. Ships that are driven by conventional power can switch to batteries as an alternative source.

As with electric cars, the use of batteries on vessels is limited because the units need charging after relatively short distances. On longer journeys, conventional power can be used to charge the batteries, allowing them to take over in specific situations such as travelling in coastal areas and manoeuvring in port. Vessels fitted with fully hybrid systems can select the most effective combination of power sources for the circumstances.

At the moment, the key challenge in developing new battery technology for vessels is that a battery's charging capability is linked to the rate at which it self-discharges. The faster a cell can be charged the more likely it is to discharge independently, creating heat, which is a potential fire risk.

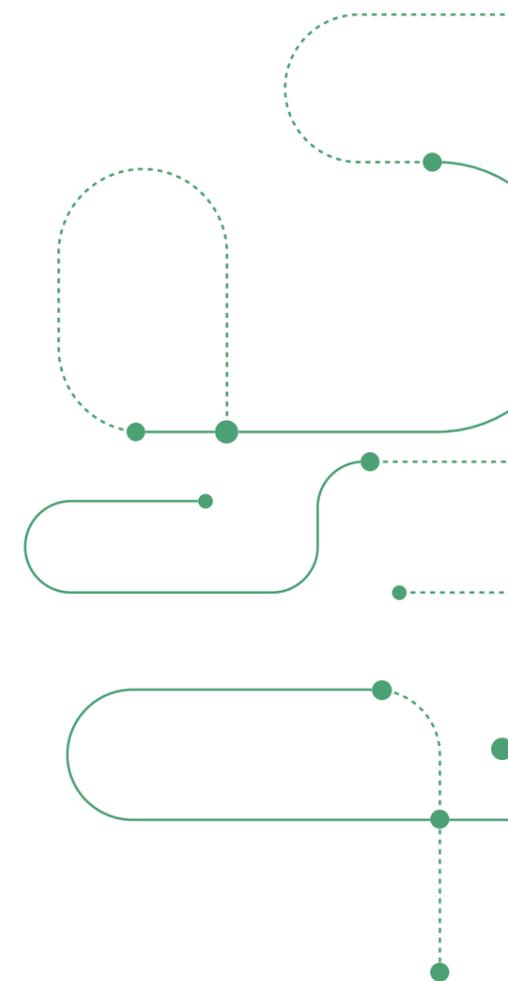
“We aim to help our clients establish a process for approving [battery] installations which will remain relevant regardless of the way battery technology evolves,” said Dunsby.

“If our research achieves a power-dense energy source, the scope of battery technology is revolutionary. Industry could be completely changed and the impact on the maritime sector could be immense. LR is poised and ready to play our part in these exciting developments,” she added.

Download your copy of the guide and watch a video about battery technology at: [www.lr.org/technologyreport](http://www.lr.org/technologyreport)

“We aim to help our clients establish a process for approving [battery] installations which will remain relevant regardless of the way battery technology evolves.”

LR's Louise Dunsby



## E-KOTUG RT *Adriaan*

The LR-classed E-KOTUG, *RT Adriaan*, is Europe's first hybrid tug. Launched in 2012, the 32m-long vessel is a member of the KOTUG fleet that operates in the Port of Rotterdam. The vessel has an AKA Canada-built system that can switch propulsion between diesel and electric power, creating 50% less harmful emissions, improved fuel economy and reduced CO<sub>2</sub>.

*RT Adriaan's* hybrid technology allows its main engines to be shut down while the vessel is in transit. For low-power operations, the vessel can run solely on battery power.

Continuing the development of *RT Adriaan*, KOTUG has this year launched two LR-classed hybrid rotortugs, *RT Evolution* and *RT Emotion*.



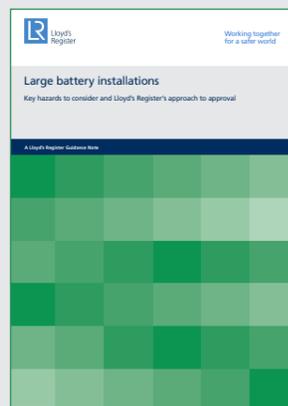
Europe's first hybrid tug, *RT Adriaan*



The LR-classed ferry, *MV Hallaig*, the world's first diesel-electric hybrid ferry

## Lloyd's Register battery projects

LR is involved in a wide range of projects that aim to make batteries efficient, stable and commercially viable. Our work in the laboratory – and increasingly on the water – is helping shipowners save fuel and increase efficiency, while reducing emissions. Battery installations give substantial reductions in noise and vibration compared with traditional fuel-based power systems.



## *MV Hallaig*

The world's first diesel-electric hybrid ferry, *MV Hallaig*, was launched in December 2012 and classed by Lloyd's Register. The vessel was developed under the Low Emission Ferries Project, which was funded by the Scottish government. It serves the Scottish island of Skye and is operated by Caledonian MacBrayne.

## TESO's *Texelstroom*

Lloyd's Register is to class a unique ro-pax ferry called *Texelstroom* which uses electric batteries along with several other energy sources to reduce her impact on the environment. The 135m-long *Texelstroom* will be powered by solar power, diesel and compressed natural gas (CNG) as well as batteries, thus giving her even more independence from conventional fuels and gases than dual-fuel hybrids.

The 1,750-passenger, 350-vehicle double-ended ferry is being built for her owner, TESO, at La Naval Shipyard in Bilbao, Spain, ready for delivery at the end of this year. She will operate between the Dutch island of Texel and Den Helder on the mainland.

The ferry's design was supported by the European Union's Transfer programme. She will be Ice Class with a strengthened hull to enable her to navigate in icy waters and will also have a PCAC (Passenger and Crew Accommodation Comfort) notation, ensuring a safe and comfortable journey for passengers and crew.



CGI of TESO's *Texelstroom* which is powered by batteries and several other sources of energy



*Svitzer Euro*, one of four LR-classed Svitzer ECOtugs

## *Svitzer Euro*

The building of four green ECOtugs powered by diesel-electric hybrid systems was recently completed for Copenhagen-based salvors Svitzer with the support of a team of LR technical specialists.

The eco-friendly tugs, which were built at ASL Marine's Singapore shipyard, are the world's first IMO Tier III-compliant tugs and are equipped with technology that reduces noise and light emissions. They started operating in June this year on the Gorgon LNG Project on Barrow Island, Western Australia, which is one of continent's most environmentally sensitive regions.

# Pioneering hybrid technology

LR is uniquely placed to help you find and implement the right technologies and designs for your ships, while ensuring they are safe and sustainable.

Our new guidance on batteries describes the key hazards to consider when installing battery technology, and gives an overview of our non-prescriptive approach to approval.

**Download your copy at**  
**[www.lr.org/battery](http://www.lr.org/battery)**

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



Lloyd's Register  
Marine

Working together  
for a safer world