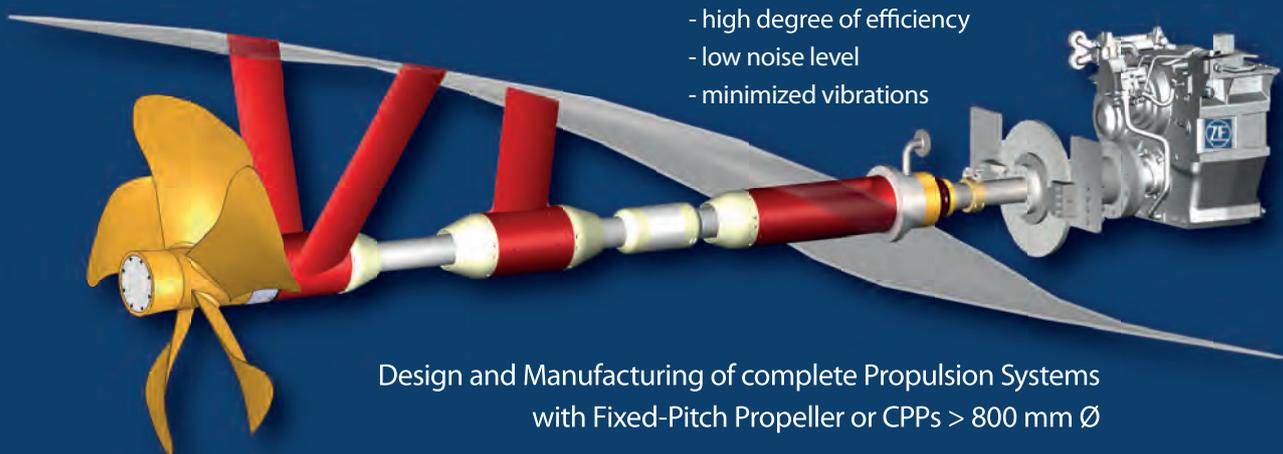




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February 2012

NUPAS

CADMATIC

3D Ship Design Software



Ship model courtesy of Wärtsilä Ship Design Norway AS



increases
ease of use and efficiency

Nupas-Cadmatic latest software version, V6, is an extremely powerful tool for ship design and engineering. The most eye catching feature of V6 is the introduction of a new user interface that will further ease work and bring new efficiencies throughout the ship design process.

The new user interface combines a modern Office 2007 look and feel with enhancements welcomed by both novice and experienced users. It will change the way the software is used and allow for faster and more efficient work. In V6 it is available in Plant Modeller with other modules to follow in due course.

The software's easy-to-use 3D modelling tools can be used for early and basic design, detailed engineering, and the production of workshop drawings and generation of ready-to-use production data for production machinery.

With Nupas-Cadmatic you can successfully carry out the entire ship design project, right from the early start, up to the detailed engineering and final production phase. It improves engineering quality and shortens design and construction times. Nupas-Cadmatic seamlessly distributes engineering projects globally between different sites while ensuring effective communication between project partners.

Version 6 highlights

New GUI For the first time in history an Office 2007 style User Interface has been applied to 3D software, making it easier and faster to learn than comparable systems. Nupas-Cadmatic's intuitive and efficient User Interface speeds up design projects. **Distributed design** Nupas-Cadmatic's CoDesigner technology is the most advanced and easiest tool to use for distributed projects. It does not require massive hardware or very fast internet connections.

Easy administration Administration of 3D software has never been so easy. Nupas-Cadmatic has the most modern tools for library and catalogue management. **Internet-based technology** Nupas-Cadmatic was the first developer to launch an Internet-based 3D model viewer and data query tool on the market in 2003. Today eBrowser is the most advanced software to visualize 3D models, to walk through, to query data and to communicate design details interactively with other users and project parties. The internet-based technology has unlimited scope for easy integrations.

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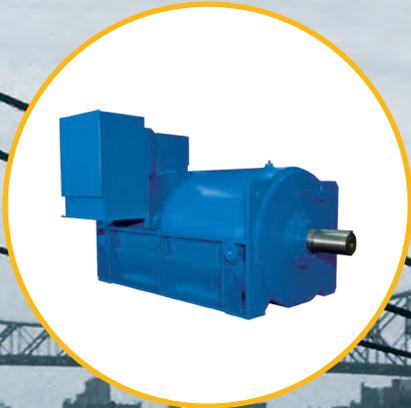
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Napa onboard aides cruise ships' steering.



Tom Boardley explains the future of LNG.

On-line Edition

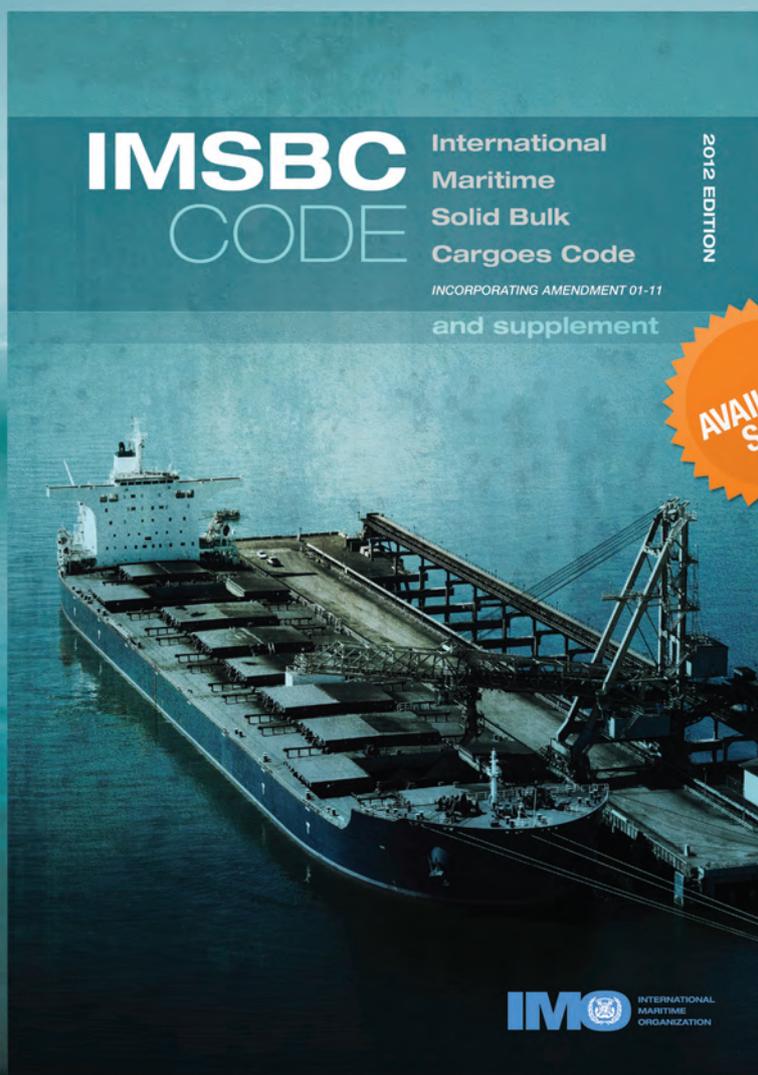
The Royal Institution of Naval Architects is proud to announce that as of January this year, *Shiprepair and Conversion Technology* journal has gone digital. We are very pleased to inform the maritime industry that each issue will be published online, on the RINA website. Visit www.rina.org.uk/srct and click on the issue cover you wish to view. This means that the entire publication, including all editorials and advertisements in the printed edition, can be seen in digital format and viewed by members, subscribers, and (for a limited time) any other interested individuals worldwide.



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Turning sea turtles

Ship operators must make the right choices for future fuel needs; failure to do so could see many in the industry turning turtle.

As far as reducing CO₂ and other greenhouse gases go the shipping industry has done an about turn as complete as any modern politician. Famously Margaret Thatcher told the world that “the lady’s not for turning”.

Notwithstanding the former Conservative parties leader’s statement, what is clear is that the maritime industry has performed a considerable *volte face* over greenhouse gas emissions, even if it is not perhaps away for all the right reasons.

A senior shipping executive remarked only a few years ago that he didn’t really believe in global warming. He went on to say that slow steaming would be a thing of the past once the recession is over in 2011. He was not alone, with many in the industry merely relying on the argument that shipping was the most efficient mode of commercial transport, emitting far less greenhouse gases per tonne of freight and per kilometre of transportation.

Wind on several years and the industry has found many new green converts, it is now fully recognised that CO₂ emissions from the shipping industry as a whole (some 3-4% of global emissions) are comparable to those of a major national economy. The shipping industry therefore accepts it must now play its part in further reducing CO₂ emissions.

One of the change that has occurred in the intervening years is that demand for vessels has collapsed, the capacity has increased significantly and there are more ships to be delivered and the price of oil

following the conflicts in the Middle East and North Africa has soared.

The effect of all this is that shipping lines, shipyards and owners have seen their profits eradicated and many are faced with bankruptcy. Hence the need to cut costs, and quickly or fail as a business. New regulations will pile further pressure on the industry requiring owners to limit emissions and burn cleaner fuel. All this has helped to conspired to turn a previously sceptical industry into soldiers for the environmentalists’ cause.

LNG has been touted as the possible saviour of an ailing shipping industry, at least in the short-term. Currently LNG is a fraction of the price of HFO and the fuel can be used in emission control areas because of the significant reductions in NO_x, SO_x and particulates.

Greenhouse gas emissions from LNG when burnt as a fuel are somewhere between 15 and 25% lower than diesel, but the need for far greater cuts in emissions than this means that LNG can never be the answer to the global warming element of the shipping industry’s needs. In fact by the industry’s own calculations the increase in shipping activity up to 2050 will be so great with the increase in prosperity for those in developing countries that a cut closer to 70% of 1990 emission levels is necessary to make a substantial dent in the greenhouse gas emissions from the industry globally. Furthermore, there is no guarantee that the LNG price will remain low once demand for the fuel increases.

In which case setting up a global infrastructure that will allow ocean-going vessels built at great expense to use a fuel for a limited period seems pointless. It is even more pointless if that fuel offers little in the way of decreasing greenhouse gas emissions. And according to some in the industry the case for LNG may be overstated by some. Bunkering of large quantities of the fuel is costly and slow. Costly because the boil off gas that is created in the process cannot be vented or flared so must be either burnt as a fuel, which may not be immediately possible or re-liquefied which increases costs to near current HFO levels. Ships will not be allowed to bunker in terminals which will further add to costs.

Additionally, the problem of methane slip where a greenhouse gas 21 times more potent than CO₂ is emitted from an LNG powered engine because it does not burn all the fuel efficiently, has not been solved for all the industry’s claims that it will find a solution.

Given the prognosis for LNG as a universal fuel and the significant difficulties in delivering a global bunkering system that is safe and sustainable in the long term is poor. Alty that to the profound crisis that many ship owners and yards have been plunged into as a result of the global economic crises of the past five years; then shipping’s epiphany as far as global warming goes, and the use of LNG as a fuel, could be less of a U-turn than turning turtle for many in the industry. *NA*

LNG Ferries

Fjord perfect

The steel hulls for Fjord Line's new cruise ferries are being built at the Stocznia Gdansk yard in Poland and when completed assembly, fitting and finishing work will be done at Fosen in Norway. The first ship *Stavangerfjord*, is due to be delivered in 2012 with an operational start date in October.

Ingvald Fardal, president and CEO of Norway's Fjord Line, said his company is planning a dual fuel LNG upgrade within a year of two newbuilds being delivered in late 2012. He told the recent Interferry conference in Barcelona that: "Where we operate is the strictest control area in the world and it's going to get even tighter. We know that switching from HFO to distillate is going to cost a lot of money and we are not attracted to the scrubber option, so LNG seems a very good alternative.

"But where can you fill your ship? There aren't many facilities in Europe today. And can you fill with passengers onboard? This is a crucial consideration and we need confirmation of indications that we will get approval."

Installation of LNG terminals in ports remains an issue in the development of LNG fuelled ships. However, converting the Fjord Line ferries to LNG is now under consideration in view of an EU project backing the use of natural gas as fuel for ships.

According to the line, "Even without LNG, Fjord Line's new cruise ferries will be equipped with fuel-efficient machinery in order to minimise emissions of harmful substances into the air and water. Through an agreement with Rolls-Royce Marine we have obtained access to an advanced propeller system that optimises the ships' propulsion with low fuel consumption and no loss of manoeuvrability".

Seismic Ships

Polarcus sprints through NSR

As the Northern Sea Route becomes a major option for ships transiting to Asia and the Pacific, Polarcus Limited's 3D SX134 seismic vessel *Polarcus Alima* completed a historic voyage from Hammerfest in Norway to Cape Denzhnev in the Bering Straits in nine days. According to the company, expected savings on routes between Norway and New Zealand using the route amount to eight days when compared to the Panama Canal and 13 days when using the Suez Canal route.

Due for delivery in the second quarter of 2012

Polarcus Adira, also built to the Ulstein 134 design by Ulstein Verft. Polarcus claims that the vessel will be the most "environmentally sound seismic vessel in the market with diesel electric propulsion, high specification catalytic converters, double hull and advanced ballast water treatment and bilge water cleaning systems."

Equipped with four 9L20 and two 9L26 main engines built by Wartsila, plus two 4400kW CP propellers, one Brunvoll 830kW tunnel thruster and one Brunvoll 1200kW bow thruster as well as a Brunvoll 850kW retractable azimuth thruster, the vessel has a maximum speed of 16knots.

One of the key elements of the design being highlighted by the company is the X-Bow hull design which Norway-based Ulstein says is characterised by a "novel hull shape with a redistributed foreship volume and substantially reduced flare".

Ulstein says that a sharper bow shape, coupled with a larger volume distribution in the foreship, overcomes the challenges presented by traditional bow shapes. The X-Bow design, a backward sloping bow which Ulstein says will allow the vessel to respond to large waves more efficiently, whereas a conventional forward sloping bow "pushes the waves down and forward" with a consequent absorption of energy slowing the vessel down.

Benefits of the bow configuration include, reduced power consumption, improved fuel efficiency, reduced emissions, elimination of slamming and bow impact, reduced vibration levels and increased comfort and improved safety for the crew, the company says.

Ice Class

Ulsteinvik to build OSV

With reductions in fuel consumption essential in a time of fuel price hikes and the demands of environmental legislation, the Kleven yard at Ulsteinvik has recently signed a contract with Myklebusthaug Offshore for a new multi-purpose offshore service vessel.

"We are delighted to establish a relationship with Myklebusthaug as a new customer, and proud of the fact that Myklebusthaug's new vessel will be the first to incorporate new, advanced technology," Ståle Rasmussen, Kleven Maritime's chief executive said on announcing the order. ABB's Onboard DC Grid system introduces a new way of distributing power to main components onboard, leading to significantly reduced fuel consumption.

The vessel is to be delivered in Q1 2013. Kleven Maritime now has an order book comprising 11 vessels with a total value of around NOK4 billion (US\$686.61 million).

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Marin Teknisk in Herøy has designed the vessel, a type MT 6015 multipurpose platform supply vessel. This will be the fourth vessel of this design to be built by Kleven Maritime.

At 5000dwt, the vessel is 93.8m in length, 20m across the beam and the deck area is in excess of 1100m². The vessel can accommodate 60 persons and will be built under the new SPS code with arrangements that makes the vessel highly suitable for ROV and construction projects. With ice-class DeIce and ICE 1B, the vessel will be well suited for operations in rough and cold areas in the north, and Stand by Class and is fitted with advanced oil recovery equipment.

LNG ships

Boxship designs push LNG power

Two leading yards have released new large LNG powered container ship designs with fuel tanks under the accommodation block in anticipation of a change in the IMO regulations.

Kawasaki Heavy Industries (KHI) and Daewoo Shipbuilding and Marine Engineering (DSME) of Japan and South Korea respectively have announced super-post panamax carriers both capable of using MDO and LNG as fuel.

DSME's vessel is a 14,000TEU container ship developed jointly with class society Bureau Veritas (BV) and French carrier CMA-CGM. KHI's design was jointly developed with Norwegian class society DNV, with both vessels powered by dual fuel units and the DSME design specifies the use of a MAN ME GI engine.

Both designs have placed LNG fuel tanks beneath the accommodation block even though the current debate at the IMO is around whether ships should be allowed to store gas fuel under living quarters.

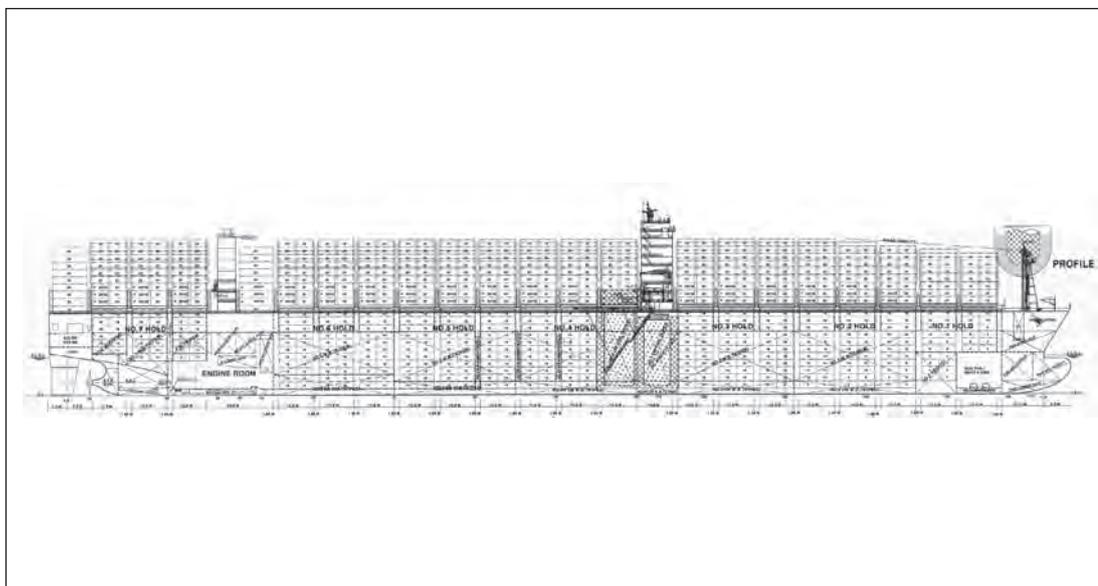
DNV COO Tor Svensen says: "It is important to understand the environmental imperatives that shipowners face, but it is also important to recognise that, in reality, the uptake of new technologies is a balance between risk and business need. Together, DNV and KHI have struck just the right balance with this vessel."

