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July/August 2008

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Marketing Manager Adelaide Proctor
Publisher Mark J Staunton-Lambert

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The Royal Institution of Naval Architects
Editorial & Advertisement Office:
10 Upper Belgrave Street
London SW1X 8BQ, UK
Telephone: +44 (0) 20 7235 4622
Telefax: +44 (0) 20 7245 6959
E-mail editorial editorial@rina.org.uk
E-mail advertising advertising@rina.org.uk
E-mail production production@rina.org.uk
E-mail subscriptions subscriptions@rina.org.uk

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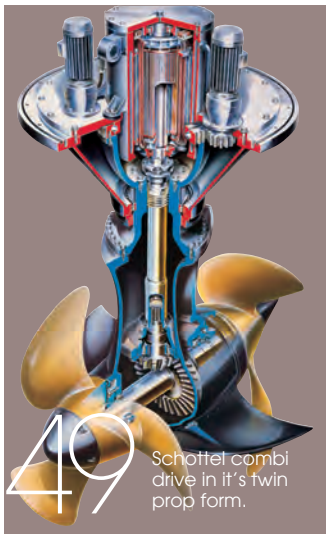

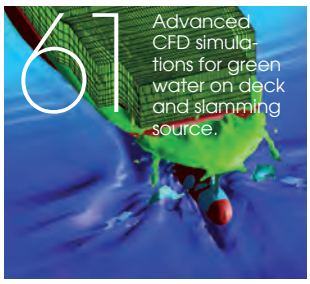

On-line Edition

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

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How to foster schism

A 'magic pipe', but should seafarers be criminally liable for unwitting spills?.

The European Court of Justice (ECJ) has ruled that the validity of EU Directive 2005/35/EC on Ship Source Pollution operates outside the MARPOL Convention and the UN Convention on Law of the Sea.

The original Directive was challenged by the English High Court, after a case brought by shipping industry interests comprising Intertanko, Intercargo, the Greek Shipping Cooperation Committee, Lloyd's Register and the International Salvage Union.

The coalition of applicants challenged the Directive as being inconsistent with, and contrary to, the internationally harmonised rules on the same issue contained in MARPOL 73/78 and UNCLOS 1982.

The English High Court agreed that the coalition's arguments were well founded and requested the ECJ to say:

(1) Whether the EU can impose criminal liability for discharges from foreign flag ships on the high seas or in the Exclusive Economic Zone independently of MARPOL, thereby limiting MARPOL defences.

(2) Whether the EU can legislate for discharges in territorial seas otherwise than in accordance with MARPOL, again limiting MARPOL defences and expanding parties who may be liable.

(3) Whether the standard of criminal liability for discharges resulting from 'serious negligence' breaches the right of innocent passage.

(4) Whether the standard of liability in the Directive of 'serious negligence' satisfies the requirement of legal certainty.

The Grand Chamber of the ECJ ruled that the validity of the Directive cannot be assessed by reference to MARPOL or UNCLOS. It upheld the Commission's argument that as the Community itself (unlike its member States) is not a party to MARPOL, concluding that it was not bound by the Convention. The Court took the view that, although the Community is a party to UNCLOS, that Convention did not give individuals rights or freedoms on which they can rely against States.

A joint statement from the complainants included the following comment on the judgment:

1. The main provisions of the Directive remain valid;
2. The criminal liability regime for pollution remains undecided because the Court expressly held that the provisions had to be interpreted taking account of MARPOL 73/78. No guidance was given by the Court to national courts quite how this is to be done. Potentially the effect of the judgment is that the scope of criminal liability for accidental pollution may be broader than the international regime.
3. What is also significant is the general approach taken by the Court to the broader principle raised, namely, the relationship between international law laid down in treaties and community law. The Court has taken the view that UNCLOS regulates issues between states and not individuals and therefore cannot be applied to test the validity of the Directive.
4. The restrictive view of the status of UNCLOS as limited to States is unfortunate given the universal recognition of UNCLOS as relevant to determine not only the rights but also the obligations of users of the seas.
5. On the issue of validity of the Directive no effect is given to the fact that the Directive was specifically designed to harmonise implementation of MARPOL within the EU.

In making this judgment, the industry groups said that the Court had departed from the detailed opinion of Advocate General Kokott, who had concluded that the validity of the Directive could and should be tested by reference to UNCLOS and MARPOL, and that the Directive exceeded the Community's powers in international law unless 'serious negligence' was construed to have different meanings inside and outside territorial waters. 'This would have entailed treating 'serious negligence' as adding nothing to the MARPOL test of intent or recklessness, contrary to what the framers of Directive clearly intended', the groups said.

'Observers of the proceedings have waited with interest to see whether the Court would accept this novel way of rescuing the Directive from the conclusion that it was contrary to international law. In the event it has not done.' *NA*

Design

Wärtsilä snaps up Vik-Sandvik

Wärtsilä Corp has acquired Norwegian ship design group Vik-Sandvik, in a deal worth €132 million, with an additional maximum sum of €38 millions to be paid based on the performance of the business over the next three years. In 2007, Vik-Sandvik's turnover was €55 million and its number of employees now stands at 410.

Wärtsilä, which last year took over fellow ship design house Schiffko, of Germany, said that its latest move was a major step in its 'strategy to strengthen its position as a total solutions provider and to be the most valued partner for its customers. By combining ship design capability with its existing offering in propulsion systems and automation, Wärtsilä will be able to provide more added value to its customers, with further growth potential in new lifecycle services,' the company said. Wärtsilä said its goal was to become the leading provider of ship design services in various segments.

The purchaser said that the role of ship design was becoming more and more important due to higher performance requirements, more sophisticated systems, and increased integration onboard most vessels. 'Also, the environmental and emission regulations regarding NOx and CO_2 are becoming increasingly stringent. Through this acquisition, Wärtsilä can offer competitive solutions that will lead to better total efficiency, improved environmental performance, and reduced life cycle costs for its customers.'

Vik-Sandvik will be integrated into Wärtsilä ship design within its ship power arm. All personnel - including the management - will continue as Wärtsilä employees.

Vik-Sandvik specialises in the design of high-end offshore vessels, as well as product and chemical tankers and more specialised vessels. The company has its headquarters in Fitjar, in western Norway, and has operations in Norway, Poland, India, Brazil, Serbia, Bulgaria, Turkey, Russia and China. Vik-Sandvik has up to now been wholly-owned by the Sandvik family.

Regulation

IMO adopts investigation code

The International Maritime Organization's Maritime Safety Committee has adopted a new Code of International Standards and Recommended Practices for a Safety Investigation into a Marine Casualty or Marine Incident (Casualty Investigation Code). The Code will require a marine safety investigation to be conducted into every 'very serious marine casualty', defined as a marine casualty involving the total loss of the ship or a death or severe damage to the environment.

The Code will also recommend an investigation into other marine casualties and incidents, by the Flag State of a ship involved, if it is considered likely that it would provide information that could be used to prevent future accidents.

The new regulations expand on SOLAS Regulation I/21, which requires an Administration to undertake an investigation of any casualty occurring to any of its ships 'when it judges that such an investigation may assist in determining what changes in the present regulations might be desirable'.

A work plan for the continued development of goal-based standards was also agreed, which would see MSC 85 finalising and approving Tiers I to III of GBS for bulk carriers and oil tankers, and finalising and approving associated SOLAS amendments; and MSC 86, in 2009, finalising generic guidelines for developing goal-based standards.

In the longer term, the work plan will include assessing the experience gained from the application of GBS; application of GBS to other ship types on an incremental basis; and expansion of GBS to cover every aspect of the design and construction of new ships.

Regulation

EU state aid prolonged

The European Commission has prolonged the Framework on state aid rules for shipbuilding for three more years, until 31 December 2011. This extension follows an earlier extension in 2006. The Commission has concluded that the Framework, which came into effect on 1 January 2004 has been applied without any problems and does not need to be revised at this stage. The Framework's main principle is that horizontal state aid rules apply to shipbuilding except where specific provisions apply that reflect the specific characteristics of the shipbuilding industry and market. The specific provisions contained in the Framework concern regional aid, closure aid, export credits, development aid, employment aid and aid for research, development and innovation. The Commission said it wished to continue applying these rules and assess their impact on fostering innovation in the sector.

EU Competition Commissioner Neelie Kroes said: 'EU shipyards need to innovate, and the innovation aid rules in the Framework on state aid for shipbuilding were designed to foster such innovation. I am pleased to see that so far these rules are increasingly applied, although we need further experience with their application before drawing conclusions on whether specific sectoral rules are still necessary.'

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Equipment

Rolls-Royce acquires SEH

Rolls-Royce has announced its intention to acquire 100% of Scandinavian Electric Holding, a supplier of system packages for hybrid and diesel-electric marine propulsion systems, for NOK430 million (£43 million). The proposed deal is subject to regulatory approval from the Norwegian competition authorities.

The company will form part of the Rolls-Royce marine business and is expected to increase the sales of Rolls-Royce ship design and equipment packages, especially in the offshore sector, by adding new electrical, automation and control capabilities. Rolls-Royce said this would boost the company's existing ship systems capabilities as the market moves towards greater use of diesel-electric propulsion.

SEH currently employs 150 people, in Bergen, Norway, and Gdansk, Poland, and recorded sales of £40 million in 2007. It has a current order book worth £100 million. The company undertakes system design and engineering, testing and commissioning and provides through life support, also manufacturing some of the switchboards, instrumentation and power management system elements for the systems it sells.

Regulation

Five on CO_2-Index

Five large containerships of Greek shipping company Costamare will be the first worldwide to operate in compliance with MEPC/circ. 471 of the International Maritime Organization regarding operational CO_2 indexing.

Costamare has registered *COSCO Guangzhou*, *COSCO Ningbo, COSCO Yantian, COSCO Beijing* and *COSCO Hellas* with Germanischer Lloyd's operational CO_2 indexing programme. On the basis of consumed fuel, transported cargo and distance sailed, CO_2 emissions are to be determined using Carbon emission factors. Computed index values can be compared to sister ships' indices and eventually used to minimise emissions from transport.

Applied on several ships of a fleet, the indexing system allows a comparison of CO-indices. This function is expected to trigger a learning effect as differences in fuel consumption will be made explicit and more transparent with the data associated to each vessel and voyage segment.

The tool can be used to record fuel consumption, transported cargo and distance between two consecutive ports, calculated for each voyage and later averaged for a defined period, usually a year. At the end of the period, a GL surveyor will check the recorded data and eventually issue a certified operational CO_2-index which is then valid for the next period.

The inclusion of maritime transport in a future emission control regime is currently under discussion at international political levels and it is assumed that it will become reality after 2012. The operational CO_2 index for ships is considered as a future link towards market-based instruments like, e.g., an emission certificate trading system.

Naval

Closer to MARS

The UK's Ministry of Defence has taken another step towards the procurement of a new fleet of naval tankers to support the Royal Navy on operations worldwide.

Baroness Taylor, Minister for Defence Equipment & Support has provided Parliament with the details of the four companies which will work alongside the Department over the coming months to finalise the requirement for the new MARS (Military Afloat Reach and Sustainability) Fleet Tankers. The four companies are: Fincantieri (Italy); Hyundai Heavy Industries (Republic of Korea); Navantia (Spain), and BAE Systems with BMT DSL and Daewoo Shipbuilding and Marine Engineering (Republic of Korea).

Following the competition, MoD will make a final decision to select one of the companies to design and build the new ships.

The MARS project seeks to replace a large number of existing Royal Fleet Auxiliary vessels. The existing Royal Feet Auxiliary tankers support global naval operations by replenishing Royal Navy warships with ship and aircraft fuel, and wider armed forces with fuel and supplies.

None of the four bidders have indicated to date that they would build Fleet Tankers in the UK. This reflects the fact that UK capacity is taken up by Type 45 and the Future Aircraft Carrier.

Equipment

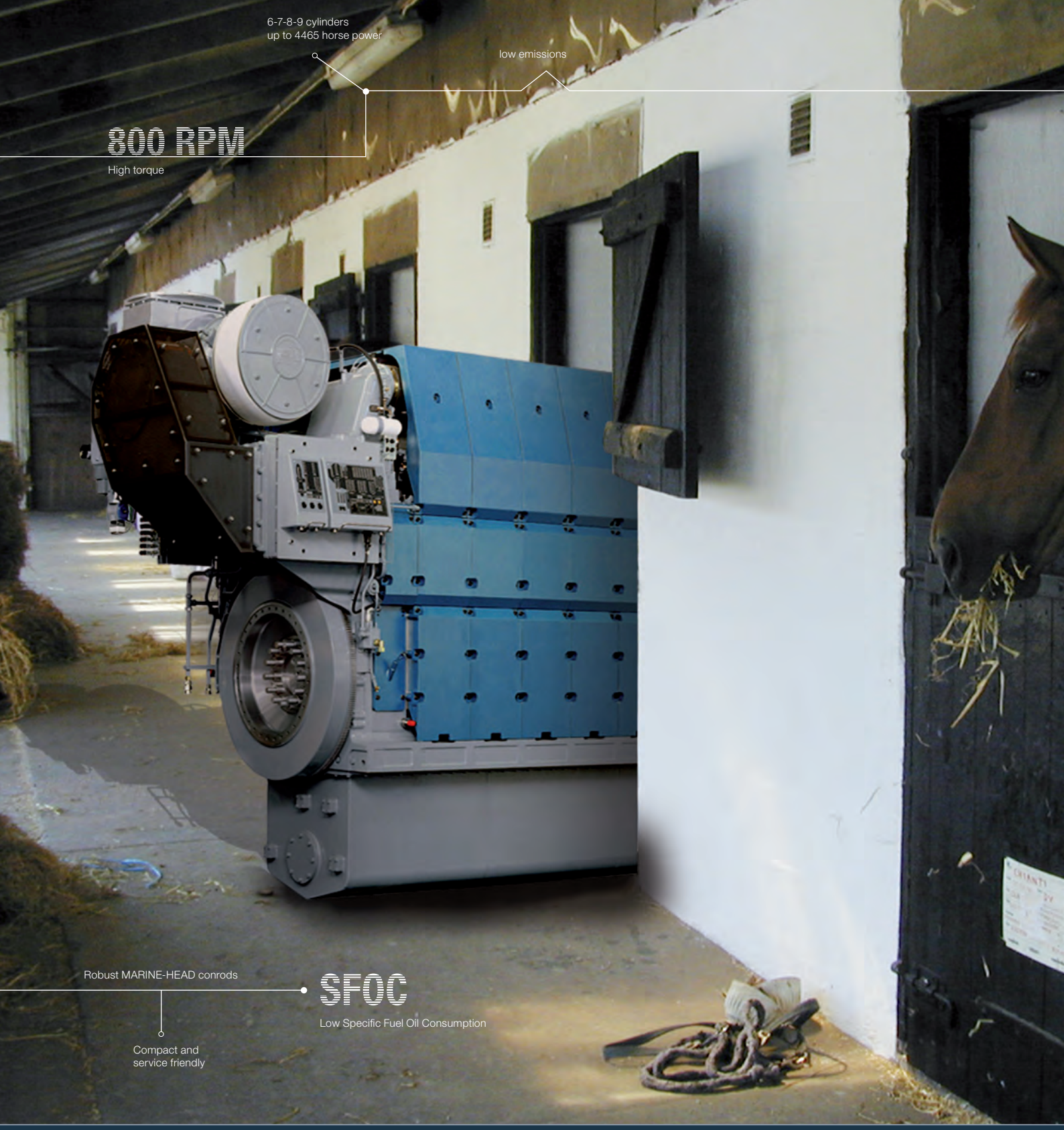
Dresser Rand enters Brotherhood

Engineering company Peter Brotherhood - headquartered in Peterborough, UK - has been acquired by a subsidiary of Dresser-Rand Group Inc, for £31 million.

Peter Brotherhood designs and manufactures steam turbines for the generation of electricity from renewable fuels such as waste wood, sugar cane residue and domestic refuse and marine waste heat recovery, as well as gas compressors for oil refineries and petro-chemical plants around the world.

Correction

An article in the June issue of *The Naval Architect* (New force from Greenwave, *pp82-83*) wrongly reported that research carried out in connection with the Greenwave initiative had been undertaken by Massey University. In fact, the research was undertaken by Auckland University. *The Naval Architect* would like to apologise for this error.



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Engines

MAN meets Tier-II limits

MAN Diesel has relaunched its engine portfolio, to emphasise that all of its engines are compatible with the limits established by the International Maritime Organization (IMO) in its Tier II regulations. The relaunch was an historic milestone, the company said, and one which pre-empts the January 2011 implementation of the new IMO NOx emission limits by some time.

In a separate move, MAN Diesel said it had enhanced its electronic, low-speed, ME-B engine programme with the launch of the MAN B&W S46- and S60ME-B type engines. These add to the existing MAN B&W S35ME-B and S40ME-B engines that were introduced in mid-2006, and the S50ME-B, introduced in early 2007.

The ME-B design is based on the experience gathered from MAN Diesel's existing engine ranges. It uses a camshaft-operated exhaust valve and an electronically controlled fuel-injection system. In addition, the physical dimensions of the S46- and S60ME-B bedplates are identical to those of their MC-C and ME-C equivalents.

As with the larger MAN B&W ME-engines, the Alpha Lubricator comes as standard with all engines. The 6S40ME-B delivers 6,810kW at 146rpm with an MEP of 21bar.

With the launch of the new engines, the ME-B programme is available in outputs ranging from 4,350kW to 19,040kW.

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

Engines

Wärtsilä and Mitsubishi extend

Wärtsilä Corporation of Finland and Mitsubishi Heavy Industries of Japan have signed a joint development agreement to design and develop new small, low-speed marine diesel engines of less than 450mm cylinder bore.

Such engines are suitable for a wide variety of small ship types, including bulk carriers, product tankers, chemical tankers, container feeder vessels and reefer ships.

The new agreement is an extension of the alliance created by Wärtsilä and Mitsubishi in September 2005. This alliance was formed on the basis of the joint development by the two companies of the Wärtsilä RT-Flex50 and Mitsubishi UEC50LSE low-speed engine types.

Contact Wärtsilä Corporation, John Sternbergin ranta 2, PO Box 196, FI-00531, Helsinki
Tel +358 10 709 0000
Fax +358 10 709 5700
www.wärtsilä.com

Business

Wärtsilä acquires automation

Wärtsilä has acquired the German company Claus D. Christophel Mess-und Regeltechnik (CDC), which specialises in the design, delivery and service of automation systems for shipowners and yards. The company is based in Hamburg and has three business areas, which are maritime information technology, project engineering and customer service.

CDC's net annual sales were €2.1 million in 2007. The company employs 12 people, all of whom are said to have a high degree of competence in electrical engineering.

CDC's operations will be integrated into Wärtsilä Services and all employees will continue as Wärtsilä employees. The company's founder and former owner, Claus D. Christophel, will now work for Wärtsilä. The acquisition value is not published.

