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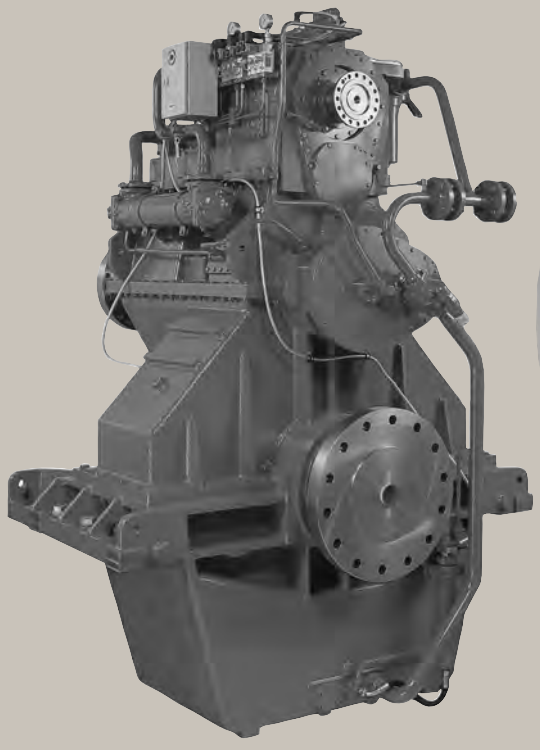

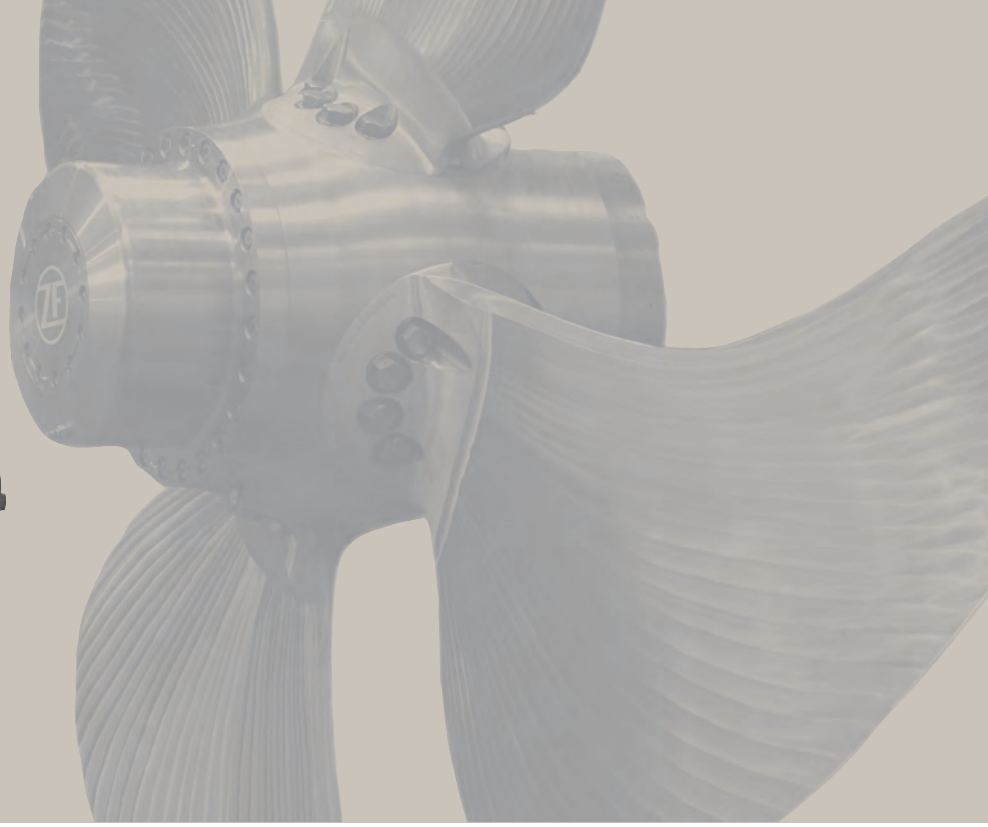

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THE NAVAL ARCHITECT

The SkySails kite concept as envisaged on the *Beluga Skysails* cargo vessel. Increasing fuel costs, concerns over security of oil and gas supplies, legislation to reduce engine emissions, and general pressure to make full use of renewable energy are forcing ship designers and operators to reconsider natural forms of propulsion. *See p23.*

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Standard bearers for ballast water resolution

NORWAY'S decision to implement strict controls on ballast water management during 2007 in line with the International Maritime Organization Convention on ballast water has been welcomed as a step in the right direction for an area of regulation in danger of fragmentation.

Norway, which represents 2.4% of the world's maritime fleet, will apply the standards set down in the IMO Convention on ballast water to ships calling at Norwegian ports, even though it may be many years before the convention comes into force internationally.

Wikborg Rein, Norway's leading maritime law firm drew the worlds maritime community's attention to the December decision of the Norwegian parliament that authorised the government to accede to the International Convention for the Control and Management for Ships' Ballast Water and Sediments years ahead of its expected entry into force.

The move provided a clear signal that Norway believes that the threat posed by invasive species to the marine environment needs to be tackled immediately, rather than waiting for international ratification.

Morten Lund Mathisen, a partner at Wikborg Rein said that the early introduction of the 2004 Convention showed that Norwegian authorities were not going to wait for the rest of the world to follow. 'Finalisation of the draft regulations to give effect to its provisions are anticipated during the spring of 2007, and will be subject to a three month consultation period', he said. 'Subject to Norway's obligations under international law, the Ministry intends to implement the Convention rules in relation to ships calling at Norwegian ports before the Convention enters into force internationally. In particular, the restrictions on ballast water uptake and discharge set out in the Convention are expected to enter into force by the end of this year. The Ministry is now considering which areas along the Norwegian coastline shall be designated as ballast exchange areas.'

The Zebra Mussel, one of the most aggressive invasive species to have afflicted the marine environment.

The move has considerable commercial and operational implications for vessels calling at Norwegian ports, which will now be required to adhere to a ballast water plan, keep a strict log of ballast water management, and will only be allowed to discharge clean ballast which has been exchanged at sea in accordance with the Convention.

The Convention requires ships to conduct ballast water exchange at least 200nm from the nearest land, in at least 200m depth of water and in accordance with guidelines issued by IMO. If it is not possible to conduct water ballast exchange as described, it shall be carried out as far from the nearest land as possible, at least 50nm from the nearest land and in water at least 200m in depth.

Violation of the Convention may result in the ship being detained, excluded from port or offshore terminal or prevented from discharging the ballast water. Owners who trade or may trade to Norway should get good advice on the requirements now.

The move is further evidence of the high priority being placed on environmental matters related to the marine sector by Norwegian interests, where current initiatives include using fuel cell technology to bring about the possibility of ultra-clean ships, the development of technology to clean ballast water rather than exchange it, and the introduction of ship engines powered by liquefied natural gas (LNG) instead of conventional diesel engines.

However, it has a wider import in terms of sustaining a global approach to the regulation of the environment. Intertanko welcomed what it termed a 'bold move', interpreting it as a 'positive sign that the International Convention can be implemented effectively by individual states without the need for developing their own separate and differing requirements'.

Australia, Brazil, Canada and the USA have implemented regional interpretations of ballast water management regulations. There has been concern that shipowners will be faced with a variety of standards in lieu of the full Convention picking up ratification from the 30 states whose combined merchant fleets constitute not less than 35% of the gross tonnage of the world's merchant shipping, required for it to enter into force.

Without naming names, Intertanko said: 'Since the adoption of the Convention in 2004, a number of states and regions have proposed, developed and implemented requirements which are at best loosely based on the IMO Convention.

'Intertanko has previously voiced its concern relating to the proliferation of regional requirements which differ from those in the IMO's Convention.

'With this move by Norway, Intertanko hopes that other states wishing to develop and implement ballast requirements for shipping will revert to using the already developed international standards,' the shipowner association said. 'Ironically, we note that many of the states considering the implementation of national requirements which differ greatly from the IMO Convention were those that actively participated in the Convention's development since 1993.'

Norway joins some eight other states which have already ratified the Convention, namely Croatia, The Maldives, Nigeria, Poland, Saint Kitts and Nevis, Spain, The Syrian Arab Republic and Tuvalu.

However, ratification is only one part of the story. For some, the Convention's allowance of ballast water exchange as an acceptable means of management involved risk – the fear being that, in some circumstances the operation can destabilise a ship, or overstress the hull. What is needed for successful implementation of the Convention is for the technology to be developed to kill the micro-organisms that pose such a threat to non-native environments.

Not surprisingly, given the above, among the frontrunners in developing such techniques is the Norwegian company OceanSaver, which is offering Convention compliant ballast water treatment as part of a system that also offers efficient corrosion control and coating protection of the steel structure in the ballast tanks – providing a potential life extension for ships.

The system combines a number of physical processes exposing ballast water organisms to pressure differentials, causing the rupture and destruction of organisms' cell membranes.

Waiting on CREATE3S

A PILOT project short on detail but high on ambition to develop a new generation of shortsea containerships and bulk carriers has been formed by an EU-funded consortium.

The 36 month project, dubbed CREATE3S, aims to develop new design concepts that improve the efficiency of shortsea ships, by designing them to transfer complete cargoes in a single move so that they spend less time in port.

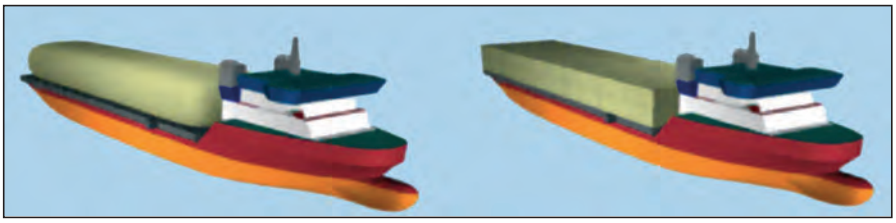
CREATE3S (Creative Concepts REalised by Advanced design & production to improve Total Efficiency of new generation Short Sea Shipping) is being coordinated by Samskip's Multimodal Container Logistics in Rotterdam. The company said that, once final designs were arrived at, it intended to be a prominent user of the concept.

Other partners in the project comprise PD Ports, Damen Shipyards Group, Estaleiros Navais de Viana de Castelo, Imtech Marine & Offshore, TTS Ships Equipment, LogIT, Center of Maritime Technologies, Norwegian Maritime Technology Research Institute, Maritime Research Institute Netherlands, Delft University of Technology, University of Newcastle, Bureau Veritas and Centrum Techniki Okretowej.

EU funding of €2.5m has been made available, out of a total budget of €4.2m, on the grounds that the project seeks a means of transferring more cargo from road to sea. Based on the premise that larger shortsea ships are needed to achieve these ends, the project aims to address the conundrum that such ships would need to spend longer in port loading and discharging. The CREATE3S concept envisages a vessel consisting of two principal modules: a ship hull module and one or more large cargo modules.

When the vessel arrives in port, the concept envisages separating the cargo modules from the ship section and placing it on the quay in a single load. The 'ship module' would then be 'mated' with other cargo modules for the return voyage. Time in port would thus be minimised.

One of the concepts being considered envisages a ship featuring an intermediary cassette-style platform between the hull and the cargo unit(s), with the ship entering a dock comparable to Amsterdam's Ceres Paragon Terminal, where ships can load and unload on both sides. Then, the entire platform could either be lifted using hydraulic lifting gear, or the platform could slot into a fixed structure, enabling the ship to take on ballast and move free of the structure.



An artist's impression depicting how the CREATE3S concept of ship and cargo module(s) might look.

However, according to project coordinator Fabian Heynen, of Samskip, the project is at such an early stage that even vessel dimensions remain to be established, although the partners have already said that the approach will work to a 'standard ship design'.

NCL OPTS FOR CONVERTEAM - CONVERTEAM has won its first contract to equip cruiseships fully with its new electric propulsion solution, based on high-torque density induction motors and MV7000 converters.

The company has been awarded a multi-million euro contract by Aker Yards to supply electric power and propulsion systems on two new cruiseships for Norwegian Cruise Line.

The ships, to be built at Aker Yards in Saint-Nazaire (France) and delivered one apiece in 2009 and 2010, will be 325m long and 40m wide, with a gross tonnage of approximately 150,000 and 4200 passenger berths.

The contract also includes 12 generators (six per ship) with a total power of 160MW, to be supplied by Converteam Ltd (UK), and 12 electric motors for thrusters (six per ship) with a total power of 30MW, to be manufactured at Converteam Motors' Nancy plant (France).

Each ship will be powered by two shaftlines, directly driven by two 24MW slow-speed induction motors. Supplied through four MV7000 converters using press-pack IGBT (Insulated Gate Bipolar Transistor) technology, these motors would help make the propulsion chain more reliable, more efficient and more compact, the supplier said. Passenger comfort would be improved thanks to a low level of noise and vibrations, while maintenance time would be significantly reduced by the use of induction motors and of converters with plug-and-play technology.

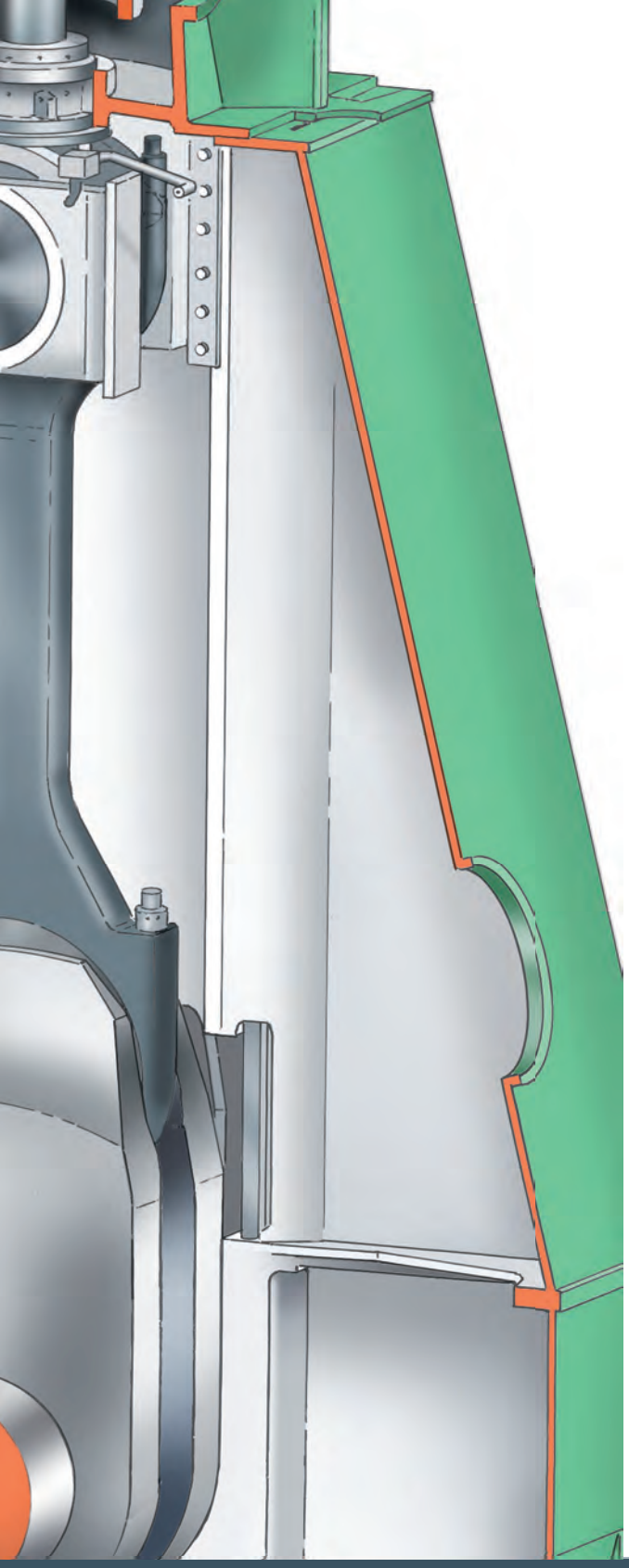
LOW SPEED EXTENSIONS - BOTH MAN Diesel and the Wärtsilä Corp/Mitsubishi Heavy Industries alliance have strengthened their ability to deliver low speed two stroke engines under licence in China.

Wärtsilä Switzerland and Yichang Marine Diesel Engine Plant (YMD) of Yichang, China have signed an agreement to extend their existing licence agreement for the manufacture and sale of Wärtsilä low-speed marine diesel engines.

YMD currently manufactures Wärtsilä low-speed marine engines between 48cm and 70cm bore. With the new agreement, YMD will also sell and manufacture Mitsubishi marine engines of small bore size up to 50cm which cover a power range of 1230kW - 13,280kW. These will be delivered to Chinese shipyards.

MAN Diesel has signed a new 10 year licence agreement with joint venture CSSC-Mitsui Diesel, based in Lingang to produce MAN Diesel's largest low speed engines in the 60cm to 98cm bore ranges and, with the first engines due to be delivered in October 2007, anticipate reaching annual production of 2m kW by 2010.

At the same time, MAN Diesel also renewed its own licence agreement with YMD.



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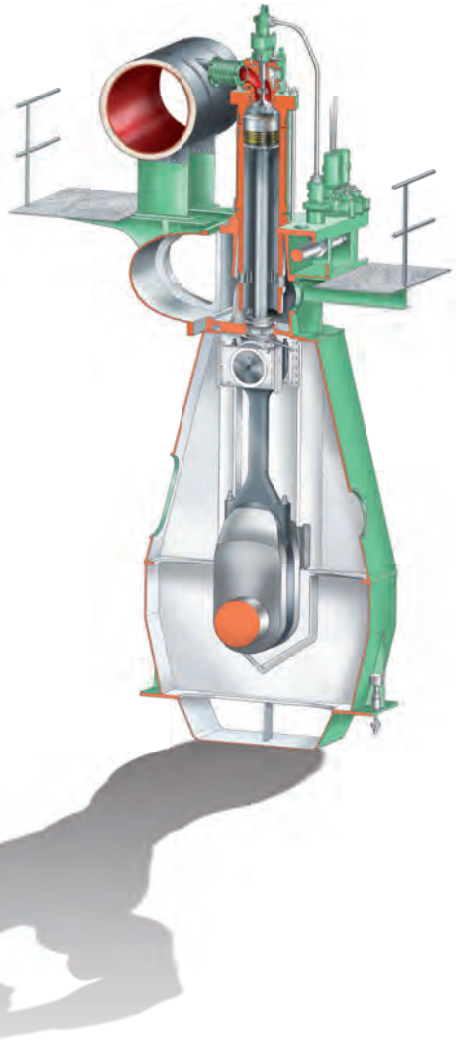

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TEVO grows the Finnscrew range

FINNISH company Raahen TEVO Oy, which today owns the Finnscrew propeller manufacturing operations, intends to increase the size range of the propellers its subsidiary manufactures up to a diameter of seven metres.

Tevo/Finnscrew Turenki propeller plant. Picture, taken in January, showing a CNC lathe of type DYE TV5600 in action at Tevo/Finnscrew Turenki propeller plant.

TODAY, Finnscrew offers propellers in the range of 800mm to about 5.6m in diameter but a new CNC lathe means that, within months, propellers with a diameter of up to 7m will be available.

With Tevo's net sales in 2006 reaching €13m, compared to €5m in 2005, one third of revenues come from the production of propellers and azimuthing pods. Now is an ideal time to invest.

The current staff of 30 working at Tevo's propeller manufacturing plant and foundry in Turenki will also be increased - by some ten people. According to Teuvo Joensuu, owner and managing director of Tevo, the intention is to reach an annual propeller production capacity of 1000tonnes within six months, against a current annual capacity of 600tonnes.

In 2006, Tevo/Finnscrew produced 160 propellers of different types, including various fixed pitch and CP propellers. The Finnscrew branded propellers are all made of NiAlBronze alloy.

At the propeller manufacturing plant, there are two 25tonne smelters which handle casts with a total weight of 50tonnes. Until now the maximum diameter has been 5.6m and maximum weight 9tonnes, but the intention is to increase cast weight to near maximum capacity. The plant has one mechanical lathe and one CNC operated lathe of type DYE T5600. The third modernised lathe, being installed for handling 7m diameter propellers, has been manufactured by German company Shiess-Froriep. Final grinding of propellers and hubs alike is done using an ABB IBR6000 grinding robot, capable of grinding propellers with a weight of up to 5000kg. Recently an 80t overhead travelling crane was also installed to handle the bigger propellers to be produced. The Tevo/Finnscrew plant has a total area of some 10,000m^2.

Big clients

Tevo's biggest client is Rolls-Royce, for which the company manufactures propellers as a sub-contractor in Turenki, but also the steel

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structures for azimuthing propulsion units for Rolls-Royce's propulsion unit plants in Finland, Sweden and Norway. Steel structures are manufactured at one of Tevo's Raahe plants. Another major client is Finnish azimuthing propeller manufacturer Steerprop, with deliveries of both propellers and turning pods, while Tevo/Finnscrew also has propeller orders for some azipodding units from ABB Finland.

'One of the main reasons for buying the facilities of Finnscrew in Turenki back in 2005, was, in fact, that the main clients were the same as at our Raahe plant,' Mr Joensuu told *The Naval Architect*. The old plant in Turenki went into bankruptcy in 2005.

The company also produces shaft lines for various clients as well as marine reduction gear steel parts for customers such as Valmet. The clients for the company's marine propeller repair services are typically Finnish and other European repair yards. Here, the propeller material can also be stainless steel, in addition to NiAlBronze.

Typically, marine propellers are either fixed pitch propellers or CP propeller blades and hubs. The CP propeller blades are machined using a Pegard machining centre with a machining reach of y=2850mm, x=3500mm, wz=2000mm. It is equipped with two desks of 1800mmx2200mm.

Propellers for non-cavitating, semi-cavitating and super-cavitating conditions can be built as well as open, ducted and surface-piercing propellers. Finnscrew manufactures propellers to clients' specification and design, but can also offer comprehensive design services, based on the client's vessel and machinery specifications and hydro-dynamical analysis services.

The slewing housing for one of Steerprop's LU6 class icebreaker propulsion units, before heat treatment and machining. Finnish company Steerprop has recently delivered the two mechanical azimuthing propulsion units for the second vessel in a series of diesel-electric line icebreakers being built at the Baltic Shipyard in St Petersburg for Rosmorport. Each vessel in the series of three ships are fitted with a pair of the company's SPO 4.5 ARC azimuthing propulsion units, the biggest of this type ever built, with a total power of 8.2MW each. The propeller diameter is 4.5m.

Finnscrew's reference list includes propellers for cargo ships, tugs, luxury yachts, passenger vessels, patrol boats and fast naval ships. The company has also manufactured propellers for submarines, indicating the high quality achieved at the plant. Propellers of S Class tolerance standard can be manufactured. In addition ISO Standard 484/2 is applied for pitch tolerance and ISO 1940 G2.5 for balancing tolerance.

Mr Joensuu pointed out that Tevo is one of very few metal industry plants of its size in Finland where the operations fulfil the requirements of the ISO 9001 quality management standards and ISO 14001 environmental standards, in addition to EN 729-2 quality requirements for welding.

New model for ship evacuation

IN the second part of their in depth analysis of passenger response times during ship evacuation, E R Galea, S Deere, G Sharp, L Filippidis, P Lawrence and S Gwynne, of the Fire Safety Engineering Group, University of Greenwich, UK, recommend a fundamental rethink of International Maritime Organization methodology.

UNDERSTANDING how people behave in emergency situations within maritime settings is vital if we are to design and develop evacuation efficient vessels and crew evacuation procedures, train crew in the management of evacuation situations and regulate the design and operation of vessels. An essential component of this understanding is the collection and characterisation of human performance data.

The EU project Fire-Exit, which included the University of Greenwich, BMT, BMT Fleet Technology, Marine Institute of Memorial University of Newfoundland, Mettle Groupe and Gruppo Grimaldi has made an important contribution to the development of our understanding of human behaviour within the maritime environment.

Grimaldi made one of its ro-ro ferries available for use in trials in April 2005. Two trials were conducted over two days on the Port of Rome to Barcelona route. Both crew and passengers were aware that they were participating in experimental assembly trials. Both trials were conducted in the morning with passengers distributed throughout the vessel according to their normal shipboard activities. On both days, passengers were instructed to assemble and don lifejackets.

The vessel consisted of 11 decks of which three could be utilised by passengers. The total passenger capacity of the vessel is 1400, with 208 passengers in aircraft style seating, 626 accommodated in cabins and 566 deck passengers. The vessel has a crew complement of 100. The vessel has 200 cabins of single, double, triple or quadruple berth. Onboard the vessel are two restaurants, two bars and a casino area. The ship has also a reception area, shop and outdoor pool.

In order to capture most of the behaviour and data for timed analyses, video cameras were positioned in key locations within the vessel.

The first trial took place on the outward leg of the voyage. On this leg of the trip, there were some 508 passengers onboard, the majority of which were unaccompanied teenage school students. The weather conditions were quite poor and a large number of passengers experienced sea sickness. The conditions were so poor that the Master decided not to allow passengers to assemble in the uncovered areas of the vessel.

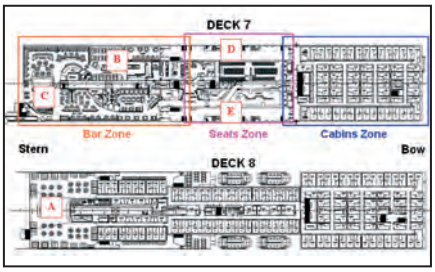


Figure 1: Location of assembly areas, *Roma*.

The second trial took place on the return leg of the voyage on the following day. On this leg of the trip, there were some 236 passengers onboard. There was a mixture of adult and unaccompanied school aged children. In this trial a large number of passengers were located in cabins and the public spaces. The weather conditions were fine and calm. In this trial the Master allowed the passengers to assemble in the uncovered areas of the vessel.

According to the trial protocols, once passengers boarded they were to be informed that an assembly drill would take place and that their performance would be recorded as part of a research study. It was considered important that the exact time at which the drill would take place was not passed onto the passengers until the last possible moment. Furthermore, while it was considered necessary to inform senior members of the crew concerning details of the drill, the majority of the crew should not be informed.

Even so, the degree of forewarning meant that the passengers and crew were alert to the impending drill well in advance. This meant that some passengers did not take the drill very seriously. In addition, a considerable number of passengers disengaged from their normal activities, for example bars and recreation spaces, including the casino were closed and ceased trading, and passengers returned to their cabins and were even donning lifejackets well in advance of the sounding of the alarm. Other passengers were moving towards the designated assembly areas prior to the commencement of the drill.