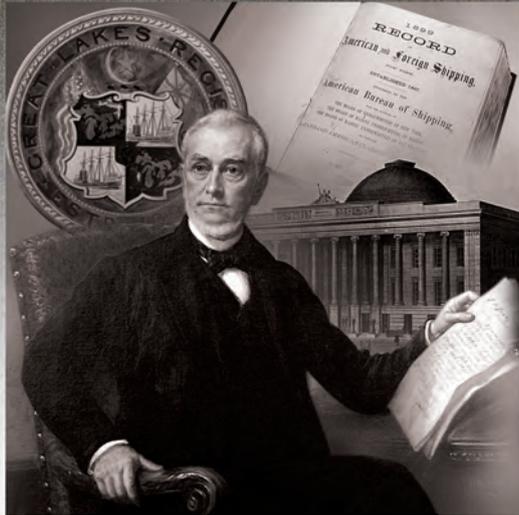
In addition Jean-Francois Segretain, BV's deputy technical director, says: "After an in depth HAZID analysis we can say with confidence that there are no technical or safety barriers to introducing LNG as a fuel for long-haul large containerships."

However, Andy Alderson, deputy MD at consultants Hart Fenton, argues that current regulations mean that gas carriers are not allowed to have accommodation above the cargo tanks. He says the argument at IMO BLG is currently that because the fuel is bunkers it is not cargo and the ships are not LNG carriers, "therefore IMO regulations do not apply".

In order to highlight the lack of consistency Alderson says; "An LNG Bunker vessel trading internationally with 500m³ of LNG onboard must comply with the IGC Code and for safety reasons it is not allowed to have accommodation, for around 12 crew, in the cargo area (area above the containment system). Once the 500m³ LNG passes the ship's rail it changes and becomes 'bunkers or fuel' and now it is acceptable to have it stored in a tank under accommodation with potentially hundreds if not thousands of passengers and crew." *The Naval Architect* February 2012 pp 18-22).

GA of DSME's LNG box ship design clearly displaying the LNG tanks below the accommodation block.





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FOUNDED 1862

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Grounding of Costa ship raises “serious” design questions

Costa Concordia’s grounding could forge a rethink on ship design, but that will depend entirely on what investigators uncover, *The Naval Architect* has learned, writes Julian McQueen.

The Royal Institution of Naval Architect’s technical director, Mark Staunton-Lambert, told *The Naval Architect* that the vessel’s stability performance as well as possible human error would be scrutinised by investigators.

Once the extent of the damage caused to the ship has been established, the key question to be asked will be: was the damage and subsequent flooding – within or beyond what the ship is designed to handle?

If flooding remained within these limits, then “some serious questions [on design] would need to be asked”, added Staunton-Lambert.

Knowing how many of the vessel’s watertight compartments were compromised would be critical in establishing the effect of water ingress into the ship’s hull and its operation.

After the collision, the ship moved away from the coastline only to turn back on itself before grounding on the rocks. “When a ship turns, there is always a heel. This may have had some effect,” noted the director.

The exposed gash in the side of the stricken ship can be seen in photographs. However, basing assumptions on its final resting position is unwise as “that could have been effected by the actual grounding,” suggested Staunton-Lambert.

Despite a torrent of press coverage on the accident, it is likely to be some time before the facts are known.

There are two investigations underway. An Italian judicial enquiry focused primarily on the actions of the ship’s captain, Francesco Schettino.

This is a criminal investigation, run by the state prosecutor’s office, into the conduct of the master although the investigation may be widened to include others. There could be a year’s wait before a first judgement is made.

The second investigation is under the Italian maritime administration, which has set the Italian Coastguard the job of carrying out a full inquiry into the incident. The administration has told the IMO that a preliminary report can be expected in time for the next meeting of the IMO’s Maritime Safety Committee, set for May this year.

In the meantime, the mainstream media has focused on the personality and actions of *Concordia*’s

master and the timing of his decision to abandon ship has been subject to much speculation.

Concordia was holed at 21.42. By 22.30, the captain sent a Mayday signal, leaving 48 minutes to elapse between the collision and distress call.

IMO rules detail the position for launching lifeboats from a sinking ship.

Regulation 13 under SOLAS III states that the “survival craft in the embarkation position is not less than 2m above the waterline with the ship in the fully loaded condition under unfavourable conditions of trim of up to 10degs and listed up to 20degs either way”.

According to British newspaper the *Daily Telegraph*, by the time of the Mayday signal, the ship was listing at 20degs.

The order to abandon ship was sounded at 22.58, some 30 minutes after the Mayday signal and taking the time from impact to around 80 minutes.

SOLAS rules (regulation 21) require half an hour to elapse from the abandon ship signal to enable lifecraft to launch.

“All survival craft... shall be capable of being launched with their full complement of persons and equipment within a period of 30 minutes from the time the abandon ship signal is given,” they state.

Had the order come sooner, and assuming the veracity of the timeline, a more orderly evacuation than the one that has been reported would have been possible. However, investigators will also look at the ship’s technical functions to determine how it performed with a punctured hull.

The possibility of a re-think of passenger ship safety regulations has also been raised. IMO secretary-general Koji Sekimizu has said the IMO should “seriously consider the lessons to be learnt and, if necessary, re-examine the regulations on the safety of large passenger ships in the light of the findings of the casualty investigation”.

The 2006-built cruise ship remains marooned on the rocks. It was carrying 4200 passengers and crew when it hit a granite rock outcrop off the Italian island of Giglio on 13 January sustaining a 50m gash below the watermark. Fifteen people are known to have died with a further 20 recorded as missing.

Dutch salvage firm Smit will begin to remove the ship’s bunkers, an operation that could take between four to six weeks. Captain Schettino remains under house arrest in Italy. **NA**

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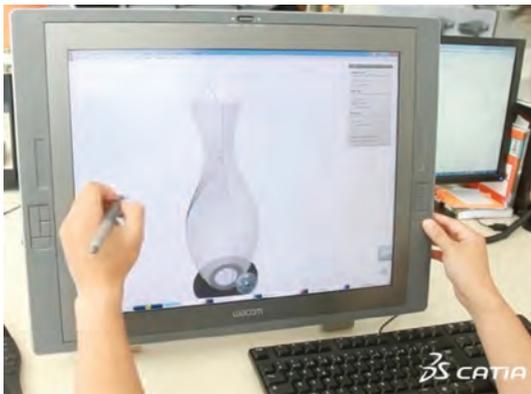
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CAD/CAM

3D Sketching from Dassault

Dassault Systèmes has announced the availability of CATIA Natural Sketch, a breakthrough 3D sketching experience that brings together the intuitiveness of creative 2D painting gestures and the power of accurate, realistic 3D modelling, by the use of freehand drawing.

Anne Asensio, VP, design experience, Dassault Systèmes said: "To turn dreams into reality we have successfully brought together forward-looking designers and Dassault Systèmes technology experts, resulting in registered patents and delivering this unique 3D sketching experience."



Dassault's latest sketch tool enhances designer's skills.

This lifelike creative experience helps designers to free up their creativity and share their ideas more rapidly and precisely. CATIA Natural Sketch eliminates workflow disruptions through the entire industrial design process. Sketching in 3D with the system enables designers to better understand their design in 3D, avoid misinterpretations of 2D views, and better communicate their ideas to 3D modellers the company claims. It also gives designers and design studio teams the ability to use 3D sketched curves to create a model with surface modelling or subdivision surface modeling tools within CATIA. By directly transforming a 2D sketch into a 3D digital product, inconsistencies between the design intent and reality can be avoided, resulting in dramatic improvements in design quality.

CATIA Natural Sketch completes the CATIA for Creative Designers solution, which combines 3D sketching, concept modelling, class-A surface modelling, rapid prototyping and visualization. CATIA for Creative Designers addresses the complete

industrial design workflow in a unified environment, from the initial idea and concept to refinement, design validation, and final production-ready 3D product.

www.3ds.com

Ancillary equipment

New respirator from ESAB

ESAB has launched its Aristo Air PAPR (Powered Air Purifying Respirator) system for operatives undertaking welding, gouging and grinding. Used in conjunction with the Aristo Tech welding helmet, the Aristo Air helps to protect welders from the hazards associated with welding fumes and dust; when used and maintained correctly, the pre-filter and P3 main filter, filter out 99.8% of fumes and dust claims ESAB.

The Aristo Air is designed to provide heavy-duty protection, but, the battery-powered system weighs 1kg and can, therefore, be used anywhere. Users can adjust the airflow rate from 170 to 210litres/minute and the rechargeable Li-ion battery pack provides up to eight hours' operation at the maximum flow.

Other features of the respirator include audible



Latest respirator from ESAB.

and visual alarms for 'blocked filter' and 'battery low', LED indicators for air flow and battery charge, and a wipe-clean membrane switch panel. To ensure that the system is comfortable to wear, the Aristo Air benefits from a wide waist belt and comfort pad.

Each unit is delivered ready to use, complete with an air hose and Proban hose cover, battery, intelligent charger and filter elements.

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CONTINUAL PROGRESSION

Communications

Seamless broadband from Iridium and KVH

Iridium Communications Inc. and KVH Industries, Inc., has announced an agreement to offer a fully global, seamless broadband satellite communications service for the maritime market. Under the agreement, KVH will offer an integrated service package that combines its mini-VSAT BroadbandSM service and the Iridium OpenPort broadband service. The combined offering will give the maritime industry the first seamless, global, broadband connectivity, helping mariners connect in ways never before thought possible.

The integrated shipboard system will use common below-deck user interface equipment for voice and data connections, combining the Iridium OpenPort and KVH TracPhone V3 or V7 terminals. KVH's CommBox shipboard network management tool automatically selects the mini-VSAT Broadband service or the Iridium OpenPort service using intelligent least-cost routing software. If mini-VSAT Broadband service is ever unavailable, the system immediately switches over to the Iridium OpenPort service without operator intervention. The Iridium OpenPort connection can also serve as a means to access the mini-VSAT Broadband terminal remotely as well as other shipboard maintenance and calibration equipment.

KVH's TracPhone V3 and V7 platforms offer download speeds of up to 2Mbps and clear voice connections through the world's smallest stabilised VSAT antenna. The company has noted that the integrated maritime service will be fully supported by Iridium's next-generation satellite constellation, which is scheduled to be deployed starting in early 2015.

www.iridium.com

Ancillary equipment

Saft powers hybrid river shuttles

Saft, the French-based designer, developer and manufacturer of high-technology batteries for industry, is supplying advanced lithium-ion (Li-ion) battery systems to provide quiet, efficient, low-emission power for two hybrid diesel-electric ferryboats that will operate a shuttle service across the Garonne river in Bordeaux.

Keolis, France's largest private sector transportation group, will launch the new hybrid ferry service in 2012 to help the Urban Community

of Bordeaux (CUB) move towards greener transportation methods that will enable the port city in southwest France to meet its stringent environmental targets. The river shuttle service is expected to carry around 200,000 passengers and their bicycles a year.

Each hybrid ferryboat will be equipped with a 140kWh Saft Li-ion battery system that will supply power both for its electric propulsion motor and auxiliary loads such as lighting and communications. The battery will work in conjunction with the boat's diesel engine, storing power produced by the generator as well as providing additional propulsion power when required.

The batteries will be charged overnight from the local grid and during the diesel propulsion phase. Their energy storage capability will provide the boats with six hours of autonomous, fully-electric operation during the two busiest periods of the day – three hours in the morning and three hours in the evening – helping to both reduce fuel costs and CO₂ and NOx emissions.

www.saftbatteries.com

Paints and coatings

International Yacht Paint adds to its range

International Yacht Paint has launched Micron WA, a premium antifouling range. Micron WA features Water Activated Matrix technology, which allows efficient use of lower copper levels, as well as efficient and effective biocide delivery and substantially reduced patina formation on the hull the company claims.

Water Activated Matrix technology offers multi-seasonal protection in all types of waters including high-challenge areas. It combines powerful performance with a very low volatile organic compound (VOC) levels.

Micron WA helps to deliver a smooth, clean hull for cost-effective operation for up to 24 months, dependent on total DFT (dry film thickness) applied. For 24 months' performance, a total dry film thickness of 120µm (microns) needs to be achieved. Extra coats are needed if vessels are expected to operate at speeds in excess of 15knots for extended periods. Extended in-service periods also mean that owners save money by the boat remaining in the water for longer.

Water Activated Matrix technology allows efficient use of lower copper levels than in most other premium antifoulings due to the copper release rate being optimised, as well as use of fewer non-renewable, oil-based resources, which

results in efficient and effective biocide delivery and substantially reduced patina formation on the hull. For owners who choose to remove patina before recoating, this means they save maintenance time and cost, ultimately allowing more time on the water.

The water based formulation means that Micron WA delivers low odour and fume emissions and helps to create a pleasant and safe environment during application.

www.akzonobel.com

Ancillary equipment

AMOT detects more

AMOT has announced that its latest Metal Particle Detector (MPD) alerts operators to perform oil condition checks to determine machinery health status. It is an online continuous wear debris monitor that signals the presence of metal particles in lubricating oils. Timely detection of metal particles ensures reliable machine conditions and maximises asset availability by avoiding unnecessary downtime.



AMOT launches new particle detector.

In addition, metal particle detection can verify filter system performance and failure, confirm system flushing, detect high corrosion and abrasion wear, identify improper machine repair, eliminate sampling errors and confirm corrective maintenance.

The MPD is a compact and robust metal particle detector. It has a corrosion-resistant stainless steel body with no moving parts. It is simply installed in a side stream of the lube oil/fluid for gas or diesel engines and reciprocating or rotating compressors, pumps, turbines, transmissions and gearboxes. Its unique grid-sensing patented technology detects all conductive materials, including non-magnetic particles, in non-conductive fluid lubrication systems.

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LNG's Bunker mentality

The Naval Architect continues its LNG series with two more points of view from industry leaders. Touted as the fuel of the future LNG has some way to go before it becomes the short-term answer as a comparatively clean ship fuel. *Andy Alderson*, deputy MD at Hart Fenton & Co consultants relates some hard facts about the critical factors and issues of LNG bunkering from a designer's point of view.

LNG bunkering has been successfully undertaken for a number of years in Norway for small ferries and offshore vessels. The quantity of LNG bunkered on each occasion is typically 30 - 200m³ and based upon 'Satellite LNG Terminals' technology such as that used in the road transport industry where it has also been very successful.

In the Norwegian example the individual vessel quantities are relatively small compared with the existing bunker fuel market; this makes it easier to develop the local infrastructure and commercial agreements required. When considering the expansion of the LNG bunker infrastructure to cover other commercial vessels such as container, bulk carrier and large passenger ships we need to consider the critical factors and issues of the bunker infrastructure to meet this demand. Failure to do this would likely result in LNG fuelling being seen as too difficult and relegate it to a fuel for small coastal ferries and ships.

There is a lot of discussion about and there are many safety aspects to consider with LNG Bunkering when scaled up, such as whether bunkering in conjunction with cargo operations is possible, bunkering with passengers onboard, which should be considered as uncontrolled potential sources of ignition. This paper does not address these issues, but does acknowledge that they exist and need to be resolved. However, until the practical bunkering process is resolved and we know the limitations, risks and equipment being used it is somewhat premature to go into details on the safety aspects.

This paper will consider whether the way forward is to 'scale up' the current practice for satellite LNG and road transport industry or 'scale down' the current practice of the marine LNG transportation industry

where LNG is transported, transferred at atmospheric pressure and -162°C.

Tank types & location

The first issue to consider when increasing the capacity of bunkers is how and where this will be stored onboard the LNG fuelled vessel. LNG has a lower energy density than existing liquid fuels and with LNG at -162°C you need approximately double the volume of LNG compared with the liquid fuel. This has an impact on the size and also location of LNG fuel tanks in order to obtain a similar vessel range and operating time.

Currently there are discussions within IMO BLG on the location of the fuel tanks. Commercially the ideal situation would be to replace the existing bunker tanks with LNG bunker tanks as this then does not impact on the commercial capacity of the vessel whether this is people, cars, or containers. However, in reality we must also consider the nature of the fuels or rather the differences between traditional liquid bunkers (HFO, MDO etc.) and LNG bunkers. Two of the differences are flashpoint and temperature. The SOLAS Convention requires liquid bunkers to have a flashpoint greater than 60°C and liquid bunkers are also not cryogenic. LNG on the other hand has a flashpoint of -188°C, is cryogenic and is generally carried at temperatures less than -120°C. These differences are the reason why SOLAS and the IGC Code (International Gas Carrier Code) prohibit LNG from being carried underneath accommodation and service spaces onboard LNG carriers. The IGC code applies to all internationally trading gas carriers with no lower limit on the quantity carried so an internationally trading LNG tanker of less than 500m³ would be prohibited from having accommodation situated above the cargo tanks.

The discussion currently taking place in the IMO BLG Correspondence group centres on the following argument; 'That because the LNG is bunkers not cargo, and the ships on which it is carried are not LNG carriers, then the existing IMO safety regulations do not apply and are not relevant.'

These IMO requirements prohibiting accommodation to be placed above tanks containing low flashpoint fuels were brought in over 30 years ago as a result of explosions under accommodation blocks. Is there a compelling need to reverse this IMO decision? If there is then the risk assessments put forward to justify allowing LNG fuel tanks under accommodation should be submitted to IMO for consideration for all vessel types including LNG carriers and SOLAS itself should be amended otherwise we are in danger of double standards within the industry.

In order to highlight the issue and the lack of consistency let's consider the following;

An LNG bunker vessel trading internationally with 500m³ of LNG on board must comply with the IGC Code and for safety reasons it is not allowed to have accommodation, for around 12 crew, in the cargo area (area above the containment system). Once the 500m³ LNG passes the ship's rail it changes and becomes 'bunkers or fuel' and now it is acceptable to have it stored in a tank under accommodation with potentially hundreds if not thousands of passengers and crew.

Can this logic be supported?

I would suggest that commercial implications regarding the issue of tank location is one that should be addressed by intelligent design of vessels rather than be the rewriting of rules which are based on existing established safe practice.

Vessel	Bunker Capacity	Range@ full power (-162°C)	Range@ full power (-126°C)	Difference
Small Ferry	50m ³	39 hours	34 hours	-5 hours
Offshore Vessel	1500m ³	236 hours	203 hours	-33 hours
Container Vessel	10,000m ³	793 hours	681 hours	-112 hours (4.5 days) (2000 nM)

Table 1: Range of vessels.

Energy density

The LNG industry trade is conducted in thermal units not in volume LNG and is priced in \$/mmbtu (million British thermal units) not \$/m³ as the bunker industry currently does. One of the reasons for transportation at atmospheric pressure and temperature is that the energy density is greater and the maximum mmbtu's can be carried per m³. This happens because the density of LNG changes with temperature; 423kg/m³ at -162°C as opposed to 363kg/m³ at -126. This difference in density is not an issue with relatively small quantities of LNG, however, as we look to increase volumes then there is a significant effect as we can see in the table 1. Another way to consider it would be in the case of a container ship carrying LNG at -126 °C which is the temperature, at 9bar would be required to have an LNG fuel capacity 16% greater than that required at -162°C to achieve the same range; in the container ship example in table 1 this would be the equivalent of losing 40TEU.

If we look to expand the capacity of LNG as a fuel, we already have a disadvantage due to its energy density when compared to liquid bunkers (HFO, MDO) if the LNG is loaded and carried under pressure this disadvantage is increased further.