Contact Wärtsilä Corporation, John Sternbergin ranta 2, PO Box 196, FI-00531, Helsinki
Tel +358 10 709 0000
Fax +358 10 709 5700
www.wartsila.com

Ancillary equipment

Siemens' shoreside breakthrough

Siemens Energy is installing a shoreside power system on behalf of the Lübeck municipal utilities on the Nordland dock. The system will provide ships with electrical power via the local medium voltage system while they are berthed in port. The first customer for the shoreside power system is Finnish shipping line Transatlantik. The shipping company has already had the port of Kemi in northern Finland equipped with a system of this type. From June 2008, the three ferries *Transpaper*, *Transpulp* and *Transtimber* are being supplied with electrical power from the shore-based supply at the destination ports of Kemi and Lübeck.

The Transatlantik ships, with their 400-V/50-Hz onboard systems, have already been retrofitted for the Finnish shoreside power system and have a cable drum with plug-in connector, a control system for the coupling process and a transformer on board. In

Lübeck, Siemens is installing the matching connecting point on the dock and creating the connection to the medium voltage network of the Lübeck municipal utilities. For this purpose, the company is installing a 10kV-kV switchgear for connection to the utilities and a 6kV-kV switchgear for connection to the onboard system. A cast-resin insulated transformer rated at 2500kVA is also being installed in a concrete substation on the harbour site for separating the two networks electrically.

The Lübeck shoreside power supply system operates at 50Hz only because the onboard system of the ships uses the same frequency as the local power supply network. About 80% of the ships cruising the world's oceans are equipped with a 60Hz onboard system. If these ships are to be supplied with shoreside power, the frequency would have to be adapted. For this purpose, Siemens has developed the cold ironing system Siharbor, which enables onboard systems of ships and power supply systems on land to be connected together despite different voltages and frequencies.

Contact Siemens AG, Wittelsbacherplatz 2, D-80333 Munich, Germany
Tel +49 89 636 – 00
Fax +49 89 636 – 000
E-mail contact@siemens.com
www.siemens.com

Ancillary equipment

All-in-one waste management

ITT Jabsco's latest solution for onboard waste management has electronic remote control and measurement facilities, complete with a heavy-duty macerator evacuation pump. The initial model incorporates a 30litre polyethylene holding tank.

The remote control touch pad, which can be located at any convenient point onboard, shows the level in the tank to the nearest increment of 1/8th of the contents. When switched on, the indicator stays lit for one minute before turning off. If the tank reaches three-quarters full, the LED indicator will light automatically and blink continuously. However, this function can be put into 'sleep' mode and will only re-activate if the level in the tank changes, or there is power loss.

To guarantee measurement of tank levels, electronic sensors take two types of average readings: one when filling and one when emptying. This ensures any movement of the vessel is compensated for during operation, or in rough weather.

The pump will automatically stop when it senses the tank is empty. This protects the motor and impeller from damage and also avoids the possibility of pipe rupture, if, for example, it is pumping against a closed sea-cock. An LED indicator flashes on the control panel to alert the operator to the fault.

The new all-in-one waste management system from Jabsco.

The three outlets on the tank allow for emptying over-side through a skin fitting, or dock side evacuation, as well as for a vent pipe. There is also an inspection hatch for tank cleaning.

Contact ITT Jabsco, Bingley Road, Hoddesdon, Hertfordshire, EN11 0BU, England.
Tel +44 (0)1992 450145
Fax +44 (0)1992 467132
www.jabsco.com

Ancillary equipment

Napier snapped

Siemens Energy has sold its Napier Turbocharger business, a 100% subsidiary of its oil and gas division, to investment firm Primary Capital, London. Napier operates in Lincoln, UK, and employs 160 workers engaged in the design, manufacture and service of turbochargers used with diesel and gas engines in marine, power generation, and rail traction applications. Napier generates an annual turnover of more than £30 million. Primary Capital has purchased the business for an undisclosed sum and said it intended to develop Napier's product portfolio and increase the turnover of the company.

Siemens had announced its plan to sell its turbocharger business in March, 2007.

Contact NAPIER Turbochargers, Ruston House, PO Box 1, Waterside South, Lincoln, LN5 7FD, United Kingdom
Tel +44 1522 584 000
Fax +44 1522 584 900
E-mail napier.sales@siemens.com
www.powergeneration.siemens.com

Ancillary equipment

Protection against 'Stowaways'

SEDNA (Safe, Effective Deactivation of Non-Indigenous Aliens) has been granted Type Approval by the Federal Maritime and Hydrographic Agency (BSH, Hamburg). The system received final approval in April 2008 from the International Maritime Organization (IMO).

The ballast water treatment system, developed jointly by German companies Hamann (Hollenstedt, near Hamburg) and Evonik Industries (Essen), uses Peraclean Ocean as its active ingredient.

During testing, the entire system was operated at length in fully automatic operating mode: on land and on a test ship. The tests focused particularly on efficiency, reliability, and safety. Experts from NIOZ, the Royal Netherlands Institute for Sea Research, documented the test results in a detailed report that formed the basis for the approval of BSH.

The SEDNA system treats water in several steps during the intake only. Initially, hydro cyclones are used to separate out the solid material by application of centrifugal forces. This eliminates large species and significantly reduces sediments, to which living organisms often attach themselves. A filter then removes all remaining particles larger than 50micrometers. This cleaned water is then disinfected with Peraclean Ocean, a formulation of peracetic acid and hydrogen peroxide from Evonik, which is biodegradable. In practice no more than 150litres of Peraclean Ocean are needed for 1000tonnes of ballast water.

Contact Hamann AG, Bei der Lehmkuhle 4, 21279 Hollenstedt, Germany
Tel +49 4195 2211-0
Fax +49 4195 2211 52
E-mail info@HamannAG.com
www.HamannAG.com

Ancillary equipment

Hamworthy regasification order

Hamworthy has signed a contract with Golar LNG to supply a liquid natural gas regasification (LNG) system with a total value of over £18 million. The system will be installed on the 126,000m^3 *Golar Freeze*, a LNG carrier that is being converted into a FSRU ('floating storage regasification unit') before being time-chartered by Dubai Supply Authority (DUSUP) for 10 years, with options to extend for up to another five years.

After its delivery to DUSUP in the second quarter of 2010, *Golar Freeze* will be permanently moored alongside a purpose-built jetty within the existing Jebel Ali port. The FSRU will be capable of storing 125,000m^3 of LNG, and delivering up to 14 million m^3/day (about 3 MTA) of regasified LNG to DUSUP for further delivery into the Dubai gas network.

Golar Freeze's system, comprising three propane regasification skids, will be delivered by Hamworthy in the second half of 2009. Capacity per skid is 7 million m^3/day, outlet pressure is 68bar and outlet temperature up to 22°C. During nominal send-out, two skids will be used while the third is on standby. Each 100tonne skid will be 10.5m long, 6.1m wide, and 8m high.

Contact Hamworthy Plc, Fleets Corner, Poole, Dorset, BH17 0JT, UK
Tel +44 (0)1202 662604
Fax +44 1202 668793
www.hamworthy.com

Coatings

New partnership for PRA

PRA (Paint Research Association) has formed a new partnership with marine specialist coatings consultancy Safinah to provide an expanded global consultancy for the marine, offshore and protective coatings industry.

For many years PRA has provided independent technical investigation and inspection services for its members, although the association concedes that these have been limited in geographic reach. PRA said it could can now provide a global response to marine and protective coatings technical problems and disputes.

Since Safinah's formation in 1998, it has provided independent authoritative, expert advice on the whole chain of activities that link ships, structures, coatings and the environment. It also provides market research and intelligence, and has developed a suite of software products to help manage the coatings process.

Contact PRA Coatings Technology Centre, 14 Castle Mews, High Street, Hampton, Middlesex, TW12 2NP, United Kingdom
Tel +44 20 8487 0800
Fax +44 20 8487 0801
www.pra-world.com
www.safinah.co.uk

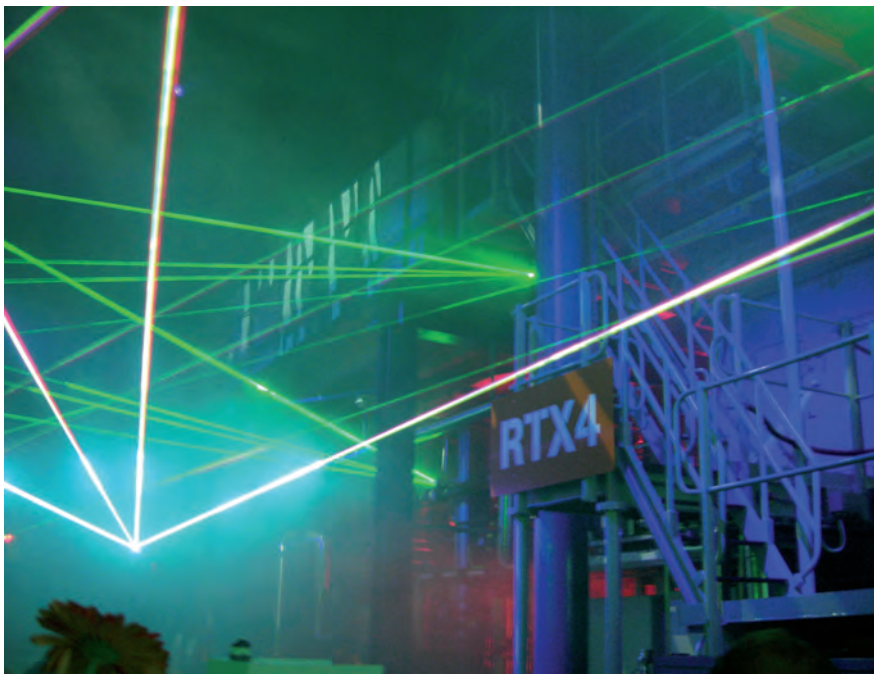
The shape of engines to come

Wärtsilä's new test engine is expected to define the future of marine diesel engine technology, writes Patrik Wheater

The new RTX-4 two-stroke engine from Wärtsilä is capable of running on anything from the highest quality low sulphur distillate to the black goo that typifies the lowest grade heavy fuel oil. It delivers 10,160kW of power from four 60cm bore cylinders and emits no more than 10% oxides of nitrogen (NOx). It incorporates an after exhaust treatment system and provides the kind of flexibility, reliability and maintainability demanded by shipowners these days.

Yet the state-of-the-art technology that embodies this brand new engine provides only a tantalising glimpse of the future; the RTX-4 installed at Wärtsilä's two-stroke technology centre in Winterthur, Switzerland has been built for research purposes only.

The test engine replaces the RTX-3 that has provided a foundation stone on which current and near future propulsion technology has been based for the past 13 years. But, while it would have been easier to adapt an engine from its product portfolio, Wärtsilä began with a clean slate. Designers were put to task and came up with a new technology demonstrator that will guide the development of a two-stroke diesel engine capable of meeting future operational, legislative and efficiency requirements.



Launch of the RTX-4 test engine.

Paramaters

'It is not only new technologies and design which we have put into this new engine,' said Klaus Heim, Wärtsilä vice president, global research and development. 'We have also developed engine parameters.'

For instance, compared to the RTX-3 – which has now been shipped to Chinese shipowner COSCO for training purposes – nominal engine speed has been increased to 114rpm and mean effective pressure (mep) has been raised to 21bar. This is a one bar increase on the mep of any two-stroke production engine currently on the market.

'Mean effective and maximum pressures have been consistently raised over the last 50-years and it is crucial for us to put sufficient margin into this new engine to further increase key engine parameters and to further explore optimisation potential beyond today's limits,' explained Mr Heim, before starting the engine during its inauguration.

The engine, which incorporates RT-flex common rail technology with integrated, full electronic control of all engine processes – fuel injection, exhaust valve operation, cylinder lubrication and air starting – will undergo a comprehensive test programme to further the thermo-dynamic parameters and to validate the design. It will also serve as a powerful research tool, with the main areas of research being engine efficiency, emissions reduction, component reliability, ease of manufacture and maintenance.

Of the €120 million Wärtsilä has earmarked for R&D, some 50% will be spent on the

KEY FACTS

Developments in Wärtsilä two stroke technology

Engine	**RTX-4**	**RTX-3**
Year of installation:	2008	1995
Cylinders:	4	4
Cylinder bore:	600mm	580mm
Piston stroke:	2250mm	2416mm
Nominal speed:	114rpm	105rpm
Power output:	10,160kW	8500kW
Dimension:	11m × 9.7m × 10.8m	9.1m × 8.3m × 10.8m
Mass:	200tonnes	230tonnes

development of environmentally-safe engine technologies. The focus will be on carbon dioxide emissions in particular. Not only is this on the regulatory agenda, but CO_2 is closely related to the efficiency of the engine.

New features have been integrated into the engine and there are lots of technologies that will be tested and validate before Wärtsilä is confident enough to market them. One of these is a system that will allow an engine to run on any fuel without restrictions on the fuel specification. To the right of the test engine was a plethora of pipes, hoses filters and heaters to warm up the fuel to 150ºC, allowing the engine to run ostensibly on sludge. To its left, a cumbersome component for testing, developing and modifying exhaust treatment and filtration systems, an important aspect of current engine development for the marine industry.

Whereas onboard ship the emphasis so far has been on integrated ways to control exhaust emissions such as through engine tuning, the RTX-4 has an extensive exhaust gas after-treatment plant including a selective catalytic reaction (SCR) unit. This technology is capable of reducing NOx emissions by 90%. The new set-up of the engine is prepared for the installation of all kinds of after treatment technologies to verify their practical application for future, more stringent marine regulations.

Control

A big difference compared to the previous test engine is the level of electronic components installed. On the RTX-4, Wärtsilä has integrated all engine-related functions, safety, ancillary, and after treatment systems into one integrated package. It includes a Condition Based Monitoring system that picks up data from more than 1000 sensors around the engine. These register 100 measurements per second and 36,000 individual measurement signals for each revolution of the engine.

The test engine is also supported by a laboratory for testing engine components and systems, such as fuel injection equipment, exhaust valve drives and a spray/combustion chamber. Fuel injection equipment can be tested using either gas oil, marine diesel oil or heavy fuel oil. There are also test rigs for full-scale RT-flex common-rail systems using actual RT-flex components, both to test and evaluate the components and systems before applying them to actual engines and for long-term endurance testing.

The RTX-4 test engine in operation.

In furthering technological advancement, Wartsila's president, Ole Johansson, said: 'We must make sure that we maintain a good leading position in the technology sector. We have a responsibility to do so. We want to be the leader as a technology and service company and that means we have to have access to the highest level of technologies, for all our different products related to ship design and ship propulsion.

'Our customers today, with the current energy prices as they are, expect miracles from us. Customers are curious to know what is behind the corner and what will be available. We have the challenge of CO_2 emissions and for our customers, shipowners and operators, they have a vast economical challenge. Improving efficiency is on top of our agenda… We are prepared to grab the challenge. We do not promise miracles but I can assure you that the new research engine will be an important contributor to step-by-step improvements we are making to our products.' *NA*

Olcher Haxsen, Captain
Weser ferry “Bremerhaven”
Bremerhaven

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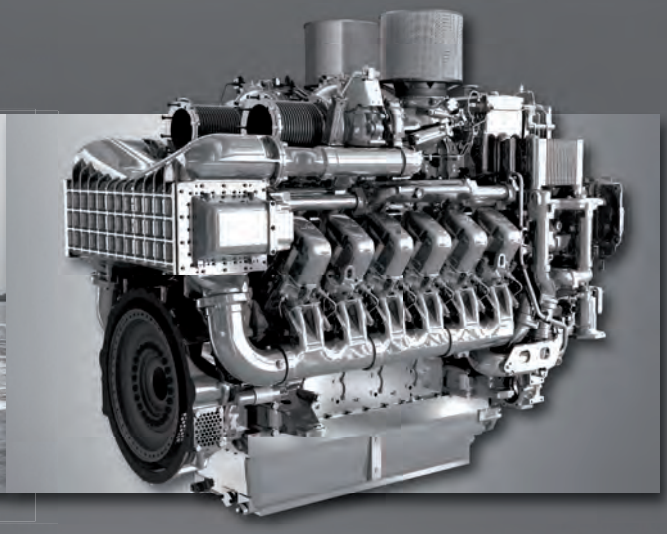

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Customer-facing Koshipa

As South Korea's shipbuilding market share has grown, so a new internationalism has found its way into the thinking of The Korea Shipbuilders' Association.

Some 112 shipbuilders are active in South Korea, including small and medium-sized companies, but just nine of them represent 93.7% of Korea's shipbuilding output, all nine of which belong to The Korea Shipbuilders' Association (Koshipa).

Seok-Joo Chung, Koshipa deputy general manager, international cooperation department, said that, at the end of 2007, his members generated work for 119,000 persons, with 6300 of them being in management and administration, 12,500 being engineers 32,400 being technical and skilled workers, and the remaining 67,800 being employed by subcontractors. Other yards generated employment for a further 8000 persons.

In 2007, new orders secured by Korean shipbuilders represented an historic high, with ships equivalent to 23.6 million cgt (707 ships) being contracted – a surge of 45.2% over the 16.3 million cgt (498 ships) ordered in 2006. This figure accounted for 36% of all ships on order in cgt terms, where China accounted for 29%, Japan 17%, Europe 11%, and others 7%.

Completions by Korean shipbuilders also increased markedly, from 315 vessels in 2006, to 340 ships (10.3 million cgt) last year. In cgt terms, Korean ship output accounted for 35% of the global total, compared to 25% from Japan, 17% from China, 17% from Europe, and 5% from others.

As of the end of last year, looking forward, Korea's mainstay yard orderbooks had grown to 51.2 million cgt (1524 ships), up 13% when compared to the 45.3 million cgt (1164 ships) on order at the end of 2006.

Mr Chung asserted that, in carving out a 40% share in world orders made in 2007, compared to a 38% share in 2006, Korean yards had demonstrated that, not only were they riding the new order boom, but that they were showing that owners were being persuaded to buy Korean by dint of 'comparative advantage in technology'.

Despite the good news, Mr Chung acknowledged that Korean shipbuilders, like others, would face stiff challenges in the years ahead. 'Korean shipbuilders, along with many other partners, understand that changing realities call for a comprehensive and fierce competition approach in this single global market,' he said. 'The traditional, narrow focus on market access is no longer adequate. In this integrated shipbuilding world, today's market faces a number of daunting challenges, which is requiring various and new types of perspectives, preparations and efforts for world shipbuilders.

'These formidable challenges in one large global market are emerging from the rapid advancement of information and technologies, expansion of trans-national investments, international corporate networks, shortage of skilled workers, the steel plate issue, and environmental and safety regulations.'

The Korean shipbuilding industry had, last year, stepped up efforts to advance into 'next generation' ships, such as larger liquefied natural gas carriers, ultra-large liquefied petroleum gas carriers, and ice-breaking oil tankers.