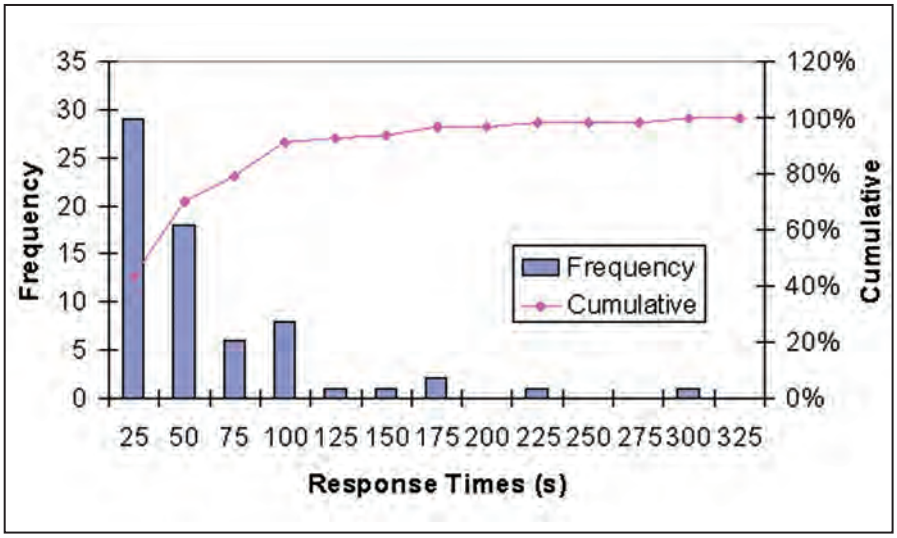
This had the effect of reducing the number of people from which useful response time data could be measured and perhaps of more importance, made the actual measured response time data less reliable as the precise start time for the process was unclear.

In situations with a reduced forewarning, passenger response time may be expected to be longer, with a greater period of time between the sounding of the alarm and the first movement of passengers. In addition, it is possible that levels of congestion experienced in various corridors and other regions of the vessel may be reduced due to the staggered nature of the passenger response.

This is not to say that the data produced in these trials was not representative of some shipboard emergency situations. In some actual shipboard emergency scenarios it is likely that a certain degree of passenger forewarning of the possible need to evacuate will be given prior to the general call to assemble, for example the *Sun Vista* and *Ecstasy* fire incidents.

The response time represents the time between the call to assemble (ie the start of the sounding of the alarm bleeper) and the time that the passenger makes a purposeful movement to leave their location and move towards the assembly area. It was noted that some

Figure 2: Histogram of the frequency distribution of the response times from the bar area across the two trials.



* Recommendations on the nature of passenger response time distribution to inform document MSC 1033 on assembly time analysis based on data derived from sea trials.

This article represents a summary of a draft paper to be published in the International Journal of Maritime Engineering(IJME) Vol148 Part A1 2007 (ISSN 1479-8751) in mid March 2007. For more information about obtaining a full version of this paper please contact publications@rina.org.uk

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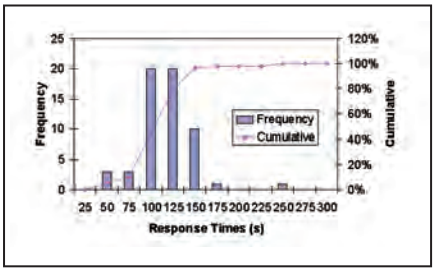


Figure 3: Frequency distribution of the response times of the passengers located in the aircraft style seating area during Trial 1.

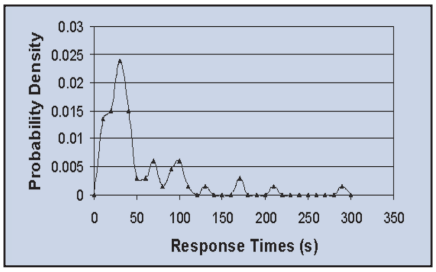


Figure 4: Response time probability density distribution for the bar area.

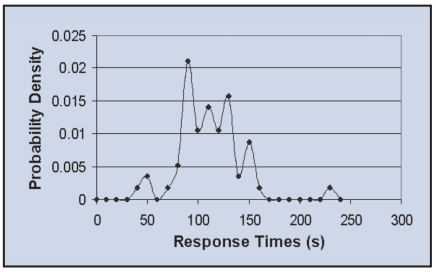


Figure 5: Response time probability density distribution for the aircraft seating area.

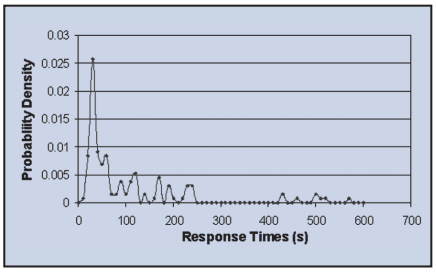


Figure 6: Response time probability density distribution for the cabin area.

passengers returned to their cabins to collect belongings or reunite with family members following the sounding of the alarm. In these cases, a preparation time was also measured. This represents the time between the time of arrival of the passenger at their cabin, up to the point when they reappear from their cabin and make a purposeful movement towards the assembly area. The preparation time therefore assumes that the passenger will have been informed of the need to assemble prior to returning to their cabin.

Across the two trials response time data for 264 people (representing 36% of the passengers onboard) was collected, 134 in Trial 1 and 133 in Trial 2. The breakdown of collected data in Trial 1 was as follows:

42 passengers in public spaces (bar area).
58 passengers located in the aircraft style seating.
22 passengers originally located in their cabins.
12 passengers who returned to their cabins.

The breakdown of collected data in Trial 2 was as follows:

25 passengers in public spaces (bar area).
0 passengers located in the aircraft style seating.
104 passengers originally located in their cabins.
4 passengers who returned to their cabins.

In the IMO uniform normal day response time distribution in the bar area extends from 210 seconds to 390 seconds.

In the trials, however, the range of response times extended from 3 seconds to 285 seconds with an average response time of 48 seconds.

As can be seen in Figure 2, the response time data is positively skewed with a significant number of the data-points falling within the lower quartile. The combined data appears to display a log-normal type shape, typical of response time distributions collected from evacuations in the built environment. In addition, the response time distribution observed in these trials for public spaces has a considerably lower minimum and a lower maximum than that specified by IMO for the day case.

Data from 58 passengers located in the aircraft seating area was collected from Trial 1. On average, these passengers responded after 106 seconds. The range of response times extended from 37 seconds to 230 seconds. The Aircraft Seating Area is a complex space as it represents an area where passengers sleep and store their possessions – as if in cabins – and it also represents a public area with day activities. It is thus potentially a mixture of the MSC 1033 day and night areas. Passengers in this area have not taken as long as passengers in the cabin area to respond (7 – 563 seconds with a mean of 98 seconds), but have response times which are comparable to those of passengers in the public area. However, in the seated area, unlike in the public spaces, we found fewer passengers with very short response times (ie response times near zero). Nevertheless, the overall response time distribution resembled a log-normal distribution, as found in the built environment, all-be-it translated slightly to the right.

Again, however, the response time distribution observed in these trials for the Aircraft Seating area had a considerably lower minimum and a lower maximum than that specified by IMO for the day case.

The range of response times derived from the two trials for the cabin area extended from 7 seconds to 563 seconds with an average response time of 98 seconds. The range of observed response times for the cabin area can be compared with the IMO night response time, which refers to sleeping passengers in cabins and extended from 420 seconds to 780 seconds and the IMO day response time, which refers to awake passengers in public areas and which extends from 210 seconds to 390 seconds. Clearly, the measured range of response time is significantly different from both the IMO night and day scenarios.

In addition to the range of response times, the nature of the functional form describing the trial distribution should be compared with the uniform random distribution specified in MSC 1033. The curve derived from this trial is non-uniform and skewed to the lower quartile times. This trend is similar to that found in response time distributions observed in day evacuations in the built environment having a characteristic log-normal shape.

The response time data for the bar, aircraft seating area and cabins was reformulated as continuous probability density distributions. This was based upon the original data taken over 10 second intervals.

Based on the data produced from the two *Roma* trials, a recommendation for response time distributions to be used in formal evacuation analysis was suggested.

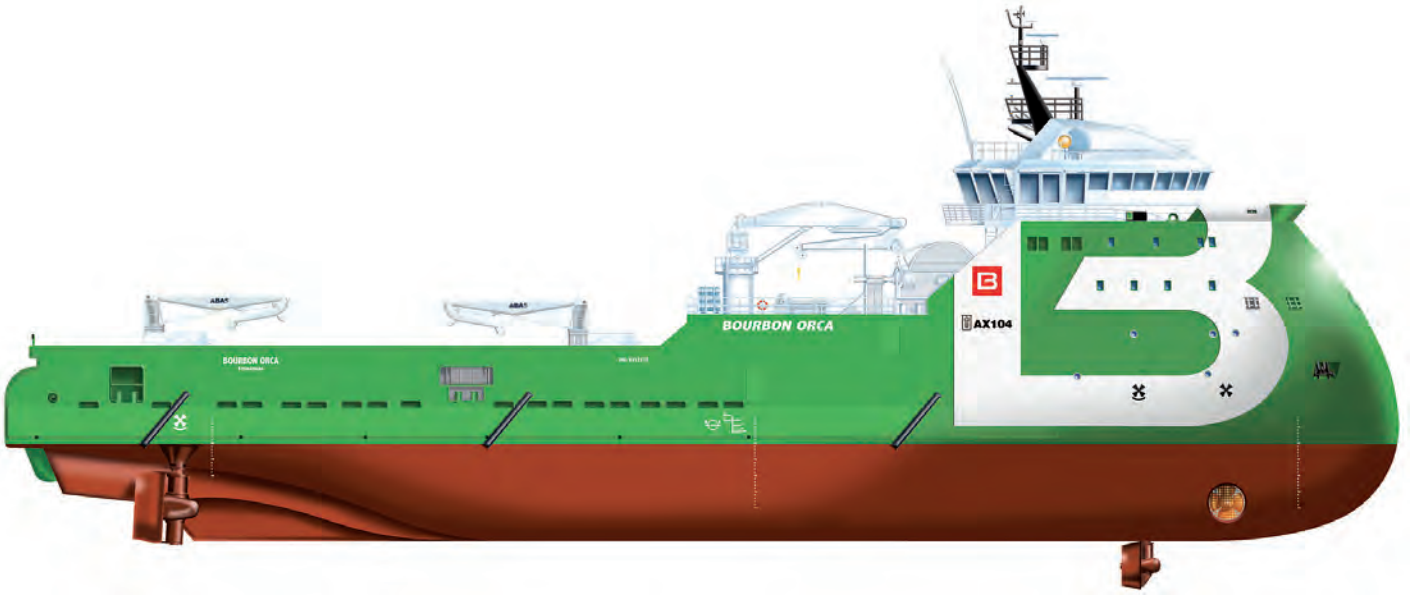
The main differences between the response time distributions derived from the *Roma* data and that recommended in MSC 1033 is the shape of the distributions and the range of response times. As already stated, the shape of the distributions derived from the *Roma* data is log-normal compared to the uniform random distribution of the MSC 1033 distribution. Furthermore, the shape of the *Roma* distributions conforms to the general shape of the response time distributions observed in the building industry.

Using the data derived from these trials, response time probability density distributions have been suggested to replace the existing uniform random distribution specified in the MSC 1033 evacuation analysis protocol for the day and night scenarios. The new curves, in particular the curve for the day scenario, has the advantage of being based on relevant experimental data as opposed to the existing curve which has been arbitrarily defined by committee.

Using the suggested probability density curves in certification evacuation analysis is therefore likely to facilitate more reliable insight into the strengths and weaknesses of a given vessel layout than the current method. The range in response times for the suggested day and night distributions start earlier and end earlier than the suggested in MSC 1033. When utilised in evacuation analysis, the suggested curves are therefore likely to produce shorter assembly times, but greater opportunity for congestion as more passengers respond to the call to assemble early on in the assembly process than produced by the current response time distributions.

As more data is collected from sea trials, the response time data used in evacuation certification analysis can be refined and more confidence in the validity of the data can be established. Furthermore, with the collection of more data, it may be possible to define response time data appropriate for different regions of a vessel. In this way a more accurate representation of passenger response can be incorporated into certification evacuation analysis.

Ask us about … new designs



The Ulstein AX104 anchor handling vessel is 83.6 metres long and has a beam of 18.5 metres. It is equipped with a 400 ton winch, DP2 (dynamic positioning) and has a maximum continuous towing power of 183 tons. The vessel is fitted out for 35 people in one and two man cabins. The vessel is equipped with a diesel electric propulsion system and can achieve speeds of 17.5 knots. Built to DNV Class.

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MANAGING RISK

Solution to fouling at lower speeds

A NEW and patented non-silicone based and biocide-free antifouling coating sees International Marine Coatings claiming to be five years ahead of the pack.

BY February 2007, some 199 ships of over 4000dwt had been specified as being coated with Intersleek 700, International Marine Coatings biocide-free, silicone-based foul release coating, designed to provide a very smooth, slippery, low friction surface onto which fouling organisms have difficulty attaching.

Owners, including AP Møller and Hapag-Lloyd have gone public in their endorsement of a product, which provides an alternative to the tributyl tin-free self polishing paints that quickly populated the market after International Maritime Organization administrations arrived at the Anti-Fouling Convention in 2001, looking to ban polluting TBTs.

With proven fuel saving or speed gain properties, variously given as between 2% and 6% over self-polishing alternatives, Hapag-Lloyd went so far as to say that the coating had saved it around US$600,000 per year, where initial application costs amounted to $150,000.

IMC itself says modestly that the average fuel saving over SPC anti-foulings runs at around 4.4%.

New users are still rapidly converting to the coating, with 100 of the 199 ships concerned booked for coating with Intersleek 700 due for coating in 2007. Applications extend across containerships (86, including *Emma Maersk*), LNG carriers (28), cruiseships (24) ro-ro vessels (22), tankers (18), vehicle carriers (6) and others (15). Even charterers are beginning to see the benefit of the application Intersleek 700 as an added sales tool.

Therefore, it is especially significant that, in considering vessels operating at speeds of below 15knots, International has broken with silicone, with a product development that supersedes its previous offerings across the board.

After seven years of development, the company has introduced what it describes as the next generation of foul release technology, in the shape of Intersleek 900. For the very first time, the company says, all vessels operating at above 10knots, including scheduled ships, tankers, bulk carriers, general cargo ships and feeder containers can benefit from foul release technology.

IMC said Intersleek 900 was a patented fluoropolymer foul release coating which significantly improved upon the performance of Intersleek 700.

As well as being exceptionally smooth, 'with unprecedented low levels of average hull roughness', the supplier said its new product offered 'excellent foul release capabilities and good resistance to mechanical damage'.

IMC business development manager for foul release technology, Clive O'Leary, said: 'The customer needs to meet schedule, and to minimise bunker costs, SOx and NOx emissions and repair costs to engines, as well as maintaining vessel appearance.'

International Marine Coatings' new Intersleek 900 exhibits its glossiness after application.

***NYK Andromeda* – one of the vessels tested that has demonstrated a new level of performance for an antifouling coating.**

He said that the coatings company was working in the context of shell fouling contributing 40% to increasing drag, while weed fouling contributed a 10% increase and slime a 1%-2% increase.

Given that fuel (currently priced at US$270 per tonne) represented the largest cost faced by a ship operator, choosing the correct fouling to keep roughness at a minimum was critical, with the world's merchant fleet reckoned to be consuming up to 300m tonnes of fuel per year. Minimising fuel burn also held one key to reducing the 960m tonnes of CO_2 and the 9m tonnes of SOx emitted into the atmosphere by ships every year. The IMO had estimated that, without corrective actions and the introduction of new technology, air emissions due to increased bunker consumption by the world's shipping fleet could increase by between 38% and 72% by 2020.

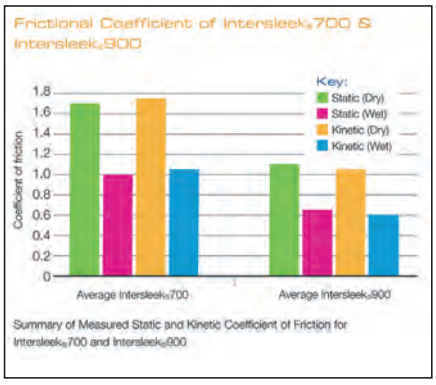
Looking to the future, IMC had considered whether silicone products could be extended to perform aboard ships operating at less than 15knots. Essentially, the question was whether Intersleek 700 could be adapted to achieve less drag, but other factors, such as shine, the ability to use an existing Intersleek 717 link coat, toughness, better cosmetic properties and improved application (no overspray) were also considered.

In all cases, IMC chemists concluded that existing silicone-based technology was not up to the job for vessels operating below 15knots.

Instead, they arrived at a fluoropolymer foul release coating exhibiting what is termed an amphiphilic surface, combining equivalent non-stick properties for both hydrophobic and hydrophilic organisms. Each type of organism was unable to stick to the ship's side because the surface exhibited opposing properties in one surface that were anathema to adhesion, Mr O'Leary said.

Marine fouling organisms secrete an adhesive that is hydrophobic or hydrophilic, depending on the species. By having a balanced amphiphilic adhesion surface, Intersleek 900 minimises the chemical and electrostatic adhesion between the surface and a wide range of fouling organisms.

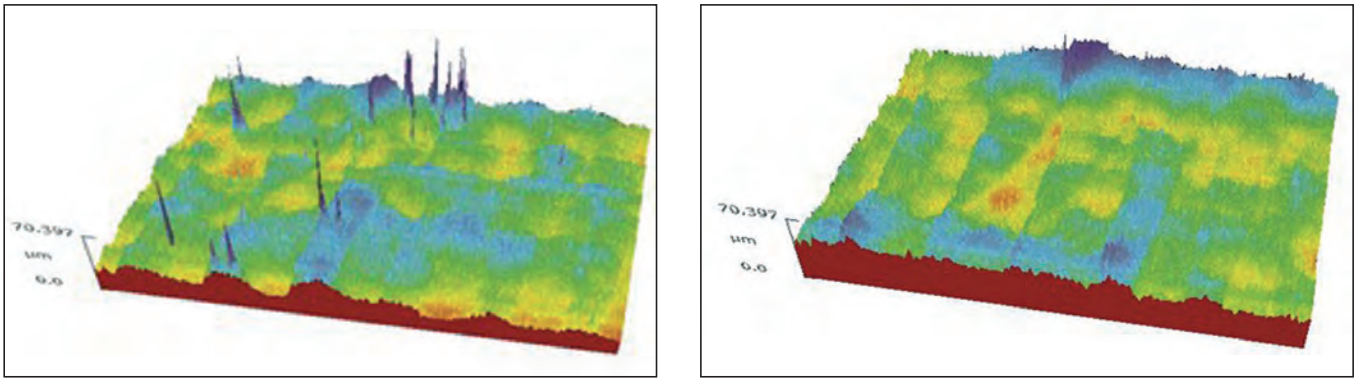
Intersleek 900 patch after 49 months in service.



Summary of Measured Static and Kinetic Coefficient of Friction for Intersleek 700 and Intersleek 900.

The technology is advanced enough for IMC to have taken out patents it reckons will afford it at least a five year start on competitors that are still pushing the wider adoption of foul release technology based on silicone.

After laboratory tests of Intersleek 900 involving Newcastle University, IMC followed up with tests involving patches aboard over 100 vessels, and nine full hull applications, including a 12 month trial aboard a VLCC operating at 16knots and a 49 month trial aboard the car carrier *Don Carlos*. IMC concluded that, across a 12knot-25knot range, Intersleek 900 was 25% smoother that its own Intersleek 700 silicone-based



Intersleek 900 profile (right) showing that the new coating is 25% smother than its Intersleek 700 predecessor.

system. In detail, the average hull roughness of Interlseek 900 measured on full ships was 75microns. This compared to Intersleek 700's 100microns and a typical SPC antifouling roughness of 125microns.

Furthermore, Intersleek 900 was established as offering a 38% better coefficient of friction; had up to 80% better static fouling resistance; 40% better foul release properties; 50% reduction in slime; 100% better hold up; 35% higher gloss; 60% reduction in overspray and 60% better abrasion resistance.

For marketing purposes, in terms of fuel efficiency and reduced emissions, IMC suggested Intersleek 900 offered predicted savings of 2% in comparison to Intersleek 700 and 6% in comparison to self polishing antifoulings. That is, the new antifouling can be seen to offer roughly 50% better fuel saving characteristics than IMC's market leading product.

In less formal circumstances, IMC chemists were willing to say that tests have shown an average fuel saving of 7.1% over SPCs. The potential existed for even greater savings in comparison to controlled depletion antifoulings, said the supplier.

'For a single VLCC currently coated with an SPC antifouling this could mean savings of over 4500tons of fuel, a reduction in carbon dioxide emissions of over 14,000tons and US$1.2 million over a five year period,' IMC said.

Where tanker operators would be interested in the extra speed conferred by the new coating, containership operators may be more swayed by its fuel saving properties.

The absence of biocides also brings claimed cost advantages at the next drydocking on treatment and disposal costs of wash water and blasting abrasive. European shipyards in particular may wish to note that the supplier is also claiming a 41% reduction in volatile organic compound emissions on application.

Conversion costs to the Intersleek 900 system from approved SPC antifoulings can be controlled via the use of IMC's especially designed linkcoat.

IMC reported that it had already secured 27 ships for application of its latest product in March and April, estimating, for example that an application aboard the 76,000dwt car carrier *Corona Ace* would achieve either a one knot gain in service speed, or the same operational speed but a reduction in engine operation from 105rpm to 98rpm, in turn leading to a $202,000 per year saving in fuel consumption, against a $220,000 initial Intersleek 900 application cost.

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Dual fuel engines make mark on LNG

THE dual fuel alternative has proved transcendent in the liquefied natural gas carrier market's break with steam turbines.

WHILE slow speed diesel engines were preferred for the very largest liquefied natural gas carriers ever to be ordered, owners of a more significant portion of latest generation LNG carriers have preferred dual fuel engines in their move away from the traditional steam turbine power plant fuelled by boil off gas.

Wärtsilä has so far been able to meet the demand for dual fuel engines with a unit that has been well proven in power generation applications - the 50DF. The engine is based on the 46 design, found in many ships running on HFO.

Dual fuel is a slight misnomer, because the 50DF is capable of running on natural gas, and both light and heavy fuel oils. Wärtsilä has supplied over 200 of these engines for 52 LNG ships.

Due to this success, and with demand expected to continue growing at a fast pace, Wärtsilä and Hyundai Heavy Industries (HHI) recently signed an agreement to set up a 50/50-owned joint venture in South Korea to manufacture dual fuel engines for LNG. The total investment in the company will be €58 million, each company putting up half of the funds. The new company will be known as Wärtsilä Hyundai Engine Company.

The joint venture will manufacture Wärtsilä 50DF dual-fuel engines for the Korean, Japanese, Chinese and Taiwanese shipbuilding markets. Focusing on assembly and testing of the engines, it is scheduled to deliver its first engine in the second half of 2008. The factory will have sufficient capacity to produce 100 engines a year. Wärtsilä will serve the Japanese, Chinese and Taiwanese markets through its own sales organisation, while the Korean market will be served directly by the joint venture company.

The two companies have a long history of close cooperation, with HHI being a major licensee building low speed engines to Wärtsilä design. HHI is in fact the world's largest builder of two-stroke engines, for both Wärtsilä and MAN designs.

Wärtsilä's Trieste factory in Italy will continue to manufacture 50DF dual fuel engines for markets other than the East Asian marine sector.

According to Wärtsilä, the 50DF can switch over from gas to LFO/HFO and vice versa smoothly during engine operation. It is available in configurations from 6 cylinders in line up to 18 cylinders in vee format, giving 950kW per cylinder at 500 or 514rev/min. The designers claim a maximum thermal efficiency of 47% (± 0% tolerance), higher than for any other gas engine.

The 50DF is designed to provide high output with fuel flexibility, low emission rates, high efficiency and high reliability. The engine functions are controlled by an automation system that allows optimum running conditions to be set independent of the ambient conditions or fuel. Power output is the same regardless of the fuel being used.

Both the gas admission and pilot fuel injection are electronically controlled. This ensures that the correct air-fuel ratio can be set for each cylinder individually and that the minimum amount of pilot fuel can be injected while ensuring safe and stable combustion. All parameters are controlled automatically during operation. Emissions are designed to be within IMO and the German TA-Luft standard for operation on natural gas.

The 50DF operates on the lean-burn principle: the mixture of air and gas in the cylinder has more air than is needed for complete combustion. Lean combustion reduces peak temperatures and therefore NOx emissions. Combustion of the lean air-fuel mixture is initiated by injecting a very small amount of LFO (pilot fuel) into the cylinder. The pilot fuel is ignited in a conventional diesel process, providing a high-energy ignition source for the main charge.

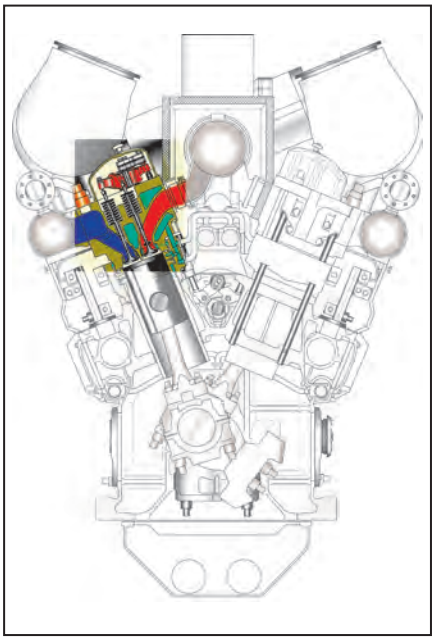
A divided fuel system handles gas and oil separately; the oil side being further divided into pilot fuel and backup fuel. The engine is started in diesel mode and switched to alternative fuels when combustion is stable in all cylinders. The twin-needle injection valves, for diesel mode and pilot fuel oil, are electronically controlled, and the main diesel injection is hydro-mechanically controlled. The gas admission valves are electronically actuated and controlled to give the correct amount of gas to each cylinder.

Wärtsilä says that the pure gas fuel used contributes to an extended time between overhauls, although ease of maintenance is also an important design feature.

The 50DF can run on most natural gas qualities. The nominal design point is a Methane Number of 80. The engine can be operated on gases with lower Methane Numbers with a different performance.

Meanwhile, MAN Diesel's dual fuel engine for the LNG carrier market was demonstrated in October 2006, and is designated the 51/60 DF. It is designed to be capable of running on boil-off gas from the tanks of LNG carriers or on conventional liquid fuels as back-up. It, too, has been developed to give LNG carrier operators a more efficient alternative to propulsion systems based on steam turbines and offers a power output of 1000kW per cylinder, with versions available of nine cylinders and vee configuration versions with 12, 14, 16, and 18 cylinders. The 51/60 DF features the capability to switch smoothly from gaseous fuel to liquid fuel without interruption of propulsion power.