It would be logical from the point of view of energy density for LNG to be carried as a fuel at atmospheric pressure in the same way LNG tankers do.

Boil off gas

On an LNG carrier the LNG is carried as a boiling cryogenic fluid; the easiest analogy is to boiling water. If we boil a pan of water when the water reaches 100°C it produces steam, if we continue to put more heat in the

water temperature doesn't increase but the amount of steam increases and the water level falls. If we seal the pan so that the steam cannot escape as we do with a pressure cooker when we heat the water it boils and the pressure inside increases until the safety valve releases the steam, the temperature of the water will be at a higher temperature dependent upon the pressure inside the cooker. For example if the pressure is 2bar then the corresponding water temperature is 120°C. Exactly the same thing happens with LNG only instead of 100°C the boiling point at atmospheric pressure is -162°C and at 2bar the boiling point is -152°C.

In order to load the LNG bunker tank to its maximum capacity in terms of energy, as we have seen, the way to achieve this is by ensuring that on completion of loading the bunkers are at atmospheric temperature and pressure.

The current practice of LNG-fuelled vessels is to have fuel tanks operating at around 7bar, which gives the correct pressure at the inlet to the engines without the need for mechanical pumps. The temperature of the LNG at this pressure is about -131°C in order to have the bunker tank at atmospheric pressure and temperature at the end of loading, and, therefore, the maximum energy onboard heat needs to be removed, from the tank and its LNG contents. Removing this heat generates boil off gas the quantity of the boil off gas depends upon the initial conditions of the tank (see table 2). It is possible when loading small quantities and at a slow rate for the pressure to be controlled by spraying, as is the practice in Norway, however when considering larger volumes and loading rates then this method of control becomes difficult.

Boil off gas is also produced during the transfer of LNG due to ingress of heat. Typically this is due to heat leaking in through poor insulation, or un-insulated pipes and valve, as well as heat from the transfer pumps.

The rate of boil off will be large to start with until the tank and its contents have cooled down and then steady out depending upon the heat leak in through pumps etc. The speed at which the tank and contents can be cooled depends upon the rate at which the boil off gas is removed.

The boil off gas can be managed in a number of ways, re-liquefied, used as fuel, flared or vented. Venting and flaring are not environmentally sound methods for dealing with the boil off gas. If the quantity of gas is low then it may be used as fuel, alternatively it could be re-liquefied however this requires a lot of energy. To give some perspective the only dedicated LNG ships today with re-liquefaction systems to manage boil off gas are the Qatar Gas Q-Max and Q-Flex vessels their capacity is 13m³/hr and this requires 10MW of power.

Displaced gas

In order to make LNG fuelling a practical alternative to liquid fuels then bunkering has to be achieved in a reasonable time and the rate of transfer needs to match that of traditional liquid fuels.

The transfer of LNG is a closed cycle and there must be no venting or discharge to the atmosphere as the greenhouse gas effect of 1kg of methane discharged to the atmosphere is the equivalent of 21kg of CO₂ being emitted. In a closed system when we have an empty tank if we fill it with LNG, unless we remove the same quantity of gas from the tank, then the pressure inside will increase. If we want to maintain the pressure at atmospheric then we need to take out at least the same volume of gas as the LNG we have put in as well as any boil off gas. When an LNG carrier is loaded then large gas return blowers are used to send the gas back to the terminal. If we consider small gas vessels normally carrying LPG these can load without a gas return line and instead the boil off and displaced gas is re-liquefied, the rate of loading is governed by the re-liquefying capacity.

Tank Size	60m ³	60m ³	1000m ³	1000m ³	1000m ³	1000m ³
Quantity in Tank at Start (Heel) (m ³)	6	6	100	100	100	100
Pressure (Bar)	9	9	9	9	Atms	Atms
Temperature (°C)	-126	-126	-126	-126	-162	-162
Loading Rate (m ³ /hr)	2	60	100	500	100	500
Loading Time (hrs)	30	1	10	2	10	2
Boil of Gas Generated (m ³)	3.25	2.97	53.8	51.69	1.4	1.46
Boil of Gas Generated (kg) @-162	2	1.8	33.2	31.9	0.865	0.9
Boil Off Gas as CO ₂ Equivalent (kg)	42	37.8	697	667	18	18.9
Average Boil Of Gas Rate (m ³ /hr)	0.1	2.97	5.4	25.8	0.14	0.73
Max BOR (m ³ /hr)	7	20	20	79	0.6	2.47
Min BOR (m ³ /hr)	1	2.5	2.5	11	0.06	0.4

Table 2: Boil off examples.

On an LNG carrier if we do not have a return gas blower then the gas will be returned by free flow and the loading rate restricted by the size and routing of any return piping. Currently all LNG bunkering in Norway is conducted either by free flow via a re-condenser to the storage facility or truck, or by allowing the tank pressure to increase during loading period and controlling the pressure by spraying LNG with the tank pressure at the end of loading around 3bar or more.

Custody transfer

If LNG bunkers are bought and sold in volume then depending upon the pressure and temperature that they are loaded at there can be a significant difference in the energy and, therefore, range of the vessel. For small vessels and in the Norwegian model this is not a problem as we have seen the range of small ferries is not affected significantly,

and the LNG is delivered in almost the same conditions as it is stored and used onboard, therefore, trading could in theory be undertaken in volume. When we consider increasing capacity then this becomes a problem as there can be a significant reduction in the energy depending upon the pressure and temperature.

For an LNG carrier there is a fairly sophisticated custody transfer procedure, the backbone of this being calibrated and certified measuring equipment which includes the certification of the tanks themselves. The

process at the start and finish of the transfer includes calculations to determine the quantity of energy (mmbtu) transferred. The basic formula is;

Energy transferred = energy of LNG from vessel – energy of return gas to vessel – energy of boil off gas used as fuel (see formula below).

When increasing the quantity of bunkers carried then we need to consider the following;

- When we consider the issue of custody transfer who will determine the quantity on delivered?
- Will the ship owner pay for the volume received or the energy received?
- Will the ship owner want credit for the gas returned?
- What if there is excess boil off and who will pay for its management (energy to reliquefy, CO₂ taxes if combusted/flared)?

Fuel quality

Weathering or ageing of LNG happens as a result of the lighter fractions of the LNG, methane and ethane evaporating (boil off). The main component of boil off gas is CH₄ methane as it has the lowest boiling point, at -162°C. When the methane boils off and is either transferred in the boil off or displaced gas during loading then the LNG left behind will have slightly different composition.

When considering LNG as a fuel this composition is extremely important as it directly impacts on the fuel's methane number (MN). The majority of gas burning engines state that the minimum MN of the gas should be 80; below this number the engine may suffer from knocking unless the engine is modified or de-rated.

Table 3 below shows the typical composition of methane from Algeria and the effect that changes in composition of LNG have on GCV (gross calorific value) and MN. The two changes considered are a reduction in methane by 1% with an increase in other combustible elements, and a reduction in

$$E = (V_{LNG} \times D_{LNG} \times GCV_{LNG}) - E_{GAS\ DISPLACED} - E_{GAS\ DISPLACED}$$

$$E_{GAS\ DISPLACED} = V_{LNGLOADED} \times \frac{273.15}{273.15 \times T_{BOG}} \times \frac{p_{TANK} - GCV_{GA}}{1.01325}$$



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	LNG from Algeria	Methane -1 %	Nitrogen +1 %
Methane	87.75	86.75	86.75
Ethane	8.36	8.86	8.36
Propane	2.11	2.61	2.11
Isobutane	0.30	0.30	0.30
n-butane	0.43	0.43	0.43
Isopentane	0.00	0.00	0.00
n-pentane	0.00	0.00	0.00
Nitrogen	1.06	1.06	2.06
Carbon Di-oxide	0.00	0.00	0.00
METHANE NUMBER	80.64	79.56	76.95
GCV (MJ/kg)	54.652	54.569	54.643
GCV (Btu)	51.800	51.721	51.791

Table 3: Effect of composition on MN.

methane by 1% with an increase in nitrogen by 1%.

As can be seen from the table, the change in methane content does not affect the energy content GCV of the LNG; however, it does have an impact on the MN of the LNG. We

can also see that if there is an increase in the nitrogen content of the LNG composition this has an even more significant impact on the MN of the LNG. As I have previously mentioned LNG is traded in energy content (\$/mmbtu), but the GCV value alone is not sufficient for a shipowner to be aware of the quality of the LNG fuel.

When loading LNG bunkers it is important for a shipowner to be aware of its quality, in particular MN and that of any mixture already existing in a fuel tank. It is not practical to take a sample and submit to LR FOBAS (Fuel Oil Bunker Analysis Service) or equivalent programme as you would with MDO/HFO, however it is possible to sample and test during the transfer process. Similarly if you have large quantities of LNG bunkers, for example in an ocean going vessel, the composition will change over time due to the boil off removed from the tank as part of the auto-refrigeration process. It will be important to know if the MN of the remaining LNG is still within an acceptable range.

Conclusion

In order for LNG as a fuel to become successful there are a number of issues that need to be considered;

- size and location of LNG fuel tanks
- storage conditions for LNG fuel tanks and transfer
- management of boil off gas
- custody transfer
- quality (GCV, MN, temperature).

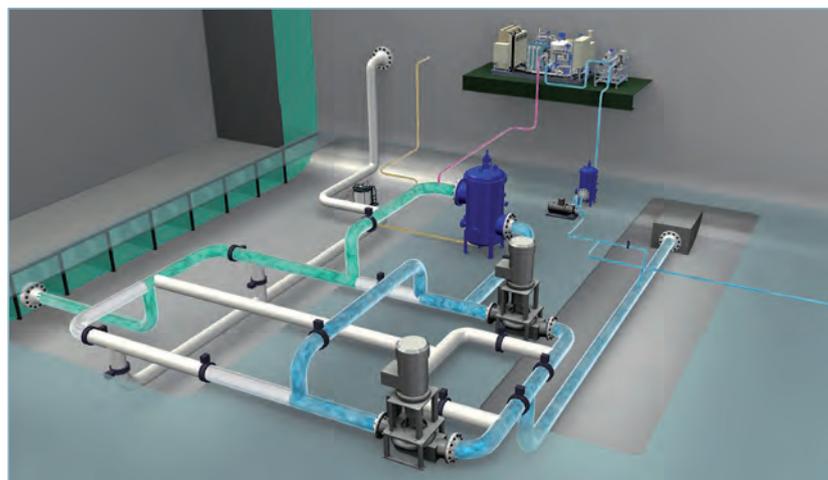
These issues will have a big impact on the structure of the future LNG fuel supply chain and in order to be successful will need to become part of some industry standard.

LNG is successfully being used as a fuel in small scale situations in Norway, but when we consider what is required when increasing the scale and the volumes there are doubts as to whether this model will continue to be fit for purpose.

If the industry uses the experience from LNG carriers and the international LNG industry a number of these problems can be overcome. In particular;

- if LNG is stored and transferred at atmospheric pressure and its corresponding temperature it addresses the issue of energy density by ensuring the maximum energy is carried in the volume available, thereby improving range and operability
- if LNG is stored and transferred at atmospheric pressure and its corresponding temperature then the cool down and boil off issues are minimised
- if gas handling equipment (gas blower) is utilised then bunker rates could be approaching conventional bunkering
- calculation of the energy quantity transferred is made simpler.

In conclusion the way forward for increasing LNG bunkering and capacity is to look to the experience of LNG carriers, terminals and operations and scale this down to meet the requirements and demands of the LNG bunkering industry. **NA**



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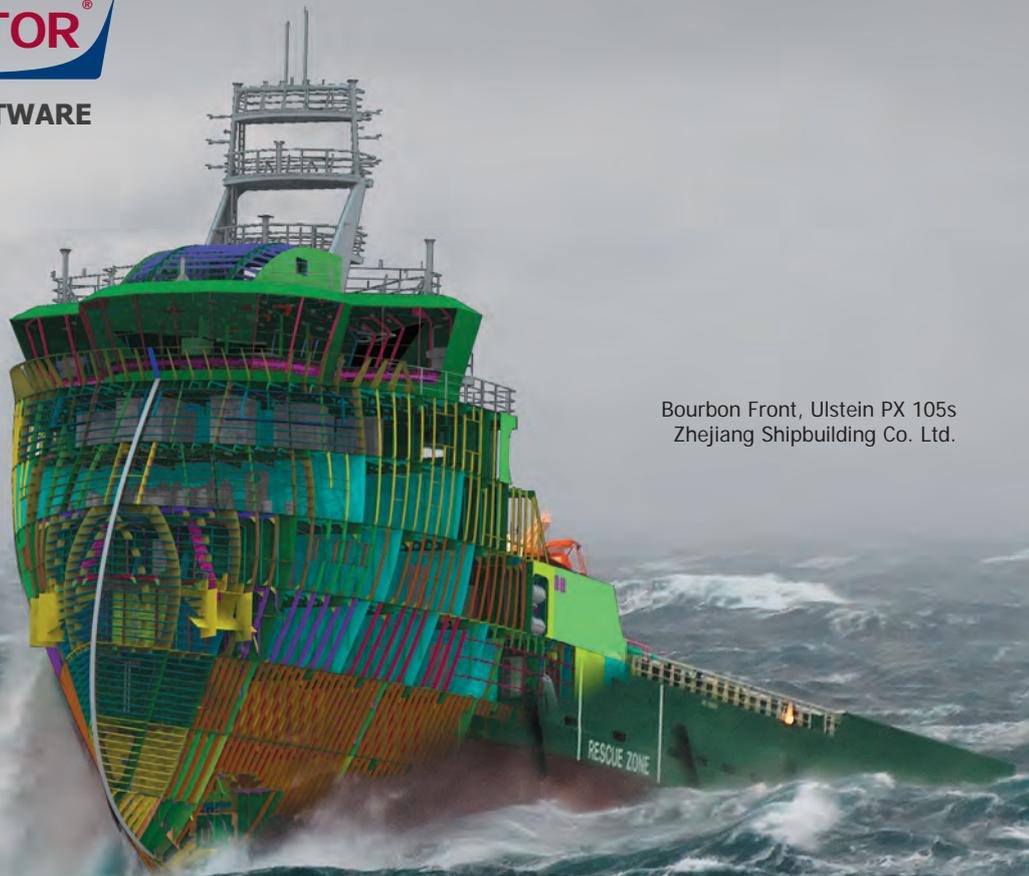


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Lloyd's Register puts the case for LNG

Is LNG the fuel of the future for shipping? Much has been said about the potential for the use of LNG as a marine fuel. *Tom Boardley*, marine director at Lloyd's Register (LR), offers the UK class society's views and sounds a note of caution.

LNG as a marine fuel is in use today and has been used for decades in LNG carriers. In many ways there is little new to understand about the technical feasibility of its use. LR has classed the greatest share of these ships and is currently involved with the largest newbuilding application to date – Viking Line's new cruise-ferry project at STX Finland.

We are very positive about the possibilities for LNG as a clean fuel. It is highly suitable for short sea applications and is an option in Emission Control Areas (ECA).

The question is whether and how to apply that understanding to broader application - beyond either small scale or specialist uses.

Whether LNG is to be either the best, the most practical and the global solution to our current and future challenges requires decision makers to be confident that it meets operational requirements – these requirements are commercial as well as technical.

Our role as a classification society is to help industry stakeholders understand technical issues so that they can make investment and operational decisions and to have the confidence that safety standards are either maintained or enhanced.

The primary technical case for LNG is that it is, compared to heavy fuel oil, a clean burning fossil fuel. The regulatory requirement to reduce SOx and NOx and particulate emissions can be met by using LNG as a marine fuel. Using 100% gas lean burn engines you would no longer see the black discharge as engines start up in harbour – although dual fuel engines would still use oil at low loads.

There are further technical benefits such as cleaner engines and engine room environment. In the event of a major casualty there would be no heavy oil in the water – although rapidly expanding



Tom Boardley looks at the pros and cons of LNG.

gas escaping from a compromised tank would pose other problems.

Another benefit of LNG is that in the context of Energy Efficiency Design Index (EEDI) on the basis of tank to flue onboard an EEDI ship, the use of LNG as a marine fuel could enable the requirements to be more easily met or exceeded.

Early application of LNG as a fuel has been mainly in Nordic countries, especially Norway, where there are strong drivers to use LNG in small, niche ferry or offshore markets. The local availability of gas and support, in Norway, by local incentive schemes is partly behind the enthusiasm. Establishing such use is relatively straightforward: bunkering is small scale, most routes are short and destinations are fixed, while LNG can easily be moved by road to where it might be needed.

The case for LNG as a marine fuel certainly requires much more caution where there are claims being made for its potential to reduce global greenhouse gas emissions from shipping and, to enable widespread global use, the fact that a bunkering infrastructure needs to be established.

Even before addressing the issue of methane slip (and methane is 20-25 times more GHG intensive than CO₂)

or management of boil off gas during bunkering and from onboard storage, anticipated growth in world seaborne trade by 2040/50 would see GHG emissions from shipping more than doubling if average growth rates from 1950 onwards are maintained.

And of course the whole LNG supply chain is energy intensive. Natural gas is liquefied by cooling it (compressing it to 1/600 of its original volume). It then must be kept liquid at -163°C and transported over, potentially, large distances. And then all that compressed energy is released, turning it back into gas ready for combustion. This energy cost needs to be measured and compared with existing and alternative sources of energy supply chains to establish relevant greenhouse gas emissions data.

If an absolute reduction in greenhouse gases from shipping becomes necessary, either through direct regulation, direct customer demands or financial pressure in market based measures, then we need to realise that - for all its local air quality benefits – LNG is just another fossil fuel.

If LNG is to be a globally available fuel for shipping then a global market for LNG and a bunker network will need to be developed. We are working to better understand the potential for such an infrastructure to emerge and have initiated an LNG Bunkering Infrastructure Study considering a global approach for deep-sea vessels' possible use of LNG.

We need to understand what will provide net global environmental benefits. This is all about what risks society wants to manage and how to balance environmental and commercial ambitions.

Our strategic research department and global technology leaders are exploring a broad range of alternatives in joint

research projects with the industry. Biofuels, methanol, fuel cells are all being examined and cannot be dismissed. The new focus on efficiency measures that we are seeing with recent deliveries such as Delphin's new 57,000dwt *Atuila* bulk carrier delivered in China last month will also reduce energy demand per tonne of

cargo transported whatever fuel is used.

Moreover, future patterns of consumption may have an impact on total energy requirements. What is beyond the remit of a classification society is attempting to predict future energy prices. But, ultimately, it is the relative price and performance of different fuels

that will drive decision making about future fuel choices. LNG is certainly one of the fuels of the future – and if LNG as a fuel is a potential option for a client we will help them understand and manage the technical risks, enabling them to make properly informed commercial and operational decisions. **NA**

Man traps

Enclosed spaces on ships have too often proved a danger to those working within them. Many operational difficulties may be partially to blame for these potential hazards, but Adam Allan and Captain Michael Lloyd argue that there are design issues here too that must be addressed.

It is now a matter of record that ships have more accidents and fatalities involving enclosed spaces than any other component of the marine sector. These accidents and subsequent fatalities are predominantly the result of people entering, working in or ironically attempting to rescue from these enclosed spaces.