Mr Chung said that Korea's growing share in the world orderbook had brought with it greater responsibility with respect to the global shipbuilding market. This had been demonstrated by Korean participation in OECD shipbuilding negotiations that ran between 1989 and 1994, and again between 2002 and 2005. Also exemplary was the fact that, while Korean companies have participated individually at the SMM show, Hamburg's monumental shipbuilding and marine equipment exhibition, and indeed the Korean national pavilion in 2006 extended to 458m^2, the 2008 event will be the first to play host to a separate 213m^2 Koshipa stand. Meanwhile, the Korean national pavilion would be larger, at 519m^2, while the Korean Register of Shipping would independently take a 39m^2 stand, again for the first time.

Formerly, in attempting to build relations with international owners, the Korean industry had focused its 'national' attentions on events like Posidonia and Nor-Shipping, Mr Chung said. *NA*

Korean shipbuilding results to 2007.

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STX aims for top spot

With a new yard in China, a mandatory offer for Aker Yards under development, and suggestions that it will bid for Daewoo Shipbuilding and Marine Engineering, few can doubt the aggressive ambitions of STX Shipbuilding.

June saw STX acquire over 1.3 million more shares in Aker Yards. The Korean group, whose interest lies in extending its reach into the cruiseship market, now holds a 40.5% stake in Europe's largest shipbuilding group, in turn triggering what will be a mandatory offer from STX for all remaining Aker Yards shares. At time of writing, the offer was due to be made by 21 July.

The move came after a European Commission anti-trust investigation approved STX's initial 39.2% stake, concluding that effective competition on the shipbuilding markets would not be significantly impeded.

STX said it would 'back up Aker Yards for continuous growth while maintaining the current management team. STX plans to establish a portfolio by ship types so that cruiseships are built in France and Finland, and offshore structures and special ships are built in Norway and Germany. In addition, it will reinforce the global competitiveness of Aker Yards by applying its own specialised management strategy.'

The French government suggested in June that, in a belated bid to retain control of French shipbuilding in France, it would look to buy what amounts to a blocking share in Aker Yards France from Alstom, where Aker Yards took only a 75% share in the former Alstom yard Chantiers de l'Atlantique in 2006, broadening its own interest in cruiseship building. However, in doing so, the French state acknowledged that any such transaction would have to be subject to approval by the Aker board, where Aker had already formally agreed with Alstom that it had an exclusive option to purchase the remaining 25% of shares. No further statement has been forthcoming.

The Aker board has now been joined by STX stalwart Su-Jou Kim, who has already been appointed as chief executive of 'STX Norway', the organisation set up by STX Shipyards to manage its interests in Aker Yards, and indeed Aker Yards Norway.

STX has broadened the portfolio of ships it can deliver, but this is just the start of the story for a group with its eyes on becoming the number one shipbuilder in the world.

As of July, Aker Yards had benefited from an interim loan from STX worth NKr400 million (US$79 million), paid to tide the European group over as it awaited approval for the sale of a 70% stake of its merchant ship construction business to Russia's FLC Group. The proposed sale was initially announced in March 2008. After approval by competition authorities, it was expected to be completed by the end of July. It covers the transfer of two shipyards in Germany and one in Ukraine.

With all of these machinations played out in public, it became easy to forget that STX as a shipbuilder emerged as recently as 2001. Now, with the acquisition of Aker Yards, the group has signalled intent to achieve an annual turnover from shipbuilding of US$25 billion by 2012 - $10 billion from Aker Yards; $10 billion from its domestic shipbuilding and machinery activities at Jinsae and Busan; and $5 billion from its new STX Dalian Shipbuilding Complex. The Dalian yard will launch its first ship at the end of this year. Taken together, the group said these steps would see it 'become the world's top shipbuilding group operating 21 shipbuilding yards around the globe'.

Furthermore, STX Shipbuilding added: 'We are open to the chance to consider any possibility of overseas project in a bid to catch up with market demand.

Feet on the ground

Before that happens, it is perhaps worth taking stock of the state of play today. In 2008, STX Shipbuilding plans to turn out 59 ships from its two Korean operations. Fifty of these will be delivered from Jinhae shipyard, and nine will come from the Busan shipyard. These ships will include 29 MR product carriers, three 62,000dwt product carriers, two 75,000dwt product carriers, five Aframax tankers, seven containerships, four 9000m^3 capacity liquefied petroleum gas carriers, and five 13,000dwt product carriers.

STX Shipbuilding said that, in terms of the number of vessels delivered, its 2008 output would be some 23% above that witnessed in 2007.

By enhancing production efficiency, output would rise to 73 vessels in 2009, and would be around the 72-vessel mark in 2010.

It was unable to release specific figures for 2011 and 2012, because it was still working on a facility expansion.

STX said that it had some 277 vessels on order as of the end of June. 'And also, we have been under serious discussion for securing more newbuilding contracts with notable shipowners, which presumably will add up to our business showing unprecedented numbers.'

STX has also been extending its portfolio of ships offered. 'In order to fulfil the market demand, we have decided to move toward membrane type LNG carriers of 173,600m^3 [capacity] from the 'Stream' Project, toward mega containerships of 12,400TEU [capacity], and towards 320,0000dwt VLCCs and 181,000dwt Capesize bulk carriers,' the company said.

Orders for four LNG Carriers were placed with STX by the Stream, a joint venture. Between Spanish concerns Repsol YPF and Gas Natural. The first LNG carrier is scheduled to be delivered in the first half of 2010. STX reached an agreement with LNG storage specialist GTT (France) in May 2005 in its bid to enter this market, and also acquired certification from the world's top five ship classification societies.

The yard group offers 155,000m^3 and 174,000m^3 dual fuel diesel electric-type LNG carriers at this time, featuring GTT's NO 96 containment system. However, STX added: 'In addition to these conventional LNGCs, we are very much interested in FSRU, FPSO and LNG RV as well, so that we are developing these designs. Please note that we are planning to focus marketing such vessel types as soon as the designs become available.'

Big ship picture

STX received its first orders for very large crude carriers of 320,000dwt class and iron ore carriers of 320,000dwt class in March. Four VLCCs were ordered by European shipping companies, each with length overall of 332m, breadth of 60m, depth of 30.5m and service speed of 16.1knots. They are scheduled to be delivered in 2011. In addition, STX Shipbuilding also accepted an order from a European shipping company for two very large ore carriers (VLOCs) amounting to US$250 million. These VLOCs have a length overall of 327m, breadth of 55m, depth of 29m with service speed of 14.6knots. They are scheduled to be delivered in 2011.

STX Shipbuilding also said it had developed the first 22,000TEU class containership in the world, 'exceeding the 20,000TEU that has been recognised up to this point as the limit in the aspects of technology and economic efficiency'.

While short on detail on its plans for such a beast, STX said it had developed both one-and two-propeller types of containerships, which would be 460m in length, 60m in width, and 30m in height, 'and equipped with a deck area as wide as the area of four football fields'. Even with one propeller, the shipbuilder said the 22,000TEU ship could sail at between 24knots and 26knots, although it gave no information regarding the engine capacity or propeller diameter it had in mind. *NA*

Oil prices drive HHI to fresh fields

The continuing escalation of the price of oil has major consequences for shipbuilders worldwide, both in terms of the business they are pursuing and the expectations from owners for fuel-saving design innovation.

Hyundai Heavy Industries, the world's largest shipbuilder, has placed fuel saving technology high on its agenda and, last year, also made its entrance in the high value drillship market.

As previously reported in *The Naval Architect* (Marine Power & Propulsion supplement, October 2007, p48), HHI has developed the 'Hyundai Thrust Fin', modifying the rudder by adding a fin mounted behind the propeller. The device is claimed to reap 4%-5% gains in propulsion efficiency for larger containerships operating at cruising speed.

Chul-Hee Lee, HHI executive vice president, project planning office/shipbuilding division, said that the thrust fin had been designed to recover energy generated by a ship's screw propeller's rotational flow which has hitherto been lost.

The fin 'produces' the maximum thrust when installed at the front of the rudder in line with the propeller shaft centre. It is hydrodynamically designed to 'produce' the maximum thrust after consideration of the combined fields of the ship's wake and propeller-induced velocities.

Having been trialled onboard an 8600TEU capacity Hapag-Lloyd containership, early results point to real benefits, and it is understood that the German owner has specified the thrust fin for a further half dozen ships. Other owners have also expressed keen interest in the device, Mr Lee said.

He said that, supposing oil prices were US$500 per tonne, and a ship operated 300 days per year over a 25-year life cycle, shipowners could be looking at savings of $45 million.

Drillship entrance

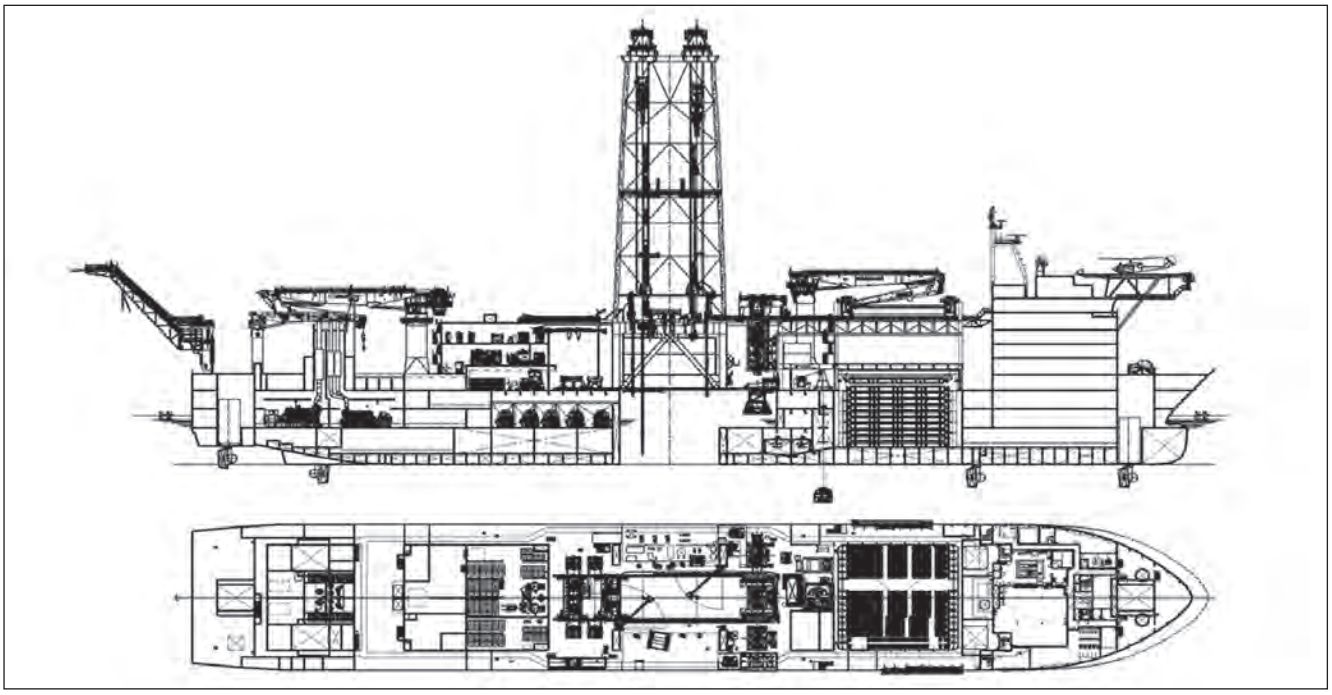
The high price of oil has also seen shipowners ordering drillships in numbers, with prices for these complex vessels now heading north of US$800m. Interest is also high in other, more complex offshore storage and production vessels.

Mr Lee said the market for drillships was 'very bright', citing the fact that Petrobras had recently launched a project looking to build 10 drillships as indicative of more business to come.

HHI has now secured three firm orders for drillships, with one on order for Transocean and two more ordered by Metrostar. Steel cutting for the first vessel is due to start in March 2009, with delivery due in October 2010. In the case of the first ship, Mr Lee said subsea equipment would be supplied by the owner. 'However, for the second and third ships, we will build everything.'

Designed by Gusto MSC, of The Netherlands, the HHI Gusto P-10000 drillship will be 229.4m long, by 36m wide, by 18.15m deep. Classed by Det Norsk Veritas to dynamic positioning DPS-3 standards, the vessel will offer accommodation for 209 personnel and operate at speeds of up to 12knots. Said to be more compact than competing designs, the vessel nonetheless offers a large free deck area, by virtue of the

The HHI Gusto P10000 drillship. HHI has three firm orders for this new vessel type.



Gunsan is go

Next year will see Hyundai Heavy Industries add a completely new yard to its production facilities, at Gunsan, east of its main Ulsan facility. Already booked until 2011, the huge facility will concentrate on Capesize bulk carriers and VLCCs. Steel cutting for the first Capesize bulk carrier, for Nordcapital, is due to begin in March 2009, with HHI already reported to have secured orders for 12 bulkers and nine VLCCs. Once complete, it is expected that the Gunsan yard will produce around 30 ships per year. Taking into account the 80 merchant ships per year HHI turns out from its Ulsan facility, the 20 or so turned out by its offshore division, and the target of affiliate Hyundai Samho Heavy Industries to build 50 ships each year, HHI said its current overall group target was to deliver 170-180 ships every year.

fact that much of its subsea equipment will be installed under the main deck

The ship will be able to operate in water depths of up to 12,000ft, and undertake drilling to a depth of 40,000ft, as well as having a 160tonne capacity knuckle boom crane for triple activity.

The rising price of oil and gas are also stimulating thinking over a new generation of offshore storage and production vessels. Mr Lee said HHI was keenly interested in a Shell project looking to develop a 400m long by 75m wide LNG floating production storage and offloading vessel, with liquefaction plant onboard, and capable of storing 200,000m^3 of LNG, 100,000m^3 of LPG and an unspecified volume of condensate. He said that, should the pre-study into Shell's so far generic design prove successful, HHI would call on its offshore division to offer a topside design, with the hull to be developed by its shipbuilding division.

Steel cost consequences

Other rising materials costs are also having an impact on the way HHI builds ships. Mr Lee said that the shipbuilder was increasingly looking to the greater use of thinner high tensile steel. Current building practices meant that less than 40% of the steel used to build VLCCs was of the high tensile variety, but Mr Lee said that HHI hoped to lift this portion to above 50%, with more high tensile steel to be used in deck plating.

In passing, Mr Lee said that raising the high tensile steel content from 40% to 50% would also produce a VLCC five per cent lighter than before, which should have some consequences for fuel consumption.

For containership construction, HHI also plans to factor in the use of the YP47 plate developed in Japan by Mitsubishi Heavy Industries and Nippon Steel. This material features a bending moment 10% higher than the conventional steel used in box ship building. On larger containerships, 100mm thick conventional plate is often required, which is hard to weld. The same structural strength can be conferred by 65mm-70mm thick YP47, according to MHI.

Mr Lee said that, in the first instance, HHI would use YP47 as deck plating for a number of Japanese owners with orders for 5000TEU capacity containerships at the yard. *NA*

Samsung shows strength in depth

The world's number two shipbuilder develops its portfolio of higher value, complex ships.

Production is ramping up at established South Korean yards, with Samsung Heavy Industries reporting that it foresees building some 70 ships in 2012, compared to the 47 it turned out in 2007.

The increased workload demands construction of a new floating dock at SHI's Geoje Island facilities, to be in place by 2009, augmenting the existing three drydocks and two floating docks.

However, with steel and labour costs rising, it is critical that the shipbuilder focuses on ships of high value, including advanced liquefied natural gas carriers and drillships, as well as the tankers that provide bread and butter business.

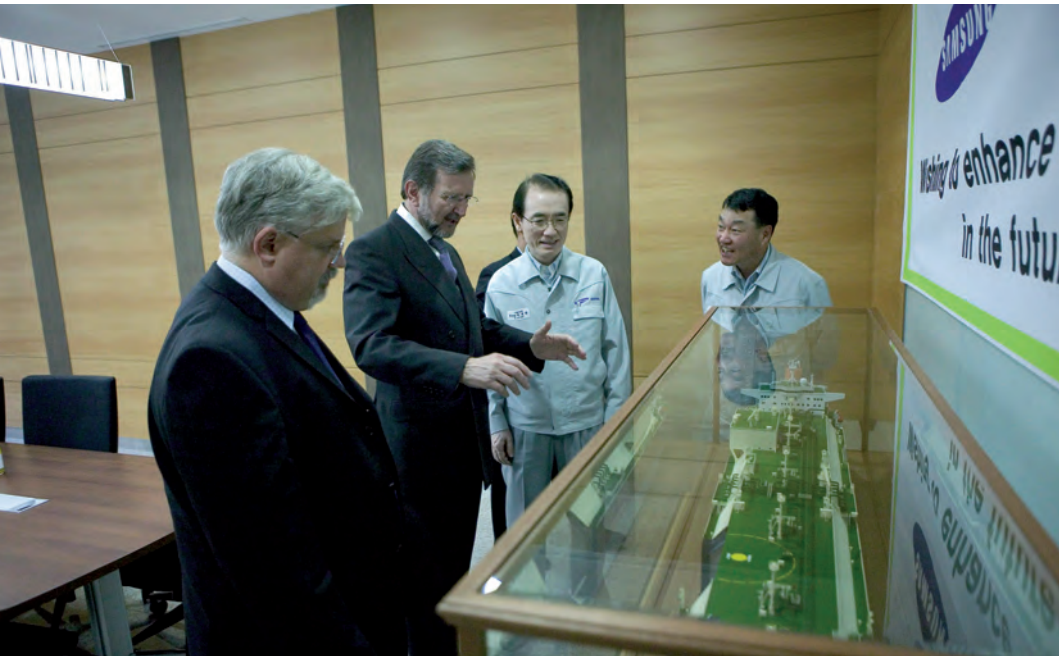
While workload is also high in containerships, for the moment the market for new orders for this ship type is becalmed, although SHI said that it was preparing a presentation for European shipowners of its latest design for a 16,000TEU capacity containership monolith, with a length of 399m, a breadth of 57m and a depth of 30m. Such a ship would feature 24 x 40ft bays, with 20 rows below deck and 22 above deck. The container stacks in the holds will be up to 11 tiers, while on deck there will be eight tiers using three-tier lashing bridges.

Here, SHI is offering a twin-island superstructure, with the accommodation around two thirds of the way from the aft, and the engineroom and funnel positioned one fifth of the distance from the aft. The forward position of the accommodation improves visibility, at the same time accruing 5%-6% greater container capacity in the bow region, and also mitigating noise levels and the potential for engine/propeller excitation in the accommodation quarter. Fuel oil tanks are to be positioned beneath the accommodation.

The debate about whether to go for a twin or single screw design for larger containerships has not resurfaced, with SHI opting for a 14-cylinder single main engine generating 108,640bhp at 104revs/min, giving such a ship the customary 25knots capability.

It is also understood that the ship would feature HT47 steel plate in its hatch coamings, whose structural properties mean that thinner than conventional HT40 plate can be used to achieve the same performance.