MAN Diesel says that with the dual fuel engine technology it has concentrated on the whole LNG ship, in partnership with other organisations such as gaseous fuel supply system specialist Atlas Copco and classification society DNV. The company's safety concept for LNG carriers has already been approved in principle by DNV and Lloyd's Register.



Cross section detail of MAN Diesel's innovative 34/40 PGI gas engine.

According to MAN Diesel, the 51/60 DF will be ready-for-market in time to power LNG carriers that are currently at the project stage. The company expects gaseous fuels will play an increasingly vital role in the global energy economy and with both the 51/60 DF and the smaller 32/40 PGI gas engine, currently offered to the power plant market, it expects to be able to meet market demands.

The 32/40PGI gas engine is not yet launched to the marine market, but it is of considerable interest, as it operates on the Otto principle, using a novel start-up and ignition system, which does not need spark plugs. MAN Diesel claims that the 32/40PGI combines the advantages of a diesel engine such as high power density and high efficiency with the benefits of a gas engine. As a result, it enables efficient conversion of natural gas into thermal and electrical energy with what MAN Diesel claims to be the lowest possible emissions.

In the PGI-ignition process a small quantity of ignition gas is injected into a pre-chamber separate from the main combustion chamber. There, it is ignited on a hot surface and initiates the ignition of a lean air-gas mixture in the combustion chamber. This lean mixture contains a high excess of air so that, in combination with an effective method of ignition, efficiencies are achievable approaching those possible with a current diesel engine. This results in low emissions without the need for elaborate after-treatment to reduce NOx. Efficiencies in excess of 46% are claimed, in combination with NOx emissions of less than 250mg/Nm³ at 5% O_2.

Further major technical details of the new gas engine are individual gas supply lines to each cylinder, which, together with MAN's own engine management system, ensures optimum fuelling of each individual cylinder. The ignition system is characterised by long maintenance intervals compared with conventional gas engine ignition systems.

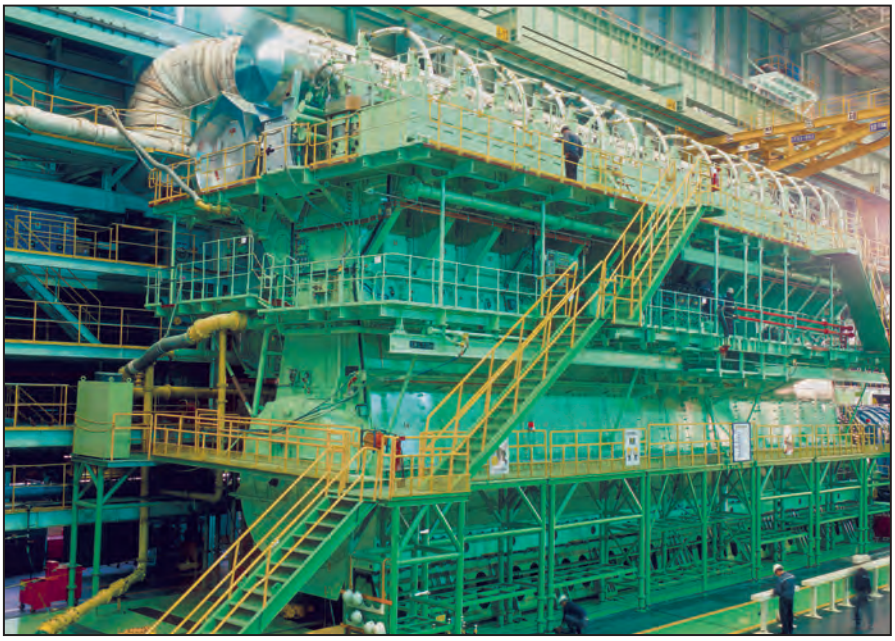
Landmark engines for landmark projects

THE last year has seen some notable advances in two stroke engine design.

THE propulsion landmark of 2006 remains the entry into service of the most powerful marine engine yet built. The world's first 14-cylinder low-speed engine entered service in *Emma Maersk*, built at Denmark's Odense Steel Shipyard. The engine was built by Doosan Engine Company of South Korea, under licence from Wärtsilä. The 14-cylinder RT-flex96C engine has an output of 80,080kW (108,920bhp).

The 14-cylinder RT-flex96C engine is worthy of closer scrutiny in that it extends the power available to suit the new generation of large containerships while combining the benefits of proven, reliable engine designs with the flexibility of common-rail fuel system technology. This is claimed to result in smokeless operation at all operating speeds, lower fuel consumption, reduced maintenance costs and lower steady operating speeds for better manoeuvring.

Emma Maersk is the first of a planned 12-ship class of similar very large 11,000TEU-plus container carriers for AP Møller. The similarly-powered sisters *Estelle Maersk* and *Eleanora Maersk* have also already been delivered.



The first 14-cylinder Wärtsilä RT-flex96C marine engine has a maximum continuous power output well over 100,000bhp. Measuring 27.3m long and 13.5m high, it has an overall weight of 2300tonnes.

Traditionally low-speed marine engines have been built with a maximum of 12 cylinders. However, when it was recognised some years ago that envisaged containerships would need a greater power output, a solution was found to extend the engine power range by offering 13- and 14-cylinder engines. The practicality of the increased numbers of cylinders as well as safety, reliability and durability considerations are said to have created considerable challenges for the designers.

The RTA96C engine design had already seen modifications to accommodate the common-rail fuel system, which resulted in greater stiffness and lower stresses in the structure. These changes took into account the 14-cylinder engines to ensure that they had adequate structural strength and rigidity.

The crankshaft of the RT-flex96C was designed with sufficient torque capacity for 14 cylinders, the material having been upgraded to enable an increased shrink fit for a greater design margin. The thrust bearing structure in RT-flex96C engines with a mid-gear drive has been revised to reduce deformations and stresses even with the increased thrust in the 14-cylinder engine when the vessel is equipped with a shaft motor.

The common rail system has solved potential problems of camshafts and fuel supply in 14-cylinder engines by introducing fully electronic control, simplifying the pump arrangements.

An important feature of the first installation of the 14RT-flex96C is the high-efficiency waste heat recovery system. It contributes to reductions in fuel consumption and in exhaust gas emissions.

Exhaust gases of the ship's main engine pass through an exhaust-gas economiser to generate steam for a turbine-driven generator. The turbogenerator set also includes an exhaust-gas power turbine driven by a portion of the exhaust gases diverted from the main flow through the engine's turbochargers.

This can provide an electrical output of up to about 12% of the main engine power. The generated electricity is supplied to the ship's main switchboard and employed in a shaft motor to assist in ship propulsion. A portion of the steam from the exhaust economiser is used in shipboard heating services.

Energy recovery is maximised by adapting the engine to the lower air intake temperatures that are available by drawing air at ambient temperature from outside the ship instead of from the ship's engineroom. The engine turbochargers are matched for the lower air intake temperatures thereby increasing the exhaust energy without affecting the air flow through the engine. There is no increase in the thermal loading of the engine, so no adverse effect is expected on engine reliability.

Rival MAN Diesel has indicated that its solution for the very largest of containerships continues to focus on wringing out the last drops of power from engines with fewer cylinders. The first 7S65ME-C is installed in oil tanker *Ice Explorer*, delivered by Universal Shipbuilding Corporation in Japan to its Greek owner in September 2006. The S65ME-C engine is a direct result of close cooperation between MAN Diesel and its customer, and, according to the designer, is tailor-made for efficient power production for a broad range of medium sized vessels, including bulk carriers and containerships. Sister vessel, *Ice Transport*, was delivered during October, with a third in class also contracted.

MAN B&W says that its S65ME-C is designed to offer owners of vessels requiring power outputs between 14,350kW and 22,960kW a compact power unit employing the latest technology to optimise fuel use, reduce lube oil consumption, extend time between overhauls and offer reduced overall maintenance costs.

An electronic control system is intended to give precise control of the fuel injection and exhaust valve timing, and optimum fuel efficiency. Other features of the new design include improved piston ring pack configuration, bore-cooled cylinder liners, better exhaust valve performance and an OROS-profiled piston crown designed to improve combustion temperature parameters.

MAN B&W Diesel has also introduced two new smaller engines to its low speed portfolio. The S35ME-B and S40ME-B are upgrades of the existing 35MC and 42MC engines, offering electronic control for improved economy, management and manoeuvrability. The company says that its market research showed a need for a 35cm bore engine with slightly reduced speed at 167rev/min and higher engine power, as well as a 40cm bore engine running at 146rev/min, to fill a gap between the company's S26MC and S50MC-C/ME-C types.

To keep production costs down, which MAN B&W says is important in this sector, the exhaust valve is still camshaft-operated, but the camshaft is smaller and simpler.

Orders were soon received for the first examples of both types, with two 8S35ME-B units ordered by a Turkish company for delivery in 2008. The engines will be built by MAN B&W Diesel in Frederikshavn. A Cypriot owner has ordered a total of twelve 6S40ME-B engines, two batches of 25,000dwt multipurpose cargo vessels, six to be built in China and six in South Korea.

The designer says that the electronic fuel system control enables owners to meet environmental requirements, as well as offering fuel consumption as low 170g/kWh.

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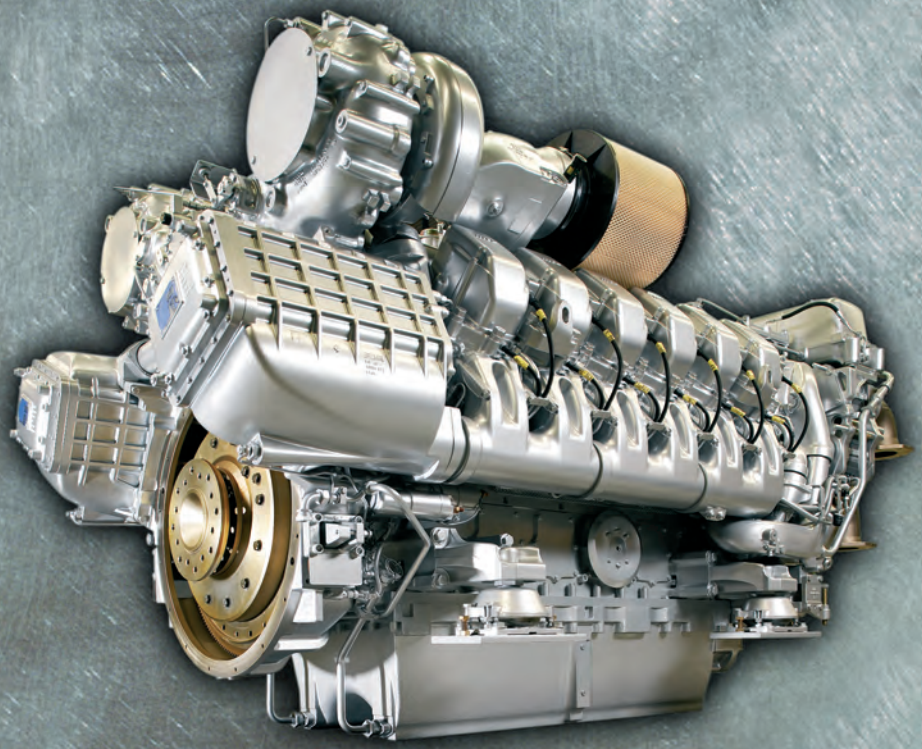

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Medium speed range gains common rail system

TWO step approach to electronic control.

DURING 2006, Caterpillar introduced a common-rail fuel injection system for its MaK range of long-stroke medium speed engines. The first engine in the four-engine portfolio to gain electronic control is the M32.

Although Caterpillar sees electronic controls as the way forward in meeting emissions limits and improving performance and fuel economy, it decided to adopt a two-step approach to introducing the new technology. Step one uses what the company calls its flexible camshaft technology (FCT) while step two incorporates the Caterpillar common rail fuel system (CCR).

FCT is intended to achieve synergy between flexible fuel systems and advanced air systems. While maintaining a high fuel injection pressure over a wide operational range, fuel injection timing is load controlled. Increased injection pressure at part load leads to finer fuel atomisation and reduced smoke. At part load, inlet valve timing is also changed to raise the effective compression and enhance complete combustion. FCT is based on a mechanical lever shaft automatically influencing both injection timing/pressure and inlet valve events. The engine load required to activate the lever can be flexibly set according to the operator's needs. The major benefit is elimination of smoke at part load, and FCT has already been used on M32C and M43C engines supplied for passenger vessels.

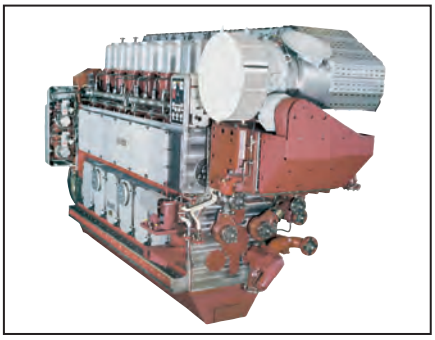
For future regulatory compliance, the company is now introducing the CCR concept to cope with even stricter soot reduction limits. It employs 'injection maps', a technology to tune injection characteristics for every engine operating point.

In general, CCR permits vessel operation without visible soot throughout the whole of the operating range. Furthermore, during normal load, fuel consumption can be reduced without sacrificing NOx emissions. CCR is suitable for HFO, MDO and DO operations and can be retrofitted to MaK C-series engines.

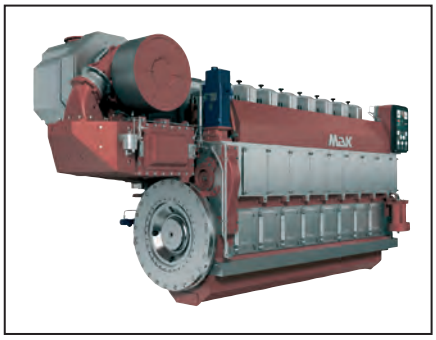
CCR stems from Caterpillar's experience with electronically controlled high speed engines, which provided the basis for the high-pressure pump, rail, injector, electronics hardware and control strategies.

The company says that it was testing common rail solutions for MaK engines as long ago as 1988. Since then the various solutions have been developed, and although MaK's common rail system may not be the first on the market, the company believes this is no bad thing. Compared with mechanical solutions, the electronically controlled injection system is expected to provide stable operation and stable emission values long term – due to closed-loop control. Injection mapping has the potential to balance the overall wear of an ageing engine.

CCR follows extensive research on system durability with HFO operation. Starting with the M32 C series, CCR will eventually be available for the whole MaK medium-speed portfolio, comprising the M20 C – which has recently seen some improvements – M 25, M 32 C, and M 43 C engines.



The MaK M32C is the first of the company's medium speed range to receive a common rail fuel system.



MaK has recently incorporated a package of improvements into its M20 long stroke engine, for increased reliability and ease of maintenance.

More power for HiMSEN

HHI-EMD has developed the fourth model in its growing range of medium speed diesel engines, in the shape of the Hyundai-HiMSEN H32/40. The latest product joins its existing H17/28, H21/32 and H25/33 models.

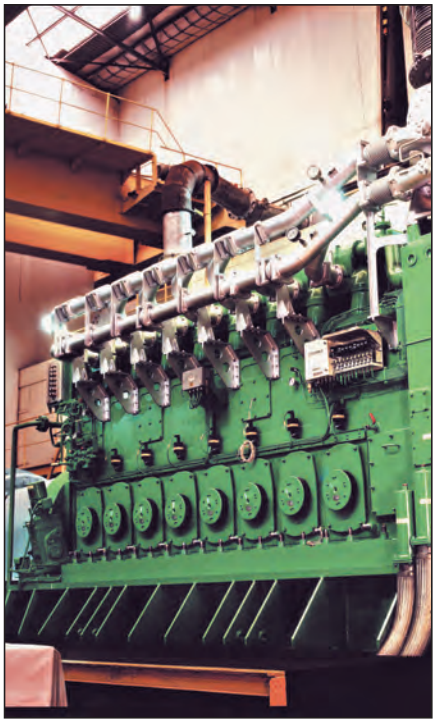
Type approval tests of the new H32/40 engine were carried out at HHI's engine development laboratory over three days in December 2006 in the presence of six classification societies including ABS, DNV, GL, etc.

The H32/40 was developed based on a design concept that aimed at a practical and environmentally-friendly engine. Its cylinder bore measures 320mm with a piston stroke of 400mm, while the engine has a speed of 720rpm or 750rpm, producing 3000kW in its 6 cylinder configuration and to 4500kW in the 9 cylinder engine, based on the 500kW per cylinder.

The new model has the most powerful output capacity out of the four engine models within the HiMSEN line and includes a damper-less system in the principal axis and optimised design in its major components.

		H32/40	
Bore	mm	320	
Stroke	mm	400	
Stroke/bore		1.25	
Engine speed	rpm	720	750
Output/cyl.	kW	500	500
Piston speed	m/s	9.6	10.0
BMEP	bar	25.9	24.9
Power Density	b.m/s	249	249
Pmax	bar	190	190
SFOC	g/kwh	183	185
kW per cylinder	6	3,000	3,000
	7	3,500	3,500
	8	4,000	4,000
	9	4,500	4,500

HiMSEN's new 32/40medium speed diesel engine being put through its paces for type approval in December 2006.



High speed engines get cleaner

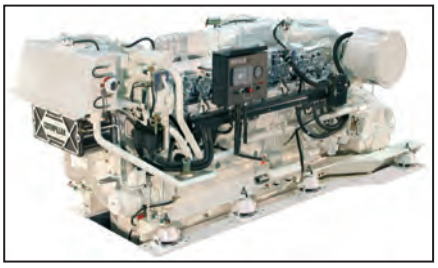
HIGH speed engine builders are on the march. Caterpillar's high speed range has seen the 3500 series receive significant upgrades to provide lower emissions with higher power outputs. Featuring 8-, 12- and 16-cylinder designs, the Cat 3500C marine engine family covers a power range from 578kW to 2525kW. Applications include workboats, patrol craft, tugs, fast ferries, coastal freighters, and yachts.

The company says that demand for the larger 3500 and 3600 families of engines has grown substantially for most applications.

The new ratings for the 3500 engines come thanks to Caterpillar's ACERT technology, featuring optimised injector spray angles and a combustion crater, high-efficiency turbochargers, A3 electronic control unit, drilled connecting rods and high-flow piston cooling jets. For the 16-cylinder high power ratings, a modular pulse exhaust manifold combines with a wastegate to provide optimal turbocharging efficiency.

The smaller C18 and C32 series commercial high-speed engines are also benefitting from the ACERT components.

Scania, meanwhile, has managed to fight off a takeover from the rival MAN Group and remains an independent Swedish company with two marine engine families, based on 12- and 16-litre blocks, handling a power range in commercial ratings from 221kW to 478kW.



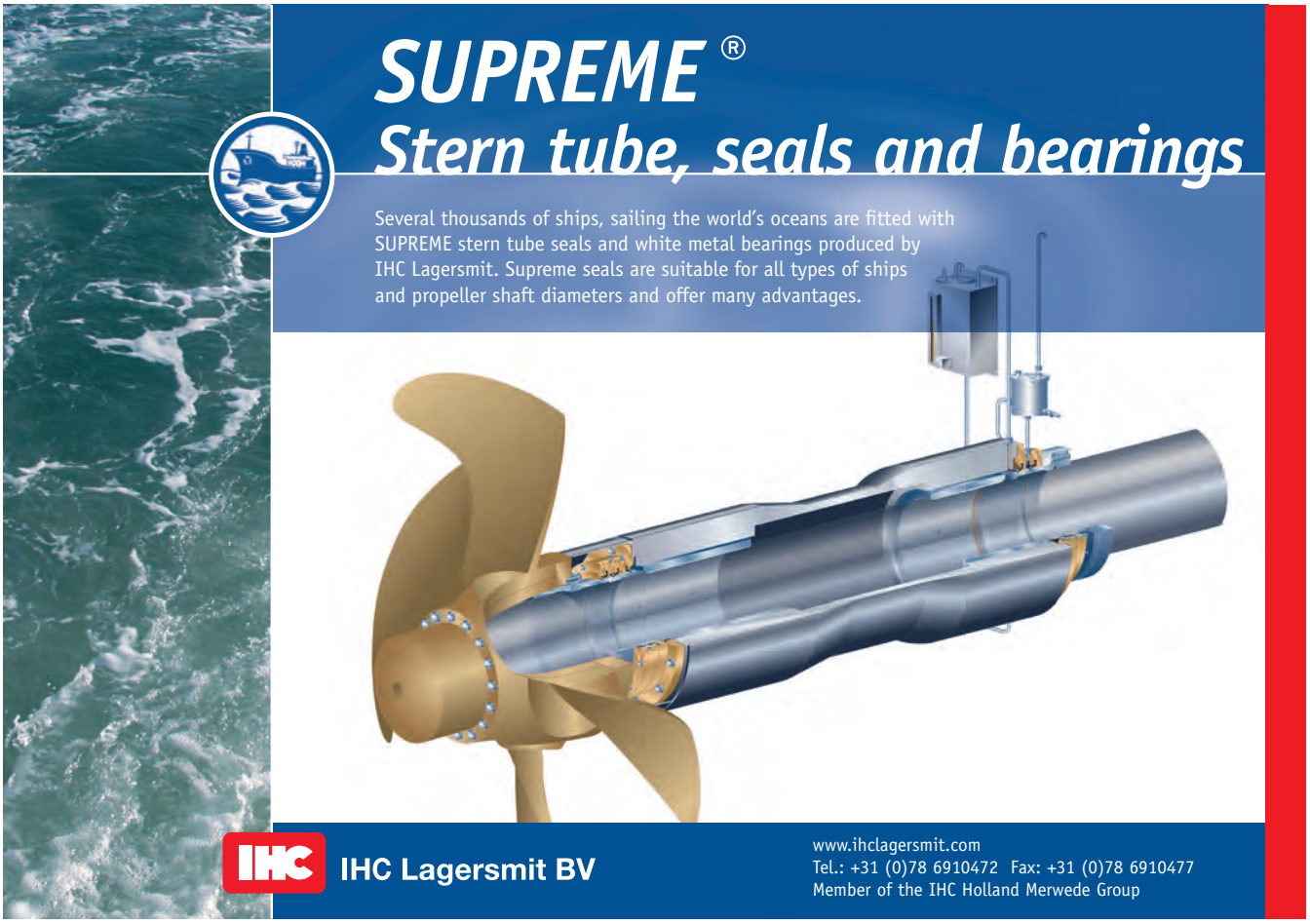
The Caterpillar 3500 series has been upgraded for higher power and lower emissions – the maker says that demand for the larger versions, like this 16-cylinder 3516, is at record levels.

A pair of MTU's 20-cylinder 8000 series engines – half of a fast ferry propulsion package.

Volvo Penta is also active in the high speed market with propulsion engines and marine gensets.

Elsewhere, MTU of Germany has regrouped itself under the Tognum name, along with other former Daimler-Chrysler group companies including Detroit Diesel and L'Orange, in 2006. The common-rail version of the 2000 series engine was joined in 2006 by a similar upgrade for the 4000 series, with higher power and lower emissions.

Most of the engines mentioned briefly above have their homes in the sub-100m vessel category, but for larger vessels MTU's 8000 engine offers a high speed alternative to the MAN RK280 series for large fast ferry propulsion. A typical installation is the Austal-built trimaran ferry *Benchijigua-Express* which has four MTU 20V 8000 diesel engines, with total output of 32,800kW, sufficient to give the 127m vessel a service speed of just over 40knots. More recently, the first 107m fast ferry for Hawaii Superferry was delivered by Austal: this ship also has four 8200kW MTU 20V 8000 M70 main engines connected to four ZF 53000 gearboxes, driving Kamewa 125 S11 waterjets. The yard said that another make of engine had originally been specified, but this had to be changed to MTU because of supply difficulties, but MTU was able to supply four engines within schedule – and they were in fact installed in the hull, at Austal's USA shipyard, ahead of schedule.



Gas turbines maintain naval position

GAS turbines still remain mostly in their niche markets of naval vessels and generating sets for electrically-propelled cruiseships.

Rolls-Royce describes its MT30 as 'the largest naval gas turbines in the world'. The engine has been ordered to power the Lockheed Martin-designed Littoral Combat Ship (LCS). Two MT30s have been installed in the first LCS, and two more have been contracted for the second vessel, with delivery to the builder, Bollinger Shipyard, scheduled for early 2007. The MT30 is also the chosen power unit for another US Naval project, the Northrop Grumman DD(X) destroyer integrated power system engineering development model, at the US Navy research site in Philadelphia.

Rolls Royce says that the MT30 has 80% commonality with the Trent 800 aero engine, which has achieved more than 8 million flying hours since entering service in 1996.

Rolls-Royce also delivered the first three gas turbine generator sets which will provide the main electrical power system for the Republic of Korea Navy's first 7000-tonne destroyer, designated KDX-III. The first AG9140RF gas turbine genset was produced at the Rolls-Royce Indianapolis plant, and the other two were assembled by Samsung Techwin from Rolls-Royce supplied kits. Another six sets, being assembled by Samsung Techwin from Rolls-Royce supplied kits, will be supplied to the other two KDX-III destroyers on order.

The MT30 being prepared for test at the Rolls-Royce site in Bristol.

GE Marine says that gas turbine engines continue to enjoy a prominent position in the market for propulsion of naval vessels. The company points out that its LM series aeroderivative engines have been chosen by ten European navies to power a variety of surface ships, involving a total of 169 engines. To date, the European naval fleet of LM gas turbines is claimed to have logged more than 1.5 million hours in military service.

The first European COmbined Diesel And Gas turbine (CODAG) configuration for naval service was applied to the German Navy's three Sachsen-class F124 frigates. The LM2500 engines were supplied through GE's German partner MTU.

Other German LM2500 applications are the F122 Bremen-class frigates and F123 Brandenburg-class frigates. GE reports that the LM gas turbines are being considered for the F125 next-generation frigate.

GE's newest engine in the LM range, the LM2500+G4, is being supplied to the Italian and French navies for their Fregatte European Multi-Mission (FREMM) project. The engines are being supplied by Avio of Italy, which is a GE Marine Systems supplier and the prime contractor for the FREMM propulsion system. LM2500 gas turbines currently power four Horizon frigates about to be introduced in the French and Italian fleets. In the Italian navy fleet, the LM2500 was the choice for the latest Cavour aircraft carrier, while GE has supplied a further 40 LM2500 gas turbines for the Italian Navy's Lupo, Maestrale and Artigliere class frigates, its De la Penne-class destroyer and its Garibaldi aircraft carrier.