This situation is now intolerable and concerted efforts to address the safety aspects of entry and rescue from these spaces are currently under way. The first step forward came with the identification and acceptance that a problem exists. Many reputable organisations have written about this situation and suggested potential solutions, but until legislation is enacted governing purposeful training and dedicated equipment, the problems and accidents will persist.

Culture, equipment, training and design are all contributing factors to accidents in enclosed spaces. Changing the culture of people within the marine industry toward the problems of enclosed space entry is a formidable undertaking. The more neglected aspect, and one which deserves more attention, is enclosed space design.

Accidents

It is regrettable that in any review of enclosed space incidents, the impact and effect that enclosed space design had on entry, work and rescue had not been considered. Our many years of experience operating in and rescuing from enclosed spaces, enables us to realise the importance



An example of a difficult access. As can be seen it is not possible to wear any type of BA set to enter this compartment.

of design safety and to suggest solutions to the marine industry where potential problems are identified.

In shore-based industries entry, work and rescue are major considerations in the design of any structures that contain enclosed spaces. It may come as a surprise to some, that the only regulation on tank design for ships is that regarding the manhole size on bulk carriers and tankers, which requires sizes of 800mm x 800mm for vertical and 800mm x 600mm for horizontal entries and these dimensions are specified with the sole intention of allowing a person wearing a

breathing apparatus (BA) set to enter them. It is strange that only these ships are singled out for even this very basic requirement as accidents and fatalities are shown to occur on all types of ship.

Design factors

Human activity within the space should always be the prime consideration and it must be seen as the starting point in the design cycle. Safety procedures, training and specialist equipment can be put in place when the ship is completed but the design of the spaces will determine the effectiveness of those measures.

The factors which may affect human survivability need to be considered and where possible, solutions established. Amongst these are:

- Adequacy and quality of respirable air and suitable lighting
- Ease of access into and out of the space

- Ease of movement within the space
- The ability to undertake rescue operations.

If, at the earliest stages of design, these factors could be assessed, and where possible, the space designed to

an established standard, then there are many improvements that can be made to present layouts.

Respirable air

The first and foremost requirement for any person entering an enclosed space is to be

Case Studies

Case 1

In the case of the *Viking Islay* and the tragic death of three crew members what was missed by the investigators in their conclusions was that of the contributory factor of 'tank design', especially the entry point was a factor in the ensuing tragedy.

The following is an extract of the report:

"During the consequent rescue efforts, the first rescuer found he was unable to enter the chain locker wearing a BA (breathing apparatus), and therefore donned an EEBD (emergency escape breathing device). He subsequently entered the space, but at some point the hood of the EEBD was removed, (or became dislodged) and this rating also collapsed".

Of course the rescuer should not have entered the tank with an EEBD, but it was the inability to get in with a BA that caused him to wear it.

Case 2

Extract of the investigation into the fatality on board *Saga Rose* which occurred in Southampton in September 2008.

"The rescue team entered the cofferdam wearing SCBA at 15.25hrs and assessed the second bosun to be deceased shortly before 16.00hrs. The limited room available, the possibility of contaminated air and low oxygen levels, and the high temperatures experienced, all hampered the removal of the second bosun from the tank which was not completed until 19.10hrs".

This prolonged and unacceptable rescue time was not suggested as the responsibility of the ship as the report goes on to say that;

"The ship's internal procedures worked very efficiently. The response team assembled in the purifier room within about three minutes, and the safety officer, staff & chief engineer were quick to enter the space with ample breathing apparatus."

Case 3

Apart from accidents due to lack of oxygen or the presence of dangerous gases there are numerous accidents in enclosed spaces due to falls.

The MAIB's accident database records 16 serious

injuries since 2005 occurring on board UK registered ships of 500 gross tonnes and over as a result of falls from fixed ladders, including those fitted in tanks, when the casualty was not wearing a safety harness or fall arrestor. It must be remembered that these accidents are only those investigated on UK registered ships. It can only be surmised that the total worldwide must be many times higher.

On 28 January 2009 the chief officer of the UK registered *Ville de Mars* entered a water ballast tank for inspection purposes. During his inspection he fell.

Extract taken from the report;

"Without an eye witness, it is not known exactly how or why the chief officer fell. Given the oxygen levels measured during his entry, and that none of the crew who rescued him from the tank wore BA, it is extremely unlikely that he lost consciousness through asphyxiation. It is also extremely unlikely that he fell through the access hole in the first stringer; otherwise he would have landed on the middle stringer where the ladder terminated. Also, had the chief officer fallen backwards from the ladder, he would probably have landed near the centreline, not on the port side of the tank. Therefore, as the chief officer stepped onto the stringer moments before he fell, it is almost certain that he fell off its un-guarded edge, possibly as a result of slipping on its sludgy coating while holding his torch in one hand and the gas analyser in the other.

On this occasion, the absence of lighting was significant. The chief officer was totally reliant on his torch, which was probably of limited use as he descended the ladder."

There are many more such cases each different in their own way, but all of them involving some aspect of failure of 'human' design in these spaces. Essentially, we need to recognise that, when designing any enclosed space on board a ship, consideration should always be given to the fact that people may require to enter these spaces and, in some instances, be rescued from them. Full accident investigation reports are available at the Marine Accident Investigation Branch website: www.maib.gov.uk

able to breathe freely and without hindrance. It follows, then, that the adequacy and quality of respirable air within the space is of utmost importance.

Prior to opening a possible hazardous space, consideration should be given to the previous contents which may have produced substances or gases that are hazardous. An obvious benefit would be to check the air quality prior to opening the space. This may be achieved by allowing samples of air to be drawn through sampling pipes fixed in place through bulkheads via an external valve arrangement. Internally, the open end of the sample pipe can be positioned to give the most effective representation of the inner space.

Regardless of this function being present operators should allow sufficient time for the space to be ventilated and to ensure that sufficient of oxygen is introduced into the space before entering.

This air may be introduced in one of two ways: natural ventilation, where a compartment has two or more access points, these need to be opened simultaneously in order to create a flow of air through the space; secondly mechanical ventilation using apparatus such as fans to either force air into or exhaust air out of a space. Whatever the system, entrances are opened simultaneously and the mechanical system introduced to the space. In both cases care should be taken to duct away air from the space if the presence of contaminants is suspected.

Lighting

The vast number of spaces entered will be without a natural light source meaning that some means of artificial lighting is required. On the majority of ships, crew members carry a torch into the space to illuminate the immediate work space. Often such lighting encumbers the users, or is not adequate to light up dangers within the space.

Whilst accepting that there are certain spaces in a ship, where for safety reasons, fixed lighting cannot be fitted, there are many spaces where fixed lighting could be installed. This would considerably improve the safety standards of those entering and working in the enclosed space.

There are two systems of internal lighting: fixed permanent and temporary lighting. Obviously, fixed permanent lighting is the



Manhole covers are often difficult to remove, heavy and the opening is too small to readily allow rescue equipment or a person wearing breathing apparatus to get through.

best and most suitable option, utilising fittings which are robust, waterproof and where required intrinsically safe. A second and more commonly used method of fixed lighting is 'string lights', frequently used when in port or dry dock; these low voltage lights may be installed throughout the space on a temporary basis and removed on completion of the work.

Access

Access into and out of enclosed spaces are a particular concern and, in the majority of cases, they are not designed with safety and rescue as the prime consideration.

The following are points to consider: due to the design of certain openings, it can be a

time consuming and labour intensive task to remove the nuts and open up the space.

These covers, normally being of heavy plate construction, have a notable lack of bespoke lifting handles, giving rise to the opportunity of nipped or fractured fingers or toes. During a temporary stoppage of work these covers are rarely replaced due to time constraints. At best the cover is placed across the manhole leaving gaps at each end. In heavy weather, these covers can slip away if not secured. This problem could be addressed by employing quick release mechanisms and built in lifting points, thereby saving time and increasing safety factors.

Of paramount importance is the physical size of the opening. It is essential that anyone going into an enclosed space must be capable of being rescued from that space.

Restrictive openings

Raised hatches on deck are designed to prevent open seas cascading into the enclosed space in heavy weather, but welded into the raised hatch are restrictive man holes which often limit the entrant's manoeuvrability when either entering or exiting the space. In many cases, there is little support for a person entering by such means, owing to the lack of hand holds either outside or inside the opening.

Handrails and hand holds should always be present at the point of entry and immediately

Another very small access within a tank, restricting movement inside.



inside in order to provide the entrant with additional support. All platforms inside a space should have guard rails.

Most vertical access points into tanks or compartments have permanently fixed ladders or foot holds to enable safe and easy entry. Positioning of the ladders needs to be immediately below or inset from the openings thereby not restricting the person when entering. On many ships these are bent, broken or corroded. As with all ladder systems these should be continually maintained. Another design improvement would see ladders constructed in short removable sections.

Permanent anchorage points are also essential and should be fitted above each vertical entry point where a temporary tripod or quad pod lifting system cannot be employed. They should be checked and load certified at the required intervals in conjunction with the winch system.

Ideally, these issues should have been picked up at the design stage and the problem engineered out. Unfortunately that is not always the case.

Ease of movement

Most commonly operators enter an enclosed space onboard ship in order to inspect or repair a system or component. Once inside the space the entrant can find it difficult to traverse due to the physical size of the space, awkward bulkheads, strengthening girders, pipes and lightning holes. Consideration should be given to the number of people having to enter the space, their physical and mental state and any additional equipment or tools which may be required to be taken in to do the work.

Other design factors to consider would be to install hand holds, safety rails and internal walking or working platforms to prevent people having to negotiate beams within the space. This would inevitably help to make the space safer for the entrant and reduce the possibility of accidents from slips, trips and falls.

Rescue operations

One of the major difficulties faced by rescuers attempting to rescue someone from an enclosed space is getting specialist equipment and trained personnel into the area.

In all enclosed space design, it must be anticipated that for the purpose of rescue a BA



This access is adequate but regrettably, the builders have put a cable run across the access.

set will be worn by the rescuers. It therefore follows that all access and entry points and indeed the areas within the space need to be able to accommodate the additional width of a person and breathing apparatus.

It is just as important that the area in front of and adjacent to the entry point is kept as clear as possible to enable an effective rescue to be carried out.

Existing legislation regarding minimum manhole sizes, only apply to tankers and bulk carriers, which in modern day shipping is totally inadequate and raises many safety concerns. Even in the absence of legislation it is difficult to understand how those involved with ship design have not concerned themselves previously with the problem of rescue.

Conclusion

The overall intention of this paper is to draw the industry's attention to the problems of entering and working in enclosed spaces caused by space design onboard a ship. Further, to discuss how these problems may be overcome or alleviated with consideration being given at the design stage or by assessment of an existing ship's spaces and modifications made when practicable.

One of the most important issues, certainly from our perspective, is that of rescuing someone should that be required. The current arrangements make it difficult to enter many

spaces wearing BA sets, surely a fundamental issue which requires immediate attention. If the entrance is too small to get in wearing a BA set, then we must question why personnel are required to enter these spaces.

Of considerable benefit is the ship's own assessment of its existing difficulties. It is surprising just how much can be done to improve the situation by ships staff with the welding of hand holds, extra steps and eyebolts. Even the use of luminous strips to mark low beams or steps in dark spaces can assist towards overall safety.

Of prime importance is the crew's knowledge of which spaces can be entered with the existing rescue BA sets and which cannot and whether rescue winches can be deployed at vertical entrances. This advance information can be lifesaving in any enclosed space emergency.

The present unacceptable casualty rate in these spaces cannot be tackled by resolving one part of the overall problem, but as efforts are continuing to deal with the culture, training and equipment issues, these should be matched by the realisation that enclosed space design must be recognised as an equal part of the problem and efforts made to deal with this situation.

Adam Allan, C.Mgr, MBA, MCMI Eng. Tech. Head of Marine Operations.

Captain Michael Lloyd, MNM, FNI. Marine Consultant. **NA**

Old technologies rediscovered

Sensors are an integral component of any measurement and automation application in the shipping and marine industry to ensure accuracy, reliability, efficiency and communications capability. Jesse Bonfeld, VP business development, Sherborne Sensors explains further.

More electronic systems are becoming automated in the marine industry which has fuelled research and development into the sensors industry and the continued innovation in sensors technology has ensured a thriving market and a growing demand for custom solutions.

According to analysts Frost & Sullivan, the sensors market in Europe is estimated to reach US\$19 billion by 2016, creating opportunities for technological advancements and ultimately new applications for sensors.

Shipping and marine companies continue to benefit from ongoing efforts to develop innovative, new sensor technologies needed to meet the ever expanding challenges of the industry. Ultra-reliability and long-life precision sensors such as inclinometers, accelerometers and load cells are common place in a number of marine and shipping applications. Load cells for example are used to convert a force into an electrical signal and offers measurement of tension, compression and shear forces.

The majority of today's designs use strain gauges as the sensing element and feature low deflection and high frequency response characteristics, which are especially beneficial for both materials testing and high-speed load measurement applications, particularly where peak forces are being monitored. In the marine industry they are often used for hoist loads, platform retention, towing forces and mooring loads and systems.

Many common trends can be seen across the sensor marketplace and application portfolio, including the use of wireless communications technologies, improvements in the ability of sensors to operate in extreme conditions (temperature, shock, pressure, Electromagnetic Fields (EMF), Radio Frequency (RF), radiation); bundling of capabilities to process multiple inputs and outputs on a single platform; and the development and use of novel materials

to enhance sensor performance, longevity and accuracy.

Over the last few years, however, the shipping and marine industry has been

under constant pressure to improve efficiency and reduce costs in the face of the worst global economic conditions in decades. Consequently, companies have a tremendous



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incentive to re-examine equipment and technologies that they already have at their disposal, and investigate ways to utilise these readily available resources to meet new application requirements. This approach, of re-examining existing patent portfolios and technologies as possible enablers or outright solutions to current and future technology development challenges is being used more and more and with significant success. Companies in the shipping and marine industry, and public entities responsible for operating and maintaining marine fleets are examining and recognising the value of existing, field proven technologies as at least a partial solution to reduced budgets, and an opportunity to cost effectively facilitate meeting near and mid-term revenue and profit goals.

There are several advantages to this approach. Existing technologies are already by and large developed, so available Internal Research and Development (IR&D) budgets can be better utilised to modify these technologies to meet specific application requirements. In many cases some level of field test data already exists, minimising the risk and cost of proving that the basic premise of the technology actually works. Further costs that validate the technology making certain it is robust enough in its basic format to be put into the field are already included. There may already be familiarity with the technology itself, or the concepts behind it,



Jesse Bonfeld, VP business development, Sherborne Sensors.

amongst the user and customer base, adding greatly to their comfort level in directing and committing funds to have it further developed and ultimately put in the field.

There are already several examples of inertial sensors supporting applications in the marine industry where field proven technologies are addressing new and more challenging applications. Inclinometers, sometimes also known as clinometers, monitor how much a vessel is pitching or rolling while both in still water and rough weather. If a ship lists excessively in an active wave environment then it could lead to a

ship capsizing. With the help of inclinometer technology that has been in existence for many years it becomes easier to determine whether the tilting of the ship is dangerous or within safe limits. The well understood accuracy, repeatability, and robust design of these existing sensors now allow owners and operators to further extend the ability to work at or near the limit of their equipment, maximising profitability, minimising downtime, and maintaining the highest possible productivity.

With depths of offshore oil wells now well beyond five miles, the attitude control of oil rigs and other offshore structures while being deployed is a very critical process, which becomes more challenging as exploration and production depths continue to increase. The levelling of these semi-submersible structures relies heavily on the tilt information obtained from existing precision inclinometer technologies, which ensure stability, control and accurate positioning with only minor modifications allowing them to operate in a very difficult and aggressive environment.

Another application for proven inclinometer technology is found in ballast transfer systems for offshore barges, ships and other marine applications. Here inclinometers check the load balancing of a vessel for both safety reasons and to ensure optimum trim, thus reducing drag and energy requirements, improving efficiency and profitability.

As the above examples demonstrate, trying to develop new technologies to address the most current application challenges is not always the most cost effective approach. Often, existing, field proven solutions can be translated to these applications, completely intact, or with only minor modifications. Given the current economic conditions, and global competitive environment, engineers and product managers in all industries, including marine, need to keep an open mind when contemplating novel sensor solutions to their most difficult applications. **NA**



The sensor has a bigger role to play in the maritime industry.

New regulations spur RCCL projects

In designing and building new vessels Royal Caribbean Cruise Lines (RCCL) has sought to set high targets for improved performance of its new vessels. The company's latest projects are no exception to that rule, reports Sandra Speares.

RCCL is always keen to innovate in shipbuilding and has two newbuilding concepts on the table – Project Sunshine, a contract that was signed last year with Meyer Werft, and a new TUI Cruises project with STX Finland.

According to Harri Kulovaara, vice president marine at Royal Caribbean, with the new design concepts 2011 was an extremely busy year. On top of this, the company completed refurbishment work on six of its vessels. And work on the “revitalisation” of the ships has amounted to US\$250 million.

The Project Sunshine order calls for one ship to be delivered in autumn 2014 with an option for a second ship by spring 2015. The 158,000gt newbuilds will carry just over 4100 guests based on double occupancy. The estimated all-in cost per berth is about €170,000 (US\$217,300). This all-in cost includes the yard's base contract price plus everything needed to design, operate and build the vessel. The TUI newbuild is for a 97,000dwt ship to be built at STX's Turku yard with an option for a further vessel.

In considering what is driving the design of the new vessels, Kulovaara points to new regulations like the safe return to port requirements. For the last 15 years, he says, Royal Caribbean has had a tradition of building split engine rooms for its ships, however, new rules have added an additional layer of complexity.

One key element which is constantly under consideration is how to improve the environmental friendliness of the company's vessels, he says. “The big driver on that side is energy efficiency.” With every new generation of ships, the company is looking to make improvements. With the Oasis class vessels the aim was to improve energy efficiency by 15-25% and that was achieved, says Kulovaara. With the Solstice class vessels a further 15-20% improvement was the target “and we've reached that”.

On both of the new projects very high

targets are projected compared to previous vessels operating on the same routes. This means a “constant focus on propulsion” and refinement of the design process so that ships are not only designed “for a defined condition, but for actual operation.”

These design concepts offer room for improvement, according to Kulovaara. The company is looking at new technologies, most notably to reduce friction because 80% of resistance of the ship is the friction between the water and the ship's hull.



Harri Kulovaara says that both of RCCL's new projects have been set very high targets.

In the past wave power played a greater role in the resistance equation, but now that bow designs have improved to reduce wave action on the hull, reducing resistance to about 20%.

Aside from new technology, one element to be considered in friction reduction, and which has been the subject of much research, is air lubrication. It is too early to say whether this will be successful, and Kulovaara acknowledges that “it has its challenges”. Having the smoothest possible hull surface is one way of reducing friction. Blasting air bubbles under the hull of the ship means that a layer of air can be created between the hull and the water, reducing drag. A key issue is to manage flows, and understand the bubble creation, Kulovaara says, and the means by which the effectiveness of air lubrication can be measured, not least by the use of modelling.