Lloyd's Register chairman David Moorhouse (2nd from left) talks to Samsung Heavy Industries' S. H. Lee, executive vice-president, ship design and research and development Division (2nd from right) and C. H. Park, executive vice-president, project planning division (right) about a scale model of *Mozah* that Samsung presented to him in recognition of Lloyd's Register's work on the world's biggest LNG carrier.



Gas connection

Among SHI's most significant firm orders has been the project to build an initial one (of four proposed) 'LNG producer' hulls for FLEX LNG, featuring shipboard pre-treatment, liquefaction, storage and offloading plant. These ships will be the world's first floating LNG production units.

FLEX LNG, Mitsubishi Corporation and Peak Petroleum Industries Nigeria signed a Heads of Agreement in June to develop and market the world's first floating liquefaction project offshore Nigeria jointly. The parties expect the project to produce 1.5 million tonnes of LNG per year for 15 years, with the first commercial LNG cargo planned for second half 2011.

Also in June, Kawasaki Kisen Kaisha became a strategic investor in FLEX LNG, after agreeing to take a 15% stake in the company through participation in the private placement of ordinary shares. The two companies entered into a Memorandum of Understanding following the election of K Line as a preferred partner to provide LNG and offshore related transportation services.

Meanwhile, the build contract with SHI was adjusted earlier this year, such that the capacity of these ships will now be 170,000m^3, rather than an initially envisaged 90,000m^3.They will be 293m long overall, with a moulded breadth of 50m, and a depth to upper deck, moulded of 31.6m, with a fully loaded draught of 12.2m.

After the design adjustment, production capacity is given as 1.7mtpa, compared to an original 1mtpa.

Then, on 9 July 2008, FLEX LNG and Samsung Heavy Industries signed the Letter of Intent to enter into an Engineering Procurement Construction Installation and Commissioning contract (EPCIC) for the first complete LNG production topside, with options for additional units.

These LNG producers, which cost almost twice as much as a conventional LNG carrier, will use the SPB (self-supporting prismatic shape IMO type B) LNG containment system, in four LNG cargo tanks, licensed to the shipbuilder by Japanese yard group IHI Marine United. By using the nitrogen expander liquefaction cycle, the LNG producer will be able to source gas from numerous potential offshore locations worldwide where natural gas today is either left stranded or is being flared. A separate pre-treatment module will be installed upstream of the liquefaction module, and additional space and weight capacity will be reserved for add-on field-specific modules. LNG will be offloaded from the LNG producer via loading arms fitted on the starboard side. A standard LNG carrier will be able to load from the producer using mooring equipment fitted onto the producer.

As well as securing the latest order from BG, for two 170,000m^3 capacity, dual fuel diesel electric-powered LNG carriers earlier this year, 2008 has proved a landmark year for SHI in LNG for another reason, with the July naming of *Mozah*, the first 'Q-Max' LNG carrier for Qatar Gas Transport Company (Nakilat), and to date the largest LNG carrier in the world. The ship, classed by Lloyd's Register and named at SHI's Geoje Island yard, has a capacity of 266,000m^3 - almost 80% more cargo than conventional ships – and has an overall length of 345m, a beam of 53.8m and a height of 34.71m.

The first of 11 such ships from SHI, with three more to come from Daewoo Shipbuilding and Marine Engineering, these new models are expected to spearhead longhaul gas shipping to the USA and Europe as the industrialised world continues its search for cleaner energy products.

The Q-Max model - 'Q' for Qatar and 'Max' for the maximum size of ship able to dock at the LNG terminals in Qatar - features twin slow-speed diesel engines that are more fuel and thermally efficient than steam turbines, resulting in about a 30% reduction in overall emissions. There is also onboard cargo reliquefaction plant returning the boil-off gas that occurs when LNG is in transit to ensure full cargo delivery.

The improved economies of scale inherent in the much larger comparative load capacity are also expected to reduce shipping costs – which typically have accounted for about one-third of the price for LNG - by about 30%.

Andy Richardson, shipping project manager for the Qatargas Operating Company, said: 'Redundant, highly efficient propulsion systems and onboard reliquefaction have realised operational efficiencies and a reduction in emissions. We believe these changes will provide meaningful benefits to all within the customer supplier chain, forever changing the traditional paradigm of LNG transportation.'

As well as the 14 Q-Max ships, 31 smaller Q-Flex-sized LNG ships have been ordered from the big three Korean shipbuilders by Qatari interests and their partners.

Drillship bonanza

In May, meanwhile, the high priority SHI has been placing on snaring drillship orders paid off once more, when it bagged an order worth an astonishing US$942 million to build such a vessel from Stena Drilling in UK. The price, more than six times that accrued by a VLCC, is

Brazil in Samsung's sights

SHI has signed a contract with the Brazilian shipyard, EAS (Estaleiro Atlantico Sul) Shipyard, to buy a stake in the firm. In 2006, SHI began technology support for the Brazilian shipyard, which was under construction at that time, and is now the largest shipyard to be built in the Latin American region.

On June 11, SHI announced that it had signed a contract with EAS Shipyard to acquire a stake worth US$12.8 million, which is 10% of the total investment in the shipyard.

SHI said the signing would enable it 'to hold a dominant position in terms of receiving orders for the total of US$30 billion worth of drillships and semi-submersible drilling rigs that Brazil intends to demand. The acquisition will also enable SHI to generate new sources of profit, as it will earn royalty income from technology support and dividend income from stake acquisition.'

Construction of the 1,650,000m² EAS Shipyard began in April 2007 at the Suape complex in Eastern Brazil. Camargo, Queiroz, and PJMR, all from Brazil, invested a total of US$220 million into this shipyard. SHIs acquisition of a stake will allow Camargo and Queiroz each to hold a 40% stake, while SHI and PJM will hold 10% stake each.

The shipyard will boast a dock that is 400m long and 73m wide, and upon the completion of construction in September 2009, it will have a ship production capacity of 160,000 tonnes.

EAS shipyard has already received orders to build 10 (of an anticipated 22) SHI-designed 158,000dwt Suezmax oil tankers for Petrobras, two VLCCs, and one semi-submersible crude oil drilling rig, worth a combined US$1.9 billion altogether.

reckoned to be 50% above the amount Stena paid for the last drillships it ordered. SHI delivered its first drillship to Stena in January this year, with a second due over this summer.

The 228m long, 42m wide and 19m high newbuild will have a displacement of 97,000tonnes. It will be able to drill as deep as 11km into the sea. After 44 months of construction, the drillship will be delivered to the North Sea area in December 2011.

As well as its overall complexity, this ship will be noteworthy because its hull will be 4cm thick, enabling stable operation through floating ice in the Arctic Ocean. Equipment will also be heated for operations in temperatures down to -40°C.

Her dynamic positioning system will be able maintain its place automatically in severe weather conditions, including waves of up to 16m and wind speeds of up to 41m/sec.

FLEX LNG's vision of the world's first 'liquefied natural gas producer'.

Orders for drillships were suspended in 2000, only resuming in 2005. Two ship orders were placed in 2005, nine in 2006, 14 in 2007, and already seven have been placed this year. Three Korean shipbuilders - DSME, Hyundai Heavy Industries, and SHI, took all of them. SHI has now secured orders for 23 of the 32 drillship orders made worldwide since 2005.

An SHI spokesman said that, given the high price of oil, the company believed demand for drillships would remain high for at least the next two years. *NA*

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We Know…

Subic Bay debut for Hanjin

Early July saw the first ship named alongside at Hanjin Heavy Industries' newly constructed yard, in Subic Bay, The Philippines.

No lesser personage than the President of The Philippines, Gloria Macapagal Arroyo, was on hand to name the first containership from Hanjin Heavy Industries and Construction's US$1.7 billion yard facility at Subic Bay on 4 July, 2008.

The 4300TEU *Argolikos* – the largest ship ever to have been built in The Philippines - is due delivery to Dioryx Maritime Corp, after the Greek shipowner purchased the newbuilds from CMA CGM on a sale-and-lease-back basis. This is the first of a series of six identical containerships for the customer, with a second due to be named in November, and the rest to follow in 2009.

HHIC now has orders for some 43 ships for its operation in The Philippines, with its most recently reported order being for four Capesize bulk carriers from Turkish owner Yasa Shipping.

HHIC's 'home' yard, in Pusan, has tended to specialise in containerships over recent years, where space constraints have dictated that it concentrated on a single ship type for reasons of productivity. While the containership boom lasted, this was not a problem, with HHIC coming up with two different post-Panamax containership designs, of either a 35m or 37.3m beam, and also innovative construction technuiques – such as building larger containerships in two sections and joining them on float out. However, it was clear that such a strategy would not be sustainable during leaner times. It is fair to point out that HHIC has not received any orders for its Pusan facility since last year, although it is understood that the yard was in negotiation to secure an order for four Capesize bulk carriers from a United Arab Emirates-based shipowner at time of writing.

The Subic Bay facility is another matter, with HHIC offering containerships ranging between 4500TEU and 7000TEU capacity, plus bulk carriers, tankers, and even liquefied natural gas carriers. HHIC said it had already secured orders for seven 180,000dwt Capesize bulk carriers and two Aframax tankers for Subic Bay, while it was in the advanced stages of negotiations over the construction of further Capesize ships, and is reckoned already to have secured orders for four VLCCs from Kuwait Oil Tanker Company.

The first vessel to be built at Hanjin Heavy Industries and Construction's Subic Shipyard – the 4300TEU capacity *Argolikos*, for Dioryx Maritime.

It was also preparing for a market 'comeback' in LNG, in expectation that the LNG carrier market itself was due to turn upwards again, and would offer designs in the 150,000m^3 to 170,000m^3 range.

In line with its expanded portfolio, HHIC has been recruiting heavily in design, with its Pusan design centre team now 800-strong. The company said that being located in metropolitan Pusan offered a distinct advantage in attracting staff when compared to other Korean shipbuilders.

A part of this design capacity will be used to reorientate operations at Pusan, with the plan being to focus on more specialised tonnage, in a bid to distinguish the yard from Chinese and other Korean operations. The Pusan yard is already contracted to build a dive support vessel, and has built and delivered its first landing ship to the Korean Navy. It is also in talks with owners over the construction of offshore support vessels in the 100m-150m length category.

Local difficulties

Meanwhile, construction work is almost complete at the Subic Bay yard, with a second drydock on course to be finished by the end of 2008. Eventually, it is expected that the Subic Bay yard will provide employment for up to 21,000 workers, becoming the fourth largest shipyard in the world. By 2012, when fully operational, the yard is expected to be turning out between 30 and 50 ships per year.

However, despite its heavy investment, and the clear economic benefits to be accrued in The Philippines, HHIC's start-up at Subic Bay has not been without what might politely be termed 'teething troubles'. A row over the construction of an apartment complex for workers agreed with central government blew up to become a potential deal-breaker at local authority level, on environmental grounds, while 13 local worker fatalities since start-up have brought safety management into question, local authorities placing a 'cease and desist' order on further construction at the yard just days before Mrs Arroyo breezed in to say that the first vessel 'shows off to the whole world the excellence of the Filipino workforce in building vessels sailing the seven seas'.

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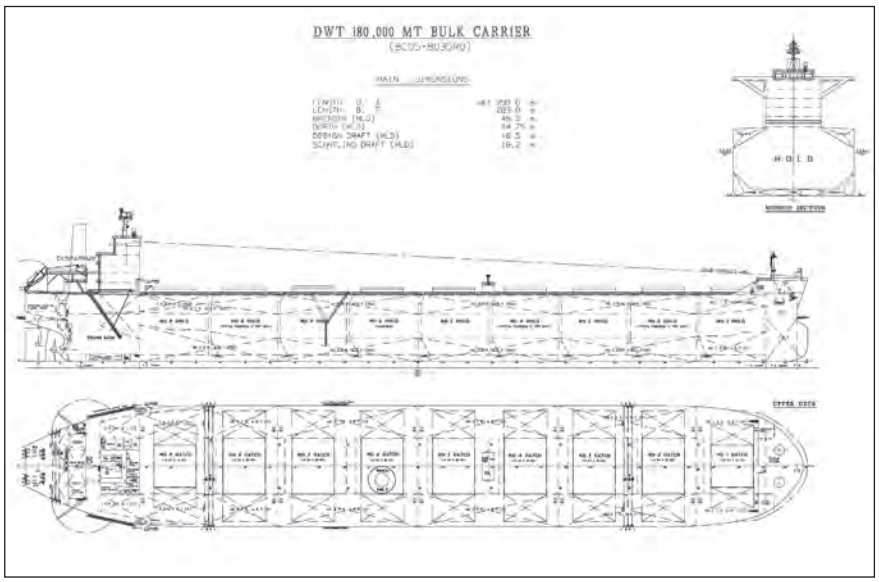
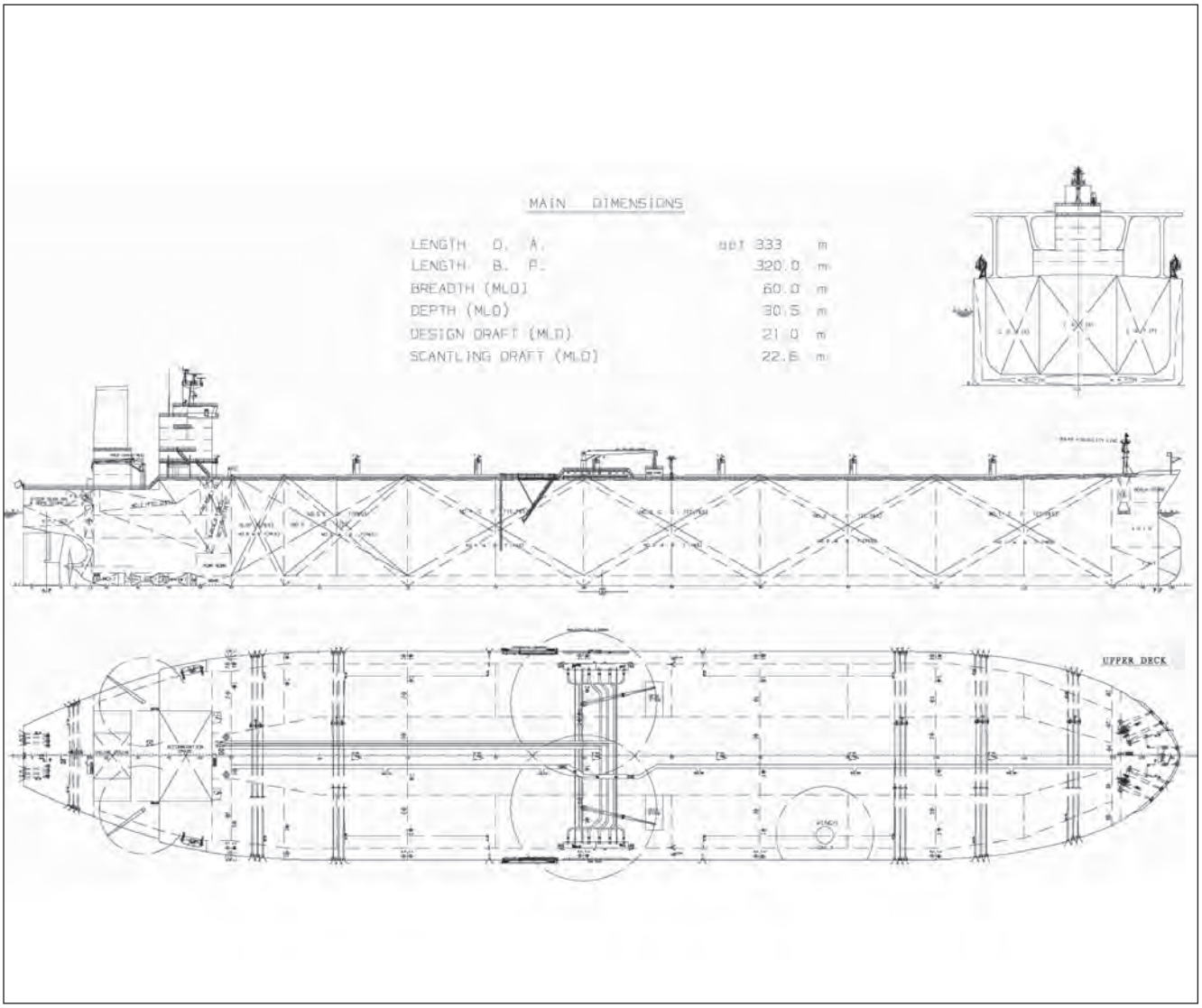
HHIC said it was making every effort to develop the same kind of safety regime it operated in Korea, while the accommodation complex spat was 'settled'.

Even so, HHIC has also previously announced plans to construct a larger facility in Mindanao, in the southern part of The Philippines but, while it has contracted with the government to use this area for shipbuilding purposes, reports have been surfacing of disagreements between the Korean shipbuilder and local officials here too. An HHIC source would not go beyond saying that a firm decision was yet to be reached as to whether the second facility would now be used for block construction or for complete newbuilding projects. *NA*



GA of the latest Capesize from HHIC.

GA of the VLCC design now on offer from HHIC.



SPP becomes top 10 player

Now offering a range of ship types, relative newcomer SPP Shipbuilding already lays claim to a world number eight ranking in terms of ships on order.

The last 12 months have seen SPP Shipbuilding transformed from an emergent yard limited to the production of product carriers alone, into a fast diversifying force, whose bulk carrier orderbook now exceeds its tanker haul, and whose offering extends to containerships of up to 3500TEU capacity.

With three types of product carriers available, up to Aframax class, SPP has delivered 20 ships, all on time, since its first completion in 2006, but its current orderbook stands at 79 product and/or chemical carriers against 86 bulk carriers. As well as strong orders for 59 x 35,000dwt bulk carriers, the yard has orders for 81,000dwt bulk carriers and 59,000dwt ships.

Paul I D Kim, SPP Shipbuilding Co executive vice president, pointed out that today, despite its remarkably short history (shipbuilding work started in 2004), in terms of ships on order SPP Shipbuilding could count itself as the number eight shipbuilder in the world. It would achieve the same ranking in production terms by 2010, Mr Kim said.

Between now and June 2009, all of the ships that SPP delivers will be 50,000dwt MR tankers. These 183m long by 32.2m wide ships feature a depth of 19.1m and can be supplied with either a Sulzer 7RTA48T-B engine from Wärtsilä, or MAN Diesel's 6S50MC-C.

However, Mr Kim said that it was essential that the yard developed a portfolio of ship types to ensure its long term stability. The yard has been helped in this ambition by runaway demand for dry bulk carriers through the latter part of 2007 and early 2008, with SPP securing orders from blue chip owners from Europe, Asia and the USA. Mr Kim said that the company would deliver its first 35,000dwt bulk carrier in the second half of 2009, with a series of 59,000dwt and 73,000dwt ships to follow in 2010-2011.

What Mr Kim did not say was that, by the same token, the yard's initial selection, to specialise in the product and chemical tanker market, could stand it in good stead if bulk carrier orders slow. The yard also has first orders for 73,000dwt product tankers from shipowners OSG and Roxana, and for 113,000dwt product carriers from Dunya.