In Norway, five LM2500 gas turbines in CODAG configuration power the Spanish-built F310-class frigates, while Spain's own four F100 multi-purpose frigates each use two LM2500s in a CODOG (Combined Diesel Or Gas turbine) arrangement. GE also supplied the Spanish Navy with 12 LM2500s that power six FFG Santa Maria-class frigates, and two LM2500s in the aircraft carrier Principe de Asturias. Other European navies that employ LM gas turbines include: Portugal (six gas turbines in three frigates); Denmark (14 LM500 gas turbines in CODAG arrangements in high-speed patrol boats, and three LM2500 gas turbines in CODOG configurations powering three corvettes); Poland (two LM2500-powered ex-US Navy frigates); Turkey (four frigates each using two LM2500s in CODOG configuration, plus eight ex-US Navy frigates); and Greece (two LM2500s in a CODOG arrangement for four Hydra-class frigates).

In the cruiseship sector, the attractions of gas turbines appear stalled. GE's aeroderivative engines continue to be employed onboard cruiseships. Most of these are in applications where the gas turbine engines power generating sets, some with further generators powered by steam turbines using recovered heat from the gas turbine prime movers (ie COGES – COmbined Gas/Electric and Steam configuration) and some with the gas turbine generating sets combined with diesel-powered generators, in a variation on the Combined Diesel And Gas turbine (CODAG) system.

The reference list comprises 22 LM2500+ and four LM2500 GE gas turbine-generator sets, on 17 cruiseships. This includes four ships for Royal Caribbean International, each using two LM2500+ gas turbine-generator sets in a COGES configuration; and four more for Celebrity Cruises, also with two GE LM2500+ gas turbine-generator sets in a COGES configuration.

Princess Cruises has four ships with CODAG propulsion system using one GE LM2500+ gas turbine-generator set, with either two or four diesel gensets.

Holland America Line's four gas turbine powered cruiseships also opt for the CODAG configuration with a single LM2500 gas turbine genset and five diesel-generator sets.

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Shipping looks to wind power to save fuel

EVER-rising fuel costs, concerns over security of oil and gas supplies, legislation to reduce engine emissions, and general pressure to make full use of renewable energy are forcing ship designers and operators to reconsider natural forms of propulsion, usually as a supplement to conventional systems.

WIND power proposals for modern commercial vessels take several forms, few of which bear any resemblance to traditional sailing ships. Earlier attempts at harnessing wind power used sails on masts, either sails similar to traditional sails or wingsails, similar to aircraft wings on end.

German company Sail Log has been carrying out investigations into sail assistance, or even full sail propulsion, using a rig similar to a traditional square rig, on a 50,000dwt panamax bulk carrier, with 20,000m^2 of sail. Because bulk carrier routes are regular runs, without the need for high speeds, and mostly follow routes in a general north-south direction that can make use of the earth's prevailing winds, these have been identified by Sail Log as suitable for this type of propulsion. Sail Log's parent company, Schwab-Orga, holds patents for a modern square rig design with automated sails. The project has reached model stage, which, says Sail Log, has confirmed its expectation that sail assistance could be used for about two thirds of a typical voyage, and overall running costs with sail assistance could be reduced by 22% or more compared with conventional full-diesel propulsion.

Earlier experiments with wingsails suggested even greater savings could be possible, but those projects were terminated when oil prices fell and it was decided that the payback time for sail systems was too long, and the increased maintenance involved with wingsails meant that such systems were difficult to justify on economic grounds. However, with emissions and sustainability entering the equation, the situation is rather different and some experts feel that the time is right for a revival. Even back in the 1980s when the original trials were carried out, the conclusion was drawn that wingsails could prove a future economic option for large cargo vessels.

A later concept from Danish consultants Knud E Hansen, known as the Modern Windship, looked at the application of sail assistance to a 50,000dwt product carrier. This showed that due to various factors, the sail assisted ship could actually use more fuel and cost more to run than a standard product tanker. However, a subsequent study suggested that the greater cargo volume possible with the windship design, running at a slightly slower speed, made it much more competitive, so the concept is far from dead. The hybrid sail concept of the windship continues to attract interest, particularly in Japan.

Perhaps the most promising of the current wind-assistance projects involve kite technology. These avoid the problems associated with masts. Masts increase drag, can make loading and unloading difficult, can be too tall for transits such as the Panama Canal, and generally increase the complexity on deck. Kite assisted propulsion aims to avoid these problems, while taking advantage of the stronger winds above the heights normally attainable by sails on masts.

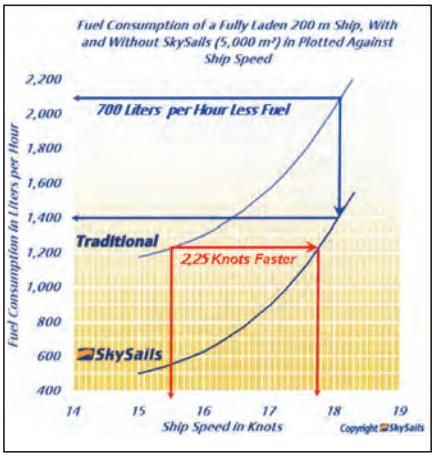
SkySails test vessel *Beaufort* demonstrates the kite concept.

Similar kite systems have been developed by SkySails of Germany and KiteShip of the USA, specifically for cargo ships.

KiteShip stresses that the system can simply be retrofitted to existing ships, and requires none of the ballast, masts, and increased weight and complexity associated with normal sail systems. The company believes that the increased cost of building sailing ships cannot be amortised over the life of a normal ship, putting them at an economic disadvantage compared with a motor ship, even when the latter's increased fuel costs are included. Added to this, wind cannot be depended on to blow when needed, so sailing ships need motors too, and parallel systems – sail and diesel – which add to building, operating and maintenance costs.

Kites can be used on existing, conventional ships. They require no masts, no ballast, do not take up deck space, and are simple to

The SkySails kite concept as envisaged on the *Beluga Skysails* cargo vessel.



Potential fuel savings from SkySails system.

maintain. KiteShip intends to fit an 8000ft^2 kite to an existing cruise vessel to demonstrate the concept.

SkySails says that it can help operators to reduce fuel costs by as much as 50%, with 10% to 35% savings being realistically achievable depending on actual conditions. Pilot systems have recently been applied to large yachts, and the first SkySails systems for commercial use on cargo vessels are expected to become available in 2007, with large cargo ship systems available the following year. Accurate figures are not available, but various estimates say that the cost of a SkySails kite system for a cargo ship should be recovered in three to five years.

2006 saw the SkySails cargo ship application reach fruition, following the purchase by German company Beluga Shipping of a kite system for a newly built 140m ship *Beluga Skysails*, with demonstration cruises to begin during 2007. The shipping company says that this is a timely purchase, with continuously rising oil prices and tightened emissions regulations combining to make renewable energy highly attractive.

Initial training and familiarising runs onboard the Beluga ship have shown the promise of the system. The concept is also thought to have considerable potential in the fishing trawler marketplace.

Fuel cells take small steps toward reality

THE fuel cell is nothing new – and as such it should hold a certain appeal for the often ultra-conservative marine engineer.

IT was nearly 170 years ago – in 1839 to be exact – when the electrochemical reaction principle behind fuel cell technology was first harnessed by Sir William Grove. It was many years after that, though, when the first practical application of fuel cells came to fruition, as part of the US Apollo space programme, which used an alkaline fuel cell to produce electricity and drinking water.

Since then, interest in the technology has really taken off, with serious investigations underway, particularly in the transportation and power generation industries. A lot remains to be done, most notably in the production and storage of the necessary hydrogen gas. So a fuel cell powered ship is still some years away, although small fuel cell powered vessels, and land-based vehicles, have been successfully demonstrated.

The three main types of fuel cells are defined by their operating temperatures: low-, intermediate- and high-temperature.

According to Wärtsilä, which has carried out its own investigations into the possibilities of fuel cells for ship propulsion, most transport applications up to now have employed low-temperature fuel cells such as the PEM type. These offer fast start-up, compactness, and a low temperature level is needed. In these applications the waste heat is not usually used. The main disadvantage of these technologies is the need for high purity hydrogen, and the use of noble metals such as platinum as the catalyst.

The type of fuel cell with the highest current commercial availability is the phosphoric acid fuel cell (PAFC) where phosphoric acid is used as the electrolyte and platinum as a catalyst on both the anode and cathode sides. However, for true commercial use, its disadvantages are high production costs and fairly low efficiency.

Cheaper and more efficient fuel cell technologies, such as the solid oxide fuel cell (SOFC) and molten carbonate fuel cell (MCFC), have been developed for industrial energy production. These technologies are expected to become more competitive than PAFC within a few years.

High-temperature SOFC and MCFC cells offer higher efficiency and have the benefit that waste heat can be harnessed as an energy saving measure. This makes them more suitable for industrial applications, including possibly ship propulsion. In continuous operation the long start-up time of the units is less of a problem.

SOFC technology is currently being developed intensively for APU (auxiliary power unit) applications to power the increasing demand for electricity in vehicles, and on a larger scale, megawatt-class fuel cells are under development for large-scale power generation.

A Siemens SOFC fuel cell, of a type that could be used as the basis for high-power applications.

All fuel cell technologies share the common features of being clean, reliable and comparatively efficient in their use for electricity generation.

Wärtsilä believes that the marine industry is coming under ever increasing pressure to reduce emissions and to become more environmentally friendly in other respects as well. Certain segments, such as cruise vessels and coastal ferries, have been a particular focus of attention and this has created a need for more environmentally friendly machinery.

The low emission levels offered by fuel cells make them an interesting option as a future ship power source.

In addition to increased efficiency and environmental benefits, fuel cell technologies also offer a silent and vibration-free method of generating electricity. Since a fuel cell system has very few moving parts its service needs will probably be considerably lower and system reliability higher when compared to conventional technologies.

However, there are a few drawbacks and uncertainties, which need to be overcome before fuel cells can be introduced to the marine market on a large scale. The largest obstacles are the high investment cost, high fuel quality requirements and the relatively immature state of fuel cell technology today.

Wärtsilä says that it will take several decades of development before fuel cells are widely used as main propulsion units for larger commercial vessels where power demand is tens of megawatts.

The company, being equally involved in both ship propulsion and power generation, says that it has a real interest in the development of an environmentally clean and highly-efficient system that can be used in both of these applications. With this in mind, it entered into a joint development programme with Haldor Topsoe of Denmark in 2002.

The programme has looked mainly at planar SOFC technology due to its suitability for cost-effective mass production and its potential for high power densities. Planar SOFC technology can operate in the temperature range of 650°C to 800°C, which allows the use of conventional materials for most components. This will further improve the competitiveness of the planar SOFC technology.

In an SOFC the primary reaction that produces electricity and heat occurs when hydrogen gas or carbon monoxide atoms react with oxygen ions. Pure hydrogen is the most suitable fuel for SOFC applications because it does not require pre-reforming. However, since pure hydrogen is costly and available in only limited quantities a number of other fuels have been used with SOFCs such as methanol (CH_3OH), natural gas, gasoline and even diesel oil and ethanol (CH_3CH_2OH).

After removing particles from the fuel by filtering, sulphur compounds must be reduced to a level suitable for the fuel reformer and fuel cell. It is normally necessary to reduce sulphur compounds to below 1ppm.

Fuel reforming can be carried out by various techniques, including steam reforming and auto thermal reforming of natural gas, which are generally used for larger unit sizes. For smaller units partial oxidation offers a more compact method.

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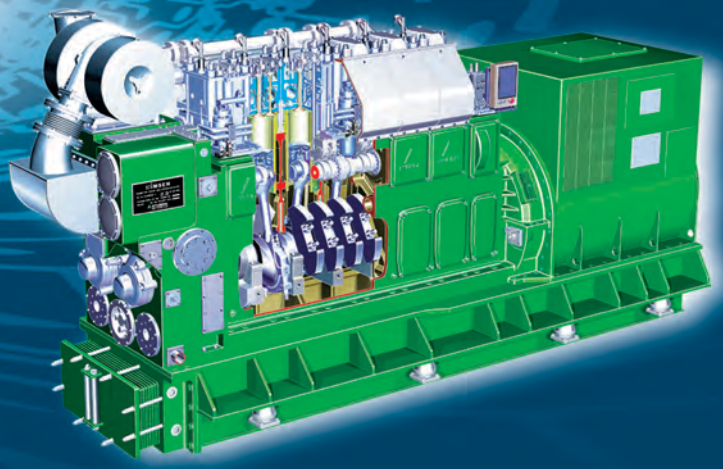

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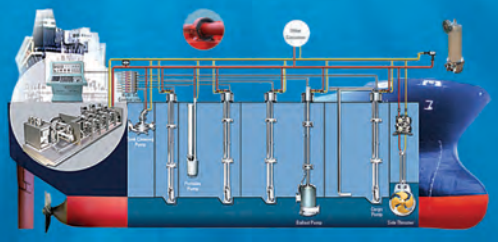

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HiMSEN, Hyundai's in-house developed marine diesel engine, is designed to be highly practical for user and environmentally friendly for the future. So far, over 2,000 sets of HiMSEN engines have been ordered from the well-known shipowners and power plant owners which shows HiMSEN engines get into the spotlight from all over the world.

Also, Hyundai serves its esteemed global customers with high-tech marine cargo oil pumping system such as cargo oil pumps, hydraulically driven submerged cargo & ballast pumps, thrusters, and so on, which have been developed by Hyundai's technical know-how accumulated from continuous R & D efforts and experience more than 10 years of producing cargo oil pumps and water ballast pumps.

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In marine SOFC applications, which will generally be somewhat larger than 200kW, the fuels offering the greatest potential are natural gas and low-sulphur diesel. Natural gas is obviously suitable for stationary SOFC applications, and offers a potential fuel source for LNG-carrying vessels. Natural gas can be reformed using conventional technology, with the higher hydrocarbons being converted to methane, hydrogen gas and carbon monoxide. Part of the methane can be internally reformed to CO and hydrogen in the SOFC stack.

LNG is also an option for marine fuel cell applications on ships operating in coastal areas, such as the LNG-powered ferry project in Norway. A disadvantage is that even a small gaseous fuel installation will complicate the entire machinery installation. On the other hand, it is easier to reform LNG than diesel oil.

For most marine applications, diesel oil would be the most suitable fuel. Diesel fuel can be reformed after the sulphur content of the fuel is reduced. This process would most likely need to be done at the refinery, to achieve a level of 5ppm-10ppm, which would allow commercially sustainable onboard fuel processing.

The use of hydrogen as fuel would do away with the need for pre-processing of other fuels, but the major problem is storage of the fuel. Wärtsilä believes that for the applications in its area of interest, high-pressure storage of metal hydride and hydrogen rich chemical compounds, such as sodium borohydride may provide an answer. But as well as the need to solve the storage issues, a cost efficient hydrogen production method must be established. If these hurdles can ever be overcome, hydrogen would be likely to become a future fuel both for fuel cells and for conventional combustion engines.

As well as high electrical efficiency, the fuel cell can help solve emissions issues. Generally fuel cells have virtually zero sulphur emissions since the sulphur is removed from the fuel before use. NOx emissions are also minimal because nitrogen does not feature directly in the SOFC process. NOx emissions from SOFC systems are below 0.5ppm and are mainly formed in the afterburner where residual gases from the fuel cell are burned.

A recirculation process can be used to control emissions and increase system efficiency. Part of the residual gases from the anode are re-circulated and mixed with the incoming fuel prior to the fuel reformer. This helps provide the necessary steam for the steam reformer. After the reformer, the reformat is preheated prior to the SOFC stack. After the stack the remaining gases are burnt in a post-combustion unit.

The SOFC also needs a supply of air as well as the fuel. The air not only provides the oxygen for the process, it also acts as a cooling medium for the stack. For this reason the volume of air flow should provide between two and five times more oxygen than is needed for the process.

Further components in a SOFC system are concerned with system control, and electronic circuitry if needed to convert the low-level DC voltage to a suitable AC current.

Siemens Power Generation claims to have built up the widest experience of SOFC technology, with the company's tubular SOFC products. Demonstration programmes in recent years have been operated at over 46% electrical efficiency for well over 20,000 hours. Siemens says that these programmes have shown the promise of fuel cells as an efficient, emissions-free and reliable power source.

However, the challenge still remains to make fuel cells commercially competitive. Developers of planar SOFC technology are also paying close attention to the lifetime and durability of the planar SOFC stack. Wärtsilä says that it is among the pioneering companies working on higher-powered (200kW plus) SOFC products suitable for ship power.

Siemens, meanwhile, is currently developing a megawatt-class demonstration power plant based on SOFC technology, in conjunction with a German energy company. The initial plant, using a Siemens SOFC of 5kW, is scheduled for operation in 2008, with the main phase scheduled to start in 2009. It is expected that a 1MW installed capacity hybrid power plant based on SOFCs with a near 70% electrical efficiency will be operational by 2012. Part of the output will come from gas turbines, fed by the hot gases from the fuel cells. Use of the gas turbine will increase the efficiency of the fuel cell by allowing it to be operated at increased gas pressure. EnBW, Siemens' partner in this project along with various German research centres and the University of Stuttgart, says that it has been involved since 2001 in fuel cell research, with recent experience in biogas-power fuel cells. So if this land-based project works as expected, fuel cells of sufficient capacity to power a large ship will become a reality.

Siemens has also been testing SOFC technology at high power density under the US Department of Energy's Solid State Energy Conversion Alliance (SECA) project. A prototype 5kW system has operated for over 2800 hours, meeting or exceeding all of the technical and economic objectives laid down in Phase 1 of the SECA programme. Siemens says that there has been no degradation of cell or system performance during the period of operation, and the company believes that its system is the only one to have achieved this during extended operation. Having achieved the DoE required test duration, the system is continuing in operation to determine lifetime, peak power and efficiency potential.

The new high power density cells in the US project are a further development of the tubular cell design, representing a significant step forward towards commercialisation of SOFC systems. The technology has already demonstrated volumetric power density four times greater than the tubular cells, which Siemens claims translates into significantly reduced volume and reduced cost per kilowatt.

Wärtsilä says that the potential market for different fuel cell technologies is enormous given their outstanding potential advantages of clean and highly efficient power production. The applicability of fuel cell technology and the flexibility to size the units for different purposes will extend the potential market from small units up to marine applications of intermediate size.

The major challenges in the development of the commercial fuel cell are current cost levels and the lifetime of the fuel cell stacks. Once these issues have been overcome in areas such as small residential applications and uninterrupted power source (UPS) solutions, the technology should see more focus on larger industrial and marine installations, where it is expected that MCFC and SOFC products will become dominant. Planar SOFC products have the potential to reach a competitive cost level in mass production. It is anticipated that for power ranges above 5MW the current combustion technologies will dominate for several decades to come.

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Energy recovered is power saved

THE PTL power turbine offers one key to marine fuel economy and emissions compliance, writes ABB's Markus Rupp.

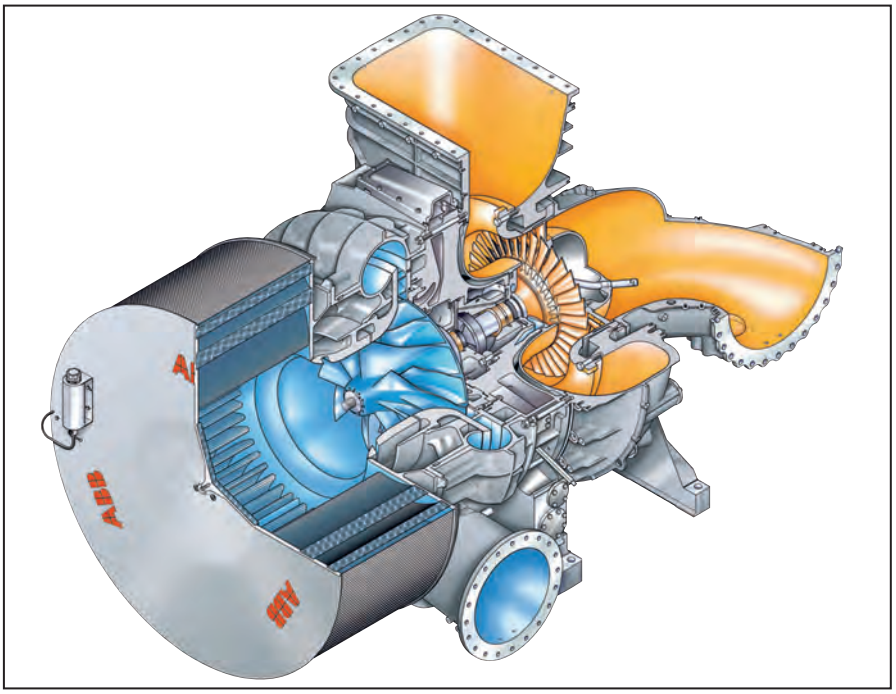


ABB TPL.-B turbocharger for 2-stroke engines.

LARGE turbocharged two-stroke diesel engines used as prime movers on containerships and other large sea-going vessels achieve efficiencies today in the region of 50%. While this figure underscores the importance engine builders attach to fuel economy, the fact remains that a large proportion of the fuel energy, about 25%, is lost through exhaust gas dissipation.

Shipowners, meanwhile, point to fuel consumption and engine exhaust emissions as being two of their main concerns. Each of these needs to be reduced, and urgently, considering the still relatively high price of fuel oil and the very real likelihood of stricter emissions legislation in the near future.

High-efficiency turbochargers for 2-stroke and 4-stroke marine engines allow some of the exhaust gas from the engines – especially the powerful two-stroke diesel engines on large containerships – to be used for other work. One obvious use is to divert the 'surplus' gas to a power turbine which converts it into useful mechanical or electrical energy. This additional onboard energy translates into a fuel saving, resulting in lower operating costs.

Shipowners have, of course, long recognised the efficiency benefit of waste heat recovery, and numerous WHR systems have been installed on large vessels in the past. Between 1985 and 1994 ABB Turbo Systems delivered more than 130 power turbines, including a controlled version for a containership that was capable of an electrical output of 1200kW. Many of these early systems are still operating on various types of ship and continue to provide ABB with an important experience base.

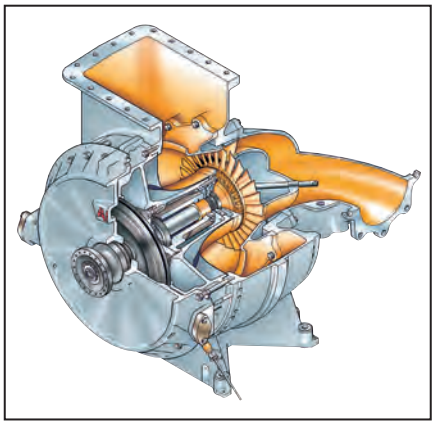
The shipping industry's interest in fuel-saving, however, waned in the 1990s. Increased demand for higher diesel engine output for the bigger ships that were being built meant that engine builders focused their development efforts more on larger, more powerful units. Oil prices, which had stabilised at a relatively low level, contributed to the declining interest in fuel economy.

A new era

In 2001 ABB began to look again into the potential of WHR systems. A study was carried out that covered the whole range of two-stroke diesel engines, with special reference to the company's high-efficiency TPL.-B turbochargers introduced by ABB in 1999. By the end of 2006 more than 3500 units from this turbocharger series had been delivered or specified for over 2100 two-stroke diesel engines with a total output in excess of 67 million bhp.

The study also took account of the heightened environmental awareness in both the public and industrial domains. Marine engine emissions had begun to attract a lot of media attention. Already subject to strict International Maritime Organization regulations, ships will in the future have to further reduce their exhaust emissions to comply with even more stringent legislation.

The market success of the TPL.-B turbochargers and end-users' growing interest in vessels being 'green' as well as cost-effective provided the rationale for developing a new power turbine incorporating state of the art turbocharger technology. The result was the market launch by ABB in 2005 of the new-generation PTL3200 power turbine, designed for an electrical output range of 1500kW to 3200kW. ABB offers the PTL power turbine either as a stand-alone unit or integrated in a WHR system with steam turbine.



PTL power turbine.

While the running-cost and environmental benefits of installing a WHR system are undisputed, shipbuilders need to consider how design, operating and other parameters can affect profitability and payback.

First there is the type of vessel, eg whether it is a containership or a tanker. Container vessels are laid out for higher speeds and their diesel engines are designed with relatively large power margins. The engines of containerships therefore run a lot of the time at about 85% of their specified maximum continuous rating (SMCR). Tankers on the other hand tend to have smaller diesel engines usually operated at close to 100% SMCR. This difference in operating profile has to be taken into consideration in the design of the WHR system.

Ambient conditions, especially the ambient temperature, are another important factor. This is because by influencing turbocharger and engine performance they ultimately affect the power output of the WHR system.

Also of great importance is the turbocharger efficiency, and in two respects: first there is the minimum efficiency two-stroke engines require for acceptable thermal loading of the engine components and for proper scavenging; second, the higher the efficiency, the more 'surplus' exhaust gas there is which can be freed up for the WHR system.

Finally, there is the cost of the fuel oil, the cost of financing the investment, and not least the size of the plant. The size is important because the investment cost is not

proportional to the produced electrical power. As a result, the payback time will generally be shorter for WHR systems used with larger diesel engines.

Which configuration?

Basically, there are two types of WHR system with power turbine for improving the fuel efficiency of a ship's main engine.

One has the power turbine in a stand-alone configuration, with its energy used directly to produce electricity via a generator and reduction gearbox. The fuel saving and emissions reduction in this case is about 4%. The other integrates the power turbine in a steam cycle for a better than 10% reduction in fuel consumption and engine emissions. In this arrangement, which makes full use of the waste heat's energy potential, superheated steam is produced in the boiler after the turbochargers and fed to a steam turbine, which drives the generator.

WHR units with ABB power turbines are packaged by UK engineering company Peter Brotherhood in close cooperation with ABB Turbo Systems.

The power turbine and generator unit is fully self-controlled and feeds electrical power directly to the grid or to an optional shaft motor. In addition to ensuring a more flexible supply of energy, this configuration allows a 4% saving in fuel and emissions.

A WHR system combining ABB's PTL3200 power turbine with a steam turbine was installed on the recently launched *Emma Maersk*. The giant vessel's Doosan Wärtsilä 14RTFlex96C engine, which is fitted with four ABB TPL85-B turbochargers, develops 80,000kW and sets new standards for environmentally friendly sea transportation. The installed WHR system delivers an additional maximum output of 8500kW, equal to a saving of more than 10% at MCR.

Calculations by ABB show that a significant saving in CO_2 emissions is also achieved with the stand-alone power turbine configuration alone, with the figure more than doubled when a WHR system with power turbine and steam turbine is used. The electrical energy gain per year for a large container vessel with a typical load profile, based on ABB measurements, would allow more than 2300tons of fuel oil to be saved annually with the stand-alone arrangement and almost 5000tons annually with the WHR system with steam cycle. It is assumed in each case that the extra electrical power is used to replace the power normally produced by the auxiliary diesel engines.