However, he believes that over time it will prove interesting and while still at an experimental stage could provide large improvements in energy saving. Royal Caribbean is considering it not only for new projects but as a retrofitting possibility.

As far as propulsion and hull forms are concerned, extensive use of computer fluid dynamic calculations is providing improvements, he says. Hull forms are so optimised that it is difficult to find any improvement “but there are still possibilities in the detail”.

Air conditioning is another area on cruise ships which has been receiving a good deal of attention. This is the second largest consumer of energy on the vessel and work has been continuing on optimising its use in the relevant operating conditions with a lot of concentration on the ducting design and pressures on the system as well as more intelligent, demand-based control systems which aim to optimise air volumes.

The third area that the company is looking at is galley operations. Energy consumption here is very high and accounts for about 25% of a ship's air conditioning requirements. This is because the air needs to be changed 60 times an hour. The system now operated by the company means that air is only changed when there is a high volume of demand, for example when chefs are at work, and there is also a higher level of technology deployed, for example in channelling air flow over food preparation areas, so as to catch steam and odours from the food. “Technology helps us to calculate the air flows better and concentrate the energy in the area where it is needed. We are looking for quite drastic improvements in galleys,” Kulovaara explains.

As far as emission controls are concerned there is a good deal of work going on at the moment on the technology, he says, although he feels it is “a little early to meet future requirements on Tier III”.

Scrubbing technology, he says, is still at the experimental level. “We have put tremendous emphasis on that in our work in order to

make sure that we have a possibility to verify and assess the designs.”

There are various tests going on round the world, but Kulovaara says he believes that while the technology has existed for a number of years, it poses particular challenges as far as the maritime application is concerned. Fitting the equipment in a small space, making sure that it is not impacting on engine performance and that it is integrated in a safe manner are just some of the issues to overcome. The hope is that Royal Caribbean will move forward with its use in 2012.

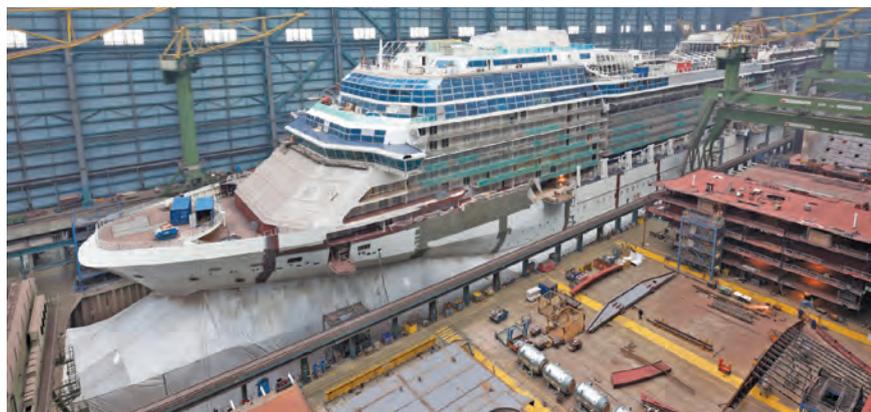
Royal Caribbean has been trialling the use of scrubbing systems and Kulovaara is certain that in the coming year, the company will be sufficiently confident to install a scrubbing system and start to make some of the investment necessary. The intention is to install the technology on the company's newbuildings and space and weight specifications have been taken into account.

Various tests have been going on with Singapore-based EcoSpec but there are no test results at this stage, Kulovaara says. The company is looking across a wide range of products as it has done in the past when considering other forms of technology such as advanced wastewater plant. The acid test is obviously whether technology will work in the marine environment.

Although ballast water management systems are perhaps less of an issue as far as cruise ships are concerned, they provide another good example of coming up with technologies that are fit for purpose for the marine industry, Kulovaara says, provided they can be produced in the necessary numbers.

Every major shipping company today is working on ballast water systems and has to deal not only with a shortage of suppliers, but with teething problems with the technology. The question is whether the technology is sustainable over time. The same issue has arisen with advanced wastewater management systems, Kulovaara adds. There are a large number of suppliers but “all of them have had large problems in meeting the operational criteria”.

“I hope that in the near future we can get together as an industry and find some vetting and verification programmes. How do we agree the standard at which these systems should be vetted and verified before they are released for installation?”



Celebrity Silhouette, the fourth Solstice class vessel in a series of five. The Solstice class ships are claimed to make 15-20% fuel savings on similarly sized vessels.

Kulovaara believes that as far as the industry overall is concerned, technology is becoming more complex and the industry is becoming more dependent on it. Suppliers of components are relatively limited in terms of production. At the early stage there is type approval but, he believes, that does not necessarily give the necessary comfort to the cruise line that they are fit for purpose.

He explains that a more systematic verification approach is now being demanded of his team.

Itineraries for Royal Caribbean's fleet have been changing, moving from the Caribbean to a more international approach. Most ships in the past were designed for Caribbean operations. According to Kulovaara, cruising is about finding a balance between the time spent on the ship and the time ashore and the speed profiles for the new itineraries are fairly similar to what has taken place in the past. “We have certain standard profiles we use”.

Another element of ship design that he highlights is what he describes as “industrialisation”, by which he means how good industry practices can be used to make the building and design process even more cost effective. This includes standardising components and an earlier advance design process which he says leads to production optimisation. He cites the car industry as an example of the industrialisation process, involving mass production.

The first stage is to come up with the design that you wish to accomplish and then have a review process in place to ensure that the design is cost effective and meets life cycle cost requirements. In the past cruise ship design was prototype driven. Now, he suggests

you design the vessel's concept, but leave much more time to optimise the way every component is used.

“We are putting much more emphasis for the conceptual design at a very, very early stage in order to give more time for detailed engineering, for industrialisation and for the review of life cycle costs”. He sees a big difference in the way ship design is being done as compared to 20 years ago. There is a tremendous opportunity to accomplish what has been done in the past, but more cost effectively.

There is a lot to be learned from the automobile industry, he believes. Ships are getting larger and consideration needs to be given to optimising the size of cabins and balcony design, for example.

Meyer Werft, says Kulovaara has taken these concepts far and he believes are the “efficiency leaders”. Now the optimal design is done at the earliest state. “Everything needs to come very early”, says Kulovaara that ultimately this will save money. There are systematic planning building blocks. Planning involves having milestones in development. “We have systemised the architectural design process to 125 points. This ensures that the design process is controlled and discipline is maintained. “People who are creative and innovative are not usually the most disciplined”. Royal Caribbean employs project managers to keep the project on track. He says he believes the interest is how many square metres are available per passenger in the ship. By making all the machinery spaces more compact, as well as ducting and waste areas, “you can get a much better space utilisation and you can offer what a guest wants.” **NA**

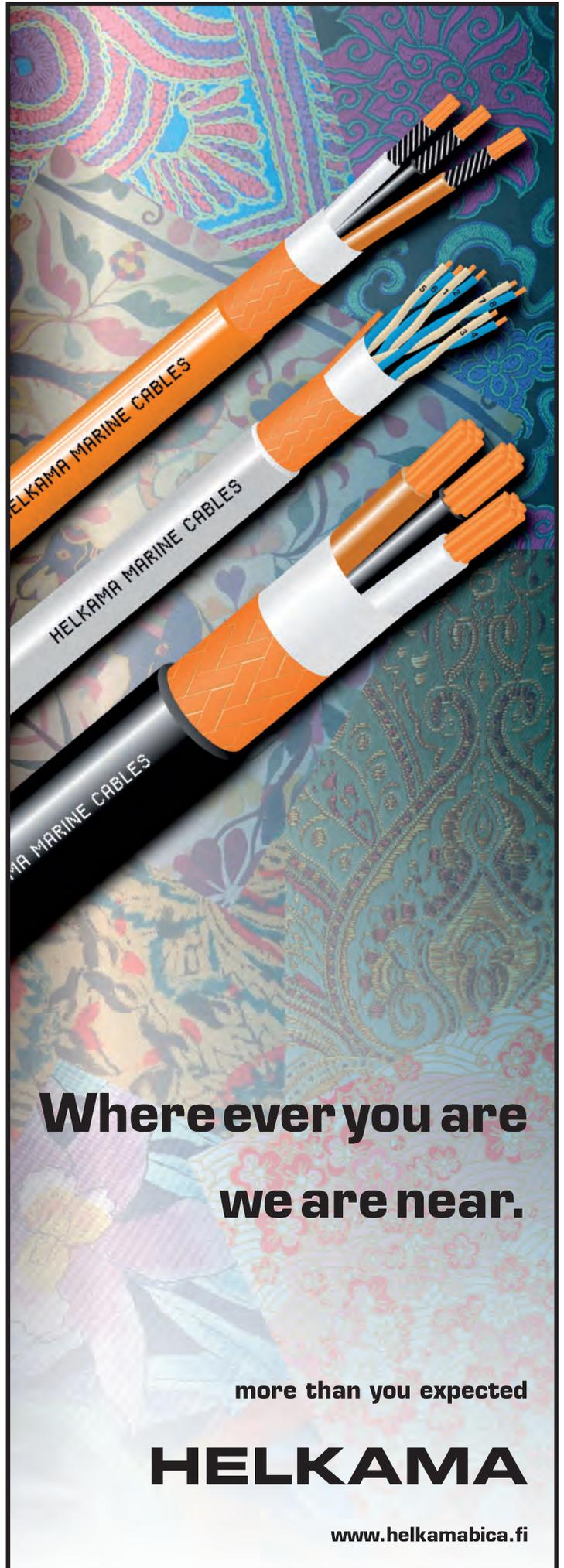


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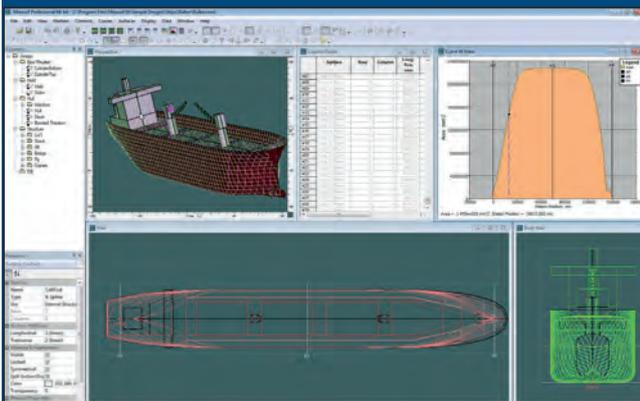
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Pre-voyage planning software cuts costs

Knud E. Hansen (KEH) USA has been awarded a contract to deliver computational fluid dynamics (CFD) analysis for trim management onboard Princess Cruises' Grand class vessels. Sandra Speares reports.

As part of an ongoing co-operation with Onboard NAPA, the company has provided CFD analysis covering a large range of trim, draught and speed conditions using the Onboard Napa Loading Computer-Optifloat Module.

Optifloat is a tool developed by Onboard NAPA, which provides the vessel's crew with a recommended optimal floating position for voyage planning. Optifloat references the vessel's current floating position, which is retrieved from the loading computer, and compares it with a speed and power dataset of various speed, trim and draught conditions that is loaded into the software prior to installation onboard.

According to the company, Optifloat can be used in pre-voyage planning to maximise fuel savings by reducing required power through properly planned operations onboard. The software instructs the vessel's crew to change the vessels trim and draught to floating position which shows the most favourable resistance based on the desired speed for a given voyage.

The technology can be retrofitted to existing vessels, explains Douglas Frongillo, general manager at KEH. "All we need is the underwater hull geometry. Depending on what is available for input we can do as little or as much as they want". There are, however, minimum data requirements to get "full functionality", he says. The larger gaps there are between loading conditions, the less functional it will be, he adds.

So is the system designed to deal with specific conditions or itineraries? Frongillo says that it is possible to map out a matrix on the assumption of the vessel's speed – say 14 -22knots – and taking into account constraints on vessel strength. Given the right data input, the computer will read the



Sun Princess, one of three Grand class vessels that has been trialling the CFD software. Photo courtesy of Princess Cruises

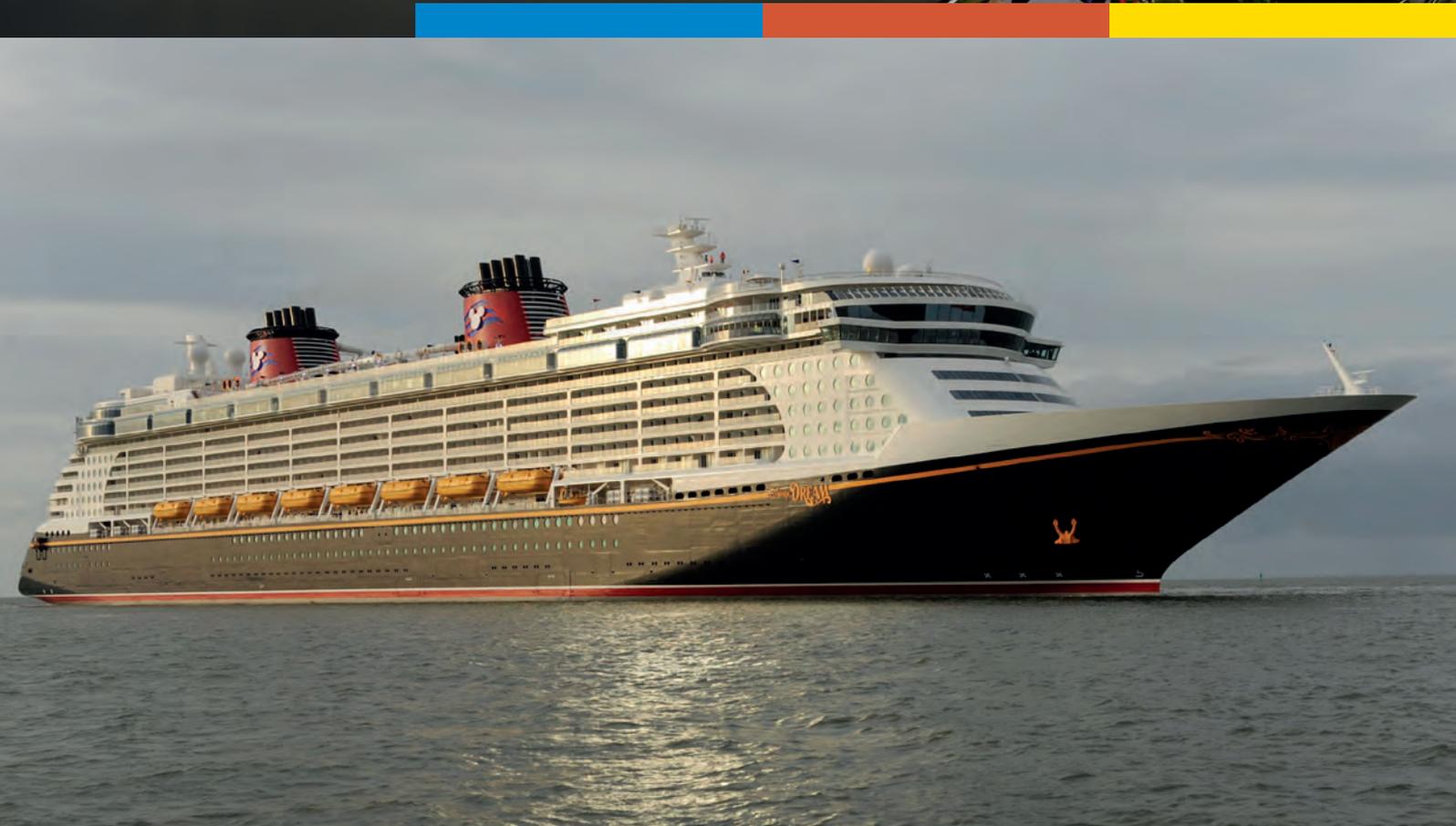
current loading position and calculate whether by adjusting ballast or draught at a given speed it will be possible to make fuel savings.

The level of savings that can be achieved is difficult to assess, according to Frongillo. For every vessel type there are definitely savings to be made through trim optimisation, but they will vary according to the loading conditions as "there is only so much you can do." Severe draught or trim changes could adversely affect the performance of the vessel. The system is adaptable to every vessel type, but offers more potential for those operating at a much wider draught range.

In terms of cruise ships, systems like this are useful as time and money are important and any percentage saving on fuel, be it half a percent or two percent is welcome. As far as cruise

companies are concerned "depending on where they are operating for the season, their voyage plans tend to be very similar." They will, he says, have the same ballast conditions, the same places where they bunker and take on consumables. The system, he says allows cruise companies to backtrack and not be so committed to shoreside logistics but look at how they can optimise their marine operations.

"One thing that is nice about this kind of loading computer is that if you find you have a very optimal loading condition you can plan your entire voyage to maintain that position if you want by how you burn fuel and how you ballast". The system will recommend a certain trim and draught and will also indicate whether, in accordance with IMO regulations, the ship is allowed to operate in that condition. **NA**



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Class can solve LNG fuel problems

Classification societies are convinced that the difficulties facing the cruise and ferry industry in using LNG as a fuel can be overcome. Though some concede that cruise ships have a tougher task than the ferry industry, writes Sandra Speares.

Using LNG as a fuel for passenger ships is currently a hot topic because the fuel is comparatively clean, eliminating SOx emissions and reducing NOx and CO₂ pollution by about 80% and 20% respectively and it is also cheap in comparison to today's oil prices.

So will we see a sudden swap to LNG fuel for passenger ships? According to Jean-Jacques Juenet, manager of passenger ships at Bureau Veritas (BV): "Definitely there is a market for LNG-fuelled ferries, and more designs are on the table. These vessels can operate on fixed routes and solving the LNG supply problem is relatively simple. For large cruise ships it is a different problem. They need to maintain global autonomy, and until there is a global LNG bunkering network we will not see big cruise ships fuelled exclusively by LNG. However, LNG as a fuel for passenger ships is a real possibility for both main propulsion and power generation when in ECAs and in port.

"Bureau Veritas is working on solutions for LNG use in passenger vessels. Engine makers have families of dual-fuel engines that can burn fuel or LNG and BV was the first to class dual fuel vessels and has both rules and experience in this field. The issues now to resolve are how to apply a technology which works on gas carriers to the more regulated

and sensitive area of passenger vessels."

At present, he explains, the SOLAS Convention does not authorise the use of low flash point fuel. IMO is working on development of a new code and has already issued interim guidelines but only a few national authorities have implemented them. So existing LNG projects are only those operating in national waters or between two countries applying these interim guidelines.

"A big issue for passenger ships that want to use LNG as a secondary fuel is finding sufficient space suitably located for the LNG storage. It may be above or below deck, in independent type B tanks for large capacity cold storage or type C pressurised tanks for limited capacity such as for short sea shipping. Location to guard against risks of collision and grounding and protection against LNG spillages is important," Juenet says.