SPP Shipbuilding operates three shipyards, at Tongyoung, Gosung and Sacheon, whose combined capacity currently stands at around 70 ships per year. Having delivered 10 ships in 2007, output will rise to 25 ships this year, with the plan being for the production of 69 ships in 2011.

Its design team, based in Pusan, consists of 200 staff, and has shown willingness to

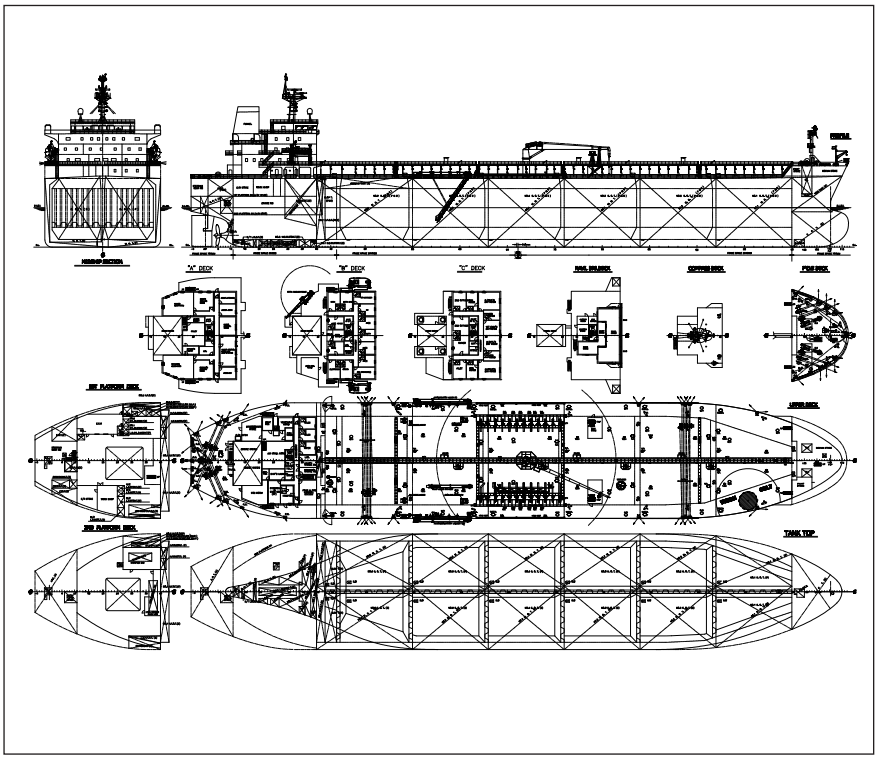
Paul I D Kim, SPP Shipbuilding Co executive vice president.

Dubai Star, an early 50,000dwt product carrier delivery from SPP Shipbuilding Co, for shipowner ETA.

augment the fewer than the 10 standard designs it offers as per client comments. The current backlog of orders, running into 2011, means that the design complement is satisfactory for current demand, but Mr Kim acknowledged that more designers would be needed if the shipbuilder was to achieve its further ambition to move into more complex designs after 2011. He said that SPP was considering how to develop the skills to build more complex chemical carriers, ro-ro ships and make a wider containership offering.

However, one key ingredient in these ambitions is the company's currently stalled initial public offering, through which it was seeking to raise $300 million, in order to invest in shipbuilding facilities and research and development capability. Even the booming shipbuilding market is not immune to the vagaries of the sub-prime financial crisis. Originally slated for this year, Mr Kim said the IPO was now being considered 'maybe for next year', and would only go ahead on the basis of the original valuation. *NA*

General arrangement for the 50,000dwt product oil/chemical tanker *Horizon Armonia*, due delivery by SPP Shipbuilding Co in July 2008.



Rising costs

In line with events elsewhere, rising steel prices continue to burden South Korea's shipbuilding sector. Twelve months ago, steel plate was available for US$600 per tonne, but today, that price is $1200 per tonne, and still rising. Last year, an average MR tanker would have fetched $47 million - $50 million. By mid-year 2008, the price of the same ship stood at $53 million, according to SPP Shipbuilding Co executive vice president Paul I D Kim, and only a portion of extra materials costs had been passed on to customers. The extra steel required to meet the new Common Structural Rules and the extra production time and manpower required to achieve the new Performance Standards on Protective Coatings would seem only to exacerbate matters. Main equipment prices are also on the rise, although Mr Kim took time to point out that in one respect, SPP has a competitive advantage over rivals bidding for geared bulk carrier orders. Having started life as a crane manufacturer in 1988, as Dongyang Heavy Industry, SPP Shipbuilding can still call upon sister company SPP Heavy Industries to supply the deck cranes it requires.

Opportune timing for C&Heavy

After a strong run of orders from big hitters in the dry bulk trades, C&Heavy prepares to deliver its first ship.

In the prevailing ship production boom, the story of another emergent yard looking to make its mark on the international stage can elicit a muted response, but any company laying claim to 64 vessel orders before it has even built its first ship, and orders running into the first half of 2011, must be worthy of separate consideration.

C&Heavy Industries, whose shipbuilding operation is based in Mokpo, not far from Hyundai Samho Heavy Industries, was formally founded as recently as November 2006, when the conglomerate C&Group, which traces its short history back to 1990 and the establishment of Chilsan Shipping, bought two block manufacturers, beginning to market complete newbuilds soon after.

C&Group itself, headed by chief executive Byung-seok Lim, grew into a conglomerate with some 33 subsidiaries, among them, until recently, C&Jindo, the Jindo part of which should be familiar to any with a passing interest in container manufacturing. C&Jindo, with operations in Shanghai, Guangzhou and Dalian, was recently merged with C&Heavy. Recent times have seen the group spin off some of its manufacturing and real estate interests, and focus on its core interests in shipping, shipbuilding and construction, with C&Heavy listed on the stock market in its own right.

As far as shipbuilding is concerned, C&Heavy Industries initially targeted the MR tanker market but, with as many as 400 ships of this type already on order by its start up, the company rapidly switched focus to the burgeoning bulk carrier market. The move has proved opportune, with the price of bulk carriers rising by as much as 40% since C&Heavy entered the market.

To date, the builder has focused largely on attracting orders for its 81,000dwt Kamsarmax bulk carrier (45 firm orders), although latter months have seen the company garner orders for 58,000dwt bulkers, while 180,000dwt ships are also in the pipeline.

The Kamsarmax vessel itself features a continuous upper deck with forecastle, a raked stem with bulbous bow, a transom stern with open water type stern frame, a semi-balanced rudder and a fixed pitch propeller directly driven by a slow speed diesel engine. The propulsion machinery and all living quarters including navigation bridge are located aft as shown on the General Arrangement.

The vessel features a double bottom and transverse bulkheads to have seven hatches and seven cargo holds and five pairs of top side tanks and double bottom tanks for ballast water. Pipe ducting is arranged in the centre part of double bottom in way of cargo hold area and HFO tanks are protected by double hull structure

The vessel will be capable of carrying ore cargoes when cargo hold Nos 2, 4 and 6 may be empty. Cargo hold No 4 is designed as floodable hold.

With yard operations at Mokpo based on the skid launching approach, steel cutting for the yard's first 81,00dwt ship, for Greek owner Target Marine, began on 15 November, 2007, with the keel laid on 28 April, 2008, the launch scheduled for late August or early September, and delivery expected at the turn of the year. Target Marine has 16 identical ships on order with the yard.

Indeed, just six customers account for the whole C&Heavy external orderbook. However, nine 81,000dwt ships and five 58,000dwt ships are actually to C&Group's own account. The conglomerate operates three shipping lines, in the shape of tanker owner C&Shipping, bulk carrier trader C&Merchant, and also the former Dongnama Shipping, since takeover rebranded as C&Line. These interests suggest that the emerging shipbuilder can expect a deal of sisterly encouragement to diversify later on.

For the moment, though, the builder is strictly focusing on the dry bulk market. This is not to say that it does not have wider ambitions. Once the Mokpo yard is fully operational, C&Heavy has plans to turn its attentikon to developing a second yard on Geoje Island, where it has purchased land with the initial intention of building Capesize bulk carriers. A company spokesman said that the company was also reviewing other vessel types, and thinking of making an entrance in the LR1 and Suezmax tanker markets once its Geoje Island facility was up and running, and also about containerships in the 2800TEU-3500TEU capacity range. *NA*

TECHNICAL PARTICULARS

C&Heavy 81,000dwt bulk carrier

Length overall	approx. 229.0m
Length between perpendiculars	222.0m
Breadth, moulded	32.26m
Depth, moulded	20.10m
Designed draft, moulded	12.20m
Scantling draft, moulded	14.45m

Deadweight and Capacities

Deadweight in sea water

At scantling draft, moulded approx. 80,500tonnes

At designed draft, moulded approx. 65,000tonnes

Capacities (100% full)

Cargo holds incl. hatch coaming approx. 96,500m^3

Water ballast tanks incl. peak tanks and No.4 cargo hold approx. 34,570m^3

Heavy fuel oil tanks incl. settling and service tanks : approx. 2,130m^3

Low sulphur heavy fuel oil tank incl. service tank : approx. 450m^3

Main Engine

Number of set : One (1) set

Type : B&W 6S60MC-C7

MCR : 11,200KW x 96.0revs/min

NCR(85% of MCR) : 9,520KW x 91.0revs/min

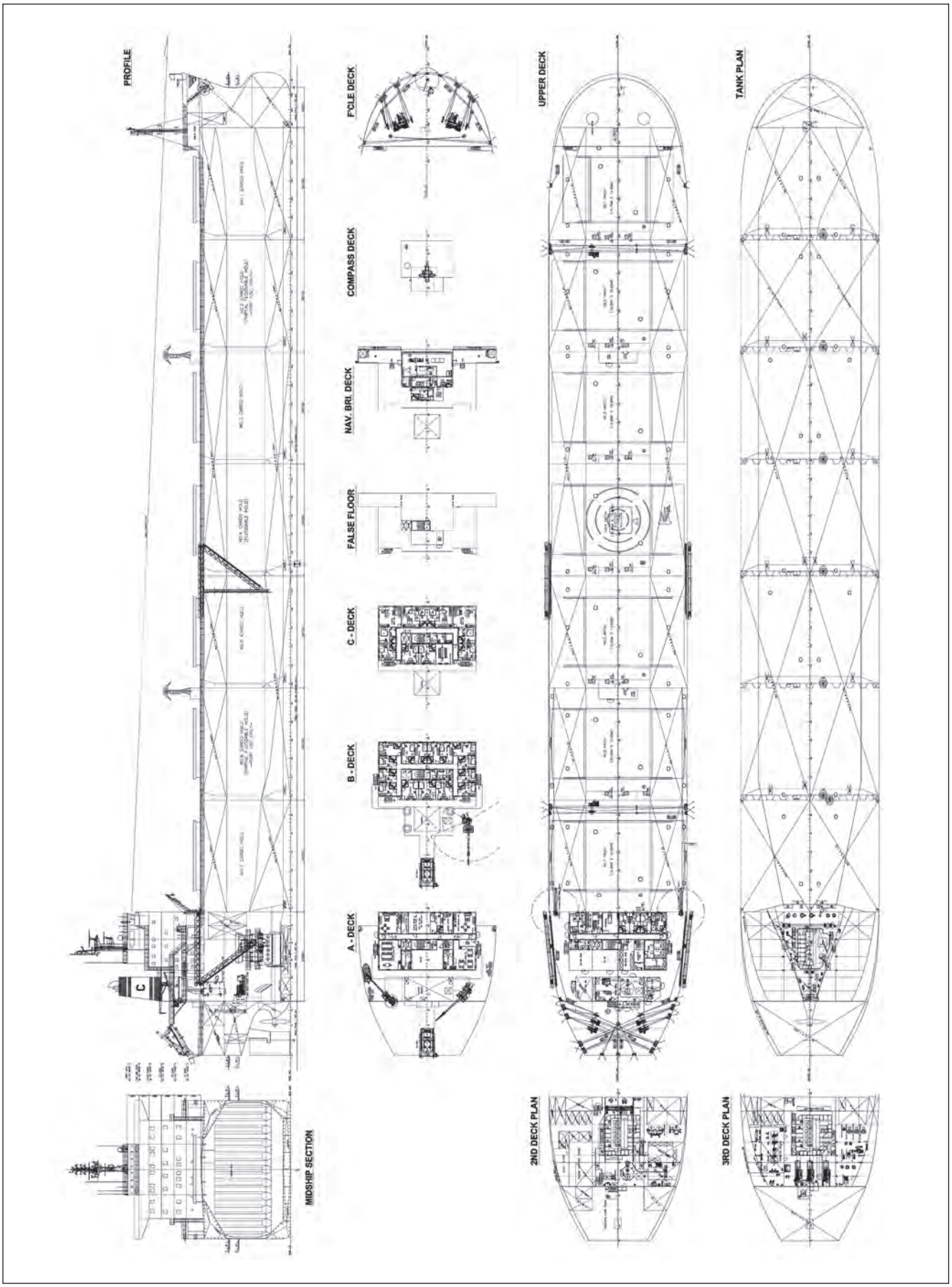
Ship speed

Guaranteed service speed of the Vessel: approx. 14.5knots

Design draft of 12.20m on even keel and at 85%

MCR of main engine with 15% sea margin

GA for the standard 81,000dwt bulk carrier from C&Heavy.



The World Superyacht Awards

Young Designer of the Year 2009

A prestigious award for talented young superyacht designers is to be awarded at the Boat International Group 2009 World Superyacht Awards

The Royal Institution of Naval Architects, the Boat International Group and Camper & Nicholsons International invite entries for the 2009 World Superyacht Young Designer Award competition.

Introduced with great success in 2008, the World Superyacht Young Designer Award competition provides a showcase for young designers to demonstrate their ability and talents, and encourages the development of the next generation of superyacht designers.

The World Superyacht Young Designer Award will be presented to the winner of the competition at the World Superyacht Awards ceremony in April 2009, at which the remarkable ingenuity and innovation demanded in the design, engineering and construction of the world's finest luxury yachts is demonstrated, and is the most obvious place for new designer talent to be recognised and celebrated.

The Competition

The competition is open to anyone who is studying for a degree or vocational qualification in a subject relating to yacht or small craft design,or anyone who has already graduated within three years of the closing date for entries, which is 31 January 2009.

The 2008 competition saw many entries from all over the world, as far afield as NZ and China, as well as from all over Europe. RINA's CEO Trevor Blakeley is proud that RINA is continuing to support this award for young designers: 'The superyacht industry is one of the most successful sectors of the maritime industry, and owes much of that success to the work of its designers who provide that unique combination of form and function, which is the modern superyacht.'

The Award

The World Superyacht Young Designer Award will be presented to the young designer who produces the best concept design for a superyacht. The entries will be judged by a group of leading world-class designers selected by the Royal Institution of Naval Architects and Boat International Group. The winner of the Award will receive a prize of €5,000 and will be invited to receive the award at the renowned World Superyacht Awards ceremony.

The sponsor

The Award is organised by the Royal Institution of Naval Architects and Boat International Group, and is sponsored by Camper and Nicholsons International: 'Following the joint Camper & Nicholsons International – Boat International initiative three years ago to reward the work of yacht designers and naval architects, we thought it was only natural to continue to collaborate with the Boat International Group and RINA in order to identify the young designers of the future, 'says Camper & Nicholsons International's CEO Jillian Montgomery. 'Taking an active part in this competition prepares the grounds for the future in many ways. Firstly, by giving up and coming designers exposure and the opportunity to get in touch with potential clients, and secondly by offering our existing and future clients a glimpse of designs that could soon be on the drawing boards, 'explains Laurent Perignon, director of marketing for CNI.

The closing date for entries is 31 Jan 2009. If you are interested in submitting an entry or would like more information, contact Giuseppe Gigantesco, E-mail: ggigantesco@rina.org.uk, Tel: +44 (0)20 7235 4622
The Royal Institution of Naval Architects, 10 Upper Belgrave Street, London, SW1X 8BQ The rules for the competition can be viewed at www.rina.org.uk/wsyaward

Easy does it for Daehan entry

Estimates vary, but analysts are increasingly predicting that many of the bulk carriers currently on order will, in fact, never be delivered. However, for one newly established yard, concentrating on a single ship type during start up, is said to have had its advantages.

Market jitters over the way economic downturn and rising materials costs will affect the shipbuilding market are focusing on emergent yards specialising in Capesize bulk carrier construction. A report from broker Gibsons published in mid-July suggested that as many as 150 capesizes on order would not be delivered, representing around 20% of the total number of such ships on order.

One yard confident of not falling prey to such a trend is Daehan Shipbuilding, which celebrated the christening of its first 170,500dwt bulk carrier in June at its shipyard in Haenam, South Korea. The vessel, *Mystic*, is 289m long, 45m across the beam, and is the first in the series of eight Capesize bulk carriers ordered by Norway's Golden Ocean Group, contracted on November, 2006.

Daehan Shipbuilding said it had 'surprised the industry by successfully delivering the first vessel to the shipowner within the time given and without any delay'. Also, it had 'received a global recognition by building an eco-friendly bulk carrier that satisfies the standards of CSR of IACS for the first time in the Korean shipbuilding industry'.

Daehan said it currently had 43 Capesize bulk carriers on order, worth US$3.5 billion. Of these, 24 will be 170,500dwt ships, and 19 will be of 180,000dwt.

Daehan Shipbuilding may be a newcomer, but its president, Ho Chung Kim, is a shipbuilding veteran with 25 years of experience.

Daehan Shipbuilding's second block factory, Taejon Heavy Industries, will be capable of producing 150,000tonnes of blocks annually, and will start operations from the end of July. This will bring the company's total block-producing capacity to around 250,000tonnes per year.

Meanwhile, while it was only completed in August 2007, Daehan Shipbuilding's No 1 dock is being extended from 340m long to 400m long, in order that the yard can build two ships in tandem. Construction of its second dock is due completion by June 2009. This facility will measure 460m by 115m.

Daehan Shipbuilding president Ho Chung Kim is a 25-year shipbuilding veteran who, until August last year was senior executive vice president at Daewoo Shipbuilding and Marine Engineering. Mr Kim said it was not Daehan's intention to compete with more established and diversified shipyards in Korea. Rather, Daehan had focused on Capesize bulk carriers.

'We think this is the market for us. It is not overly sophisticated and does not require very high levels of engineering and, in getting a big number of Cape orders, we benefit from building similar vessels repeatedly, which limits the number of engineers required.'

Even so, Daehan Shipbuilding has been painstaking in its route to market, with Mr Kim drawing on his long relationship with Sweden's SSPA, which undertook hull form testing for Daehan's bulk carrier designs.

Furthermore, in throwing itself into competition with Chinese, rather than other Korean, builders, Mr Kim said Daehan had key advantages. 'We cannot compete price-wise – our price is, perhaps 10% higher [than in China]. But shipowners are prepared to meet the Korean premium, because we are competitive on quality and delivery time. Even though we are newcomers, shipowners have shown high levels of confidence in us because, although the facilities may be new, all of the directors and managers are experienced and come from the existing major shipbuilders.'