A study carried out by ABB has shown that the complete output range of today's two-stroke diesel engines – 20,000kW to 80,000kW – can be covered by just two sizes of power turbine. ABB currently has a smaller PTL for the lower half of this range under development. A third size, eg for diesel engines rated above 80,000kW, could be added should the market require it.

Matching of the main engine and the power turbine can be further optimised by replacing the standard fixed nozzle ring by variable turbine geometry (VTG). VTG allows the performance of the main engine to be improved, for example in the tropics, by reducing the nozzle area, which reduces the output of the power turbine. Alternatively, the turbine area can be increased at low ambient temperatures or at reduced vessel speed to maximize the power turbine's output.

ABB's PTL power turbine addresses two of the most pressing issues in shipping today – fuel economy and environmental compliance.

While the unpredictability of fuel oil prices is still capable of slowing the industry's willingness to install WHR systems, there is nonetheless a growing feeling among shipowners that a 'green ship' image is the way forward. Cost benefits here could come from additional freight charters or higher freight rates. Another strong inducement to invest in WHR could be economic instruments such as differentiated port dues and tonnage taxes. In fact, several ports around the world have these in place already. Given the highly competitive business environment in which shipowners operate, power turbines, by combining fuel-saving with emissions reduction, are an attractive proposition, creating a situation that can only be described as 'win-win'.

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Issue 13 is devoted to the subject of fatigue suggesting that the problem is more prevalent than it is often believed and goes beyond issues of manning levels and watchkeeping patterns, which are seen as causing major difficulties in small, short sea ships.

It takes a close look at fatigue causes and effects, and advocates a proactive policy to mitigate the effects of fatigue through a range of management strategies. It also suggests that a great deal can be done by ship and equipment designers to produce workplaces that reduce the effects of fatigue.

Issue 13 is now available from www.he-alert.org

Magnetic solution for safer enginerooms

KRAL argues that the regular replacement of the complete mechanical seal set causes unnecessary down time and inspection, which could be avoided entirely with the installation of the magnetic coupling.

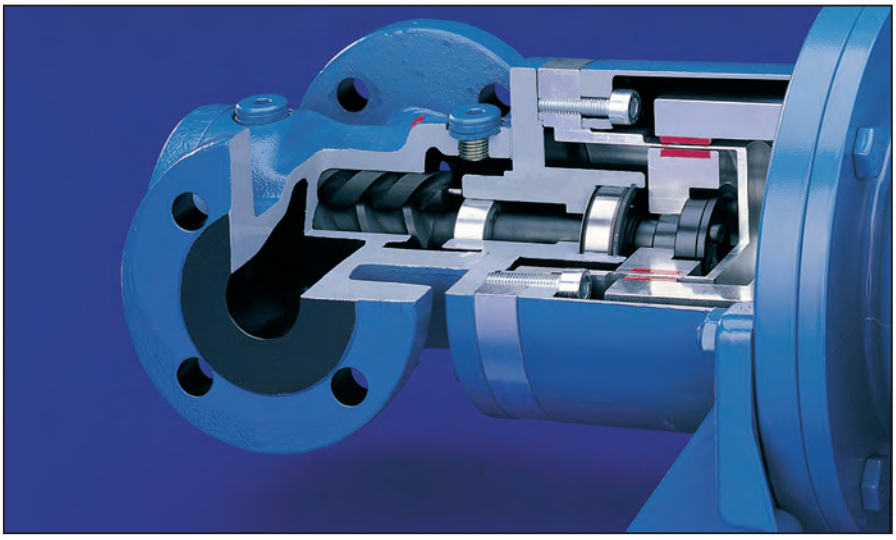

Fig.1 The magnets are marked red. Once the piping is connected, the pump is protected inside a perfectly tight casing.

THE demands of today drive oil refiners to produce ever greater quantities of lighter products such as gasoline, gas- and diesel-oil. This negatively affects the properties of heavy fuel oil (HFO). Additional refinery processes change the quality of HFO.

Viscosity is not a direct measure of HFO quality, but viscosity influences the complexity of onboard fuel handling systems like booster-modules and separators. HFO needs to be preheated to reach its injection viscosity, at approximately 13mm^2/s.

HFO is classified and bunkered according to the viscosity into so-called grades. Internationally accepted guidelines are ISO 8217, BS6843, as well as the directives offered by CIMAC. The maximum accepted grades are RMH 55 and K55, which means a viscosity of 55mm^2/s at 100°C and 700mm^2/s at 50°C.

The effect which viscosity has on the booster-module is also apparent in its preheating system. The extent of heating necessary is controlled by a viscometer. To avoid evaporation of residual water and lower volatile components HFO needs to be pressurised by pumps. The circulation flow is higher than the maximum consumption of all engines. This ensures a flushing of the fuel system and a cooling of the injection pumps. Commonly a twin set of screw pumps is used for both the supply unit and the circulation loop.

Engine manufacturers do not have sufficient restrictions listed when using HFO above 450mm^2/s (at 50°C), because of the fuel's low availability. They do advise users to observe the engine condition very carefully, if operating with this HFO grade.

KRAL was among those finding the use of these higher grades of HFO more difficult and challenging and, during the last two years, the company has noted a change in usage from grade 380 to grade 500.

To flow, HFO grade 380 needs to be preheated from around 130°C to 150°C. Grade 500 HFO must be heated by between 150°C up to 180°C. If shipping companies use grade 500 with a grade 380 specified fuel treatment system, they run a high risk of failure, which may result in grounding of the ship and fire.

Screw pumps are typically driven by electric motors. The connection between the electric motor and the set of spindles almost always incorporates a mechanical seal. Mechanical seals are widely used and have advanced technologically but, and regardless of their proper usage, mechanical seals have wearing parts.

To lubricate the sliding rings, manufacturers of mechanical seals specify a leakage flow. It is important to note that a low amount of leakage – some ccm/h – is normal and part of a well engineered design! Mechanical seals will always incorporate wearing parts that have to be replaced. The quality of the mechanical seal, especially the material of the sliding rings and the O-rings are designed according to the application.

The critical point is the change from 380 to 500 HFO which exceeds a design limit. Viton O-Rings, the secondary sealing of a mechanical seal are designed for 150°C. If used with grade 500 HFO they will be deformed by the temperature and by chemical attack. A damaged O-Ring enables the HFO to come into contact with the atmosphere to build abrasive residue - coking. These abrasive crystals can damage the sliding surfaces of the mechanical seal as well as the bearing of the pump. High temperatures will also cause bearing failure, which can lead the elastomer of the pumps coupling to melt and finally the pump can be decoupled from the electric motor. The result is a total pump breakdown and – if both pumps fail – an engine shut down is inevitable.

If leaking HFO comes into contact with hot surfaces, there is obviously a risk of fire and pollution - conflicting with IMO´s Solas and Marpol regulations.

Years ago, when the HFO grade change became obvious, KRAL changed to improved mechanical seals. For example, today KRAL uses an O-ring material with a higher content of fluorine as well as mechanical seals with a higher content of graphite in the seal faces, which acts as a dry-lubrication material bringing increased safety and extending the dry-run capability of the pumps.

Magnetic coupling

Despite these improvements, the shaft seal will always remain a critical element of a screw pump for handling HFO. The mechanical seal is a wearing element with restricted life expectancy. To avoid shaft seals altogether, KRAL argues that its magnetic coupling is a more reliable choice for onboard applications. In screw pumps with magnetic couplings, the connection between the electric motor and the pump shaft is not a fixed mechanical attachment. Permanent magnets are fastened to pump and motor shaft so that they face one another. The magnets on the motor shaft transfer the torque to the magnets on the pump shaft thereby turning the pump spindles. Sealing the pump against the atmosphere is a hermetically tight sealing element – the containment can – located in the gap between the opposing magnets. In Fig. 1 the magnets are marked red. Once the piping is connected, the pump is protected inside a perfectly tight casing.

Fig. 2 The hermetically sealed pump in the front, and in the background, the KRAL pump with attached electric motor.

Fig. 2 shows the hermetically sealed pump in the front, and in the background, the KRAL pump with attached electric motor. KRAL pumps with magnetic couplings can be used up to a temperature of 250°C. An interesting question for insurers might be: 'Who is liable for mechanical seal losses, if a more safe technology is available but not used?'

KRAL screw pumps with magnetic couplings are backed by almost six years of practice and the complaint rate is reported as zero per cent. According to the manufacturer, the higher investment for this pump technology is paid back in only three years. The regular replacement of the complete mechanical seal set causes unnecessary down time and inspection which could be avoided entirely with the installation of the magnetic coupling. In most cases the ball bearing also has to be replaced adding additional costs.

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Class helps yards come to terms with CSR

COMMON Structural Rules have demanded design reviews to demonstrate compliance.

COMMON structural rules took Class years of work to develop, and that work is far from over when it comes to bulk carrier design.

'This has been an ongoing process which we have been closely involved with over the past few years,' said Alex Johnston, global technology leader, hull structures, Lloyd's Register (LR) 'We have, for instance, recently secured the class of a pair of CSR-compliant Capesize bulk carriers in Korea. These are the first Capesize bulk carriers to be built in Korea for some time, as the Korean yards have tended to move away from bulk carrier construction to more high-value tonnage such as large containerships and LNG carriers.'

Bureau Veritas (BV) has similarly been busy carrying out a number of design reviews for compliance with CSR at the request of both shipyards and shipowners. In China, BV has recently worked in close collaboration with Shanghai Waigaoqiao (SWS) shipyard on a 176,000dwt Capesize bulk carrier, with the Jiangnan shipyard on a 76,000dwt Panamax bulk carrier, and with other shipyards and design companies on 92,500dwt, 57,300dwt, 53,000dwt, and 34,000dwt bulk carriers. The company says it has also been active in CSR work in the other major shipbuilding countries, Japan and South Korea, as well as upcoming countries such as Vietnam, where it is assisting yards with their new designs under CSR rules.

Many shipyards which want to build larger size bulk carriers including Capesize, Panamax or Handymax size, are investigating how to optimise the hull weight of new CSR compliant bulk carriers. Currently, said the Japanese classification society, ClassNK, they generally expect a more than 10% hull weight increase from their original designs which did not comply with IACS S25 nor CSR.

ClassNK also pointed out that some shipyards which want to build smaller size bulk carriers, such as Laker types, have now completed new designs to comply with CSR. They were showing a similar estimation for hull weight increase for their new design, ClassNK said.

'Generally speaking, it is currently taking more time for the approval of CSR compliant vessels than it took before,' said Hiroshige Kitada, managing director, ClassNK. 'This is partly because the designers currently have very limited experience with the CSR design rules, and also because the FEM calculations required by the CSR, for bulkers over 150m, take more time.'

He added: 'Given this situation, it is more important than ever that Class supports designers from the very start of new CSR projects and works closely with them during the approval process.'

To help yards and owners, classification societies are developing additional software solutions. 'Using new rules means using new tools', said Martin Nieuwenhuis, manager bulk carriers and containerships, BV. 'Our new generation of VeriSTAR software has been developed in order to provide a complete set of calculations of all types of bulk carriers, taking into account automatic loading and criteria checking. The new generation system has also been based on a different pre-processor, FEMAP, enabling fast exchange of FEM models with shipyards and design offices.'

Many shipyards wanting to build larger bulk carriers are investigating how to optimise the hull weight of new CSR complient ships.

In addition, BV pointed out that its MARS system was used from the beginning by the Joint Bulk Carrier Project as the benchmark for the strength calculations of the hull girder and of the local scantlings of any transverse section along the ship's length for different failure modes such as yielding, buckling, ultimate strength and fatigue.

'Today these tools are a key factor in the success of the design review,' said Mr Nieuwenhuis. 'They provide our engineers with a competitive advantage in the assessment of design according to CSR rules because they can provide accurate results within a short response time.'

Where shipbuilders are investigating how to optimise or design new NK class CSR compliant bulk carriers, they are using software which the Japanese society has developed. ClassNK has produced and distributed a prescriptive rule calculation tool which it says has been very well received by designers. PrimeShip-HULL (CSR), which includes the FEM analysis tool required by the CSR rules, has also been released. In the near future, a more comprehensive and user friendly GUI based software package including the rules, as well as the above calculation tools will be introduced and will be able to be used for the design of all vessels.

'ClassNK actively supports the design process with explanations and interpretations of CSR, as well as FEM analysis, right from the earliest design stage. This helps both designers and ClassNK with keeping the approval process running smoothly, by helping the designers develop a deeper understanding of CSR,' said Mr Kitada.

ClassNK pointed out that it had developed a range of software tools and services for bulk carrier owners, both stand alone and online. NK-SHIPS, for example, is ClassNK's main online information service system for owners and managers of NK classed ships. NK-SHIPS enables users to monitor and check key information relating to ship management, including survey status, periodical survey items, survey due dates, 24 hours a day, 365 days a year, from anywhere in the world via the internet. In addition to the online services available through NK-SHIPS, an important recent addition to NK online services is PrimeShip-HULLCare.

PrimeShip-HULLCare is an information-based support system for hull maintenance, utilising detailed information routinely collected through classification surveys. The survey data in the PrimeShip-HULLCare database can also be accessed through the Internet 24 hours a day, seven days a week, and is accessible anywhere if the Internet is available.

As the CSR rules are now common, maintenance of the rules and answers to requests for interpretation are also common to all IACS members. In order to deal with these issues, IACS has implemented two project teams under the supervision of the IACS Hull Panel. Each team is in charge of the maintenance for one set of the CSR and is made up of four IACS members,

GL develops lifecycle tools

Germanischer Lloyd has highlighted the recent development of some interesting new software tools which will have benefits for bulk carrier operators. One of these is a thickness measurement system called Pegasus, first unveiled last year, and which is the first module in GL's new Hull Lifecycle Programme.

Pegasus is designed to facilitate the work of thickness measurement firms and ship operators, saving them time and money. According to GL, from the first on-site inspection to production of the survey report, a thickness measurement inspection can take up to four weeks depending on ship size and age, as this process is still largely conducted without computerised support. The new Pegasus software was created to reduce the time required for report generation to just a few hours.

GL Pegasus employs a three-dimensional computer model of the ship, each structural component being recorded both in tabular and in visual form. The tables and graphics correspond at all times, eliminating duplicate data entry. Once the survey team completes on-site ultrasound measurements, GL Pegasus automatically references the data using the computer model. Areas of potential weakness due to corrosion are allocated different colours, depicting various degrees of rusting. Photographs, text and voice recordings can also be attached in reference to a given survey section.

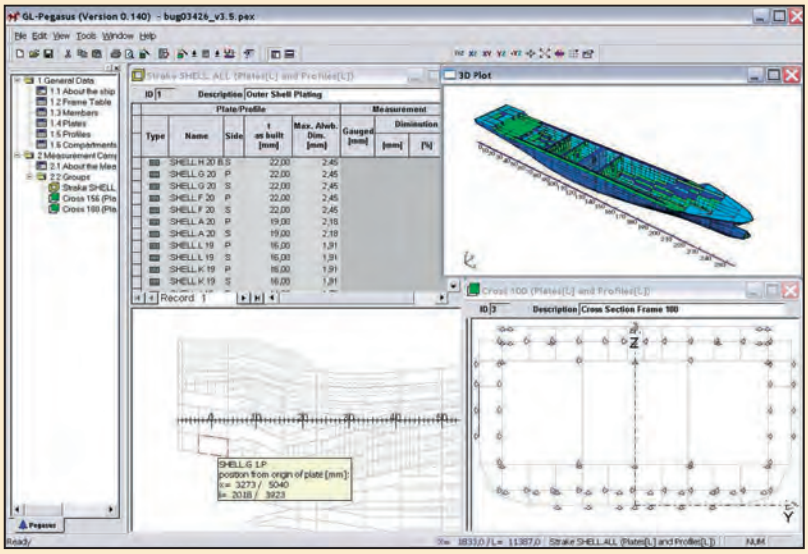
'The big advantage of this new software is the rapid and automated generation of the findings report in the format mandated by the International Association of Classification Societies (IACS)', said David Jaramillo, senior project engineer and head of the GL Pegasus project. Ship operators have direct, worldwide access to the written report and the updated 3D model via the GL online platform fleet online, enabling them to identify early on any potential repairs that may be necessary and to undertake this work in a timely way.

The Hull Lifecycle Programme is intended to allow monitoring of the technical condition of a ship throughout its entire life cycle. Volkmar Huxoll of the GL Assessment Surveys Department, said: 'HLP is a monitoring programme that provides surveying tools for identifying necessary repairs and maintenance, such as coating conditions.'

The Hull Lifecycle Programme is intended to make inspection planning easier, allowing ship operators to prepare and conduct their own inspections. Once the initial model is generated, the HLP can be run until sale or disposal of the vessel, with any changes in ship structure such as replaced plates being updated in the model on an ongoing basis. This feature is free and included in the HLP surface package, GL states.

Another recently introduced service from GL is online access to its Protos (Provisions for Transportation of Solid Bulk Cargoes) database, which contains a list of more than 60 bulk materials. The database consolidates all the legal, engineering and equipment requirements applicable to dry goods trades ships used for specific materials.

GL issues Bulk Certificates for vessels based on the Protos requirements, an onboard audit and a review of the ship's documents. The Document of Compliance for the Carriage of Solid Bulk Cargoes issued by GL confirms that the stated bulk cargoes can be carried onboard safely. Any vessel that meets the necessary technical and engineering requirements is awarded the 'DBC' supplementary classification mark and this remains valid for five years.



Pegasus is designed to facilitate thickness measurement, saving time and money.

three belonging to the class societies in charge of the Rule development for the corresponding ship type and another member.

Further to questions and requests of interpretations raised by IACS members, the teams can propose corrigenda and Rules change proposals. The corrigenda concern mainly editorial amendments of the Rules while the Rules change proposals have to be proposed to the technical committees of individual IACS members before definitive adoption by the Council.

The teams involved in the maintenance of the CSR are also tasked with providing Rule interpretations. This is a means to provide a solution which is applicable by all IACS members in the same way. The interpretations are also an intermediate step along the path to a possible Rule change process, providing a temporary solution to members and ship designers.

The common structural rules for tankers and bulk carriers began at different points in time and initially followed individual paths of development. IACS member societies agreed to harmonise the two approaches and a high degree of harmonisation between the two sets of rules has already been achieved. Outstanding items for harmonisation include the Direct Strength Analysis, the Loads and Fatigue, however.

According to BV, the design review projects in which it has been involved have up to now confirmed a number of benefits for owners. Firstly BV suggested that a CSR-compliant design was more robust than the previous ones, with hull girder strength increased usually by more than 5% and increased minimum fatigue standards to reduce cracking. Furthermore, a CSR vessel had larger corrosion additions, with a design life of 25 years, and BV estimated that only 600tonnes of additional steel for corrosion additions was needed for a Capesize bulk carrier.

In addition, BV pointed out that a CSR compliant design complied with the latest SOLAS requirements, in particular structural redundancy requirements for bulk carriers of SOLAS Chapter XII. Weight that can be loaded in each individual cargo hold of bulk carriers was also increased, and the bottom forward was reinforced to allow extended sailing in normal ballast condition, enhancing fuel economy.

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Dry sector gets a taste of innovation

NEW concepts have surfaced that look to develop the next generation of bulk carriers.

TODAY, much bulk carrier construction is being carried out in series production, with very little variation in standard designs. However, there are some interesting new design concepts which have surfaced in recent months. One is the result of collaboration between Japanese interests and appears to be a 'sort of halfway house between panamax and capesize', with extra cargo capacity being achieved through an increase in beam.

Mitsui OSK Lines (MOL) and Sanoyas Hishino Meisho of Japan are joining forces to develop a new type of bulk carrier that will be configured to take advantage of a wider Panama Canal, after the expansion of the key waterway has been completed around 2015. A new 116-type, single skin 116,000dwt bulk carrier design has been developed by the two companies, and two vessels have been ordered to date, for delivery in 2009 and 2010.

The new vessel type will have a wider 43m beam, a relatively shallow draft of 15.3m, and an overall length of 245m. The widened Panama Canal will be 50m across, but MOL has opted for the 43m width for the new vessel class as a result of other factors, including port restrictions. For instance, the company points out that Dunkirk is one of the main discharging ports in Europe for coal, but this can accept bulk carriers only up to 45m beam.

The new ships will be powered by a MAN B&W 6S60MC-C main engine, which is rated at 13,560kW at 105rpm. The service speed of the vessel will be 14.5m at design draft.

To improve propulsion efficiency, the vessel's design includes a fin system on the stern shell and a high lift rudder. For environmental reasons, the fuel oil tanks will have extra protection and there will be an onboard grey water retention system

According to MOL, trade patterns for the key bulk trades of coal, iron ore and grain are expected to change when the canal is widened, and the handy cape class bulk carrier will be able to call in ports where there are restrictions on larger vessels, while maximising cargo carrying capacity through the canal. The hold capacity of the new ships will be about 135,000m^3.

MOL believes the 116 design represents an optimum comprise between size, speed and fuel consumption. A spokesman said: 'We could have developed a bigger size bulk carrier, but we had to take into account future profitability. The bigger ship sizes are not always profitable.'

Another concept applicable to bulk carriers, and also Japanese, is a 'Non Ballast Water Ship' (NOBS) design that has been developed by the Shipbuilding Research Center of Japan (SRC). This aims to tackle the problem of how to prevent the spread of non-indigenous species in ballast water from a new angle. While many companies and research centres are seeking a solution to the problem through treatment-based technology, the NOBS system removes the need for ballast water, although two small redundant ballast tanks are incorporated for trimming and extreme sea passage.

Although SRC accepts that a slight increase in power is required with NOBS when loaded, it claims a dramatic power saving is seen during unladen journeys. Due to the increased breadth and thus bending moment of the NOBS, there is, it accepts, a corresponding increase in hull weight, but it argues that the increased costs can be recovered within 15 years. With sea worthiness, sea-keeping and manoeuvrability performance of the NOBS all within International Maritime Organization regulated limits, SRC suggests NOBS is a 'serious contender for the future of vessel design'.

However, Lloyd's Register continues to be concerned about high loading rates being imposed on vessels in some ports, particularly in Brazilian ore terminals, and has questioned the impact of NOBS in this context.

'These loading rates can pose grave risks to the structural strength of bulk carriers. In this context, the no-ballast design may not be feasible for this trade, as ship masters need ballast to retain enough structural strength to handle the stresses from the high loading rates,' said Alex Johnston, LR global technology leader, hull structures.

The problem was, LR suggested, being further compounded by certain ports requesting masters to offload some ballast before coming into port to further reduce turnaround times. Again, this could pose a significant risk to the structural strength of the vessel because the use of ballast water was essential as a means of countering the stresses imposed on the vessel by cargo operations.

The industry was taking this very seriously, LR noted, with Intercargo and the International Chamber of Shipping (ICS) both making representations to IMO to improve standards and limits for bulk cargo handling to prevent ships being exposed to unsafe practices as a result of commercial pressures.

The current bulk cargo-handling code requires a vessel to have a loading plan agreed between itself and the terminal which dictates the manner and sequence in which the cargo holds will be loaded with the purpose of managing the stresses on the ship's hull. LR said IMO was the appropriate forum for developing uniform and more rigourous controls on how bulk carriers should be loaded and cargo distributed, and added that it would fully support a move to do this.

Mitsui OSK Lines and Sanoyas Hishino Meisho of Japan are joining forces to develop a new type of bulk carrier that will be configured to take advantage of a wider Panama Canal.

New Diamond set to shine

DUE to make its entrance into the market later this year, the Diamond 34 promises new flexibility for a Handy-sized bulk carrier.

THE 34,000dwt Handy-sized double hull bulk carrier, developed for UK-based shipowner Graig by designers Carl Bro is essentially seen as an evolution of Graig's successful Diamond 53 design. This geared vessel type is laid out with five flush double-skin cargo holds, each equipped with end-folding hydraulically operated hatch covers, and four 30t deck cranes.

So far eight vessels of this type have been ordered from the Pha Rung shipyard in Vietnam, and the first in the series is expected to enter service in November 2007. The building programme has in recent months been extended also to China, with orders for two vessels, with two options placed at the RongCheng Haida Shipbuilding yard, with the first ships due for delivery in the first half of 2008.

According to Graig, the development of the Diamond 34 has focused on five main areas - safety, economy of operation and maintenance, environmental friendliness, loading flexibility and robustness, and the ability to meet future regulations for bulk carriers.

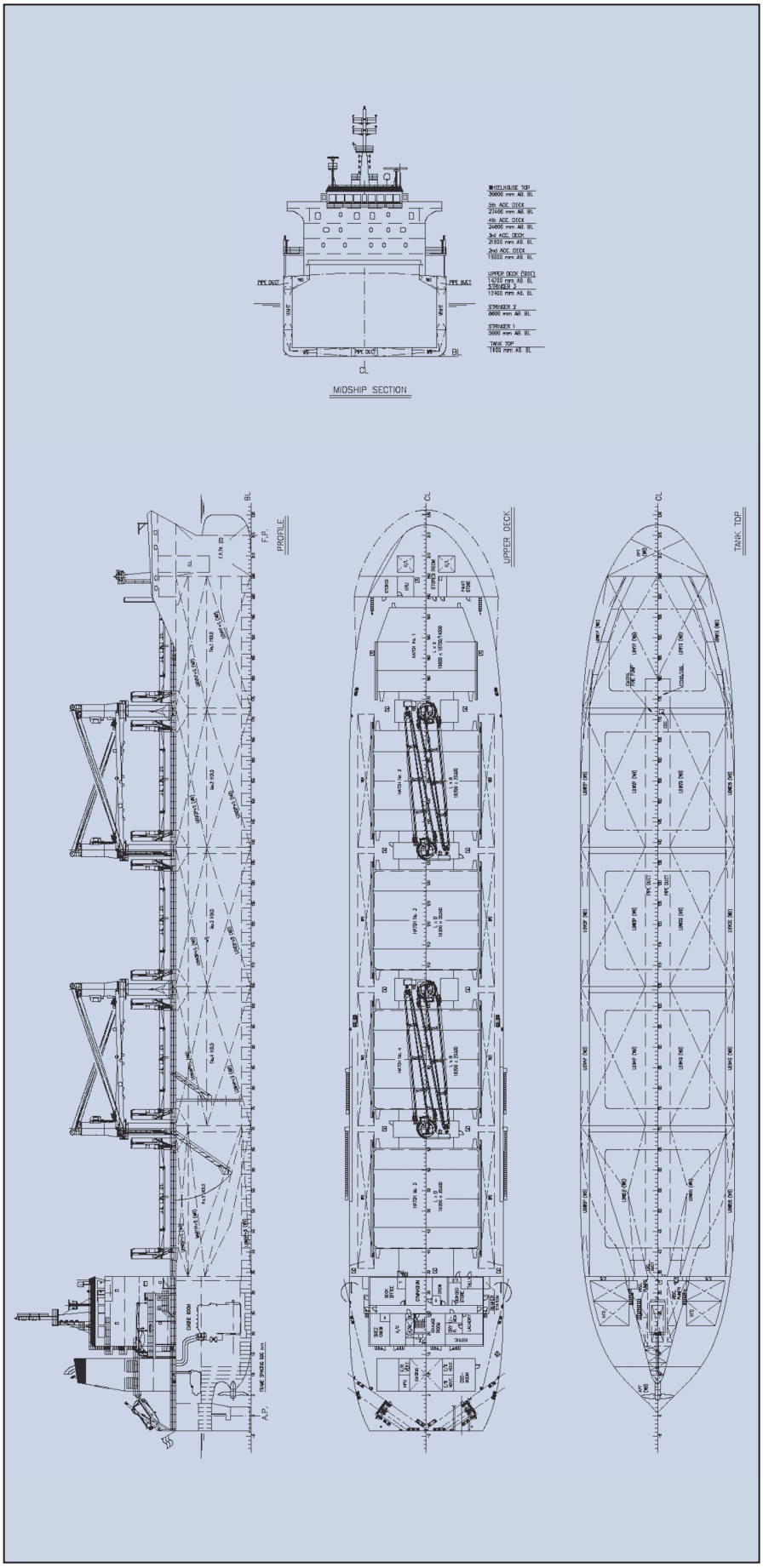
The double hull concept of the Diamond 34 is, of course, a key safety feature. However, it is also intended to help facilitate cargo loading and cargo hold cleaning, whilst at the same time ensuring that the hull has a highly robust and strong structure that is able to withstand the most rigorous operational scenarios, including alternate hold loading.