Technical solutions to install gas fuel engines in passenger vessels are in place, but there are still issues, including regulatory ones, to address. Bureau Veritas has recently updated NR 529 'Safety of gas-fuelled ships' and is working together with shipyards, operators and engine manufacturers to use LNG fuelled solutions to deliver what passengers and owners want.

According to Thomas Hamann, appointed assessor and passenger ship expert at

Germanischer Lloyd (GL), LNG is definitely a promising option for cruise ships over the coming years, especially in areas which are currently, or will in the future be, marked as Emission Control Areas (ECAs). "In terms of onboard storage this is an area where there is a growing body of information on the use of LNG – in short sea shipping in Norway where a number of ferries have been operating using LNG, GL has also recently supervised the conversion of the *Bit Viking* product tanker to run on LNG.

"The technologies in terms of LNG tanks, engines are all relatively mature; the key question for the use of LNG in cruise ships will be in terms of the bunkering procedures that need to be in place, in terms of both safety and logistics. At present in Norway bunkering takes place at specially equipped terminals and the vessels are removed from service. Whether this is practicable for a cruise vessel where at any docking passengers are coming on and off the ship, with some electing to remain onboard, remains to be seen. As the infrastructure grows around providing LNG as ship fuel it will become clearer what the requirements are to provide safe and timely bunkering."

These issues will be worked out in the development of the international code covering gas fuelled ships (the IGF code),

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to which GL is contributing on behalf of the German government. As part of the Clean North Sea Shipping initiative GL is working with the Hamburg Port Authority to explore possible options for offering LNG as ship fuel at the port in Hamburg.

Crew training to ensure safe LNG bunkering is emphasised by Italian class society RINA as a challenge for passenger ships. Classification societies can make sure LNG bunker barges are built and equipped safely, but this is not enough and there also has to be the right safety culture in the barge crews, and more importantly, the crews of LNG-powered ships.

“That is something owners have to do,” says Andrea Cogliolo, head of the machinery sector, at RINA. “Bunkering gas requires a culture which is present on gas carriers, but which is not found on most other ship types. We will not see a lot of small onshore LNG terminals and ships queuing for fuelling. I expect the fuelling will be done by smaller LNG tankers, and that means ship-to-ship transfer of very cold LNG. At the moment, ship-to-ship LNG transfer is carried out only by experienced gas carrier crews. So we will need to see a big effort to train up the crews of other ships using gas as a fuel. The training will have to mirror that of gas carrier crews and focus strongly on ship-to-ship transfers.”

Cogliolo acknowledges the many advantages in the use of gas as a fuel in terms of reducing air emissions but says there is a cost in terms of new outfit, new design, operational flexibility and crew training. “All of these issues will be covered in the new IMO Code for Gas Fuelled Ships, but that is not going to be ready before 2014,” he explains.

“The starting point for the equivalency of safety is to recognise that a big quantity of energy is present in a gas containment system and it has to be protected from collision and grounding, mechanical impact and external fire. Gas has a very much lower flashpoint than marine fuel oils, and it is stored as a liquid at very low temperatures or as a gas at very high pressure. Swapping oil for gas is not a direct equivalent, and attention has to be paid to where it is stored, how it is distributed, and, above all, who is handling it and how they understand the new risks.” Tanks and gas piping must be located so as to minimise the risk of collision and mechanical damage.

Commenting on the use of air lubrication as a means of reducing friction between the water and the hull of the vessel, Hamann said: “Air lubrication is at a fairly preliminary stage in terms of passenger vessels, with research ongoing before we see any widespread deployment of this technology, although the potential for fuel efficiency is certainly significant. In terms of stability and loading, under GL’s rules the primary concern is in the event that such systems fail that the vessel must be able to fulfil minimum safety requirements. As such under GL’s rules, in terms of the assessment of loadline or stability, any potential contribution from air lubrication systems is not factored into these calculations.”

So what does Hamann think of the use of scrubbing technology? “As we all know reductions in allowable sulphur emissions are coming sooner rather than later and there are only a certain number of options that the industry has to deal with this – either running on low sulphur fuel (which will represent a

significant increase in operational costs), switching to LNG (either pure LNG or dual fuel which has the highest initial investment costs of these three solutions), or installing scrubbers. Retrofitting scrubbers on existing vessels is less expensive than installing LNG – recent GL cost estimates for a typical vessel operating in an ECA suggest that installing scrubbers requires only half the investment of a LNG system – and technically is certainly possible.”

Is detailed design of new ships being pushed forward in the production process? Hamann says: “One significant factor in the examination of detailed design drawings by class early in the development process are the new Safe Return to Port Regulations. The impact of these in terms of examining a large number of systems in an integrated and co-ordinated manner means that the interaction between client and the classification team occurs at an earlier stage of the development process as each of the various requirements has flow on effects for other parts of the ship.

“In terms of the future design of cruise ships the continuing trend of expanding and improving the view from a cruise vessel through the increased use of extensive areas of glass, and the size of viewing areas is one where GL is continually adapting. This requires a continuing evaluation of the strength and weight of the material used as well as the interactions between these glass sections and other materials in the vessel, in particular the connections between them, across the range of its operating condition”. *NA*



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Rising incomes a threat to Indian yards

India's yards have hit several snags simultaneously; not least of these is the effect of the global economic crisis on domestic orders, inflated wage demands and a desperate need for yard investment, reports *Gavin van Marle*.

India's shipbuilding interests face an uncertain future through a combination of factors, the most obvious of which is the continuing economic difficulties facing the global shipping industry – itself suffering from weak cargo volumes and an even weaker freight rate environment caused by considerable overcapacity.

However, India's shipbuilders face other problems – the country's exceptionally strong recent economic growth has been accompanied by an equally strong rate of inflation, which has in turn forced up wage levels and hindered what was one of India's advantages.

India's largest ship owner is not immune from the downturn in shipping, while is a chronic need for Indian yards to invest in capacity to be able to build larger and more technologically advanced vessels.

However, the country's Maritime Agenda launched last year at least indicates that the government recognises that strengthening its shipbuilding industry is a strategic ambition for the country as a whole.

The economic backdrop has also affected investors' appetites for India's shipbuilding sector, and the country's leading ship owner, the partially state-owned Shipping Corporation of India, has signalled its intention to invest in the country's shipbuilders. At a press conference in Mumbai in December, chairman and managing director Subyasachi Hajara said that the pressure on its core shipping markets meant it has suspended talks with the country's major private shipyards. It had issued expressions of interest documents – as a majority state-owned company any investment it makes has to be done through public tender – for shipyards interested in having it as an equity investor, but these have now lapsed as it has had to turn its attention to its core businesses. It suffered its first ever quarterly loss between April and September, finding itself some Rs1.4 billion (US\$30 million) in the red.



Subyasachi Hajara, chairman and managing director SCI puts plans on hold.

The shipping recession has also meant that SCI has been forced to slow down its own fleet expansion programme, as confirmed by shipping minister K Vasan to the India parliament in December, who revealed that while under the National Maritime Development Plan, SCI was expected to place orders for a total of 76 vessels between 2008 and 2012, but is now expected to fall 14 short of that figure.

However, the country also has its attractions for foreign shipbuilders, evidenced by the joint-venture agreement signed at the end of December between Japanese shipbuilder Mitsubishi Heavy Industries and the shipbuilding arm of India's largest engineering and construction conglomerate, Larsen & Toubro.

In a statement, MHI said that underpinning the deal was the support it would provide for Larsen & Toubro Ship Building (LTSB) in its quest to build more technically advanced vessels. "The two companies will signed the technical collaboration agreement [in January]. MHI has recently been proactively promoting development of its engineering business, centring on technology licensing, while LTSB has been seeking to strengthen

its shipbuilding business through the introduction of technology from a leader in the field. In reaching the latest agreement, under which MHI will provide licensing and technology support, including training of LTSB engineers, the intentions of the two companies have thus converged."

The three-year deal will see LTSB engineers sent to MHI's facilities in Nagasaki and Shimonoseki for training, while MHI experts in design, construction and quality control will go to LTSB's yard in Hazira, and the facility under construction at Kattupalli, outside of Chennai.

It will also see the two companies jointly market vessels built at LTSB's facilities, but under the supervision of MHI and with some of its technical knowledge, while MHI will offer consulting services to the further expansion of LTSB's facilities.

While the deal provides MHI with a bridgehead to embark on an international expansion programme focused exclusively on emerging markets, it gives LTSB immediate access to some of the world's most advanced shipbuilding technologies that could have been prohibitively expensive to procure, an ambition that the Indian Ministry of Shipping revealed as a priority in its 2010-2020 Maritime Agenda.

It was also made clear in the 450-page document that there are three other gaps that India must bridge if it is to develop into a world class shipbuilding location: a shortage naval architectural skills; a manufacturing gap that has opened between India, China and South Korea which the government is could be rectified by the reintroduction of a previous subsidy scheme; and the gap in resources created by the fact that Indian steel producers do not produce the type of steel specific to building ships, blamed on a VAT tariff scheme.

Subsidies to yards building ocean-going wet and dry cargo ships ended in August 2007, and shipping minister K Vasan described Indian shipyards as "languishing for want of new orders" since.

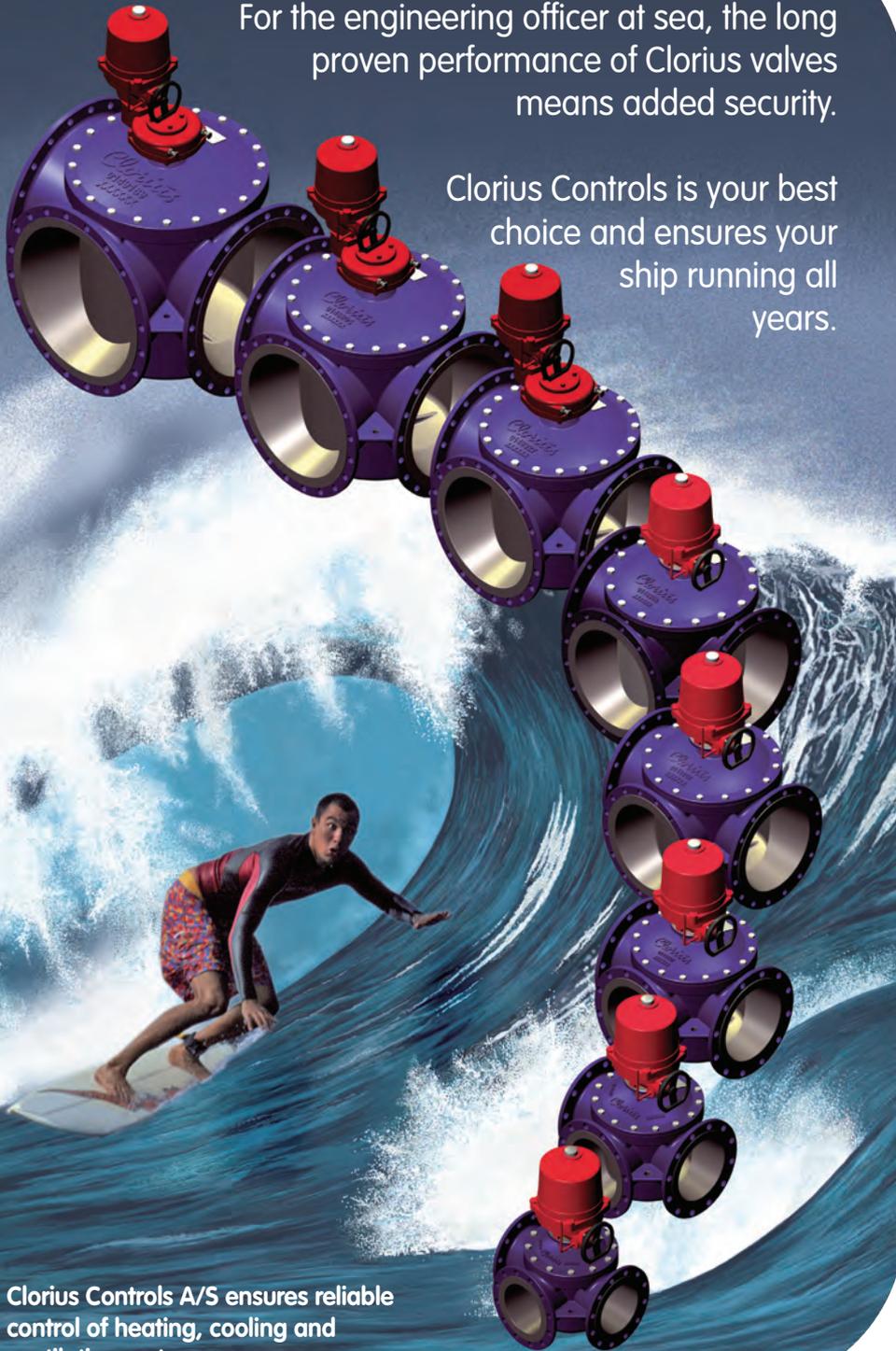
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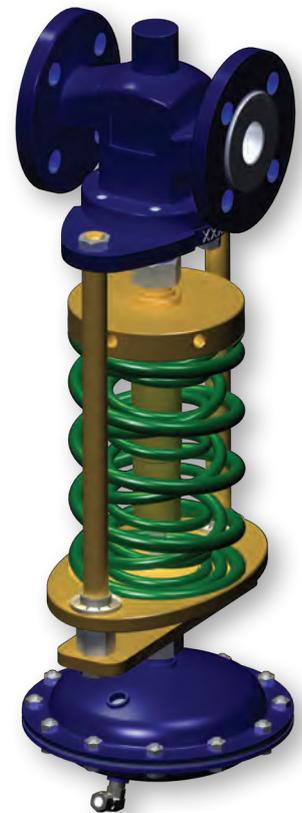
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“Indian yards could book very few orders either for export or domestic shipping lines as foreign yards, especially the Chinese yards have been outbidding them fairly consistently.” He added, saying that the momentum built up under the subsidy scheme – which saw the government undertake 30% of construction costs for international and domestic ships – had been lost. This will be of particular concern given that the government’s stated ambition is for India to achieve a 5% market share of global shipbuilding by 2020 – in 2002 its share was just 0.1%, which had risen to 1.3% by the end of the subsidy scheme, and India subsequently won just 0.02% and 0.13% of new orders placed in 2009 and 2010 respectively, according to Clarkson’s data.

The agenda clearly states that the country will have to reintroduce some sort of subsidy especially as Chinese and Korean competitors receive state support, as well as an incentive scheme to get more Indian ship owners to order new vessels domestically. However, there will also need to be continued investment in

the country’s yards, a brave move given the current economic malaise.

Nonetheless, the country’s largest privately-owned shipbuilder, Bharati Shipyards agreed at the end of 2011 to undertake a debt restructuring programme that will allow it to complete the construction of two new facilities, despite continuing fears of a recession.

The new funds will help it complete construction of new yards at Mangalore and Dabhol. The former is located 7.5km south of New Mangalore Port, where onshore shipyard facilities are being developed across 11.45hectares of land belonging to the port, and it has already commenced production of a 2900dwt platform supply vessel for MAN Ferrostal of Germany. Future plans will see capacity increased to be able to it build vessels of up to 100,000dwt within a decade.

At Dabhol, the greenfield site stretches across 121.4hectares and includes one of the largest floating docks in India. It too will be able to build vessels up to 100,000dwt, as well as jack-up rigs and offshore vessels.

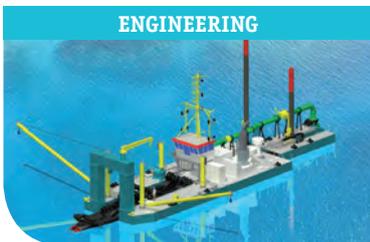
The largest capacity yard in India is currently the state-owned Cochin Shipyards, which can build up to 110,000dwt, and it is also considering expanding beyond its two drydocks, one of which is being used to construct the Indian Navy’s new aircraft carrier.

Further, the government has also outlined plans to build a new greenfield drydock elsewhere in Kerala state, with capacity to build 200,000dwt vessels, although it says it would probably need to partially float Cochin Shipyards on the Bombay Stock Exchange to finance a project

And therein lies a key feature of India shipyard development – despite the slowdown in commercial vessel orders, there has been a large increase in naval vessel orders from the Indian Navy and the country’s Coast Guard, which have a combined investment plan of almost US\$10 billion over the next 10 to 15 years as part of efforts to beef up security along the country’s 7500km. **NA**



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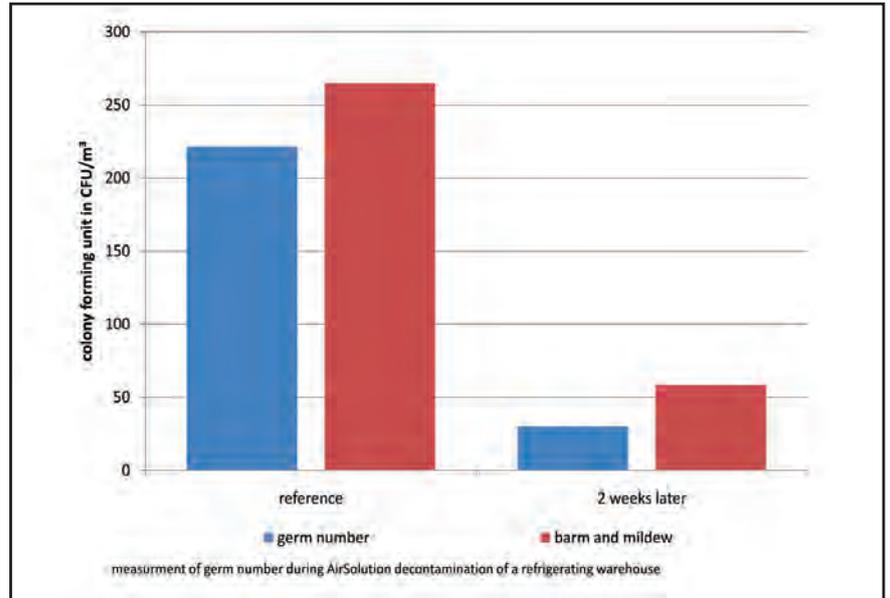
Imtech has launched its latest ventilation product that it says improves the air quality onboard cruise ships.

Imtech's new air solution was launched in 2011 under a project called "Hygiene Inspection and Maintenance for Ventilation and Air Conditioning Systems on Ships according to VDI 6022", which also covers all activities for improving room air hygiene during the complete life-cycle of a ship. Imtech worked in partnership with the Air Solution Group, which developed the active agent L.O.G. 4.

Stefan Schleper, head of standards & logistics, Imtech said: "There are several reasons for implementing a Hygiene Management System. First of all the BG Verkehr [the Institute of Occupational Safety and Health of the German Social Accident Insurance] investigated hygiene room air conditions on seagoing ships. They found that nearly 50% of illnesses onboard navy and passenger ships are caused by a lack of maintenance in air conditioning systems.

"The impact of dirty duct and ventilation components on the performance of the complete system is well known: the air conditioning system works inefficiently and bacteria are spread all over the vessel through the supply ducts and diffusers," says Schleper.