He said that Daehan Shipbuilding was also pursuing a different production model to other Korean shipbuilders. 'We are quite unique because we only have 600 workers employed directly, with 2000 more employed as subcontractors. We are free from labour disputes, which is a critical problem in Korea. Although we treat our subcontractors as if they were our direct employees, it is fair to say that labour is divided among different, small subcontractors.'

TECHNICAL PARTICULARS

Mystic

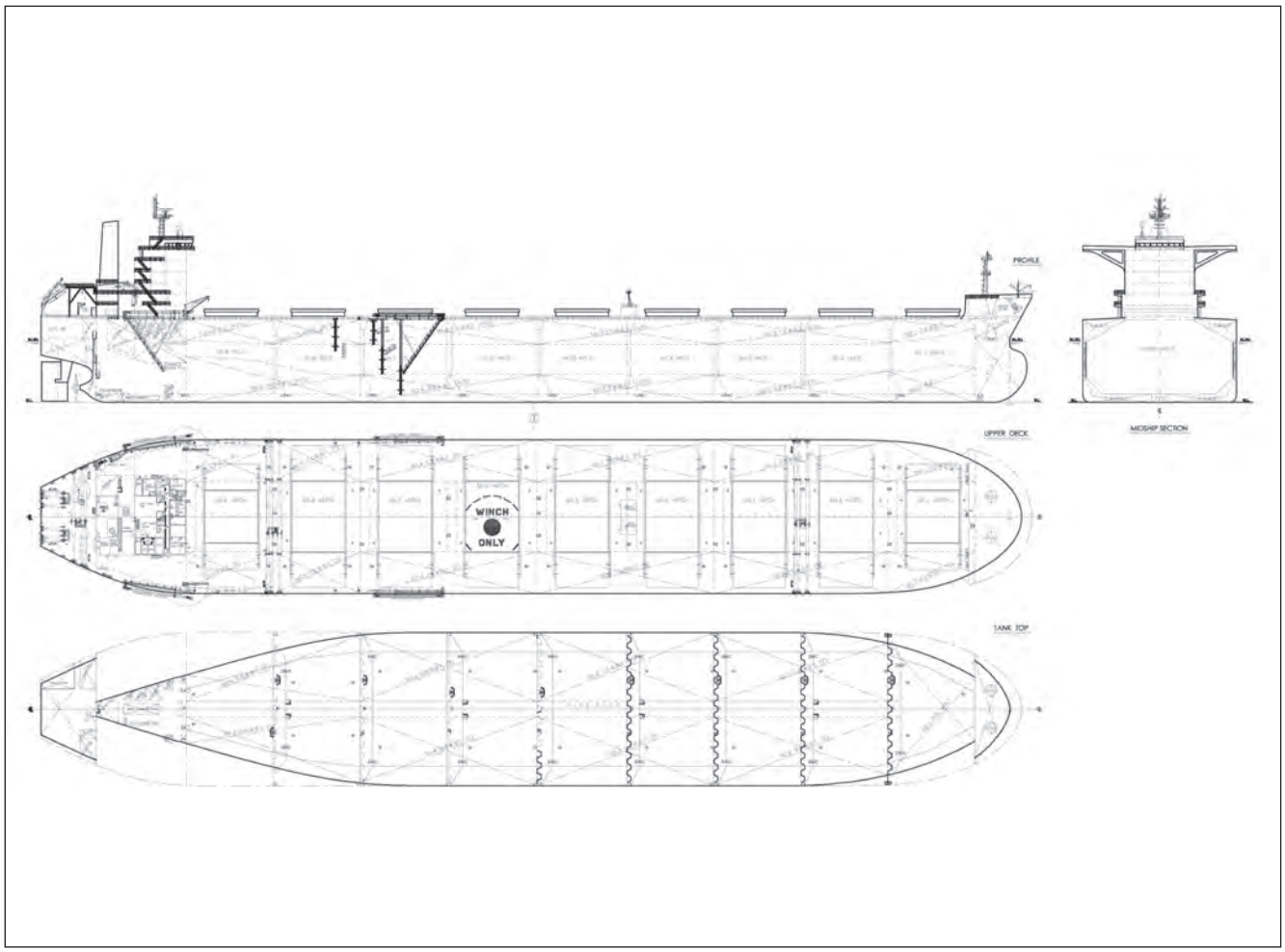
Length over all	289.0m
Beam	45.0m
Depth	24.2m
Draft (at scantling)	17.8m
Deadweight (at scantling draft)	170,500tonnes
Classification	DNV
Service Speed	15.4knots
M/Engine Power	18,660 k

Mr Kim said that Daehan was at the advanced stages of negotiations regarding a first order for two VLCCs, while it would like to add Aframax tankers, very large ore carriers and containerships to its offering at a later date. However, we would be very careful in extending our product mix further.'

Indeed, he said that he had moved sharply away from the original plan, devised before his arrival at the yard, to develop a shipbuilder on a par with the largest shipbuilding groups in Korea. 'To develop LNG carriers and FPSOs would require a big engineering staff and it is simply not possible to get them in numbers. We have 120 design engineers, where the major Korean shipbuilders might have as many as 2000. FPSOs and FSOs are one by one designs and very complex and cannot be our target. First of all, we need to survive and make proper profit levels.' *NA*

The christening of *Mystic* – the first of 43 Capesize bulk carriers due delivery from Daehan Shipbuilding.

GA for Daehan Shipbuilding's 170,500dwt bulk carrier.



HMD reaps rewards of refocus

With orders in place for some 280 ships, diversification has paid off for Hyundai Mipo Dockyard.

Hyundai Mipo Dockyard (HMD) has increasingly been looking outside its traditional concentration on product carriers, and to new markets, both for its home yard and its satellite yard in Vietnam, Hyundai Vinashin.

This may seem strange for a yard with 188 product carriers on order, including ships of 37,000dwt, 47,000dwt, 52,000dwt and 75,000dwt, but the builder has tracked a slowdown in orders for ships of this type through 2008, meaning that its 2007 resolve to diversify into car carriers and ro-ro ships and its more recent re-entrance into the bulk carrier market to take advantage of rising ship prices, have ensured continuing high levels of forward business.

On 19 June, HMD delivered hull No. 2042, a product tanker, keeping the company's delivery plans on schedule. HMD will deliver 70 vessels in 2008. Some 35 vessels have already been delivered, including 20 product tankers and 15 containerships. HMD held a delivery ceremony for the 37,000dwt product tanker *Valgardena* ordered by Navigazione Montanari, of Italy. It is the third of four 37,000dwt product/chemical tankers ordered by Montanari, and measures 184m in length, 27.4m in width, and 17.2m in depth. The ship is equipped with a Hyundai B&W 6S46MC-C engine, providing a service speed of 15knots.

As of June 2008, HMD said it had 280 ships on order in total. Figures published in March, show that among them are 14 x 55,900dwt bulk carriers for E R Schiffahrt, although the yard is known to have since secured orders for more bulk carriers, and it is believed that it now has orders for 30 such ships, including Handysize tonnage.

The March figures also showed that HMD has 22 containerships on order of up to 4300TEU capacity, plus nine con-ro vessels of either 24,400dwt or 29,000dwt, 10 x 10,800dwt ro-ro vessels (all for Grimaldi), 12 liquefied natural gas carriers of either 20,600m^3 or 35,000m^3 capacity, four 49,000dwt general cargo carriers, and 20 pure car and truck carriers of either 3500 unit or 6500 unit capacity.

Four drydocks are now in operation at HMD, three of which offer capacity for vessels of up to 400,000dwt, with the fourth offering capacity for ships of up to 350,000dwt. The builder is increasing capacity through construction of a new 300,000m^2 block factory close to its current facilities in Ulsan, for completion in 2009, in order to take on work generated by its PCTC production requirements. At the same time, its Vietnamese operation has quickly been refocused on newbuildings, where it has developed as a repair operation over the last decade.

Hyundai Vinashin, which is 70% owned by Korean interests within Hyundai (HMD holds 55%), has orders for 21 bulk carriers, of 37,000dwt and 56,000dwt capacity, with deliveries due to Cypriot, Danish and German owners. Currently, the yard is split 50/50 between newbuilds and repair work, but the intention is to close the repair operation over time, to take account of rising demand for newbuilds, and because the two activities do not work well in tandem.

Two drydocks are available at the Vietnamese site, in Khanh Hoa Province, one with capacity for ships of up to 80,000dwt, and the other with capacity for ships of up to 400,000dwt. Hyundai Vinashin is currently adding yard cranes, and a new machinery shop is under development. Steel cutting of the first newbuild ship from Hyundai Vinashin was due to start in August, with delivery set for the latter part of 2009.

A spokesman for HMD said that the plan was for the Vietnamese operation to turn out up to 20 ships per year, concentrating on bulk carrier production. Korean staff members are undertaking all design, management and procurement tasks.

As has been widely reported, the Vietnamese economy has suffered inflation rates of 25% through 2008. However, an HMD spokesman said that local economic conditions would principally be of concern to start-up shipyards in Vietnam. 'We have been operating for 10 years in Vietnam, and the Vietnamese economy is irrelevant to our shipyard,' he said. *NA*

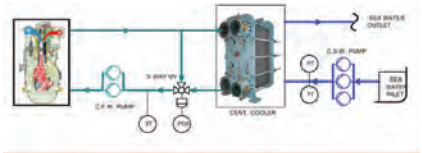
Donghwa offers energy saving

A new approach to controlling water temperatures in sea water pumps.

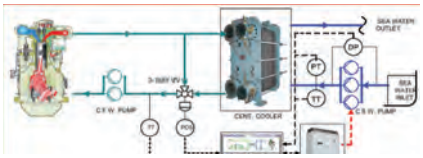
Sea water pumps that feature a conventional central cooling system are operated at full speed, regardless of any change in sea water temperature from that specified in the engine design: 32°C.

If the inlet temperature of the sea water is actually lower than 32°C, the result is that the outlet temperature of the jacket water falls below the 36°C specified in the engine design. In a conventional system, this is addressed by controlling the flow rate of the bypassed water using a three-way valve, which adjusts the jacket water temperature back to 36°C. However, because such a system delivers the required temperature through controlling the quantity of bypassed fluid, the central cooler is not operating to its 100% performance potential.

South Korean heat exchanger solutions provider Donghwa Entec says it has devised what it takes to be a first for the market, in the shape of new type 'Energy Saving System' (ESS) to control water temperatures.



Conventional Central Cooling System



Conventional Central Cooling System

ESS 'controls the revs/min of the sea water pump, sensing the variation of sea water temperature,' Donghwa says. 'It prevents overcooling of the jacket water outlet temperature and reduces the quantity of bypass fluid from [the] three-way valve.' As well as achieving central cooler performance of 100%, the system saves as much as 40% of the electric power consumption, according to the company. Such savings would pay back on the initial investment within two years.

Unlike a previous system devised to address this issue from a similar starting point, the Donghwa solution features a controller and an inverter, which means that it can achieve linear control of the sea water pumps, with changing frequency having no impact on performance.

The first commercial user of the new system will be Wallenius Lines, with four pure car and truck carriers due to be delivered starting from the first quarter of 2010 to feature ESS. *NA*

Korean Register in the chair

The reach and influence of Asian class societies are on the rise, and the Korean Register of Shipping is no exception.

For the first time in its 48-year history, 2008 saw the fleet classed by the Korean Register of Shipping (KR) reach 30 million gt. The class body said it expected its fleet to grow further to 33.5 million gt by the end of the year, and to reach well over 45 million gt by its fiftieth anniversary, in 2010.

The surge in KR's classed fleet has been driven largely by 2007's healthy newbuilding market and includes a wide range of vessels including bulk carriers and tankers, containerships, very large ore carriers, and pure car and truck carriers.

As of May 2008, the number of KR-classed ships stood at 2306 with an aggregate tonnage of just over 32.5 million gt. This is an increase of approximately 5.1 million gt compared to the figure posted in June 2007.

As its classed fleet has expanded, so have KR's international horizons, with plans to grow its overseas network to support global newbuilding activities and to improve services for ships-in-service in train. Eventually, KR plans to operate 50 overseas offices. In 2007, it opened new offices in Nanjing and Ningbo, in China, while 2008 will see the establishing of new offices in Durban, Mumbai, New Orleans, Taipei, and Tianjin.

'We also plan to establish regional head offices in China and Europe later this year,' said the class body. 'By the year 2010, a regional head office will be set up in the South East Asia also.'

KR is also the Recognised Organization (RO) of the South Korean government that undertakes statutory services related to ship inspections based on International Maritime Organization instruments. Due to this unique role, KR has been working with the Ministry responsible for maritime affairs (now the Ministry of Land, Transport and Maritime Affairs) on many IMO-related activities.

Indeed, between 2003, when 'IMO Leading Group Programme' was initiated by the Korean government, and 2007, the Republic of Korea made a total of 157 submissions to IMO, with KR involved in the majority of these proposals.

Energy for IACS

KR also took over the chairmanship of the International Association of Class Societies, on 1 July. While this is part of the normal rotation of class society governance, KR is setting out its stall for an energetic term in office.

The class body said that the following items represented the priorities for its chairmanship:

- 'Implementation of the new IACS Quality Policy
- Further improvement of IACS QSCS [Quality Management System Certification Scheme] with the inclusion of IACS CPIs [Common Performance Indicators] and other recent developments in quality promotion of IACS
- Accommodation of the relevant requirements in the EU Council Directives on quality matters into the IACS quality policy
- Harmonisation work needed with the development of IMO RO Code
- To play leading role to achieve the goals of the Industry's Poseidon Challenge'

Also high on the agenda was the promotion of the relationship between the Asian shipbuilding industry and IACS, KR said. What was needed was 'more effort to harmonise the outstanding comments from Far East shipbuilding experts over IACS CSR, [Common Structural Rules] the class body said, without further elaboration.

In general, however, there was also a need 'to encourage more positive contributions from [the] Far East shipbuilding industry to the establishment of classification rules and international convention requirements'.

Rising to CSRs

KR says it has been committed to 'ensuring diligent and consistent application of the IACS Common Structural Rules (CSRs)'. KR's CSR software package - SeaTrust-CSR - is currently being used by 24 major shipbuilders and design houses, as well as 14 universities. Its development, together with the provision of a comprehensive training package, ensures that the Rules are applied effectively, the class body says.

'Following the release of 2nd version of the CSR software in 2007, a 3rd version of the software will be released in October 2008. Using the CSR software, KR has assisted the major Korean shipyards including Hyundai, Samsung, Daewoo and STX to develop standard CSR compliant tankers and bulk carriers of various sizes.

For its part, KR would look to organise more international meetings and conferences in Asia 'to promote open dialogues'. It was committed to the 'promotion of mutual understanding on the procedures and practices in the production process through research and joint work'.

KR's tenure would also see the Korean society looking to promote the image of class in general, quality shipbuilding and a clean environment.

Witnessing that Asian class bodies have been looking to create a fresh voice in developing rules that match the region's shipbuilding prowess is the fact that meetings between KRS, ClassNK and CCS have been happening with increasing frequency recently. 'The meetings are informal in nature and the purpose of such meetings is

to exchange views on classification activities in general with emphasis on the matters related to IACS and Asian classification societies,' KR said. 'The ultimate objective is the enhancement of maritime safety and environmental protection worldwide.'

Back to basics

With so much going on at the 'macro' level, KR emphasises that it is by no means losing sight of its responsibilities at the detailed level. To promote observance of the new Performance Standard for Protective Coatings (PSPC), for example, KR has been holding seminars for shipyards and shipowners to provide information on the history behind its development, the content of the STANDARD and the procedures for its application. 'Our surveyors have also undergone training to effectively monitor the implementation of the Code', said KR. 'Although the construction of vessels subject to the Code have not been commenced with under KR class as of yet, we expect to have newbuildings which will need to apply the Code soon.

'Under the PSPC Code, inspection of surface treatment, procedure for coating, selection of coating inspectors, etc, are to be done under the mutual agreement of shipyard, shipowner and paint manufacturer. The consensus among tripartite parties with different interests, however, may not be so easy to achieve. We plan to continue our efforts to educate the tripartite parties to ensure that they have uniform understanding of what is required under the Code.'

Also critical, both for its image and for the clients that it serves, it KR's port state control record.

In 2007, class-related PSC detention records of KR-classed ships were 0.26% in the Tokyo MoU, 1.10% in the Paris MoU, 0% with the USCG and 0% with the other PSC regimes.

According to KR, the following measures have been undertaken to prevent PSC detentions:

- Spot pre-inspection for a ship calling in for the first time in European or American port where PSC inspection is anticipated;
- Implementation of a 'Special Attention Scheme' to make sure that the ships prone to PSC detention are more thoroughly surveyed. Depending on the situation, a 'flying squad' composed of experienced surveyors is employed for this purpose
- Undertaking a 'Concentrated Inspection Campaign' before the actual implementation of the PSC MOU's own Concentrated Inspection campaign, i.e. ISM in the year 2007
- Timely provision of latest the PSC related information
- Training of surveyors, ship owners, supervisor and crew members on PSC matters. *NA*

Sweet 16 order for Daewoo

Daewoo Shipbuilding and Marine Engineering Co has become the latest yard to benefit from aggressive spending by Maersk Line in the containership market.

South Korean yard Daewoo Shipbuilding and Marine Engineering, whose future ownership remains a matter for feverish speculation, has racked up a US$2.34 billion order from Danish company A.P. Moller-Maersk, covering 16 x 7450TEU capacity containerships, for delivery between 2010 and 2012.

The deal, secured in early July, is exactly the sort of order to whet the appetite of investors circling over the world's number three shipbuilder, whose current main shareholders include the state-run Korea Development Bank (31.3%), and Korea Asset Management (19.1%). KDB, which emerged with an effective controlling share in the Daewoo shipbuilding enterprise after the 1999 bankruptcy of the Daewoo Chaebol and its Daewoo Heavy Industries arm, began the process of selling its stake in the revitalised shipbuilder in March 2008. KDB is expected to select a preferred bidder by August, with suitors including steel giant Posco, SK Group, Hanwha Group, GS Holdings, Doosan Group and STX Group,

Indicating the inroads that containerised transportation continues to make into South American reefer export trades, the 16 Maersk containerships will be equipped with plugs enabling them to carry 1700 refrigerated containers each - the highest number ever carried on a container vessel. Normally, a ship of this size would feature 600-700 reefer plugs, while even the largest containerships afloat, of 10,000TEU capacity and above, generally feature only 1000 reefer slots.

Each vessel will also be equipped with a waste heat recovery system, re-using excess heat from the exhaust and thus generating energy for propulsion of the vessel or onboard electricity consumption. The reduction in fuel consumption would result in a corresponding reduction of emissions, the shipowner said. Hitherto, Maersk has favoured a steam turbine-based waste heat recovery solution, as supplied by UK-based Peter Brotherhood.