Handling benefits

Cargo handling operations benefit from the absence of hopper tanks and lower bulkhead stools, the fitting of permanent cargo hold lighting and an effective cargo hold cleaning system. Graig also notes that the bulkhead framing and side frames are all outside the holds, providing a clean smooth interior surface throughout.

Low maintenance costs are ensured, says Graig, through the specification of high quality paints and the arrangement of the ballast pipes and valves in the double bottom pipe duct. Furthermore, service systems, such as the fire main line, compressed air, hydraulic piping and cables, are arranged in the wing tank pipe ducts.

As indicated a high level of safety and environmental protection is provided for by the double hull specification. The double skin not only forms a second barrier against accidental water ingress, but allows access



Feedback has been positive from the numerous Diamond 53 vessels delivered from Chinese yards, auguring well for the new series of Diamond 34 ships.

for detailed surveys of the complete hull structure, even when the vessel is loaded. Green water protection of the forecastle air pipes, ventilation heads and stores hatch by the breakwater and protected under deck passage to the foredecks, further improves the safe operation of the vessel.

The vessel's green credentials are also provided by the installation of low emission engine plant, prepared for the use of low SOx fuel, and systems designed to facilitate ballast water exchange. Although there is a floodable ballast hold, normal ballast condition does not require the hold to be flooded, and all ballast can be sequentially exchanged at sea. Furthermore to minimise the risk of an oil spill, all heavy fuel oil and diesel oil onboard is stored in coffered tanks in the engineroom.

The Diamond 34 class is suitable for carrying a wide range of bulk cargoes, such as coal, grain, ore, cement, alumina, bauxite, fertiliser, steel coils, logs and packaged timber. Total hold capacity is 45,500m^3 and loading flexibility is ensured through superior hold girder strength, according to Graig. A high degree of 'cargo friendliness' is ensured by the fact that the vessel has relatively wide hatch openings - with four of the five hatches measuring 19.2m x 20.8m.

Graig said that the uniform tank top loading of 25.0t/m^2 allowed, for example, for two tiers of 20t steel coils, 1.5m each in length, to be carried. A further feature of the design is the large unobstructed tank top area, which had been optimised for breakbulk cargo operations.

Power for a Diamond

The main engine selected for the Diamond 34 is the MAN B&W 6S46MC-C unit, rated at 7600kW, which provides for a service speed of 14knots. Fuel consumption is said to be an economical 28.5tons per day.

The hull design has also been configured for fuel economy and the hull's stern bulb is said to offer excellent water flow to the propeller. Directional stability is achieved through a large rudder, as well as the hull design's provision for good waterflow around the rudder.

The fixed pitch Lips-type propeller for the five Diamond bulk carriers on order for Graig in Vietnam will be supplied by Wärtsilä, which previously supplied the company's award-winning Diamond 53 series. These will have a diameter of 5600mm and will be delivered complete with shafting and Wärtsilä's JMT seals, of the Sternguard 4BP type.

Feedback has been positive from the numerous Diamond 53 vessels delivered from Chinese yards and now in service with Spar Shipping of Norway and Densan Shipping of Turkey, Graig said, auguring well for the new series. The power required to achieve service speeds has been lower than expected, for example, while masters report that the ships have excellent manoeuvrability, which has led to savings on tug costs.

Feedback has also confirmed that this is a cargo friendly design that minimises port loading and discharge time, and offers significant time savings for cargo hold cleaning, the company stated.

TECHNICAL PARTICULARS
DIAMOND 34 CLASS

Length oa	180.00m
Length bp	172.00m
Breadth, mld	30.00m
Depth, mld	14.70m
Scantling draught	9.75m
Cargo hold capacity	45,500m^3
Deadweight	34,000t
Gross tonnage	23,800t
Net tonnage	10,500t
Service speed	14.0knots
Main engine	MAN B&W 6S46MC-C

Trader class - better by design?

THERE are a huge number of bulk carriers on order at the present time, mainly in the Far East, at yards in Japan and China. However, it is a sellers' market and pressure on yard space has perhaps given the yards the upper hand when it comes to specification.

For this reason, those designs that are genuinely the result of fresh thinking tend to stand out. One of these is the new Trader class 30,000dwt Handy-class double hull bulk carrier developed by the well-known GTR Campbell Marine Consultants, Bahamas, in co-operation with associated concept design firm – Algoship Designers. Mastek Heavy Industries of Busan, South Korea, has been selected to carry out basic design and detailed drawings.

The first of this series, *Bossclip Trader*, was handed over to the Clipper group by the Cochin shipyard last year, and the Indian shipbuilder has since delivered two more sisterships, with three still awaiting completion. The Shanhaiguan yard in China has received orders for four of this class, two of which have been completed, while the Hindustan Shipyard in India has contracts for a series of four Trader class bulk carriers, the first of which is due for delivery by the end of March 2007.

The biggest series of Trader class ships have been contracted by Clipper with Tsuji Heavy Industries, Japan. A total of 24 of the new design will be constructed at Tsuji's Jiangsu yard in China in two batches, with 12 ships scheduled for delivery in 2009 and 12 more the following year. It is understood that all of these will be delivered for deployment by the Clipper group.

The Trader is considered by GTR Campbell to be in many ways a natural evolution of the 500 or so vessels produced by the company since 1965. According to Antony Prince, president: 'Our aim with this project was to provide our clients with a ship of the future, but as a continuation of the past designs that they have bought. We were also looking to offer a better alternative to the marginally designed, shipyard-inspired Japanese produced bulk carriers for discerning shipowners.'

GTR Campbell has shaped the design of the Trader to reflect market and trade requirements, and to meet the need for a high level of operational safety as well as the commercial interests of shipowners and operators. As a result, the design is intended to deliver a high degree of operational economy, while still maximising cargo carrying capacity within the limits of Handysize parameters.

The Trader design incorporates an enhanced fuel efficient hull specification, that was extensively model tested at the KRISO model tank basin in South Korea, and has been developed in accordance with the relevant CSR, IACS and IMO regulations. Mr Prince said: 'The design process started in 2003 with the then applicable rules, although we did do some proactive design work based on anticipated rules changes. As a result, the subsequent upgrading of the Trader design was relatively easy.'

IACS URS requirements were applied to the first set of four Traders ordered with Shanhaiguan Shipyard and then a BC-A notation was added for the six vessels ordered at Cochin and the four from Hindustan. CSR were then applied to the first 12 ships ordered with Tsuji, while Marpol revisions that required a major revision of the bunker tank arrangements to provide enhanced protection to the fuel tanks were incorporated with the second batch of 12 Tsuji ships. More recently, changes have been made to those vessels under construction to meet the new IMO ballast tank coating standards. 'So, the design has already evolved a lot due to rules changes,' Mr Prince said.

The design, which GTR Campbell said it had optimised to provide the best possible ratio between deadweight, speed and fuel consumption, features equipment with high safety margins, and high specification coatings, including tar-free light coloured 'surveyor friendly' paints for ballast tanks and tin free antifouling paints with 60 months life for the hull, and a 1300mm wide double hull spacing to facilitate access for surveyors and inspectors.

Another feature of the Trader class is the wide hatch opening (20.8m x 21m), a typical characteristic of Algoship design work, which covers 75% of the beam with minimum overhang, and which facilitates cargo spotting. The vessel is equipped with hydraulically-operated, end folding hatch covers, also with a view towards ease of operation.

Other characteristics highlighted by GTR Campbell include the large cargo hold tank top footprint, with small side hoppers, and the four 30tons capacity electro-hydraulic deck cranes, which are suitable for cargo handling with either hook or grab, and which have a maximum outreach of 26m. These cranes give the operator a high degree of independence when handling cargoes in port, as there is no need for additional equipment such as forklift trucks or pay loaders.

Trader class ships are designed to carry a wide range of bulk and breakbulk cargoes, and the grain and bale capacity are respectively 40,700m^3 and 38,660m^3. However, particular attention has been given to the demands of transporting steel coils, especially short heavy coils, and pipe cargoes. A high tank top strength of 20tonnes/m^2 has been specified for all holds.

***Clipper Trust*, a recent Trader class vessel, delivered by the Cochin yard.**

TECHNICAL PARTICULARS
TRADER CLASS

Length, oa	178.70m
Length, bp	170.00m
Beam, moulded	28.00m
Depth, moulded	14.00m
Draft, design	9.50m
Draft, scantling	9.79m
Deadweight, design draft	29,000tonnes
Deadweight, scantling draft	30,300tonnes
Cargo hold volume	40,000m^3
Tank top strength	20tonnes/m^2
Cranes	4 x 30tonnes
Main engine	MAN-B&W 6S42MC MK VII
MCR output	6480KW at 136rpm
Service speed	14.15knots
Endurance	15,500nm
Class	ABS Class notations ABS + A1(E) Bulk Carrier (BC-A), + AMS, + ACCU, CSR, Safe Ship-CM, Strengthened for Carriage of Heavy Cargoes – No. 2 & 4. Holds may be empty, ESP, UWILD, TCM, GRAB (20).

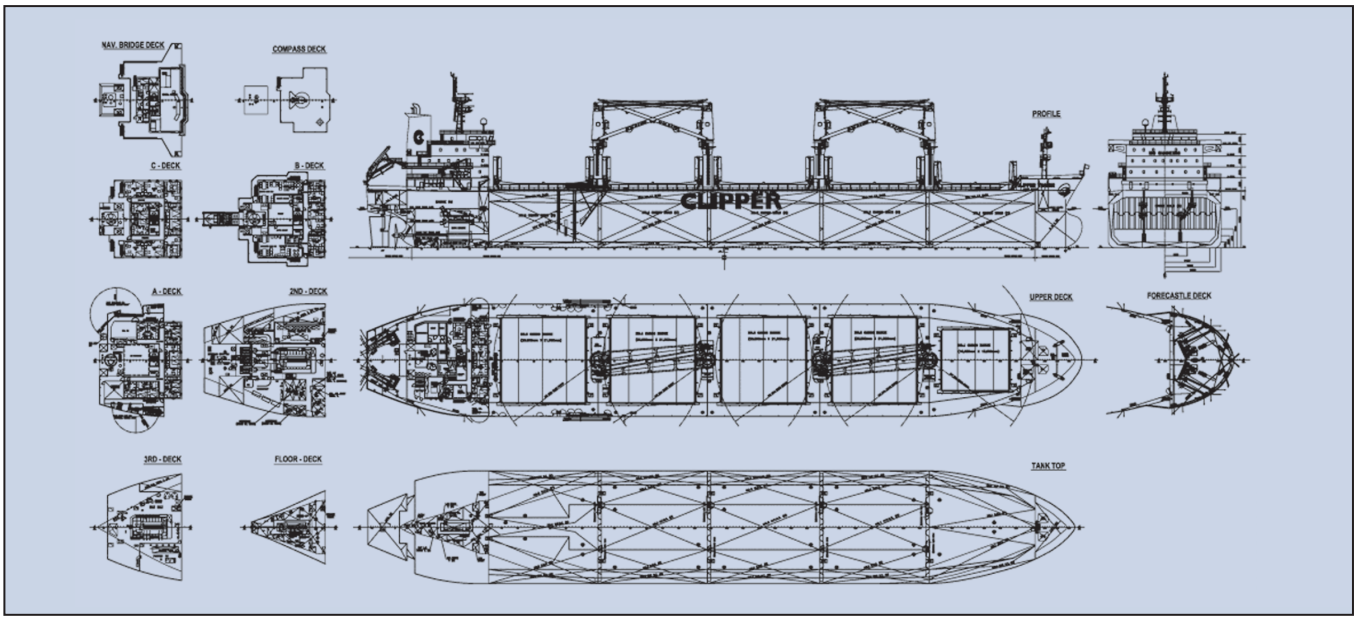
Furthermore, relatively high capacity ballast pumps have been incorporated into the Trader design. These, GTR Campbell said, allowed the ships to ballast and deballast faster than similar Handy class bulk carriers on the market.

The main engine selected for the Trader is the MAN B&W 6S4 2MC mkVII, which has an output rating of 6480kW at 136rpm. This provides a service speed of 14.3knots, while the estimated fuel economy for both the main and auxiliary engines is less than 25tonnes a day.

Mr Prince concluded: 'The Trader conforms to the characteristic Algoship design philosophy of creating simple, strong vessels that are easy and economic to operate and to maintain. They are widely accepted by charterers, can achieve fast turnround times in port and offer a high degree of flexibility in terms of cargo operations, especially for multiport loading and discharging. Charterers can hire a Trader and know what vessel they are getting and how it will perform.'

Based on current market conditions, he said that charter rates of US$30,000 a day could be 'easily achieved' by the Trader class.

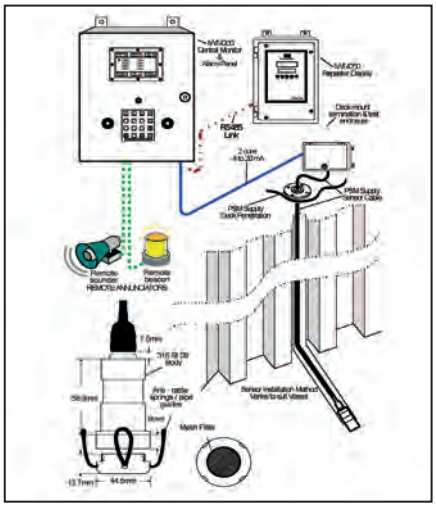
GA drawing of *Bossclip Trader*, the first in the new series of vessels, which was delivered last year.



Leading the way on water ingress monitoring

THIS year, water ingress monitors start to become compulsory on small single hold cargo ships, affecting many thousands of ships worldwide. The experience gained on bulk carriers to date should offer important guidance, according to UK-based PSM Instrumentation.

PSM's water ingress alarm kit.



Overview for the operation of the Bulksafe water ingress alarm system.

WATER ingress monitoring systems have been mandatory in bulk carriers since 2005 and with effect from 1 January 2007 they became compulsory for smaller new and existing single hold dry cargo ships, following a change in the SOLAS regulations.

The new rules require the fitting of a specially IACS type-approved system that has undergone homologation testing specific to this application standard. They apply to existing cargo ships of less than 100m in length built before 1998 and all new and existing cargo ships less than 80m in length built after that date. Systems applied to existing ships must be installed during the first intermediate or full survey after that date.

When the initial legislation came into force for bulk carriers, there was little time for owners and operators to gain compliance, resulting in a large number of suppliers bringing WIS systems to the market attracted by the sheer number of vessels to be retrofitted. Simple systems, particularly those using simple float operated switches as a primary source of water detection, were initially attractive on the grounds of equipment price.

However, the cost of installation easily outweighed the cost of the equipment and the bottom line saving was not only negligible, but worse was to come. 'Simplicity does not always mean reliability especially when related to such an arduous environment and many owners found their systems failed after a very short time or only one voyage,' said Geoff Taylor, managing director of PSM Intrumentation.

Comments received by the company from the larger bulk carrier sector suggest that some of the systems fitted to those ships have proved less robust than might have been expected. Common faults reported include sticking float stems, clogging of filters by dusty cargoes, physical damage to sensors and cables even when installed in pipes and false alarms generated by condensation or wet loading.

The regulation requires the system to be fully effective at all times and in many ports Port Safety inspection will require the witnessing of equipment tests before allowing the ship to depart and will sometimes prevent the ship from leaving until it is rectified. That could entail removing the cargo because many systems are only accessible in that state.

According to Mr Taylor, 'The water ingress system is a primary safety device intended to prevent such disasters as befell *Derbyshire*, that sank in only a few minutes during a typhoon. The contention surely must be that with only minutes to act, the alarm system must have a 100% reliability.'

He added: 'If the primary sensor is a passive device, there can be little confidence that it will operate when it needs to. This is not limited to float switches but encompasses any passive detector. Even the simplest float switches, for example, might be tested by immersion in a bucket of water before loading, but that is hardly practical, once the hold is full and the switch located near the bottom of the hold.'

To address the issue, PSM Instrumentation selected one of its existing type approved analogue level sensors as the initial detector for the system. As the water depth increases, so does the pressure on the sensor's membrane increasing the current as it does so. PSM claims that the sensor is accurate enough to show the gradual rise in water depth in a flooded hold, allowing the situation to be better monitored than those systems that just have low and high level alarms.

Mr Taylor explained that the rationale behind the use of an analogue sensor was that it always measured an empirical level whether that level was present or not. In this way there was always a 'sensor healthy' signal monitored by the alarm station. Any deviation of this signal would activate an alarm. The alarm monitoring station also detected the difference between a sensor failure and an active alarm status and annunciates accordingly. Furthermore, PSM has devised a simple and practical method of mechanically testing the entire system at any time and in any condition of hold loading. By applying a negative pressure to the rear of the sensor's detection membrane, the sensor behaves in a correct operative manner.

Solas regulations require that, in general, two alarm points are required in each hold. For most manufacturers, that means installing two detectors at different heights above the hold floor. Depending upon the installation, that will require two sets of cables, protection pipes, deck penetrations and so on. However, PSM said that its system was fully IACS type approved using only one sensor. Again Mr Taylor explained: 'We were able to demonstrate to class that a system with continuous health self-monitoring would negate the need for a second sensor by affording both a pre alarm and main alarm derived from a single reliable sensor. This not only reduces the cost of the system but more importantly the cost of installation materials and time.'

PSM sees the market for single hold cargo ships as even more price sensitive in view of the small operating margins of these vessels. Many are owner operated and can ill afford any downtime if PSC inspectors delay vessel departures because of an inoperative WIS system. PSM claims that the 'check from the deck' test after load will reduce turnaround time by affording a single and swift proving test for surveyors. PSM also says it is very confident in the selection of sensor since this series has seen extensive service in similar applications for over twenty years. Nevertheless in the unlikely event of a sensor failure its system can allow for the replacement of a sensor directly from the deck, even when the hold is full.

PSM has a range of sensor fittings and styles and installation is therefore, not limited to one fixed method or position. This should provide added benefit in substantially reducing costs for smaller ships, since it should be practical to install some sensors on the aft bulkhead, possibly from the engineroom side, making cabling installation very much easier, and removing any need for hold and deck protection pipes completely. Mounted in this way, the sensors retain their 100% serviceability from outside the hold, the company suggested, pointing out that with conventional float switches and systems only approved with two sensors this would be difficult to achieve.

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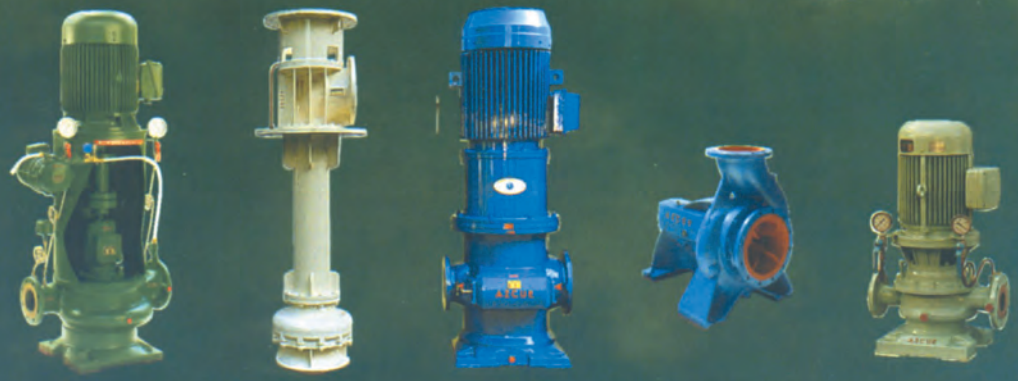

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Toning down the noise

STRICTER environmental regulation in the marine world is increasing the pressure on shipowners and designers to control noise and vibration aboard ship, writes Richard Higgs.

GREATER attention than ever before is being paid to preventing and controlling shipboard noise, particularly aboard passenger vessels. The comfort of fare paying passengers, seeking privacy and peace in their cabin space, as well as the comfort of resting crew members, remain high priorities. Reducing vibration to protect delicate, sophisticated equipment onboard has been another factor in the development of quieter vessels.

One major issue has been that of propeller noise, especially aft onboard cruiseships, where public passenger areas tend to be concentrated. But vibration and noise from diesel engines is a potentially important problem too.

In recent years, an increase in the size of ships has prompted an equal demand for greater power provided by auxiliary engines. This means that engines are getting larger while the dimensions of the engineroom, in comparison, seem smaller. So, higher noise levels are generated, and these may not comply with International Maritime Organization noise legislation.

One way of accommodating IMO requirements is to employ sound absorbing material in the engineroom. But it is essential to gauge the potential effectiveness of sound reduction measures. Thanks to the use of room acoustic computer software, the sound reducing performance of such material can be predicted very accurately, according to consulting engineers Ødegaard & Danneskiold-Samsøe, of Copenhagen.

A noise and vibration control specialist, ØDS has now begun applying ODEON, which is an established computer tool developed in Denmark, in the marine field. This tool was used previously in other applications to predict the acoustic characteristics within buildings on land.

The ØDS software program has only just been deployed in the case of a full size vessel, but for commercial reasons, the firm is still unable to reveal the name and details of the ship concerned, ØDS marketing director Ulrik Danneskiold-Samsøe said.

Although the use of ODEON in relation to ships' enginerooms is new, the software was employed in other contexts over a period of more than 15 years. ØDS deployed the software in room acoustic computation of factories, train cars, churches and concert halls.

'The main advantage of the software is that the sound reducing performance can be simulated according to the actual mounting options,' said Mr Danneskiold-Samsøe. 'This means that the most practical and economical alternative can easily be identified.

'Furthermore, recent field measurements have shown that the accuracy of the noise prediction lies within a margin of only 1dB (decibel).'

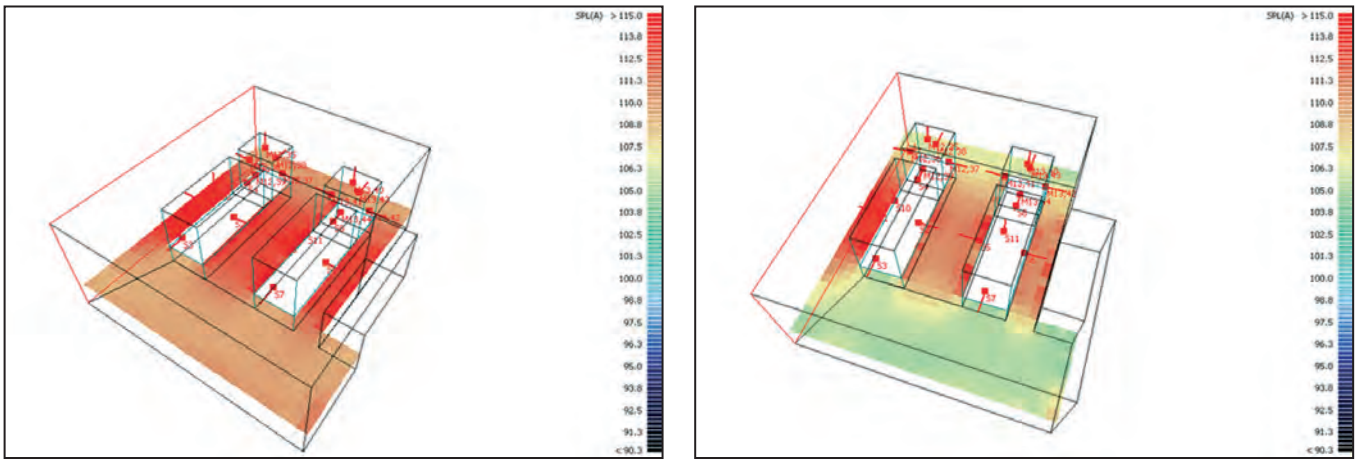
Even so, regardless of how the sound absorbing material is mounted, there will be positions, close to the engine, where the influence of such materials is very low. It will be difficult to establish IMO compliance in these limited areas by using sound absorbing material alone. In a case where a sound reduction has to be achieved in these areas also, some decrease in the noise emission from the engine will be necessary.

ØDS also pointed out that there is a limit to the degree that sound can be reduced further away from the engine. In practice, at greater distances the benefit will be limited to approximately 5dB - 6dB, the firm said.

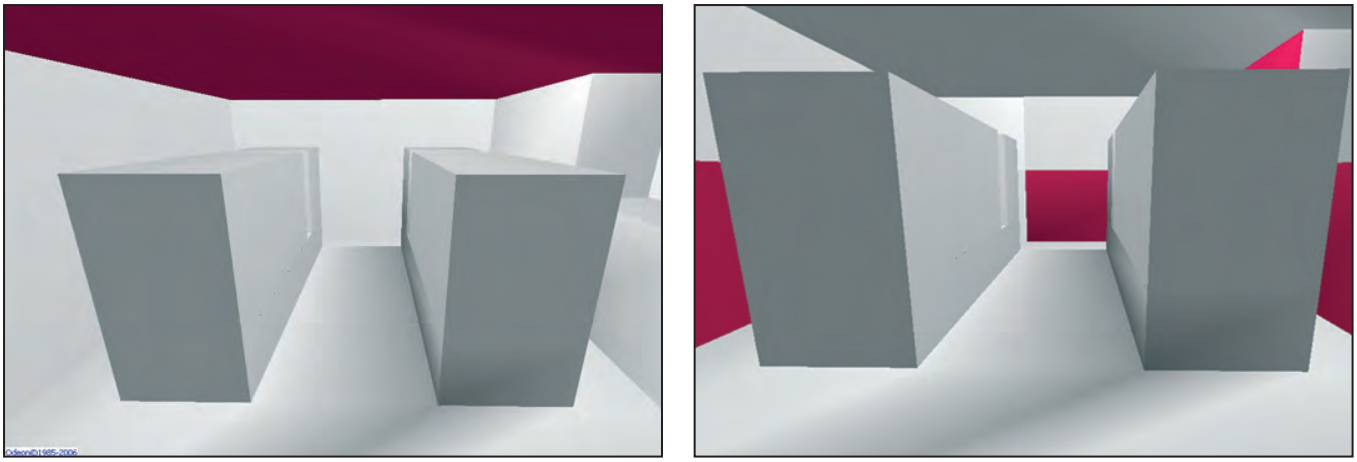
ODEON is the product of a university/industry cooperation which originated as a science project devised by Professor Jens Holger Rindel at the Technical University of Denmark.