He added that the amount of recirculated air has been increased over time for energy saving reasons. Because of this, the air needs to be treated in the same way as fresh air to



Before and after using Air Solution.

ensure that the same hygienic measures, by the use of filters and biological air treatment, will separate dust and kill bacteria.

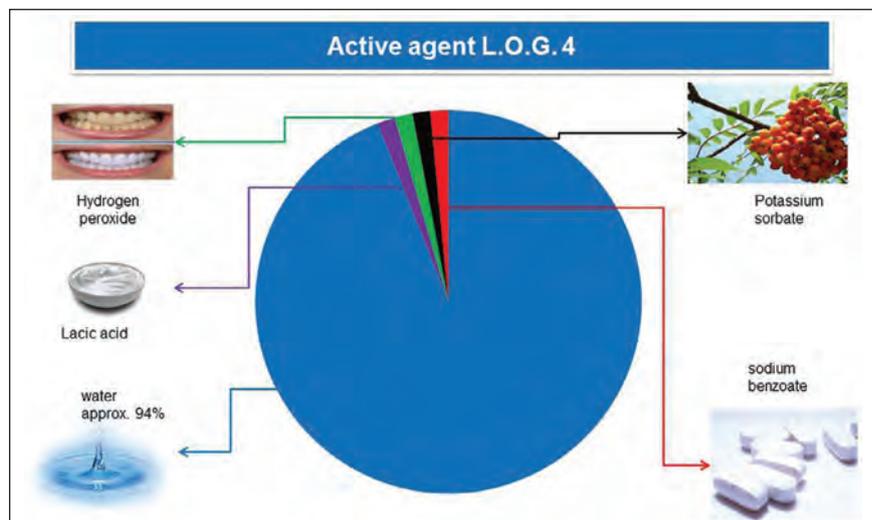
L.O.G. 4, which is used in the system is a water based solution which kills the cells' nucleus, stopping any reproduction of germs. "The technical part of the Hygiene Management system which induces L.O.G. 4 into the air is commonly used in land-based

applications", Schleper added.

"Several reasons motivated Imtech to develop this new solution. In comparison to other systems used for cleaning germs in room air (for example ionisers, ozone generators, UV-lights, etc.), Imtech's system provides several advantages. The filtration of air can be centralised without affecting its operation range. The L.O.G. 4 is mixed in the air which distributes it to the complete duct system and even into the room. So the active agent can work all over the ship wherever a germ may appear. Other active ingredients, like ions, reduce their activity by neutralisation after a short period of time. For that reason they can only be used in local applications and a lot of units are necessary", comments Schleper.

The system is easy to integrate; compared to other systems which clean air by ozone generators or UV-lights, no complicated units, automation systems and safety devices are necessary. Imtech has also highlighted that the biological working principle of L.O.G. 4 marks out the new system as an innovation which differs from other solutions: without using substances which can be toxic and/or sensible in high concentrations the germs and bacteria are defeated effectively. *NA*

What's in L.O.G. 4.



GL PRE-CHECKs for all

Vibration is an issue that is increasingly being considered in ship design not only in terms of preventing fatigue and damage to structure and machinery, but in terms of passenger and crew comfort.

The likelihood of the imminent entry into force of the International Labour Organisation (ILO) regulation ILO MLC 2006 will mean that assessment and control of noise and vibration in the shipboard environment becomes an important consideration for operators and owners. To come into force, the MLC must be ratified by at least 30 member States with a 38% total share in the world's gross tonnage of ships. Currently, 22 member states equalling 56% of the world's shipping tonnage have ratified this convention.

Germanischer Lloyd (GL) has highlighted that the latest in crew safety standards will cause ship operators to make changes. "The MLC, 2006 will have a wide ranging impact on the way that ship operators especially deal with crew and crewing issues. One of the key issues for ship yards and as a result for ship owners are the provisions dealing with Crew Accommodation in Title 3 Regulation 3.1. of the convention. GL offers the ILOAccom service to help owners ensure they are in compliance. As the Flag States implement

the requirements of the MLC, 2006 individually into their own national laws", the company stated.

GL launched its PRE-CHECK in 2010 to give clients the ability to access the potential compliance of a ship at a very early stage of the design process. GL commented that: "It is a direct response to the noise and vibrations requirements of the MLC 2006."

PRE-CHECK

GL's FutureShip unit has developed the PRE-CHECK service which is an analytical tool that can assess the noise and vibration signature of a newbuild design, very quickly through the use of a standardised procedure. Analysis during the early design stages of a project means that potential problems can be identified and preventative measures taken, avoiding costly fixes during or after construction.

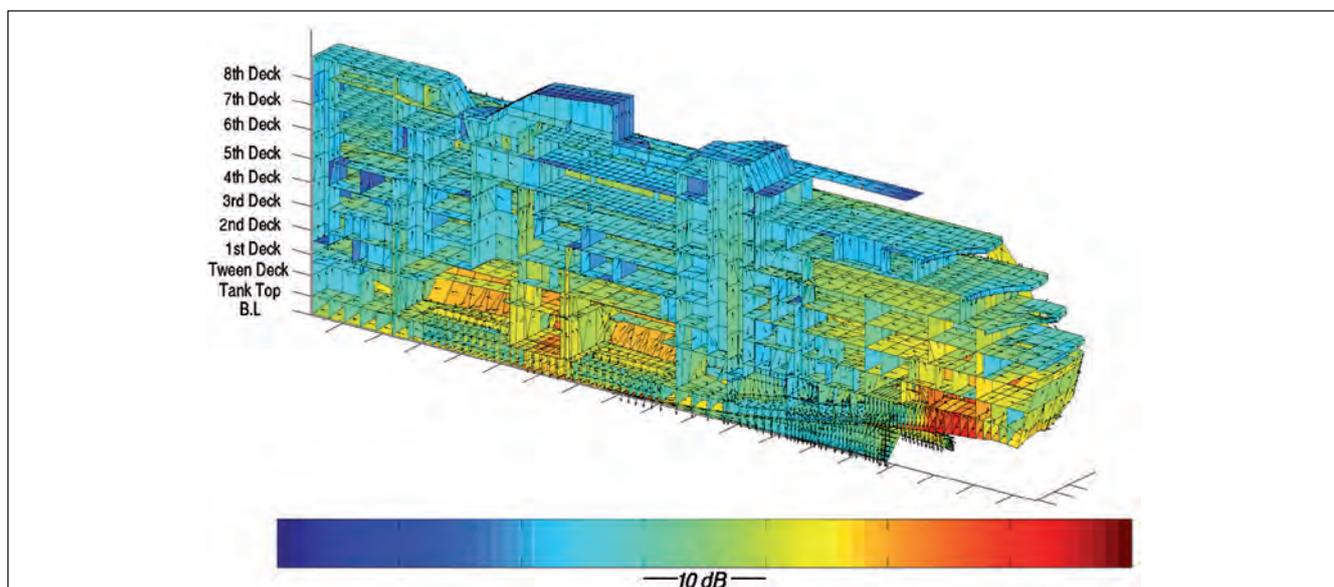
Based on a relatively small amount of data, the analysis is able to look at both the direct effects of vibration sources and the effect of interaction between other relevant factors, such as the number of propeller vanes, the type of engine installed, where the

deckhouse is situated, deck reinforcements, panel arrangements, and the performance parameter of the individual vessel.

The vessel then receives a grading based on the risk of failing to meet the MLC requirements, which gives a firm basis for deciding whether action is required. The tool can then also be used to offer engineering solutions to the problems identified. PRE-CHECK has been launched for the intended use in the design stage of newbuilds. GL has said that PRE-CHECK could be used in vessels in service to assess problems, but making changes or modifications at a later stage would be much more costly to the owner.

"The analytical tool helps identify prospective sources of excessive noise and vibration. These are analysed not only in terms of their direct effects but how each interacts. From these results various weighted key factors, such as the risk of resonance, are assessed and this gives the vessel grade. The grading reflects the likelihood or otherwise of standards or requirements being met – from very low to very high." *NA*

The PRE-CHECK tool helps to detect sources of excessive noise and vibration.



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Fluid safety

Sea-Fire has continued its development of its latest product Novec 1230 fire protection fluid in order to keep up with changing safety standards.

With the phase out of halon in fire extinguishing systems due to its Global Warming Potential (GWP), Sea-Fire offers its latest solution to the market of its Novec1230. The fire protection fluid is a CO₂ replacement fluid, which is less toxic than its predecessor.

Due to the fluid having the highest heat capacity available, a fire is stopped at the molecular level by removing heat to the point where the fire is extinguished. Novec 1230 can be used in engine rooms, pump rooms and communication and control units. Also, as the solution is non-corrosive and electrically non-conductive, it vaporises quickly and leaves no residue behind.

“GWP has moved to the forefront as a major environmental concern”,



said Sea-Fire president Ernie Ellis. “In the 1990s, Sea-Fire addressed ozone depletion with FM-200. Novec 1230 also has zero ozone depletion potential, but a GWP of just one. Compared to halon’s atmospheric life span of 300 years, Novec 1230’s is only five days.”

Sea-Fire offers its product in pre-engineered systems protecting areas from 0.7 to 42.5m³, as well as custom applications for spaces up to 495.5m³. Requiring smaller and lighter cylinders than CO₂ systems, storage and handling is easy and efficient. The fluid also complies with global standards and has certificates from RINA, DNV, USCG and ABS. [NA](#)

Sea-Fire offers latest solution to keep up with environmental regulations.

Edda Fides latest kid on the accommodation block

Wärtsilä Ship Design has been involved in the design work onboard the biggest accommodation vessel delivered to date, *Edda Fides*.

E*dda Fides* is the world’s first purpose built mono-hull service and accommodation vessel. Designed by Wärtsilä Ship Design and built at the Astillerio H.J. Barreras shipyard in Spain, it was delivered in 2011 and represents a pioneering concept for the offshore accommodation industry. The ship acts as a floating hotel and is utilised to accommodate maintenance personnel working on drilling platforms and offshore wind farm installations, as well as for other floating accommodation needs.

Wärtsilä has remarked that the marine industry is undergoing a period of great challenges and rapid change. In order to remain competitive, owners

and operators require vessels that meet all of today’s needs for fuel and environmental efficiency. Above all, the intended operating profile is crucial to the design and this is equally true of accommodation vessels. Today’s leading global ship designers are, therefore, looking at providing a total solution that meets all the criteria that add up to overall efficiency.

“The large challenge on this project was to combine the offshore service vessel rules and the passenger ship rules which are both applicable for this vessel.

“As for the hull form, it was a challenge to design the vessel’s hull form to incorporate the ordered propulsion equipment in the fore ship”, says general

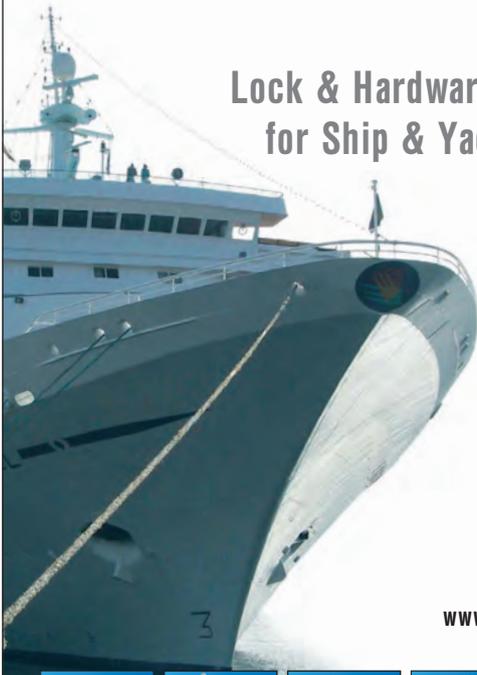
manager Inge Skaar, Wärtsilä Ship Design in Norway.

The vessel is designed to accommodate up to 611 persons during offshore operations, and up to 1000 while moored to a pier. Its comfort class is comparable to that of a cruise ship, and the ship can also be used to transport workers to offshore installations without the need of a helicopter. The transfer of personnel to and from an offshore installation is done by using a telescopic heave-compensated walkway. The gangway can, in fact, be landed on an offshore platform, a floating production storage and offloading (FPSO) unit, or any other fixed object to allow safe and convenient transfer of personnel.



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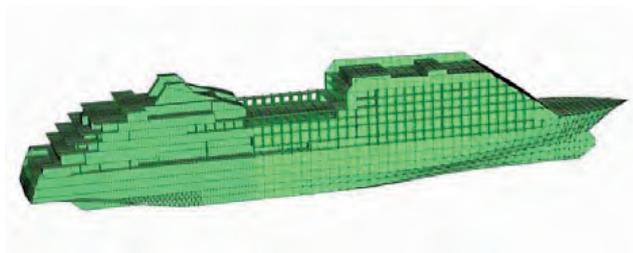


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TECHNICAL PARTICULARS	
<i>Edda Fides</i>	
Length oa:	130m
Length bp:	127m
Breadth moulded:	27m
Depth moulded	
To main deck:	9.4m
Width of double skin	
Side:	1.5m
Bottom:	1.5m
Draught	
Scantling:	7.2m
Design:	7.2m
Gross:	20,323gt
Displacement:	17,800tonnes
Lightweight:	10,955tonnes
Deadweight	
Design:	6800dwt
Speed, service:	11.5knots @ 80% MCR
Main engines:	Wärtsilä 9L26
Number:	6
Type of fuel:	MDO
Output of each engine:	2925kW
Complement	
Officers:	13
Crew:	40

The need for such a vessel is created by the fact that when, for example, an offshore platform is shut down for periodic maintenance, the number of service personnel employed typically exceeds the available accommodation on the installation. The conventional answer to this problem is to use barges or semi-submersible rigs at the location. Both solutions have considerable drawbacks.

“When it comes to challenges, our approach of working closely with the customer from day one is the key. Meeting the challenges with commitment is a way to support our customers”, commented Skaar.

Purpose built

In contrast, *Edda Fides* is purpose built for this application. In addition to providing adequate accommodation facilities, such as offices, lounges, a fitness room, sauna, pool, first aid facilities, a cinema, library, etc, the ship has an onboard workshop where repairs of the platform equipment can be carried

out. Furthermore, the deck is utilised for storing large items and has a crane for transferring machinery back and forth between the ship and the platform.

One of the major challenges in transferring personnel and equipment to and from the accommodation vessel is heavy sea conditions. For this reason the ship has positioning and station keeping capabilities built into its design. The Class 3 Dynamic Positioning (DP) system combined with the five Voith Schneider thrusters provide very precise, fast and accurate positioning capabilities and also reduce fuel consumption.

The unique hull design also takes into consideration the vessel’s operating purpose. With both ends bow shaped, the ship can rotate around the gangway hinge point to turn into the prevailing weather, and the design enables effective operations in significant wave heights of up to 5m. This means that the vessel can operate in the North Sea with the gangway connected for more than 92% of the time throughout the year. *NA*

Edda Fides, the largest accommodation vessel constructed to date.



International Conference on Ship and Offshore Technology

"Developments in Ship Design & Construction"

Ambon, Indonesia, 7-8 November 2012



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CALL FOR PAPERS

Today, the international maritime industry faces new challenges as it emerges from the global financial crisis. It is therefore understandable that the industry's priority and attention is on consolidation and continued survival. However, at such a time it is all the more important for the industry to look ahead in order to respond to the continuing challenges it will face from the increasing demands of operators, regulators and society for greater efficiency, safety and the protection of the environment, as it emerges from the current crisis. This response will require innovative thinking from all sectors of the maritime industry, and particularly those involved in ship design and construction.

The International Conference on Ship & Offshore Technology - Indonesia 2012 will take "Developments in Ship Design & Construction" as its theme, and will bring together members of the international maritime industry to present and discuss the latest developments in the ship design and construction process which will provide the improvements in productivity and cost-competitiveness necessary to respond to the demand for lower cost of ownership and greater environmental sensitivity. Whilst covering developments in all ship types, it will look particularly at developments in those vessels which are essential to the economies of countries in the region, e.g. fishing vessels.

Papers are invited on the following topics for all ship types:

- Hydrodynamics and structures
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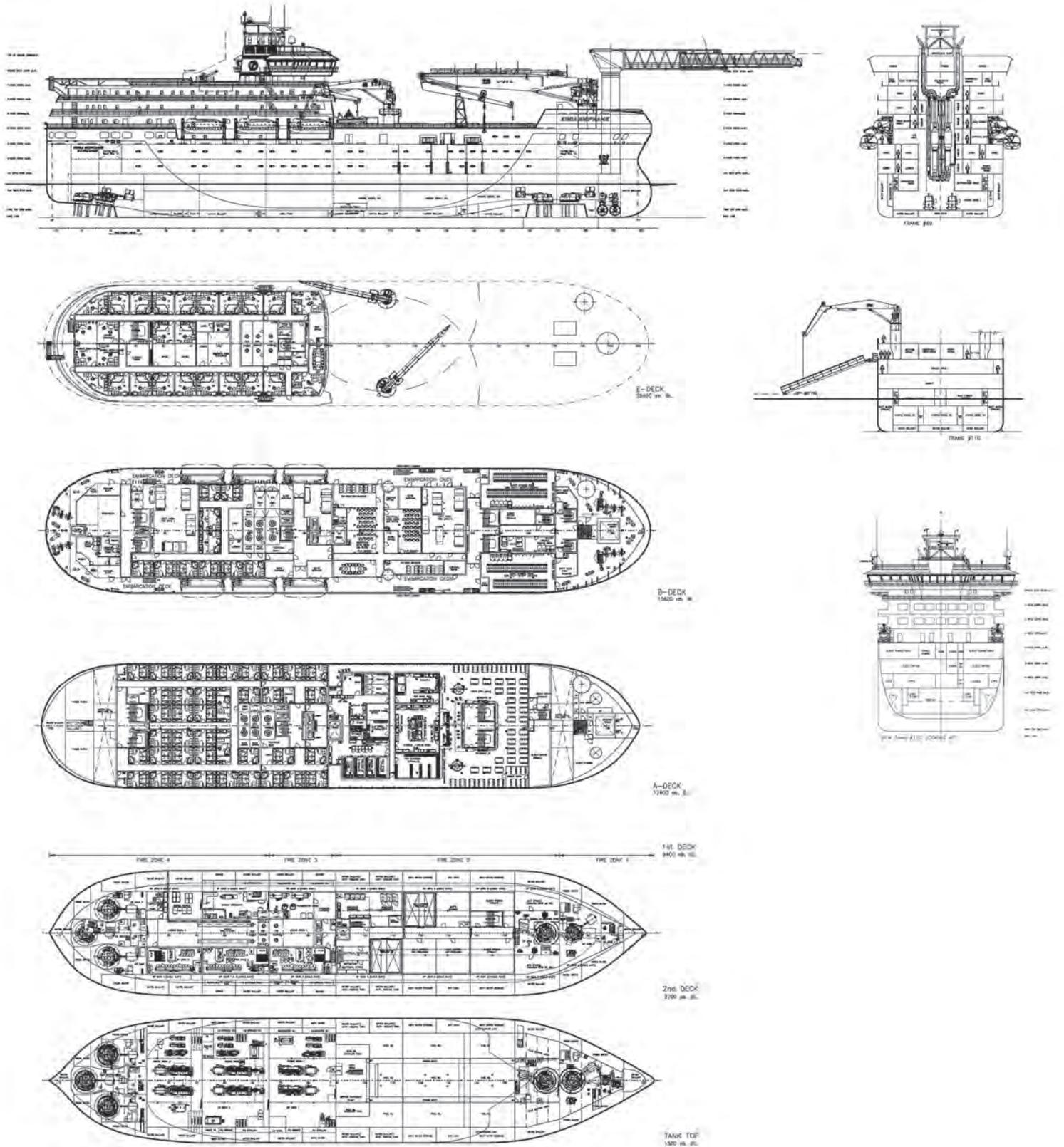
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Feature 3 | ACCOMMODATION AND VIBRATION

GA for Edda Fides.