The 16 ship order came just 10 days after A.P. Moller-Maersk signed an agreement with Hyundai Heavy Industries covering 18 x 4500TEU capacity container vessels, slated for 2011 and 2012 delivery. These ships, which are expected to be deployed in trades connecting Europe and Sub-Saharan Africa, will also feature waste heat recovery systems. *NA*

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Driving efficient propulsion

While emissions legislation has been the primary driver behind the gradual take up of more energy efficient propulsion technologies, there is nothing quite like an oil price spike to spur things along at an inordinately faster pace. Report by Patrik Wheater.

If crude costs continue to surge, which many analysts predict they will despite Saudi Arabia's decision last month to ramp up oil production, heavy fuel oil (HFO) could top $1000/tonne, accounting for more than 80% of a vessel's annual operating costs. Therefore, if operators want to reduce their operational costs, they will have to improve considerably on their propulsion systems' fuel efficiency.

Optimising hull form and propulsion arrangements and the use of relatively new concepts such as pulling propellers, wing thrusters, contra-rotating propellers (CRP), as well as understanding more fully the interaction between the rudder and the propeller, can in some applications offer fuel savings of up to 20% or more and reduce resistance noticeably.

CRP configurations

A podded CRP could offer lower power demand than the twin shaft lines commonly used in a ro-ro/ro-pax ferry, for instance, because the configuration recovers some of the rotative energy in the slipstream of the forward propeller. A more favourable wake, together with lower resistance, can also be achieved with a single skeg hull form.

The energy efficiency of the CRP concept in this application was recognised in 2004, when Japan's ShinNihonkai Ferry Company took delivery of two 30.5knot ro-pax vessels, *Akashia* and *Hamanasu* – Japan's largest and fastest ferries, and the first ever reference for ABB's CRP Azipod.

Even in 2004, when fuel was a fraction of the cost it is today, the visionary decision to install the then untried propulsion concept was driven by the increasing cost of fuel. After almost four years in service, ShinNihonkai is still able to document a 20% saving in fuel consumption, compared to the two twin-shaft, diesel-driven fast-ferries that previously operated on the same route, as well as a 15% increase in transportation capacity and increased manoeuvrability.

The CRP in a ferry application is viewed with such potential that Wärtsilä's ship and propulsion concepts guru, Oskar Levander, is quite happy to abandon the conventional double-shaft-line solution for 'the ferry of the future', replacing it with a CRP or a wing thruster, which has a shaft line in the middle and two thrusters pulling at the sides. In a CRP arrangement, the aft propeller recovers some of the rotational energy in the slipstream from the forward propeller. The advantage of wing thrusters/wing pod propulsion is that individual propeller loadings are reduced by using three propellers, which improves operating efficiency. Having twin steerable thrusters also increases the ferry's manoeuvrability at slow speeds.

'These new propulsion concepts reduce resistance and result in lower power demands. This leads to lower fuel consumption and reduced emissions,' says Mr Levander, in the latest edition of Wärtsilä's in-house magazine Twentyfour7.

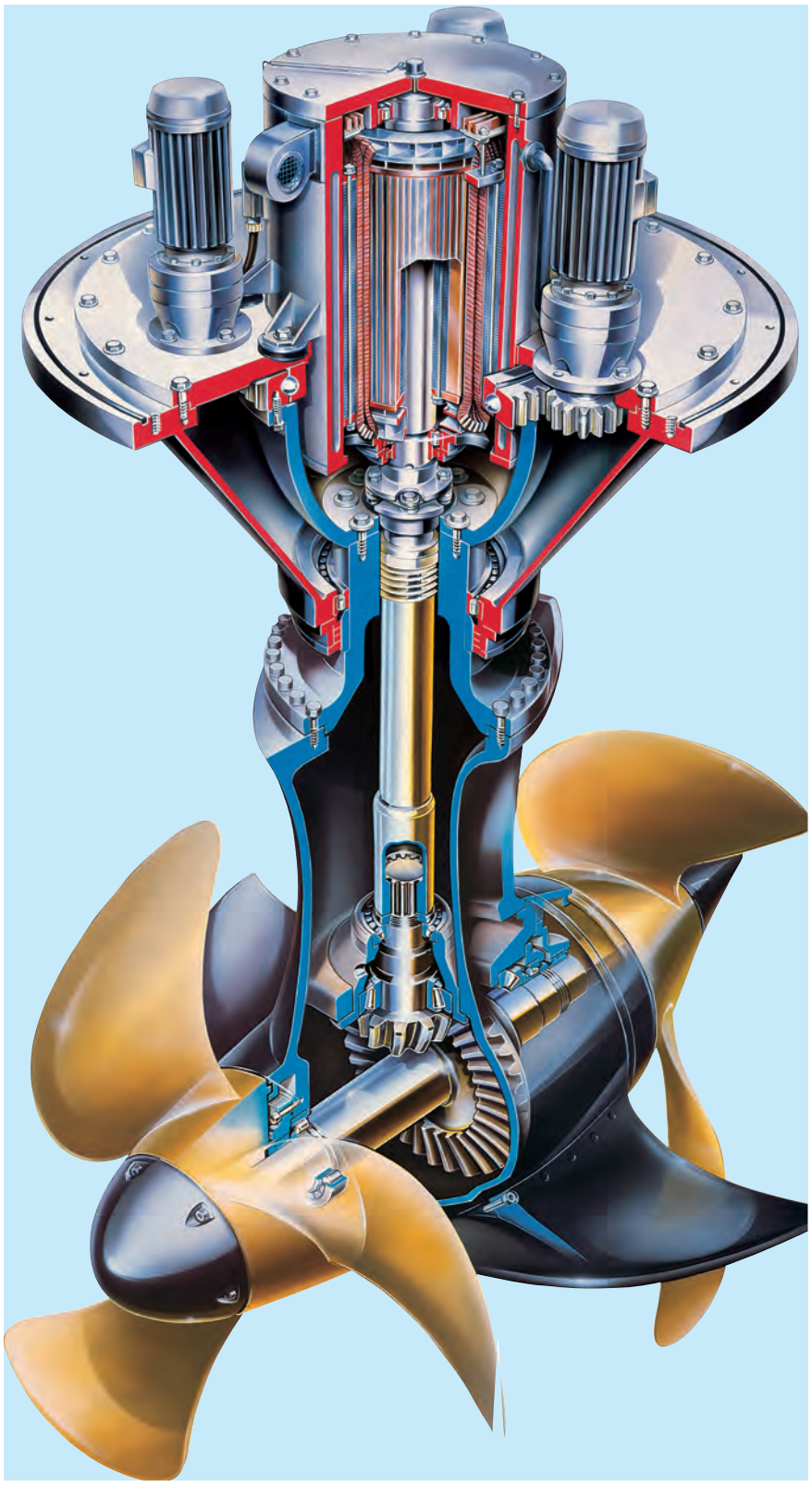
'Combining two propulsion concepts offers clear power savings. A diesel-electric power plant provides optimum efficiency at low speeds. In addition to propulsion, this power plant handles the electricity demands of the hotel section,' he says.

For a containership, the potential propulsive gain offered by the CRP configuration, when compared to a single screw solution, is also favourable, and more than 8% of rotational losses can be recovered. The solution also affords lower propeller load (the higher the propeller load, the higher the efficiency gain) and significantly improved manoeuvring, with a shorter turnaround in port and less of a need for expensive tug assistance, according to Wärtsilä.

In a study carried out by ABB to assess

Optimising the interaction of forces between rudder and propeller could shave thousands off the fuel bill.

Schottel Combi Drive in its twin prop form.



the efficiency of a CRP propulsion system for a 12000TEU ultra large containership, model tests demonstrated an 11.4% increase in propulsion power, which means that less installed diesel engine power would be needed.

Petteri Ämmälä, the author of an ABB paper detailing the study, concluded that propulsion power can be produced with optimum machinery and that remarkable savings in operational costs can be achieved due to lower fuel consumption. He says that when hydrodynamic efficiency, less installed diesel engine power, the power plant principle and extra cargo carrying capability are combined, savings can top $10 million over a 15-year period when compared to a twin-screw, twin-skeg system.

Thrusting forward

It is the wing thruster and its retractable cousin, however, that form the propulsive centrepieces of a unique Offshore Support Vessel (OSV) design developed in a collaborative venture between Wärtsilä and Vik-Sandvik.

The new design, claimed to afford a 12% reduction in the power demand at the propeller, combines the low resistance of a single skeg hull form with the manoeuvring performance of steerable thrusters. This flexible mechanical-electrical combination is based on four W9L20 engines, two of which are connected via reduction gears to 1200kW shaft generators to drive a feathering controllable pitch propeller. Two 1665kW W9L20 engines would feed power to the 880kW retractable thrusters. However, to avoid the CP propeller running at nominal speed, a fixed pitch propeller could be used. The ensemble, says Wärtsilä, creates a propulsion environment in which transmission losses, emissions and fuel consumption are all reduced dramatically while providing the same manoeuvring performance as a twin thruster vessel and the same power plant benefits as a traditional diesel-electric arrangement.

Providing a first reference for Rolls-Royce's take on the rim driven thruster concept is the UT 712L *Olympic Octopus*, delivered in October 2006, which also points to significant fuel savings.

Gunnar Johnsen, head of electrical systems at Rolls-Royce Technology remarked that because the design of the unit negates the need for a gearbox in the tunnel and struts to support the propeller hub, water flow through the unit is unobstructed. Uncontrolled water flow between the blades and the tunnel is also eliminated as the propeller blades are attached to the rim, while

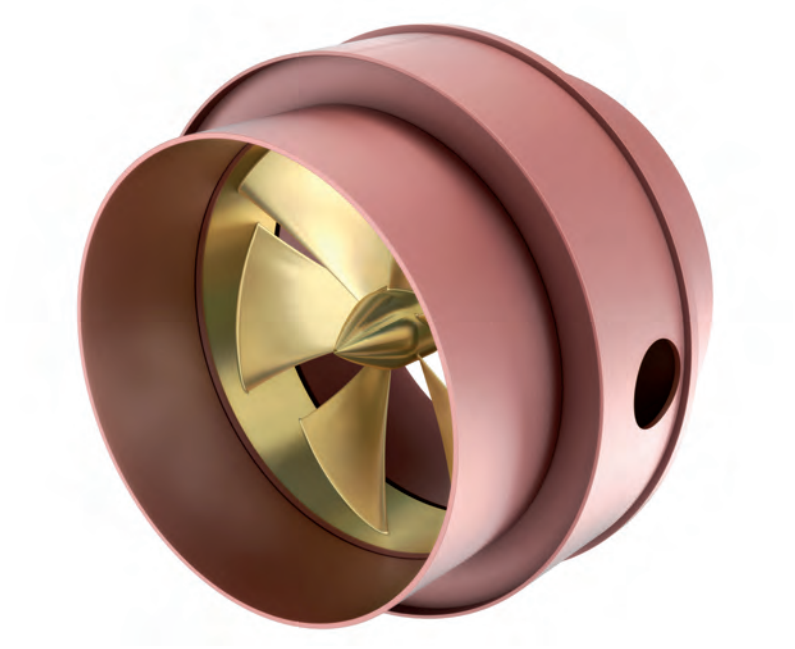
curved fairings in the tunnel engender a smoother flow of water, which in turn increases the contribution that pressure differences on the hull make to the total side thrust.

Essentially, the features inherent to this design will deliver more thrust for a given input power, therefore making the solution a cost effective one, especially in operations where the system is used for long periods in DP mode.

The relatively new Schottel Combi Drive (SCD) is another economically-efficient solution that has found favour in the offshore market. Norwegian shipbuilder Ulstein Verft selected the system for two PX105 platform supply vessels for Bourbon Offshore and, such has been the success of its SCD installations in terms of fuel consumption, seakeeping, and overall efficiency, that the owner ordered a further four similar vessels, although this contract was awarded to Chinese shipbuilder Zhejiang Shipbuilding. Other shipowners selecting the SCD include Norway's Neptune Offshore, the Cyprus-based EDT, and US shipowner Otto Candies, which has opted for two 2250kW SCDs for each of the two offshore supply vessels under construction at Dakota Creek Industries. Ducted variants will also be installed in the energy-efficient diesel-electric Anchor Handling Tug Supply vessel, due to be delivered later this year from Mumbai's Bharati Shipyard to local shipowner Great Offshore.

The SCD, both in its twin-propeller and ducted form, combines the main technical and economic attributes of the German propulsion systems supplier's established SRP 1515, SRP 2020 and SRP 3030 Rudderpropeller products to offer a power range from 1900kW to 3800kW with propeller diameters from 2500mm to 3500mm.

In contrast to pod drives with an electric motor inside the underwater pod, the motor in the SCD propulsion system is integrated vertically into the support tube of the Rudderpropeller. This arrangement means that the concept is similar to that of a Rudderpropeller with a vertical power input, but the system requires neither an above-water gearbox nor a cardan shaft, making the SCD a compact and easy-to-install solution that can prove particularly advantageous in the offshore supply vessel segment where space in the stern is limited.



Rolls-Royce rim thrusters for *Olympic Octopus*.

Second generation Azipod

Electric propulsion and the power plant concept are now widely accepted as commercially viable solutions to reduce fuel consumption and emissions. The hydrodynamic benefits of the arrangement endowed with an Azipod system, for example, have been proven to offer fuel savings typically in the region of 15% compared to electric shaft line propulsion, due mainly to reduced hull resistance.

Extensive full- and model-scale testing throughout the last decade have shown that the hydrodynamic efficiency of a twin Azipod solution can offer an improvement of 8% to 18% when compared to a traditional shaft line.

However, while ABB claims that the hydrodynamic and propulsive efficiency of the system can be improved only marginally (by two or three per cent), as current designs are said to be pretty much operating at their maximum values, the company is nearing the launch of a new, second generation Azipod system.

Under the project name Innopod, within three years ABB is expected to launch a system aimed at optimising weight, structural strength, and operational flexibility. Proposed designs feature an alternative frame to the systems currently in production and will allow the maintenance and repair of components, such as bearings and seals, to be carried out without having to take the vessel out of the water. Drydocking intervals will be extended from five to seven years.

To further increase 'maintainability' and life-cycle management, a state-of-the-art condition-based monitoring system (CBM) will be integrated into the unit to afford the real time monitoring of shaft line bearings, vibration levels, oil quality, motor temperatures, and so on. Sensors will also be fitted to the propeller control system, in order to detect cavitation and to optimise performance and environmental efficiency.

Rudder-propeller interaction

Propeller selection itself is also one key to reducing operational costs, but while propeller design itself may not be able to achieve further optimisation, the advances made are such that shipowners could shave 17% off the fuel bill by simply replacing old blades with more efficient modern ones. A reduction in noise and vibration would provide a further boon.

Data from shipowners have shown that the developments made in hydrodynamic analyses and blade manufacture can generate substantial reductions. For instance, Stena Lines' Gothenburg-Kiel route-operating *Stena Germanica* replaced its propeller blades with a new blade design from Rolls-Royce in 2005 and achieved a 10% reduced fuel consumption. Similar retrofits were carried out to the ferries *Stena Scandinavica*, and *Stena Nordic*, whose fuel efficiencies improved by up to 12% and 17% respectively. *Skåne* is also being treated to a set of new blades.

Other shipowners that have swapped their inefficient prop blades include cruiseship operator Royal Caribbean International, which replaced the propeller blades on its 48,500gt cruise vessel *Empress of the Seas* during dry docking in November 2006.

Based on data from the first nine months after conversion, *Empress of the Seas* recorded a 13% drop in fuel consumption during a Caribbean cruise of between three and 11 days (see *The Naval Architect*, May 2008, p37).

Greater understanding of the hydrodynamic forces generated from the interaction between the propeller and rudder could also improve a shipowner's bottom line and to this end Wärtsilä and Germany's Becker Marine Systems, the originator of the twisted-rudder design, entered into a cooperation agreement in 2006, to develop and market energy efficient propeller-rudder systems.

The fruit of that collaboration was the Wärtsilä Efficiency Rudder (WER), a rudder/propeller combination designed to reduce drag and increase efficiency by up to 7% in some cases. For single screw vessels, the propeller/rudder combination can improve propulsive efficiency by between 5% and 7 % and reduce pressure impulses to the hull by up to 45%. For twin-screw vessels improved propulsive efficiency is 3% to 5%, with a 25% reduction in pressure impulses.

The new WER differs from earlier concepts in that a fixed bulb is attached to the rudder horn immediately behind the propeller. It can also include a flap at the trailing edge of the rudder blade to increase lift. The leading edge of the rudder can then be aligned with the flow behind the propeller to reduce rudder drag, hub separation losses, and increase the performance of the propeller blade.

Efficiency gains

The efficiency of this rudder/propeller system has been confirmed in model tests of a 900TEU feeder containership. During the tests it was concluded that a 5% efficiency gain at service speed of 18knots was achievable with an 'efficiency rudder' compared to a conventional rudder.

Model tests of other ship types showed similar gains. At a speed of 15knots-25knots a containership could achieve a 5% to 8% improvement in efficiency. A tanker operating at 16.1knots benefited from similar gains, but a chemical tanker with a speed of 16.7knots achieved up to 9% gains. These gains are dependent on output and propeller dimension, but the tests confirmed that if the propeller and rudder are considered as one integrated propulsion unit, as opposed to two separate components in the propulsion train, fuel consumption and greenhouse gas emissions can be reduced.

Göran Pettersson at the Rolls-Royce Hydrodynamic Research Centre, in Sweden, and Kåre Krøvel Nerland, working within the company's research and technology department in Norway, both arrive at the same conclusion. They confirm that the potential for improvements in propeller efficiency alone is limited but if the propeller and rudder are optimised as one propulsion unit then the potential for improvements can be substantial.

The compromise

Although propeller design remains ostensibly a compromise between efficiency and pressure pulses, the full potential of the propeller can be achieved with what Rolls-Royce designates the Integrated Propulsion Manoeuvring System (IPMS).

This, as Mr Patterson and Mr Nerland claim in their 2008 paper 'Integrated Propulsion Manoeuvring System for Improved Propulsive Performance', is because a different approach can be taken to propeller design increasing the possibilities for suppressing vibrations and noise characteristics without trading too much propulsive efficiency. Focus on fuel economy gives possibilities to improve efficiency without jeopardising vibration and noise levels, whereas a better possibility to balance the propeller design between low pressure-pulses and noise, and high efficiency, is achieved, which is especially important for ships at higher speeds and higher propeller loadings, they say.

As far as the rudder goes, profile and thickness ratios are critical but, if the profile is cambered or given a twisted leading edge, then more efficiency can be gained as it will

be able to recover more of the rotational energy.