From the outset, five companies in the Danish acoustic industry backed the project which has grown over a period of two decades into an established program for design engineering of the

Simulation of the engineroom noise level distribution. Before mounting of sound absorbing material in the ceiling (left) and after (right).



Alternative positions for mounting absorbing material can be simulated with ODEON. On ceiling (left) and on lower part of wall panel (right)'.



acoustic characteristics of rooms. Performance tuning of the program is carried on in the enterprise ODEON A/S, a joint venture owned by the five original backers, with each holding a 20% stake.

As of January 2007, ODEON, in different forms, has been purchased by around 175 clients, some holding more than one licence. Its customers include acoustic consultancies, universities and large companies specialising in noise and acoustic technology, said ØDS.

Sound absorption material was not applied in the engineroom earlier because of the unacceptable fire risk of using the wool without an impenetrable barrier to dust and vapour in the environment.

Today, however, it is possible to mount a washable film over the sound absorbing material to prevent such risk. The outer film covering prevents oil vapour from penetrating the sound absorbing material and making it flammable. The film can be cleaned, with slippery substances on the material being removed, according to ØDS.

The washable film is so thin that it does not harm the sound absorbing properties significantly. The design therefore complies with the non-flammable requirements for engineroom components.

Thanks to the new tools for noise prediction and fire risk elimination, sound absorbing measures in ship enginerooms are continuously upgraded - and, as a consequence, engineroom staff are able to work in a satisfactory environment, said ØDS.

Research continues into alternative ways of reducing or controlling engineroom noise and avoiding the worst effects on a ship's passengers and crew. To date though, there has not been any obvious way to design out the problem where the engine and turbocharger are concerned.

'We are still waiting for the real breakthrough in this area. Applying new ignition technology by using common rail or by electronic means has not provided any noise reduction of significance,' said ØDS. Less powerful engines do not seem to be the answer in a market demanding ever greater power.

In theory, each engine could be installed in its own room so as to eliminate neighbouring engine noise, but this remains quite impractical. Designing engine encapsulation for speedy dismantling is possible, but again is unacceptable in practice because of lack of engineroom floor space and the ceiling height, according to ØDS.

Of course, there is the option of lessening direct crew exposure to the problem or eliminating human contact altogether. There has been development in automation technology and engine monitoring has made some progress, but an engineroom without a human presence remains unrealistic.

The latest ØDS software program has only just been deployed in the case of a full size vessel, according to ØDS marketing director Ulrik Danneskiold-Samsøe.

In September 2005, ØDS, which has established a specialist reputation in the mega-yacht and cruiseship sectors, was acquired by Lloyd's Register Group. LR Group already had a leading position in the classification of passenger vessels. Both organisations have forecast significant growth in demand for noise and vibration consultancy services in the LNG and containership areas.

The study of opposing forces

RESEARCH into the causes and effective control of noise and vibration onboard ship is an ever more important element in the work of the marine classification societies.

Organisations like Lloyd's Register Group are involved in identifying risks at the design, build and operation stages of new vessels, and providing technical solutions to problems that investigations uncover. They are involved in setting design standards in this area too.

In the case of noise and vibration, engineers are devoting a great deal of time and energy to researching specific aspects of the chief shipboard noise sources. For example, there are still areas of propeller sourced noise not fully understood and research at model and full scale levels is continuing to understand and to predict 'broadband' excitation completely, according to John Carlton, LR's global technology leader for marine technology investigations.

Foremost among the major source areas being studied in the course of preventing and controlling vibration and noise is the ship's propulsion system. But other important sources include the diesel engines, where mounting systems can reduce the effects.

Internal shipboard noise can also be generated by heat, ventilation and air conditioning systems and the resulting disturbance becomes an issue, particularly on passenger ships. The fourth problem area is the ship's hull with simple low level boundary layer noise or wave impact on the vessel's structure, Mr Carlton pointed out.

Much research today is concentrated on understanding the effects of the competing forces generated by the action of the propeller and improving vessels' propeller and hull design. This involves study of the opposing pressures set up through cavitation of the propeller tip and leading edge vortices and the routing of sound throughout the ship.

Engineers are also devoting time and effort to the modification of the diesel engine which has been a source of greater noise as the speed of vessels is increased.

Research into marine noise and vibration is continuing against a background of uncertainty as far as common industry-wide standards are concerned. There is still much debate about the way forward as the criteria for comfort level standards has changed and some classification societies still recognise the old order. The scene is made more complex as the societies retain differing numbers of comfort classes.

Study and development of improvements aimed at designing and building quieter ships is still at a relatively early stage, perhaps 'at the end of the beginning', Mr Carlton said. He relishes the challenge and acknowledges the excitement generated by the unexpected breakthrough in research work.

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SAFEDOR (Design, Operation and Regulation for Safety) is about to complete the first half of its four year programme. To mark this event, partners of SAFEDOR will present the latest results at a public conference at the Renaissance Hotel Brussels on 7 and 8 May 2007. The event will provide an excellent opportunity to familiarise engineers with the principles underlying risk-based ship design and approval, and to discuss early applications.

Risk-based approaches in the maritime industry started with the concept of probabilistic damage stability, were widely applied within the offshore sector and are now being adapted and more and more utilized within the shipping sector. The SAFEDOR approach focuses on risk-based design and risk-based approval to provide a transparent and consistent methodology that accounts for the safety performance of a ship design along with other performance variables like speed, cargo capacity, endurance, etc. Thus, the aim of SAFEDOR is not only to provide the technical elements of a new design and approval methodology but also to establish a new safety philosophy.

SAFEDOR tackles the new philosophy in theory and praxis. Results of development activities comprise the process for risk-based design along with a novel decision-making concept and advanced tools to predict the safety performance of a ship in extreme or accidental conditions. In parallel, practical application has resulted in eight innovative ship designs and concepts for safety-critical technology. The modernisation of the regulatory framework is the second pillar of SAFEDOR and results comprise a draft process for risk-based ship and system approval along with acceptance criteria at top and function level.

Standing for "Design, Operation and Regulation for Safety", SAFEDOR, is an Integrated Project (IP), funded by the European Commission under the 6th RTD Framework Programme, in which a total of 53 project partners – coordinated by Germanischer Lloyd - from all sectors of the maritime industry in Europe are participating.

For further information and registration details,
please visit www.rina.org.uk/safedor

If you have any questions regarding this event, please contact Sally Thomas on:

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Fax: +44 (0)20 7259 5912

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Websites: www.safedor.org and www.rina.org.uk/safedor

When the answer lies in analysis

DRAFTING shipbuilding specification clauses for noise and vibration is a complicated business, with differing design demands and an ill-defined standards map to follow.

TO avoid vibration and noise problems, it remains essential to sort out, at an early stage, the potentially conflicting demands on noise/vibration versus other ship design constraints, said Ulrik Rasmussen of the Danish marine acoustics consultancy ScanVibra.

There is no single way in which to define a good specification. For a high level vessel, the specification should always be tailored to suit the particular ship, according to Rasmussen.

The technical demands increase when special requirements are imposed on vessels, from owners' requirements, comfort class notations or those demands laid down by the authorities. For example, the Russian (SN), Danish (DMA) and German (See-BG) administrations all impose various requirements for vessels, on top of the IMO convention on noise levels, explained the Copenhagen-based consultant.

Further complication arises from the fact that the marine industry is short of generally accepted common standards. For instance, there is no single international standard that is generally accepted for the evaluation of crew and passenger vibration comfort.

The latest ISO 6954-2000 standard was originally intended to provide just such a common reference, but this standard is still not widely accepted seven years after its introduction. Similarly, all the major classification societies have issued 'Comfort Class' regulations, but many differences still exist between the society standards.

ScanVibra's core competence is the systematic vibration and noise control engineering of new vessels through design reviews, calculations and noise predictions. The key to success in this area is the use of specialist noise and vibration software tools combined with experience and design know-how, according to the Danish consultant.

His firm's customers are currently benefitting from recent significant developments in the calculation tools used, combining high accuracy calculations with fast and effective modelling and simulation of noise and vibration measures. Thanks to development work carried out over the past two years, the company has managed to reduce the time typically required for a complete vibration analysis by some 30% - 40%.

ScanVibra says it is currently busy with a wide range of projects. While its key activity areas tend to be passenger ships and luxury yachts, it is also now working with cargo ships, offshore vessels, naval and special vessel designs.

Recent ropax analysis projects clearly demonstrated the firm's work on the newbuild side. At an early stage, the main implications of the noise and vibration requirements were evaluated, including key issues such as propeller design suitability for the vessel, main scantlings of the superstructure deck structures, extent of noise reducing deck coverings and floating floors.

Later as the creation progressed, detailed structural design was analysed.

Resulting recommendations may include rearrangement, pillars, vibration girders or scantling upgrades.

In parallel, noise analysis leads to recommendations in terms of local insulation, accommodation build-up, silencing of fans, selection of diesel engine exhaust silencers and a number of other detailed measures. In this way a full set of solutions is derived in order to ensure that building specification noise and vibration requirements are complied with.

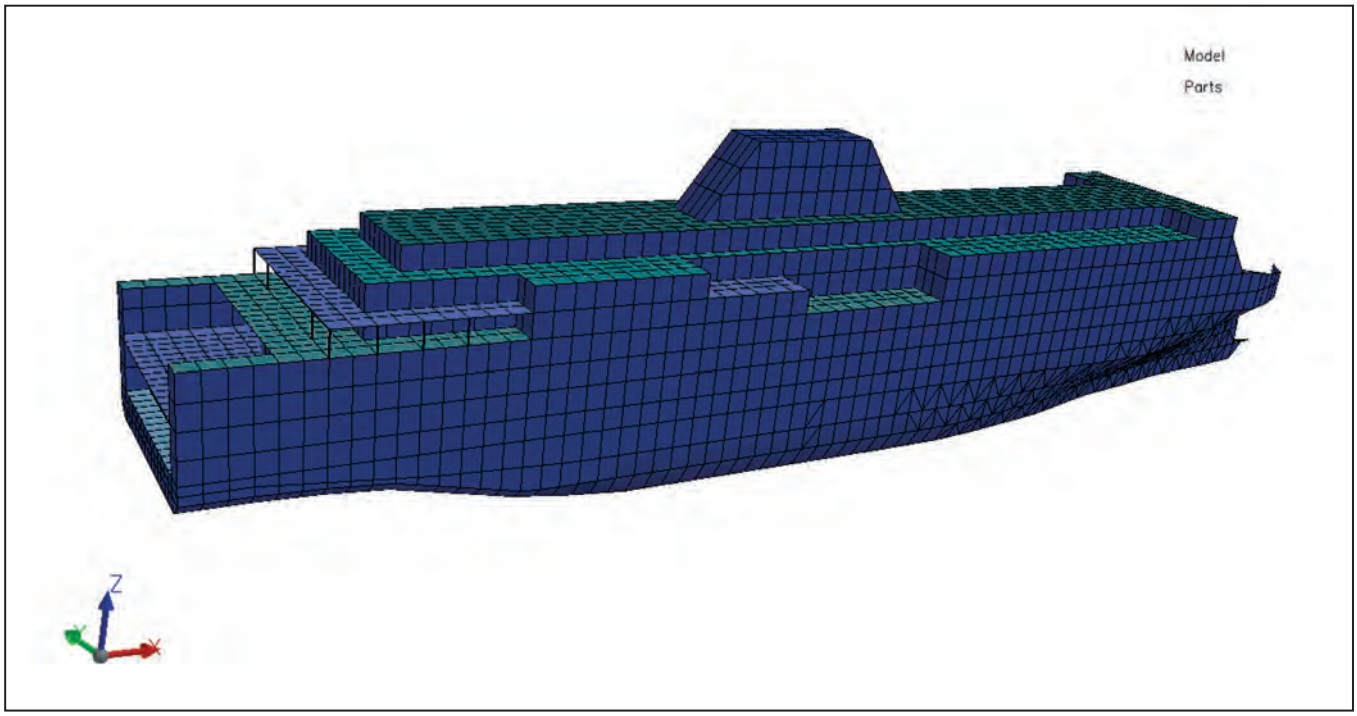
Technically demanding tasks arise, particularly on high level passenger vessels and yachts. The classic problem is noise and vibration coming from the ship's propulsion system, equipment and ventilation system. However, increasingly, passenger ships face additional requirements in the area of acoustic privacy as a result of noise from activity, speech, music and entertainment systems, etc.

Even less comfort sensitive vessels now present a number of technical problems and risks. More important examples can include hull vibration resonance problems; propeller induced noise and vibration; structure-borne noise from rigidly mounted medium speed engines; exhaust noise, thruster noise on offshore (DP) vessels and external noise in harbours, according to ScanVibra.

The firm relies heavily for its services on the in-house developed 'ShipNP' noise prediction software, in combination with advanced 'finite element' (FE) tools for vibration analysis and prediction.

In a typical newbuilding project, in parallel with the design progress, reviews and calculations are performed for the yard's planned design. When problems are identified from the analysis, solutions must be found in terms of, for example, improved propeller blade design, structural stiffening, noise reducing deck coverings and insulation. Possible solutions to the problems can be simulated in the calculations, and in this way systematic decisions can be made on the most suitable measures.

170m ropax - three dimensional finite element (FE) model for vibration analysis.



Optimising acoustic properties

G THEODOR Freese has carried out a development programme, resulting in what it believes offers comprehensive appropriate solutions for noise reducing measures onboard ships.

THE choice of low noise resilient mounted engines and low noise propellers are well known methods to reduce the structure-borne noise and vibration in cruiseships. However, experience shows that, in many areas of a ship, sufficient improvements cannot be obtained only by reducing the noise generation at the main noise sources.

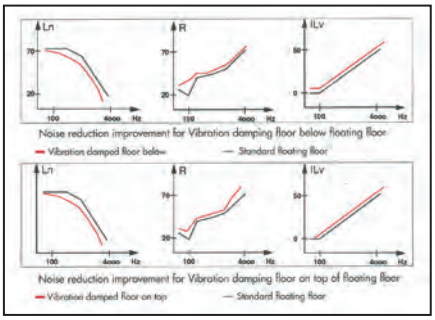
Such areas can be:

- Passenger areas in the aft of a cruiseship with substantial noise from the propellers.
- Impact noise excitation to passenger cabins located just below open deck areas, galleys, discos, etc.
- Airborne noise from machinery rooms, disco music, theatres, etc.

Such problems are normally solved by a careful design of cabins, lounges and passengers areas. In order to reach a successful result the acoustic properties of accommodation materials are extremely important. The most important element for the noise in cabins is often noise radiation from the floors. In order to meet the requirements of the market GTF Freese (GTF) has carried out a development programme, resulting in what the German firm said offered appropriate solutions for noise reducing measures onboard ships.

In practice three principal types of floor are applied in ships, namely standard levelling floors, vibration damping floors and floating floors. The acoustic properties of the different types of floor differ widely. The standard levelling floor is normally applied in areas with no need for noise reducing measures.

Vibration damping constructions are normally applied in areas where only structure-borne or impact sound contribution is substantial. The principle of the vibration damping floor is that the vibrations are absorbed by means of a specially designed constrained layer construction (Tefrotex Viscoelastic plus steel-plate or primary deck covering, for example Tefrotex 60) reducing the vibration level in the local plate fields of the ship deck structure, hence reducing the noise radiated into the accommodation. This method is often referred to as Viscoelastic damping or constrained damping construction.



Noise reduction for vibration damping floor on top of floating floor.

A vibration damping floor having the optimum acoustic properties is characterised by the following:

- High loss factor of the viscoelastic material.
- Low shear module of the viscolelastic material.
- High module of elasticity of the top plate.
- Optimised thickness of each layer.

Tefrotex Viscoelastic material can be combined with different types of top layers in order to fulfil any need in a vessel. Therefore Tefrotex Viscoelastic has been tested according to IMO Resolution 635 (16)/A. 687 (17), MED EC 96/98, in order to allow combinations with any type of top layers.

The loss factor of the Viscolelastic material is the most important parameter for the vibration damping properties of constrained layer constructions. By optimising the thickness of the materials applied in the constructions it is possible to obtain high loss factors for constrained layer constructions.

Floating floors (Tefrolith M, Tefroment S, Tefrolith FF-Steel) are applied in areas where high airborne or structure-borne sound insulation is needed. The principle of the floating floor is that the vibration transmitted is reduced by means of the mineral wool so the vibration level of the top plate and hence the radiated noise is lower.

A floating floor construction can be ascribed as a mass/spring system, with a frequency of resonance corresponding to the stiffness in the mineral wool and the weight of the top layer. The floor has the optimum acoustic properties characterised by the following:

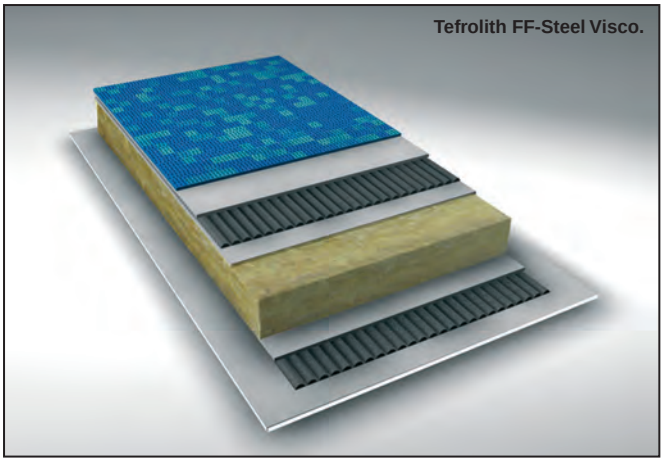
- Heavy mass of the top plate.
- Low stiffness of the mineral wool.
- Low resonance frequency in the floating floor construction.

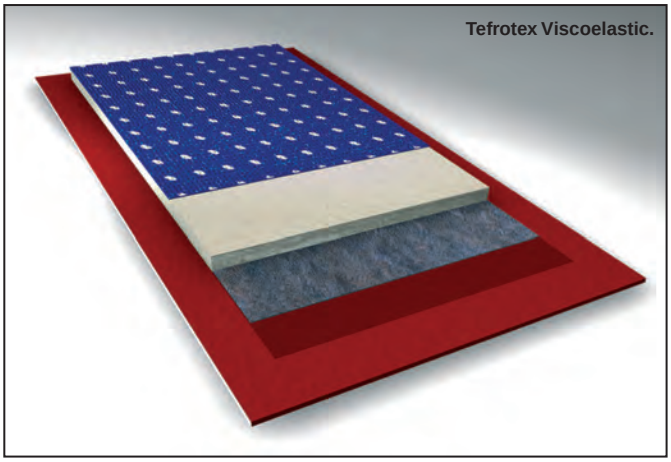
For frequencies below the resonance frequency of the floating floor the noise reduction will theoretically be zero. The resonance frequency for the floating floors is normally approximately 80Hz-100Hz.

In order to be able to select the correct type of noise reducing floor it is important to know:

- The type of the noise source (propeller, main engine, auxiliary machinery, air conditioning machinery, human activity (walking, jogging or music)).
- The noise transmission paths in the ship, eg the location of the cabins relative to the noise sources in the ship.

In very demanding applications where a very high damping is required or the noise spectrum is dominated by either high frequency or low frequency components it is possible to design variations of the standard floors or to combine different types of floors, for example Tefrotex Viscoelastic/Steel plus Tefrolith FF-Steel with remarkable noise-reduction results. This construction is for example used on cruise vessels, high technology offshore supply vessels built in Norway and on vessels and platforms in Asia. Furthermore, constrained layer Tefrotex Viscoelastic plus Tefrotex 60 are often installed constructions for noise-reduction and levelling of the steel-deck at the same time. Different references for noise-reduction performed by GTF include floating floors and damping layers as well as Tefrotex Viscoelastic/Steel constructions on bulkheads, which are available upon request. Noise-reduction constructions developed, produced and applied by GTF are claimed to provide remarkable results and can be found around the world on all kind of vessels, platforms etc.


Tefrolith FF-Steel Visco.


Tefrotex Viscoelastic.

The Royal Institution of Naval Architects

Warship 2007: The Affordable Warship

BMT

20 - 21 June 2007, Bath, UK

First Notice & Call for Papers

This conference, the 27th in RINA's successful Warship series, will look at the 'Affordable Warship'. The conference will be held in Bath on 20-21 June 2007.

The ever increasing cost of warship procurement, upkeep and operations, whilst at the same time meeting the need for ever more capable and sophisticated platforms; a dilemma faced by most navies today. This conference will consider how advances in design, construction and operations can contribute towards lower through-life cost ownership whilst maintaining fleet capability.

RINA invites papers on the following related topics, covering all types of warship:

- Procurement models for warship acquisition
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- Through life support
- Innovative design
- Designing to cost and capability
- Build in friendliness
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- Innovative support solutions
- Regulation & legislation: concept to disposal

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Double layer vibration isolation

RUBBER Design from The Netherlands recently completed a luxury yacht project in which the requirements on the vibration reduction on structure-borne noise level caused by the generator sets surpassed any criteria set to date.

The normal solution for reducing the noise level is to place the engines on one layer of vibration isolators, but this was not deemed sufficient to meet the owner's stated requirements. It was therefore decided to apply a double layer of vibration isolators (type RD3 series and RD2 series) between which a certain mass was fitted. This finally resulted in a situation where the structure-borne noise level in the band of the cylinder ignition frequency of 117dB was reduced to roughly 55dB; significantly below the stated requirements.

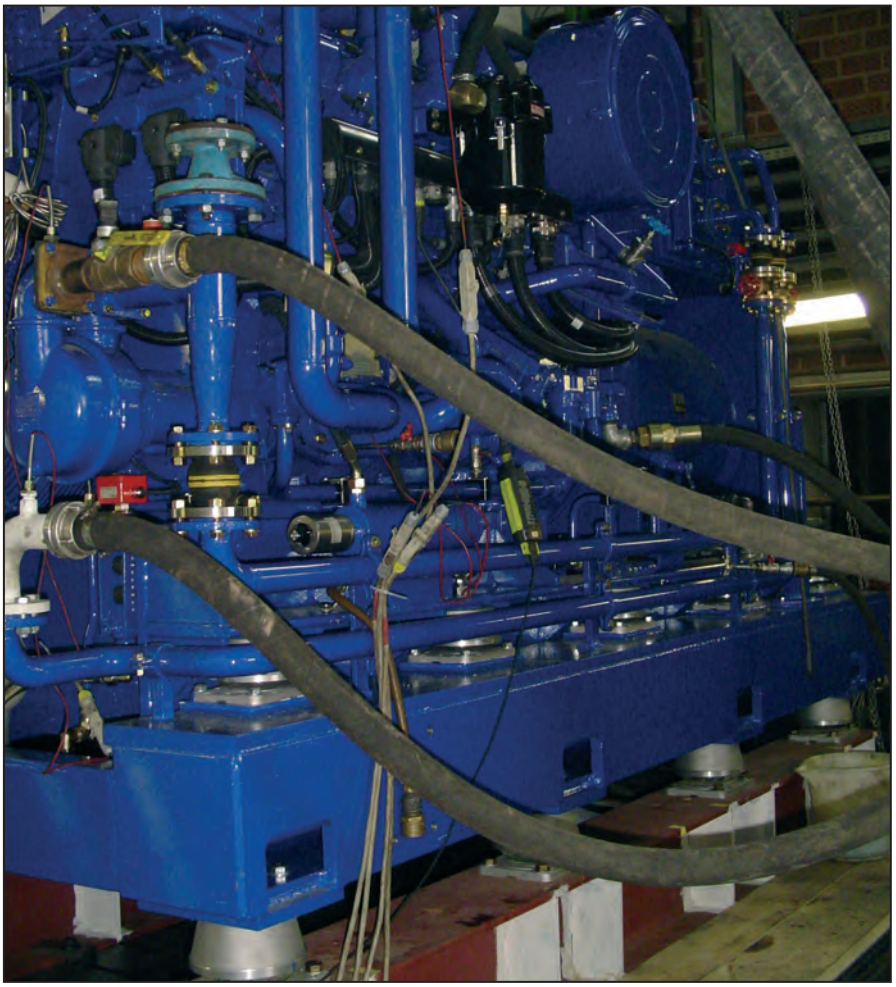
Because the achieved noise reduction of an average of 56dB is the practical maximum of what is feasible with a double spring-mounted set-up, it was deemed extra important to arrive at a good design with respect to the natural frequencies and impedance of the intermediate mass, and the position of the natural frequencies of the set-up.

To achieve its ends, Rubber Design needed to: determine the position and type of vibration isolators on the basis of load distribution and the natural frequencies of the set-up; design the intermediate mass with the aid of 3D-CAD and Finite Element Package; and calculate the structure-borne noise transfer from engine to foundation.

The developer said that use of a Finite Element Package led to an intermediate mass with favourable natural frequencies and high impedance. The engine frame was also modelled in this package and calculated on natural frequencies, strength and impedance.

To be able to simulate the complete system, it was not only necessary to enter the models from the Finite Element Package in a simulation program, but also to input the characteristics of the vibration isolators used. Rubber Design said it had a complete database that included all specific characteristics of vibration isolators. The company also has similar databases of the characteristics of engines and ships' foundations. An independent inspection organisation measured the vibration levels at maximum engine speed of the set-up on a trial bench. These findings were sufficient for release of the double spring-mounted set-up for installation in the luxury yacht.

Rubber Design said the double spring-mounted set-up would become a feature of several ship types in the future.



The double spring-mounted set up saw Rubber Design surpass its most challenging engine vibration dampening criteria to date.

Mounting to isolate shock

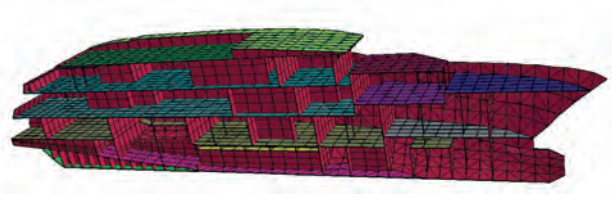
A NEW range of mounting designed to provide shock and vibration isolation for large marine engines and gensets has been launched. Trelleborg Industrial AVS, based in Leicester, UK, has produced the Metalastik Cushymount XK, which combines the vibration isolation with high deflection and load capacity.