SYSTEMS ENGINEERING IN SHIP & OFFSHORE DESIGN



28 -29 March 2012, London, UK

Second Notice

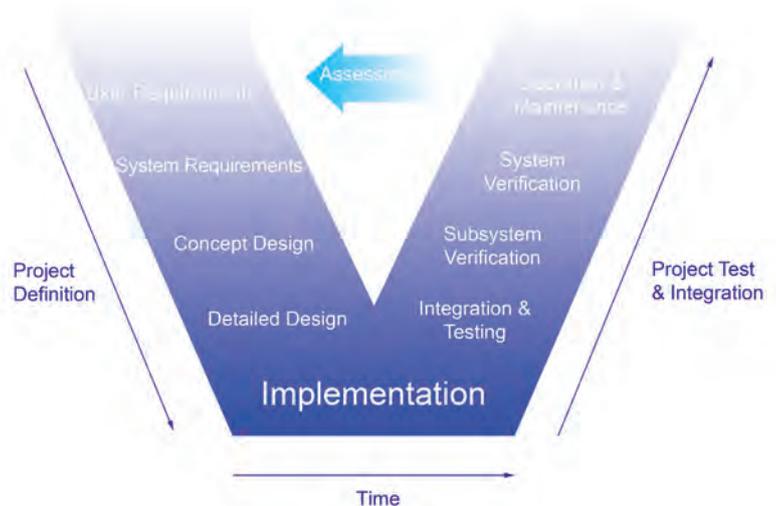
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The prompt delivery of high quality complex ship and offshore systems is made possible by ever more advanced design methods but this also poses major challenges as management teams try to balance capability and cost across global markets. The many risks and interdependencies are best addressed within a systems engineering structure that brings together all the disciplines involved and represents a single unified view of the project. Based on a sound understanding of the original requirements, multiple concepts can be developed with lifecycle management, safety and environmental issues fully integrated from the start.

RINA invites papers from those in the marine industry with a systems engineering perspective on the efficiency of their design processes and the sustainability of future assets.

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Finnish yard pioneers green technology

Scandinavia has been something of a pioneer in the use of green technology as it applies to shipbuilding and companies have been able to obtain funding from the Norwegian government for innovations in design. Now Finland, Norway and Sweden have converted a tanker to LNG fuel, *Sandra Speares* reports.

One of the pioneering projects is the conversion of the GL class *Bit Viking* to liquefied natural gas (LNG) fuel, with the work undertaken at Wärtsilä's Finnish yard and the ship chartered to Norwegian oil major Statoil by owners Tarbit Shipping of Sweden for use on the Norwegian coast.

The ship's engines were converted to dual fuel engines and the project was the first ever conversion of a vessel in service to LNG. As a result, *Bit Viking* is now qualified for lower NOx emission taxes under the Norwegian Government's NOx fund scheme.

Bit Viking has a twin screw propulsion system with redundancy including double engine rooms, propellers and steering gear. The ship's six cylinder Wartsila 46 engines were converted by the engine manufacturer into 50DF dual fuel engines

and the ship has two newly installed 500m³ LNG storage tanks.

LNG storage has been a controversial issue for those companies considering dual fuel systems, not least in the case of cruise ships where the need to maximise public spaces and accessibility of passenger cabins makes LNG a difficult storage solution. Concerns have also been raised about the location of LNG storage, particularly as it relates to passenger and crew accommodation.

Retrofitting the ship was no easy matter, according to Ronnie-Torsten Westerman, business development manager at GL Group in Norway: "It was a very extensive retrofit because we had to increase the bore of the engine from 46cm to 50cm, so most of the individual parts of the two engines had to be replaced." Safety was evidently a key concern. "We are dealing

with something that is not so much explosive as cryogenic," says Westerman. "For example, if we get a spill on the deck it can destroy the steel and you then have to cut it out or replace it as the steel will get brittle if it comes into contact with liquid gas."

Bit Viking utilises Wärtsilä's new LNGPac system, which enables the safe and convenient onboard storage of LNG. The two 500m³ LNG storage tanks are mounted on the deck to permit the bunkering of LNG at a rate of 430m³ per hour. The storage tanks provide the vessel with 12 days of autonomous operation at 80% load, with the option to switch to marine gas oil if an extended range is required. When visiting European Union (EU) ports, which have a 0.1% limit on sulphur emissions, the vessel operates on gas. [NA](#)

Latest green technology onboard *Bit Viking*. Photo: Oceanic Vega.





Image- Oasis of the Seas, the largest luxury cruise liner completed with Tikkurila MED products, 2009

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In the nick of time

Soaring fuel prices, strict environmental targets and brutal economic conditions mean ship operators need to muster all the efficiency-saving techniques available to them. Henrik Dahl, CTO at Eniram, says by using the company's Optimum Speed Assistant vessel operators can optimise vessel efficiency benefitting both the bottom line and the environment.

Getting into port on schedule – on time, but not too early – is a difficult science to get right when vessels can encounter any number of variables along their voyage. Until now, operators have got round this by building buffers into their journeys, giving them time to play with if sea conditions threaten to throw their schedules off course. The practice is far from efficient, however, not least because of the fuel implications of varying speeds during a long passage.

Soaring fuel prices and strict environmental targets have given rise to a range of technology solutions that aim to address the issue, honing voyage planning and reducing buffer times by estimating journey times and speed requirements.

In almost all cases, however, such calculations are made based on theoretical

information rather than real-time data. This limits the extent to which a ship's operator and crew can be truly confident in the estimates.

Until now, that is - following the arrival of software technology that enables operators to capture, analyse and exploit real-time data, adjusting performance dynamically based on the latest readings. This in turn gives operators greater control, reducing the need for a buffer and enabling vessels to confidently maintain a consistent speed throughout a voyage.

Once a ship owner has invested in monitoring systems capable of tracking parameters such as trim, hull condition and current sea and weather conditions, the simple addition of an intelligent speed management capability increases its ability to chart an accurate course and journey time, optimising speed and engine usage.

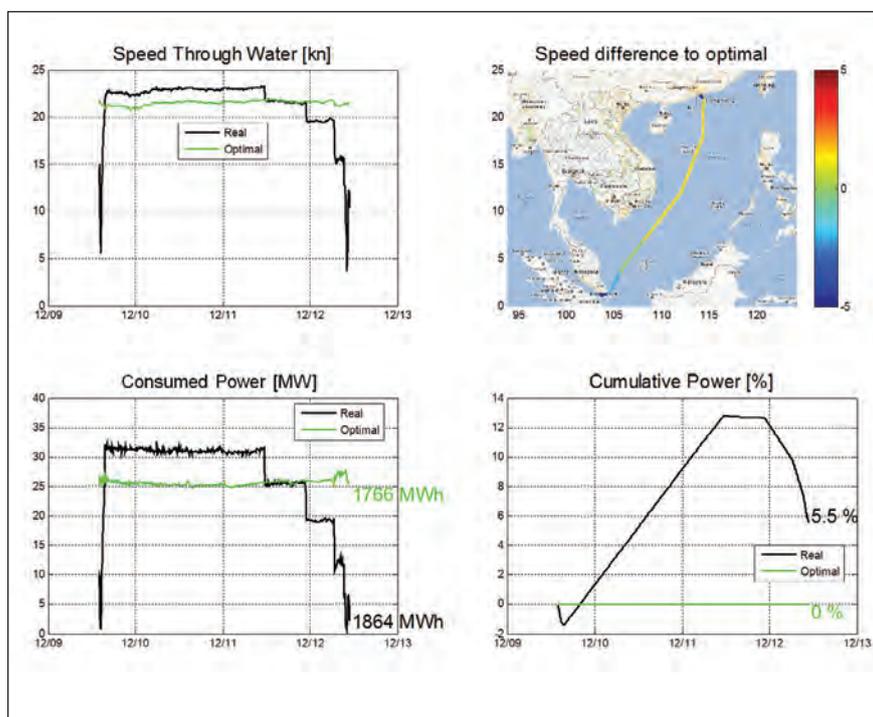
Operators who optimise the speed profile can expect to achieve further propulsion savings starting at 1-3%. On a large vessel, a 2% propulsion saving could amount to 500 tonnes of fuel, valued at over US\$300,000 per year. These calculations are based on analysis of 50,000 sea days of real data from operative cruise and container vessels equipped with Eniram technology.

In March, Eniram will launch Optimum Speed Assistant (OSA), a new software tool targeted specifically at maintaining consistent, optimum speeds on a given vessel, maximising fuel efficiency and enabling just-in-time arrivals in port. The solution builds on the company's established Eniram Vessel Platform and Dynamic Trim Assistant (DTA) module, both of which were developed in close collaboration with the shipping industry. Together, the solutions give a ship's crew guidance and visibility of accurate measurements and readings across the whole chain of operation, enabling them to make the right decisions in all conditions.

The company's dynamic data analysis software is used by more than 100 ships, with a further 50 implementing the tools at the time of writing. The new OSA module uses the same modelling capabilities, helping ship owners to optimise speed distribution and engine usage for each individual ship, eliminating speed spurts and idling, and ensuring more accurate ETAs which brings its own cost benefits.

The OSA can also be combined with a Fleet Performance Manager (FPM) to help shore-side managers track individual vessel performance across an entire fleet. This enables them to provide additional support services to the onboard crew and to schedule port operations efficiently. **NA**

A screen shot from the OSA.





SYSTEMS ENGINEERING IN SHIP & OFFSHORE DESIGN



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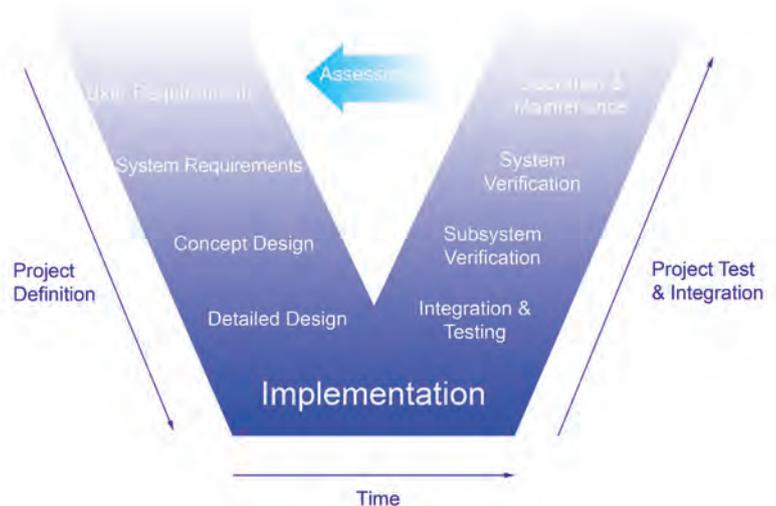
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Ship Resistance and Propulsion

E. C. Tupper

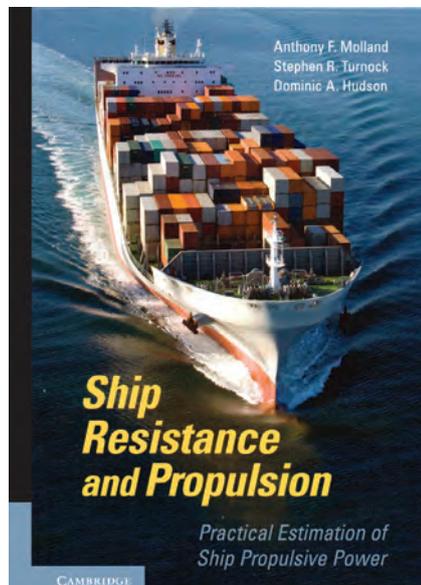
Ship Resistance and Propulsion

Written by A. F. Molland, S. R. Turnock and D. A. Hudson, published by Cambridge University Press, Cambridge, UK as a hardback, 2011, 537 pp. ISBN 978-0-521-76052-2, £70.00 (US\$110.00).

The authors, all from Southampton University, will be well known to many members of RINA including many who will have been taught by them. Tony Molland is Emeritus Professor of Ship Design; Stephen Turnock is Professor of Maritime Fluid Dynamics while Dominic Hudson is Senior Lecturer in Ship Science. Professor Molland is the editor of *The Maritime Engineering Reference Book* (2008) and co-author, with Professor Turnock, of *Marine Rudders and Control Surfaces* (2007).

As one would expect from these authors, the book is well written and comprehensive in its treatment of the subject. It brings the reader up to date with the latest developments in theoretical analysis (including computational fluid dynamics – its strengths and limitations), numerical methods and experimental techniques.

Having outlined the historical development of knowledge of, and techniques used in studying, resistance and propulsion, the authors discuss the components of propulsive power, hull resistance, model-ship extrapolation and correlation. In relation to ship resistance they go on to discuss the measurement of ship resistance components, wake and thrust deduction, numerical estimates and the presentation of resistance design data. Next they cover propulsor types, propeller characteristics including strength, the selection of propulsive machinery and its matching to the propeller and the gathering and use of



in-service performance measurements. Following an outline of hull form design they present numerical methods for propeller analysis and the presentation of propulsor design data. Over 50 pages are devoted to some two dozen examples applying the principles covered in the book to such diverse vessels as container ships, tankers, ferries, tugs, catamaran forms,

“The authors discuss the components of propulsive power, hull resistance, model-ship extrapolation and correlation.”

planing craft and warships. To aid the reader an Annex is devoted to the background physics needed to help in an understanding of the main text.

As the authors point out, an accurate estimation of propulsive power required is fundamental to the process of ship design. The aim of the book can be summed up as to give the reader the ability to carry out that assessment. In that they have succeeded. Apart from the theory the book provides guidance for the practical estimation of power for a range of different vessels backed up by enough data to enable such estimates to be made. The process is illustrated by a large number of worked examples which students, in particular, will find very useful.

As an indication of how thoroughly the authors have researched their topic, the book contains over 680 references containing material on which the text is based. These can be used by readers to study any particular topic in more detail. As is to be expected in a treatise on resistance and propulsion many of these references relate to papers presented to RINA and to work of the International Towing Tank Conference and details are provided of the website from which the latter can be downloaded. A website is also quoted where the University of Southampton Ship Science Reports referenced in the book can be obtained free of charge.

Besides undergraduates and postgraduate students the book will be very useful for practising naval architects and marine engineers. The wide coverage of vessel types mean that it will be of value to those responsible for small and specialist ship types (including warships) as well as conventional large ships.

In summary the book is well presented. It is illustrated by over 300 diagrams and many tables are included. It gives an in-depth “state of the art” review of resistance and propulsion, recording not only the latest research and theoretical techniques but also the practical application of these. It is highly recommended to those concerned with ship design and hydrodynamic research. **NA**

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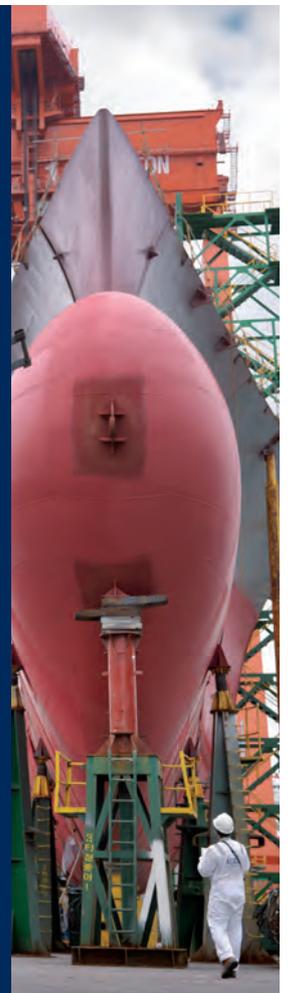
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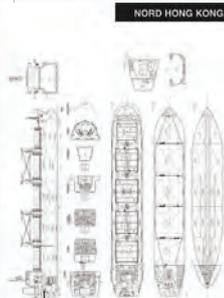
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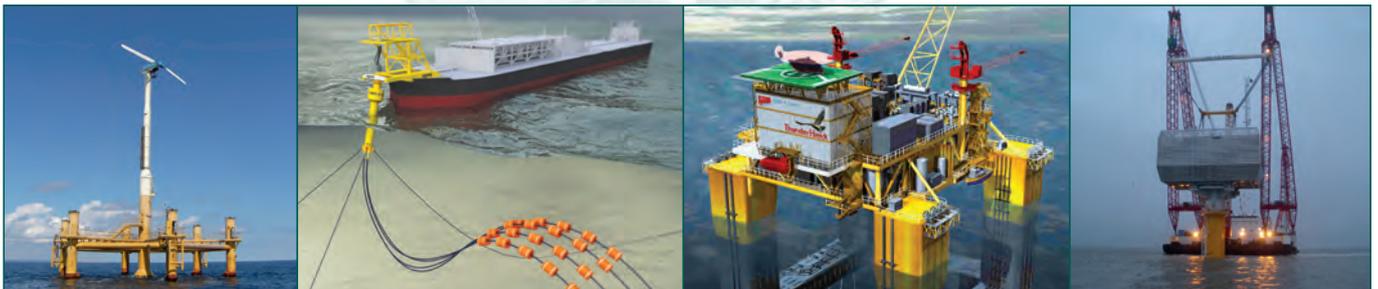
Fixed and floating offshore structures, whether associated with the production of oil and gas, or with marine renewable energy, present complex technical challenges to the maritime industry, particularly as such structures are increasingly employed in deeper waters and extreme climatic conditions when the support of such structures then presents an additional challenge.

The International Conference on Ship & Offshore Technology Korea 2012 will provide an opportunity for the global maritime industry to present and discuss the developments in the design, construction and maintenance of fixed and floating offshore structures.

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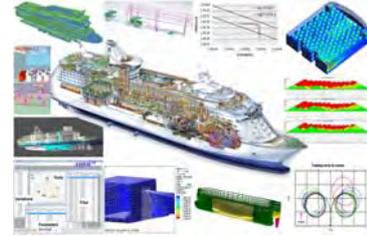
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- “*Embracing Innovation in Ship Design*”, Harri Kulovaara, RCCL
- “*Global Forces and their Potential Impacts on Marine Technology Development*”, Fai Cheng, Lloyd's Register
- “*Is Marine Design now a Mature Discipline?*”, David Andrews, University College London

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