A rotating mount eliminates the need for additional drilling, and the load range is 35kN to 60kN. It is thought to be able to withstand shock loads of up to 180kN in all directions without deformation, while the range also includes a special variant designed for shocks up to 300kN.

Three grades of rubber hardness are available, from 50 to 65 shore hardness, and different polymers can also be supplied. High-strength castings protect the captive rubber element against contamination and physical damage. There is an adjustable buffer which can be checked via a cut-out in the base casting, and the range is fully interchangeable with competitor products.

Trelleborg Industrial AVS has launched the Metalastik Cushymount XK.

SCANVIBRA



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The Royal Institution of Naval Architects

BASIC DRY DOCK TRAINING COURSE

14th - 18th May 2007

By Joe Stiglich

This four-and-a half day course covers the fundamentals and calculations of dry docking. The course begins with the basics and safety concerns, and progresses through all phases of dry docking: preparation, docking, lay period, undocking. and ends with a discussion of Accidents and Incidents.

It's designed to be relevant to Dock Masters, Docking Officers, Engineers, Naval Architects, Port Engineers and others involved in the dry docking of ships and vessels. The course is presented through classroom lectures, student participation in projects and practical application exercises. The course addresses the deck plate level of practical operation needed by the dock operator and the universally accepted mathematical calculations required to carry out operations in accordance with established sound engineering practices.

Topics to be covered:

- Basic dry docking community terminology
- Calculations
- Safe dry docking procedures
- Lay period
- Undocking evolutions
- Docking Plans
- Docking and undocking conferences
- Hull boards
- Vessel stability
- Incidents/accidents

The Course Leader, Joe Stiglich, is a retired Naval Officer, qualified NAVSEA Docking Officer and holds a Masters Degree from MIT in Naval Architecture and Marine Engineering. He has been responsible for over 250 safe docking and undocking operations. He currently runs a series of conference and training courses for personnel involved in all phase of the drydocking industry and acts as a consultant for ship repair companies.

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The following charges will be made in the event of a cancellation: £250 if received before 18th April 2007 Cancellations made anytime after that date will not be refunded. Delegates may be substituted in writing subject to the consent of the Conference Organiser.

Registration fee: RINA Members: £880+VAT (Total £1034.00) Non Members: £970+VAT (£1139.75) Group Fee (3 delegrates or more): £860+VAT (1010.50)

Ships and Science

By Larrie D Ferreiro, published by The MIT Press, 2007, 465 pp. ISBN-10: 0-262-06259-3; ISBN-13: 978-0-262-06259-6, hardback. £29.95.

THE book is one of the series Transformations: Studies in the History of Science and Technology, published by the MIT Press with Jed Z Buchwald as general editor. Larrie Ferreiro will be known to many members of the RINA as a result of his contributions to the institution's transactions. He is both a naval architect and naval historian. He trained and worked as a naval architect with the US, British and French navies as well as the US Coast Guard. He has a Ph D in the History of Science and Technology from Imperial College, London.

The book sets the development of naval architecture within the context of the development of other engineering persuasions, particularly hydraulics and canals. The author contends that 'naval architecture was born in the mountains of Peru, in the mind of a French astronomer named Pierre Bouguer who never built a ship in his life'. That alone grabs the reader's attention and creates a wish to know more. The book meets that wish.

The desire for a more theoretical approach to naval architecture arose not from the constructors themselves – they were often practical people of little or no formal training, who received their training 'on the job'. In the eyes of some they were 'mere carpenters', but they produced many fine ships. Rather it was the administrators who wished to control the product they were getting for their money. They enlisted the help of scientists and mathematicians to determine what constituted a good ship.

It is interesting to read of the differences of opinion between eminent characters of the day such as Newton and Descartes. Early work was devoted to the manoeuvring of sailing ships, for instance how to arrange masts and sails to best effect and the best pursuit curve.

Most of this work was not applied by the constructors directly in their designs, probably because they did not really understand it and because usually it dealt with one aspect of what was, in total, a complex problem. However, the work and the way it was debated and promulgated, makes interesting reading. The author shows that some of the developments were wrongly attributed to later workers because the originator of an idea did not achieve a wide enough dissemination of the idea. It is interesting to read how some fallacious theories held sway and were quoted long after they had been disproved.

Perhaps surprisingly to modern naval architects, stability was not seen as a problem early on. This was partly because it was not easy to tell when a sailing ship's stability was inadequate and when poor seamanship was the reason for ship losses. If, on completion, more stability was needed the ship was 'girdled'. Also early attention was focussed on the internal volume of the ship rather than its external form and displacement.

It was the advent of side ports in ships that made it necessary to be able to predict draughts accurately before a ship was built, and so shifted emphasis towards the volume of displacement. It was Bouguer who introduced the term 'metacentre' and it is interesting to note that the first recorded inclining experiment as such was carried out at Brest in 1748.

By 1700, only two books of naval architecture had been published, both in French. By 1800, almost three dozen books were in print in at least eight languages. Some were devoted to one aspect of the subject but the more influential Were the works of synthesis dealing with the entire discipline. The author devotes a chapter to the discussion of six books which came to define the shape and structure of naval architecture for well over a century. These six were by Paul Hoste (1697); Pierre Bouguer (1746); Leonhard Euler (1749); Henri-Louis Duhamel du Monceau (1752); Jorge Juan y Santacilla (1771) and Fredrik Henrik af Chapman (1775). Interestingly the last, whilst being the least innovative in its approach, became the best known, being widely translated and republished over the years. It contained few new theoretical concepts and was written more as a textbook.

Another chapter in the book is devoted to the growing professionalism of the naval constructor. The French and Danish schools and corps appeared in the 1700s and by the late 1800s nations around the world had their own university departments of naval architecture and elite corps of naval constructors. Naval architecture came to be seen to be at the forefront of engineering theory and practice. The great ships the constructors went on to build would arguably be the most complex engineering structures of their day.

The book is extremely well researched with 54 pages of notes amplifying details in the text and a bibliography of 52 pages. A number of the texts from which the author quotes have never been published. Twelve pages are devoted to a table of some 86 personages involved in the story, listing their dates, specialisations and main achievements.

The book is clearly written and I am sure that most, if not all, RINA members who read it will learn a great deal about the way our chosen profession developed in the period 1600 to 1800. I can recommend it.

E C Tupper

You and Your Ships

By Jim Davis. Published by The Memoir Club, Stanhope Old Hall, Stanhope, Weardale, County Durham DL13 2PF, UK. 2006. 151 pp. Softback. ISBN: 1-84104-151-3. £14.95.

JIM Davis is a very well known figure in the shipping industry, with seemingly boundless energy, even now at 77 years old, holding a myriad of chairmanships and sitting on countless boards. This autobiography details his obsession with ships, right from the age of three or four, taking the title of the book from his mother's exasperated expression, 'You and your ships.'

Born near Harwich in 1928, ships were in Davis' blood, with his father having been a sailor, and later LNER (British Rail)'s marine chief. During WWII, Davis worked on the Pilot Cutter *Landguard* in his school holidays, eventually joining the Royal Navy in 1947. Posted to Cookham, Wiltshire, he had a torrid time in dilapidated conditions, before finally being sent to a tension-filled Londonderry. His National Service demobilisation came about in 1949.

Disappointed with his naval experience, he spent a short time teaching until he received a scholarship to Cambridge, where he applied for and was offered apprenticeships at both P&O and Cunard. Davis chose P&O, as he felt they had more routes, and began there in 1952. He started as a 'checker' at the East London dockyards, where he was seen as somewhat of a 'toff' by the working-class dockers, and then just a year later, sailing on the 10knot BI general cargo ship, *Landaura*, to Calcutta. Communication between Calcutta and London proved troublesome, including the purchase of a tug requested from Mauritius that was actioned before the P&O head office refused permission.

Kobe, Japan, was Jim Davis's next destination, where he was responsible for all P&O ships, plus the Eastern and Australian Line, which operated a freight liner service between Australia and the Far East, including Empire class *Nellore* and *Eastern*. Learning Japanese was to prove useful in the future, as in his dealings with Japanese companies as part of being the International Maritime Industries Forum (IMIF) chairman, a knowledge of the language marked him out among the many Westeners who relied on the Japanese knowing English. Moving on to Hong Kong in 1956, he was in charge of running BI and the Knutsen Line.

In 1957, he returned to London, where he was given the job of overseeing the general construction of *Canberra* and planning the introduction of the ship. Leaking boiler tubes onboard *Canberra* for her maiden voyage caused problems for Davis as the ship had to slow, making her late for the celebrations arranged at each port. *Canberra* gave Davis more cause for concern when she was virtually destroyed by an electrical fire in her engineroom in 1963.

The book also gives an interesting account of behind the scenes at P&O during the 60s, during which time Davis was firstly the high profile corporate affairs director, latterly the director. Backroom politics led to him taking a job at merchant bank Kleinwort Benson in the early 70s.

Outside commitments started to build up, such as his election as president of the Chartered Institute of Transport in 1980. He also began chairmanships and presidencies at IMIF, the National Waterways Association, the Institute of Freight Forwarders and the World Ship society among many others. Leaving KB in 1988 at 60, Davis did not retire, but instead concentrated on all the board work he had taken on.

The book reflects his exuberant personality, with many an anecdote, and including lots of personal photos, as well as demonstrating his talent for sketching ships, something which he claims is an aide memoir to whichever meeting he drew during, his usual favourite time to 'doodle'.

Written in flowing prose, 'You and Your Ships' functions both as an absorbing account of the shipping industry throughout the latter half of the 20th Century, and as one man's personal life story. With a dash of self deprecating humour and fair analysis of the companies and strategies Jim Davis has been witness to, it is easy to see why he is invited to speak at so many events, and why he has often been described as the 'busiest man in shipping'.

The Royal Institution of Naval Architects

DESIGN & CONSTRUCTION OF VESSELS OPERATING IN LOW TEMPERATURE ENVIRONMENTS

30 - 31 May 2007, RINA Headquarters, London, UK

Second Announcement

Vast reserves of oil and gas are expected to be exploited in the Russian Arctic, including the Barents Sea, the Pechora Sea and Kara Sea. There are also new gas fields being developed on the Yamal Peninsula. There is a need for large tankers, LNG carriers and associated support vessels to transport the oil and gas and maintain operations in these far northern locations. Increasing numbers of passenger ships are also operating in low temperature environments.

Vessels operating in the Arctic regions are exposed to a number of unique demands. The pressure of first year and multi year ice imposes additional loads on the hull, propulsion system and appendages. New designs have evolved such as the Double-acting principle. The extreme environmental conditions can also have significant effects on vessel systems and machinery.

Low temperatures and poor visibility can have profound effects on the crew and vessel operations. Current operational experience in the Arctic is limited to much smaller vessels than those that are envisaged. There is great probability that new owners and operators without operational experience in these harsh conditions will enter the market. This will impose a need for guidance for these owners and operators, as well as shipyards building vessels for cold weather service.

RINA invites papers on the following related topics:

- Materials, Welds and Coatings
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Wärtsilä's Vietnamese breakthrough

WÄRTSILÄ has won its first orders in Vietnam to supply fixed pitch propellers. Vinashin Shipbuilding Industry Corporation has contracted the supplier to deliver propellers for a series of five bulk carriers under construction for UK-based shipowner Graig Group.

Wärtsilä has previously supplied propulsion equipment for Graig's Diamond 53 bulk carrier series, built in China.

Due for delivery in August 2007, the first LIPS-type propeller will be for installation to a Diamond 34K bulk carrier under construction at Vinashin's Pha Rung shipyard (see p36-37). The first vessel is due for delivery to Graig in November 2007.

The propellers for the series will have a diameter of 5600mm and will be delivered complete with shafting and Wärtsilä's JMT seals. The seals are of Sternguard 4BL type.

Contact: Wärtsilä Corporation, John Stenbergin, ranta 2, PO Box 196, FIN-00531 Helsinki, Finland.
Tel: +358 10 709 0000.
Fax: +358 10 709 5700.
E-mail addresses have the form firstname.lastname@wartsila.com.

MacGregor's Arctic strike

MACGREGOR has secured hatch cover orders for four more icebreaking containerships under construction for Russian owner MMC Norilsk Nickel for Arctic service. The equipment specification demands that the folding hatch cover sets can operate in temperatures down to -50°C, dictating special measures in designing the equipment and hydraulic system and in materials used, such as the rubber packing.

Following the successful introduction into service last year of the 14,500dwt *Norilskiy Nickel* from Aker Finnyards' Helsinki facility, MMC Norilsk Nickel has commissioned another four of the class from Aker Yards, Germany. For the latest newbuildings MacGregor will deliver the complete hatch cover sets and install the hydraulic piping and the tweendeck covers in a contract worth around €13 million.

A container capacity of 648TEU is arranged in three holds (389TEU) and on deck (259TEU), the holds served by an outfit of MacGregor hydraulically-operated high-stowing folding hatch covers on the weatherdeck and tweendeck.

Contact: Thomas Kappel, area manager, MacGregor (DEU) GmbH.
Tel: +49 40 25 44 43 10.
Fax: +49 40 25 44 44 44.
E-mail: thomas.kappel@macgregor-group.com

MAN upgrades smaller bores

MAN Diesel has enhanced its 50 cm-bore, low-speed engine programme by upgrading some of the market's leading engines with electronic controls that will improve operational economy, flexibility, and manoeuvrability.

It has launched a series of MAN B&W S50ME-B type engines, which augment the existing, small-bore MAN B&W S35ME-B and S40ME-B engines introduced in mid-2006.

The new S50ME-B engines, available in three variants (Marks 7, 8 and 9), strengthen the 50-bore range that also includes the S50 ME-C/MC-C/MC engine series, and which have a combined total of over 3000 engines in service.

MAN Diesel said it was using the ME-B series to broaden the application of the ME concept in its small-bore and medium-sized, two-stroke engines using the electronic, fuel-injection control already introduced in its large-bore engines.

The S50ME-B7/8 variants had clear cost benefits in their power bracket, the supplier said. 'This makes it possible for existing ship designs with the S50MC-C to benefit where application of the advanced S50ME-C type is considered less feasible.'

The S50ME-B7/8 will have the same output and installation data as the corresponding S50MC-C/ME-C versions. With the introduction of the higher-powered MAN B&W S50ME-B9, engine output increases by 12.6% per cylinder, compared with the Mark 7. 'Furthermore, the Mark 9 is designed to suit continuously evolving hull designs, based on more efficient propellers with a lower optimum speed,' said MAN Diesel.

The engine will adopt the design features introduced with the smaller ME-B engines, and will be introduced with 117rpm. All the new S50ME-B engines are available in five- to nine-cylinder variants. This means that the entire ME-B programme now boasts a total output range from 2975kW to 16,020kW.

Contact: MAN Diesel A/S, Teglholmsgade 41, 2450 Copenhagen SV, Denmark.
Tel: +45 33 85 11 00.
Fax: +45 33 85 10 30.
www.manbw.com

APL purchase order

NORWAY'S Advanced Production and Loading (APL) has received a purchase order for the design, engineering, and supply of two new ship sets for submerged turret loading systems (STL) from Daewoo Shipbuilding and Marine Engineering (DSME), in a contract thought to be worth around $20 million.

APL has been previously contracted to produce five ship sets for DSME's LNG regasification vessels and this latest delivery will take place in the first quarter of 2009. The vessels will be capable of regasifying their LNG cargoes onboard and delivering gas through an STL to be piped ashore.

This latest vessel will be used for delivering regasified LNG to deepwater ports in the Gulf of Mexico and Massachusetts Bay, near Boston, USA.

Contact: Knut R Sæthre, chief financial officer, APL ASA, Vikaveien 85, N-4816 Kolbjørnsvik, Norway.
Tel: +47 911 17 876.
www.apl.no

Hamworthy scores with VLGCs

A CONTRACT for liquefied petroleum gas (LPG) packages for three very large gas carriers (VLGCs) has been signed between Hamworthy plc and Hyundai Heavy Industries (HHI). Hamworthy will supply HHI with the packages, thought to be worth £12 million, during 2009. Included are reliquefaction plants, cargo handling engineering, deepwell cargo pumps, and inert gas systems.

Kelvyn Derrick, chief executive of Hamworthy, said that the latest contract brought HHI's order total for LPG reliquefaction systems with Hamworthy to 13 ship sets.

The South Korean subsidiary of Hong Kong's CIDO shipping placed the order for the VLGCs, which will be constructed at HHI's Ulsan shipyard.

Folding hatch cover sets able operate in temperatures down to -50°C demand special measures in designing the equipment and hydraulic system and in materials used, such as the rubber packing.

Contact: Kelvyn Derrick, chief executive, Hamworthy plc, Fleets Corner, Poole, Dorset BH17 0JT, UK.
Tel: +44 (0) 1202 662 600.
www.hamworthy.com

Danelec through Holland

RADIO Holland Group (Rotterdam) and Danelec Marine (Denmark) have entered a global distribution and service agreement for the Danelec Marine S-VDR and VDR products. All Radio Holland branches worldwide (54 at the moment) will be able to sell, install and service the Danelec products to the worldwide shipping customers.

The Danelec Marine S-VDR is among the most compact and lightweight systems on the market, and has been designed to fulfil International Maritime Organization requirements for retrofit installations on vessels above 3000gt operating in international waters.

Contact: Radio Holland Netherlands, Eekhoutstraat 2, 3087 AB Rotterdam, The Netherlands.
Tel: +31 (0)10 4283344.
Fax: +31 (0)10 4281498.
E-mail: info@radioholland.nl

Three go for PC Ecdis

CHARENTE Group subsidiary PC Maritime has won contracts from three new clients for its Navmaster electronic chart data and information systems.

John H Whitaker (Tankers) of Hull, Scotline of Romford and Dublin-headquartered Irish Ferries have all specified PC Maritime's Navmaster technology for retrofitting aboard existing vessels.

According to PC Maritime, the sales are the result of its strategy to work with chart agents to provide customers with a combined ECDIS plus electronic & paper chart service.

Whitaker Tankers is a customer of Todd Chart while the Irish Ferries sale was concluded by Lilley & Gillie.

Retrofitting the Navmaster ECDIS on an existing bridge takes between one and two days. Its hardware is modular so that customers have options for locating individual components into varying bridge layouts. The PC processor can be stored, for instance, in under-counter housing, with the display fitted into a console, mounted on a counter-top or fixed to the deckhead.

Contact: PC Maritime, Brunswick House, Brunswick Road, Plymouth PL4 ONP, UK.
Tel: +44 (0)1752 254205.
Fax: +44 (0)1752 253599.

Navmaster ECDIS as retrofitted to the 3315dwt specialised timber carrier *Scot Mariner*. This Scotline vessel, built in 2001, is currently maintaining services between Varberg in Sweden and the Irish ports of Wicklow, Belfast and Cork.

Vacon distribution double

FINNISH AC drives supplier, Vacon, has opened a new base in Chennai on the southeast coast of India and signed a distribution agreement with one of Russia's largest motor manufacturers.

Through its Indian subsidiary, Vacon said it intended to improve its service in the growing Asia-Pacific market.

The new distribution agreement in Russia has been arranged through Ruselprom, with Vacon to supply drives in the power range from 200kW up to 2MW.

'This agreement with one of Russia's major motor manufacturers will considerably enhance our supply of Vacon AC drives to the Russian market, where demand for energy-saving solutions is continuously growing in various industries,' said Heikki Hiltunen, Vacon executive vice president.

High energy prices were encouraging investments in AC drives, Vacon said.

Contact: Heikki Hiltunen, executive vice president, products and markets, Vacon Group, Runsorintie 7, 65380 Vaasa, Finland.
Tel: +358 (0) 40 8371 609.
E-mail: vacon@vacon.com
www.vacon.com

Becker Asian expansion

A NEW Asian headquarters has been opened in Singapore by Becker Marine Systems. The rudder systems manufacturer is aiming to take advantage of the growing shipbuilding market in the region, with an office located on the second floor of the German Centre Building.

The German Centre, Singapore.

New departments will be established for project engineering, research and development, quality management, after sales service, and communication systems and sales. The intention is that the new office will improve coordination and cooperation between the Chinese facilities, as well as support business contacts in Asia.

Contact: Joalin Ong Pui See, administration manager, Becker Marine Systems Asia Pte Ltd, 25 International Business Park, 02-22 German Centre, Singapore 609916.
Tel: +65 656 281 81.
Fax: +65 656 281 82.
E-mail: joa@becker-marine-systems.com

Updated fracture simulation software

VERSION 10 of Beasy's fracture simulation software has been released. The program predicts fracture mechanics data for cracks and automatically simulates crack growth.

This release includes a crack wizard tool, which aids users in performing typical simulations, while automating many of the steps. As an example, users can automatically insert cracks in models and the model accordingly remeshes as the crack grows.

Beasy computational mechanics specialist Dr Robert Adey claims that this software can simplify the task for the user, and enable crack simulation to become more widely used.

Contact: Dr Robert Adey, computational mechanics, Beasy, Ashurst Lodge, Ashurst, Southampton SO40 7AA, UK.
Tel: +44 (0) 23 8029 3223.
Fax: +44 (0) 23 8029 2853.
E-mail: sales@beasy.com www.beasy.com

Dust tape test kit launched

THE launch of a purpose-built test dust tape kit to meet with regulations for assessment of dust on steel surfaces prepared for painting, could prove useful for applying metal sprayed coatings. UK-based Elcometer Instruments can now supply the test tape, compliant with ISO 8502-3 standard, a clear acrylic dust assessment plate to ensure the dust on the tape being assessed is only from the surface. A comparator display board and illuminated microscope to make cleanliness judgements, plus a test record sheet is also included.

The 142 Dust Tape Test Kit is available in a portable box, and can be used as a 'pass/fail' test as well as a permanent inspection record.

Contact: Elcometer Instruments Ltd, Edge Lane, Manchester M43 6BU, UK.
Tel: +44 (0) 161 371 6000.
Fax: +44 (0) 161 371 6010.
E-mail: sales@elcometer.com
www.elcometer.com

Thordon Correction

The February issue of *The Naval Architect* carried an item regarding the new Composite EF water lubricated bearing from Thordon Bearings. The item suggested that the product was 'rubber' and 'bronze backed'. It is neither. Thordon has pointed out that the Composite EF has the 'ease of installation of a bronze backed rubber bearing' and 'is 1/7th the weight of metallic bearings and outwears rubber bearings.' *The Naval Architect* would like to apologise for the misunderstanding.

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For informal enquiries about the posts please contact the Head of Department, Professor Nicos Ladommatos, on +44 (0)20 7679 7068 or n.ladommatos@ucl.ac.uk. Further particulars and information on how to apply for the posts can be obtained from Miss Julia Kuznecow, on +44 (0)20 7679 3678, j_kuznecow@meng.ucl.ac.uk

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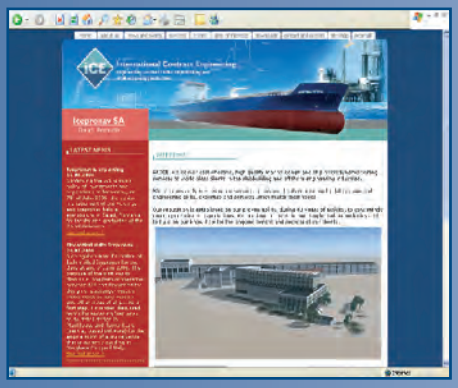

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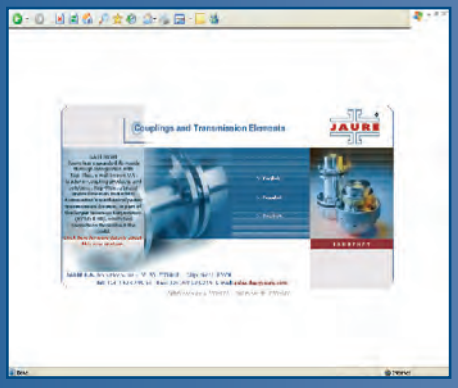

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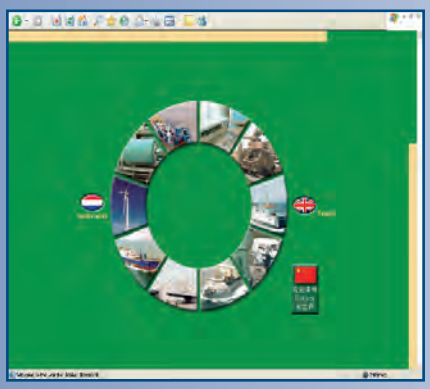

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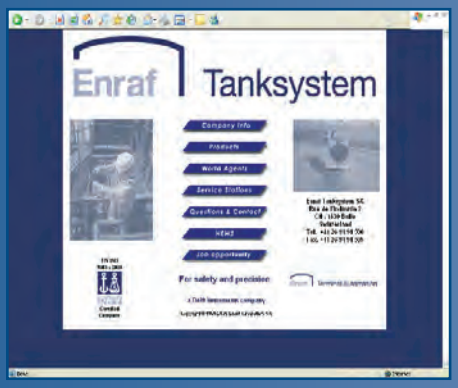

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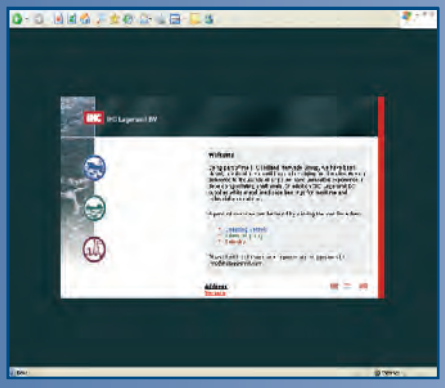

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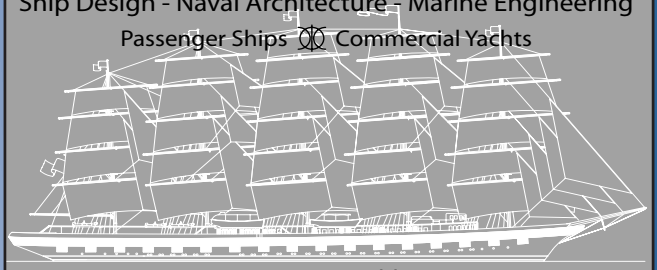

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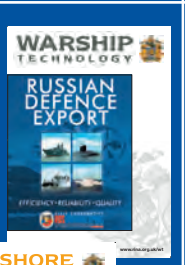

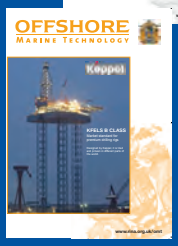

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