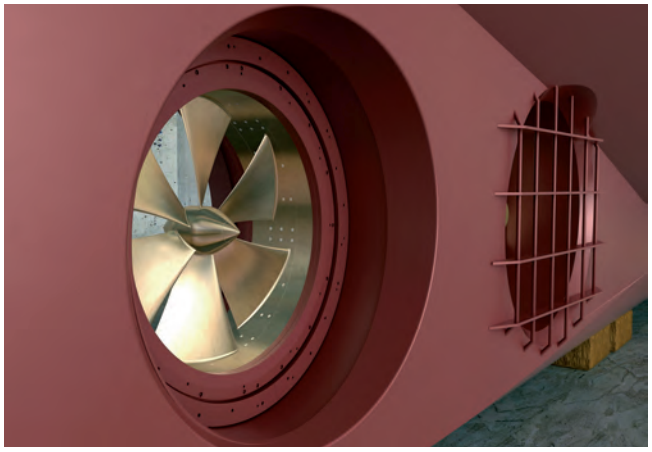
According to Mr Patterson and Mr Nerland, the profile should be twisted or camber in one direction above the propeller shaft and in the opposite direction below the shaft line. A well-designed full-spade rudder with twisted profiles, say the authors, can prevent or reduce cavitation and increase the propulsive efficiency. Yet to gain full propulsion efficiency from IPMS, the size and the vertical distribution of the twist along the rudder needs to be adapted to the flow angle and velocity distribution in the slipstream behind the propeller.

Studies carried out at the Rolls-Royce Hydrodynamic Research Centre showed that the IPMS concept, now incorporated into the company's PROMAS product, can result in efficiency gains of between 6% and 8%, depending on application, as the rudder with a twisted leading edge regains swirl energy from the slip stream. The rudder bulb and hubcap, meanwhile, reduce the propeller drag and eliminate the hub vortex.

The magic blade

The PROMAS propeller is standard but some of its 'magic', according to Jörgen Persson, Rolls-Royce commercial product manager, lies in a new blade design philosophy which allows the concept to be offered as an upgrade or retrofit package, dubbed PROMAS Lite. This consists of a Costa bulb simply mounted on an existing rudder, a hubcap and a PROMAS adapted blade design. However, the arrangement would exclude the twisted leading edge. This means that some of the benefits would be lost but, with a pay back time of two years, it is deemed a simple, cost-effective solution to meet the problem of increasing fuel costs.

The first PROMAS equipped vessels will be a series of four 33,500dwt bulk carriers for Jensen under construction in China, at the Nantong Minde Shipyard. The first of these will be delivered for seatrials in early 2009. There are a number of contracts that are awaiting official signatures and the PROMAS Lite development is attracting strong interest. In the meantime, Rolls-Royce will develop the concept for high-speed vessel application and hopes to have a design ready later this year. *NA*



Rim Drive Thruster from Rolls-Royce on mounting in the dock.

'Free suspension' from HRP

Freely-suspended nozzle solution for propellers is believed to be unique

Three recently delivered 110m long inland cargo ships feature a new and innovative propulsion solution that developer HRP, of The Netherlands, believes to be unique.

HRP, which usually concentrates on thrusters, has nonetheless applied for a patent for what it describes as a 'freely-suspended nozzle solution' for propellers, affixed to three 3000dwt vessels, for shipowner De Waardt.

The basic idea is that the upper side of the nozzle is not integrated in the hull itself, but is only suspended from it, while the covering tunnel has been raised to create more space.

According to HRP, the result is that the influx of water into the propeller is undisturbed and that, when directed aft, speed and efficiency are greatly improved. The initial aim of this new approach was to cut down on noise, and HRP said that the results have been very significant, with noise levels quoted as 58dba and vibration levels having also been greatly reduced. Directly above the propeller in the ships' living quarters, the quiet is said to be 'astonishing.' *NA*

The 'freely suspended nozzle design' from HRP – said to be unique, with the developer now seeking a patent.

Steel Giants transmit input power

Bevel gear units with a rim diameter of 2.3m and a weight of five tonnes are now available from Voith Turbo Schneider Propulsion, of Heidenheim, Germany. The company recently manufactured two of these giants.

These bevel gear sets are destined for two Voith Schneider Propellers, each featuring six blades. The two units have a joint input power of 7600kW. They are due delivery to Norwegian shipyard Karmsund Maritime, where they will be installed into an Inspection Maintenance and Repair Vessel (IMR) for shipping company Østensjø. From 2009, the vessel will be used worldwide for inspection and repairing underwater installations such as pipelines. With a speed of 18knots, it is one of the fastest and most powerful fitted with Voith Schneider Propellers.

IT Trends in Shipbuilding

An overview of the recent COMPIT conference covering computer applications for ship design, by Volker Bertram, of the Department of Mechanical Engineering, University of Stellenbosch, South Africa, and Germanischer Lloyd, Hamburg, and Patrick Couser, of Sunnypowers.

Some of the latest developments in computer applications for ship design were presented at the recent International Conference on Computer and Information Technology Applications in the Maritime Industries (COMPIT).

This year, the seventh COMPIT was held in Liege, Belgium. From the earliest phases, modern ship design methods use CAD (computer aided design) models with up to several tens of thousands of elements to define the vessel. Generic CAD tools and those developed for other sectors (industrial design, automotive, aviation, etc.) are often unsuitable due to the very specific requirements of the marine sector:

- Custom or one-off design, normally without prototyping;
- very large number of parts;
- rapid design cycle;
- and especially the complex geometrical shapes of hullforms and associated free-form parts.

Over the last two decades 3D design methods have evolved in the shipbuilding industry. Initially 3D design was used only in the detailed design phase but, increasingly, shipyards have exploited the advantages of using 3D CAD descriptions of the vessels in earlier phases of the design. Three-dimensional design, as such, has no great intrinsic value: it is possible to design ships in 2D and even without CAD at all. However, the situation is changed when the 3D design data is used to create a product data model (PDM). The PDM ideally contains all the information required for the ship: hullform definition; performance analysis; general arrangement; detailed arrangement; ship systems specifications; planning and scheduling; purchasing requirements and bills of materials; etc. In this situation the 3D ship model then plays a central role in the design process.

A major part of a ship design project deals with areas, volumes, weights, centres of gravity, etc. These can be evaluated quickly and reliably in 3D CAD systems. However, modern CAD systems now offer much more. The trend is generally towards simulation-based decisions guiding the design process (first-principles design). A 3D ship model is a prerequisite for most of these simulations. It generates, largely automatically, the detailed geometric input data required by these simulations: e.g. structural finite-element analysis (FEA), hydrostatic and CFD (computational fluid dynamics) analysis meshes. In some cases simulations are integrated within the CAD software, but the trend seems to be towards a selection of separate software applications with streamlined data transfer interfaces between them and often a central 'Manager' application or database to control the complete system.

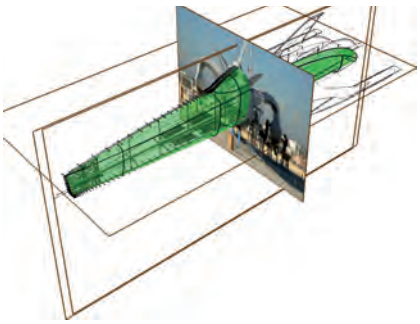


Figure 1: Paramarine allows recreation of CAD descriptions from photos, source: GRC.

Integrating and interfacing

In principle, there are two basic strategies that can be adopted to cope with the increasing diversity of available simulation programs:

1. integration of simulation programs into the CAD design tool, or
2. transparent data transfer between individual simulation programs which are independent of the CAD design tool through the use of (more or less) standard interfaces.

Integrated design tools, following the first strategy, are frequently limited to the design of certain types of ship, resulting in a loss of flexibility; and in many cases the focus is frequently towards integration rather than use of the best simulation tools.

Increasingly it is the second approach that is being used. This approach closely resembles corporate management: a top-level shell handles the user interface and farms out the work to individual simulation programs. For the user, the system appears as a single CAD system, but the modular structure offers greater flexibility for extending the system to include new and improved simulation applications. These systems often integrate the most frequently used simulation applications, such as hydrostatics and power prediction, but offer the flexibility to provide simulation tools with different scope and sophistication levels depending on the phase of the design and the level of detail required. Good business practice is to improve existing software, focussing the development on data transfer and user interface so that it may easily be incorporated into such a system.

Andrews et al. (2008) outline the Design Building Block approach as implemented in the PARAMARINE SURFCON software. The software is typical of more recent CAD systems, featuring "unusual" design and simulation options such as internal layout design and personnel movement and evacuation analysis at a conceptual design stage. This approach encourages a more holistic approach to the development of the ship design solution. The system brings together several buildings blocks

which were developed by different partners with high competency in their respective fields. Graphics Research Corporation Ltd supplied the SURFCON component, an object-oriented naval architectural design package based on the ParaSolid modeller. This module covers not only the graphical description of the free-form hull surfaces, but also several traditional analysis utilities including: resistance and propulsion, stability, manoeuvring and radar cross-section assessment. The design system has recently been coupled with marineEXODUS; software developed at Greenwich University, Deere et al. (2008), to support discrete event simulation (DES) of personnel movement and evacuation. Importantly, the approach and toolsets developed are flexible and extensible, enabling the software to grow in response to evolving customer demands.

Hekkenberg (2008) describes an integrated design system for rapid conceptual design of inland ships under development at TU Delft. This work is a good example of a CAD system aimed at a specific niche market: the design tool is dedicated to a specific ship type (in this case inland ships) and a specific design phase (in this case conceptual design). This specific application of an integrated design system is representative of the state of the art:

'The key to speeding up a (relatively simple) conceptual ship design process lies in reducing the amount of manual labour: human input should be limited to making the important decisions as much as possible, without bothering about the tedious work of generating the drawings and doing the calculations that visualise the consequences of these decisions. For the design model under discussion, the solution to this was found in combining a CAD package (Rhinoceros 3D) with basic software able to perform non-geometry related calculations (MS-Excel) and a database of pre-defined scaleable ship elements (engines, propellers, hullforms, …). These are linked through a number of command scripts (Visual Basic & Rhinoscript) that automatically draw 3D general arrangements in Rhinoceros, but can also feed geometric data (surface areas, centres of gravity) from Rhinoceros back into Excel for further calculations (weights, loads, strength requirements, stability, …).'

Hekkenberg (2008)

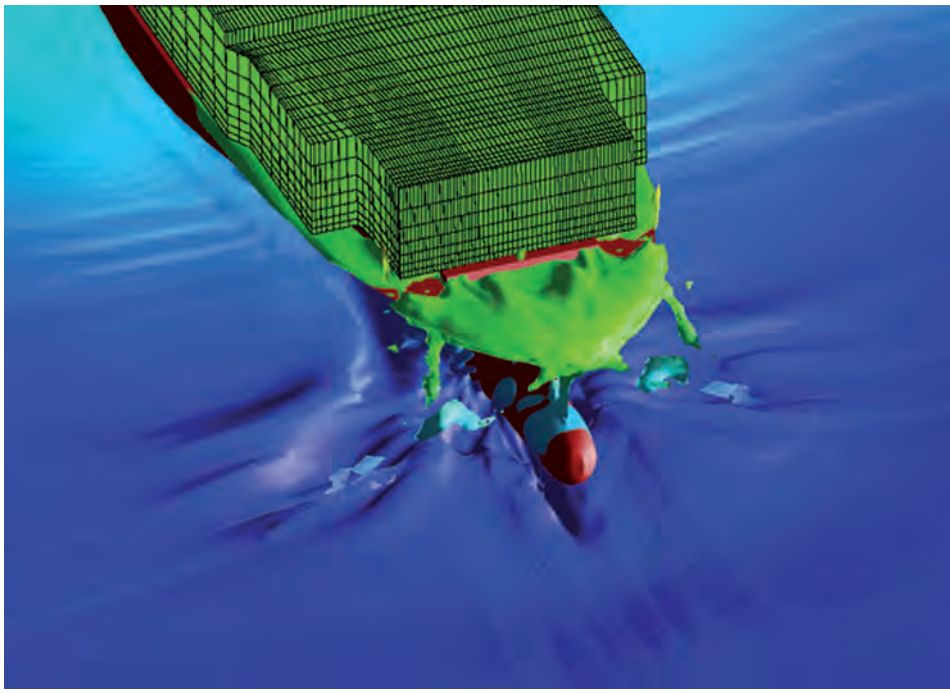
Optimisation may be seen as a special case of CAD system and design simulation integration. Optimisation requires the automatic generation (within the CAD system) and evaluation (by the simulation programs) of the design solutions. Optimisation has been a topic in ship design for at least four decades, but only the last decade has brought broader application and industrial maturity of these tools. The progress is due to three factors: better optimisation algorithms; more complex (and realistic) optimisation models; and more accurate design simulations and evaluation. Evolutionary algorithms (for example genetic algorithms) are now widely employed in naval architecture optimisations. Swarm algorithms appear on the horizon as a robust and efficient technique for optimisation. These algorithms copy the strategies of insect swarms to achieve a goal; the individual behaviour is simple and the power of these algorithms comes from massive parallel computations. While such modern evolutionary algorithms are advocated by research groups, tried and tested classical optimisation algorithms are still the preferred choice in industry. The European project IMPROVE (Rigo et al. 2008) may serve as an example: the project has developed a decision support system as a methodological assessment of ship designs. Using formal structural optimisation software, new ship types, namely a 220000m^3 LNG carrier, a large Ropax ferry and a chemical tanker have been developed.

Additional functionality

As marine CAD systems mature, they provide additional functionality either by directly integrating new features or by offering new links to external simulation software.

After a more general discussion of CAD user requirements and how different surface description techniques match these requirements (highly recommended for further reading), Forrest (2008) describes new features that have added to the PARAMARINE design system. One feature of particular interest is a novel method for the reverse engineering of existing designs: a scaleable Bitmap object enables the electronic version of a drawing (such as a lines plan) to be imported into the PARAMARINE design and positioned in relation to the 3D datum. Alternatively,

Figure 2: Advanced CFD simulations for green water on deck and slamming, source: Germanischer Lloyd.



stations of offsets may be imported which, can be used to generate splines in order to improve the accuracy of model fit between stations.

A fundamental part of the vessel's general arrangement is the definition and management of all ship spaces as well as the preliminary layout of the main equipment (including weapons systems on naval vessels) and accommodation items in these spaces and on the main deck areas. Traditionally, most of the tasks related to compartment design and to the definition of the ship's general arrangement have been done using 2D drafting tools in combination with poorly integrated or stand-alone tools for calculation and analysis. Recent evolution of 3D design tools has led to a new approach for compartment design based on the generation of a 3D compartment model. Alonso et al. (2008) describe recent activities of SENER to include a tool for compartment design in FORAN. A mixed approach combines the advantages of both the 2D and the 3D approaches, but removes most of their restrictions and drawbacks. The new method combines a 3D general arrangement tool which provides all the functionality and techniques of the 3D approach, with 2D tools used when 3D information is unavailable for the equipment or accommodation items or when it is necessary to perform quick modifications of the compartment layout. Working on the deck plan, together with 2½D modelling and visualization techniques, these 2D tools efficiently define the compartment boundaries and accommodation areas and spaces.

Structural design applications have grown beyond mere drafting and parts management tools and now increasingly include structural rules and intelligent support to handle these rules. The new Common Structural Rules (CSR) for tankers and bulkers have triggered CAD developments to support the design process for these ship types which constitute two-thirds of the world's fleet in terms of tonnage. Napa Ltd and ABS have jointly developed such a software tool for assessing ship scantlings against CSR requirements, Holmberg (2008). During the process of evaluating the rules, a 3D model of the ship structure is created behind the graphical user interface. The calculations are then performed using information derived from the 3D model. An FE model can be automatically generated as a by-product of the rule assessment and creation of classification drawings can be automated on the basis of the 3D model. Costing related data can be derived and the model can be exported to detailed design packages.

Better and more simulations

Analysis of vessel hydrostatic stability was among the first applications of computers to the field of naval architecture. Today, the naval architect can perform stability analyses for intact and damaged conditions almost at the push of a button. Modern stability regulations and simulations are closely linked. Progress in simulation techniques now offer simulation-based stability assessment for dynamic conditions, whether it be stability in waves (parametric rolling) or progressive flooding of a damaged vessel. For example, NAPA has incorporated a CFD simulation method for progressive flooding developed at the Helsinki University of Technology, Metsä et al. (2008). The tool allows for a more realistic assessment of ship safety in the damage condition, capturing dynamic effects and intermediate flooding conditions, which are frequently the most critical.

In CFD today, advanced industrial applications include unsteady viscous flow simulations with complex two-phase flow simulations (complex wave formation and cavitation). The market has consolidated to a handful of vendors who offer FEA and CFD analysis tools with associated grid generation and post-processing applications. For example, Queutey et al. (2008) present a six-degrees-of-freedom seakeeping simulation using such a free-surface capturing viscous solver (the motions are not prescribed by an external inviscid solver but are calculated as part of the solution).

The examples above represent applications of continuum mechanics. As a new approach fundamentally distinct from continuum mechanics, discrete event simulation (DES) has evolved rapidly and has proven to be a versatile and powerful tool for many applications supporting ship design. DES is used in practice by several shipyards to support operational and strategic planning of the shipyard operation. Despite the relative simplicity of the underlying theory, simulations of complex systems are able to offer considerable benefits in terms of qualitative insight (e.g. identification of bottlenecks) and quantitative information (time taken to perform an assembly or to unload a ship; occupancy rates for workstation; etc.). Essentially the same technique is applied for modelling processes in ports and the loading and unloading of ships.

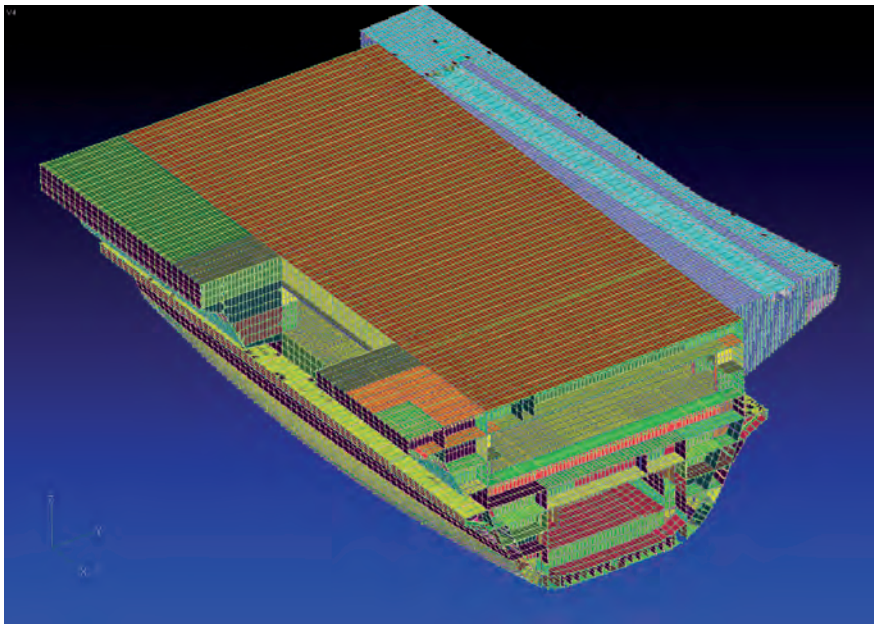


Figure 3: Rapid CAD modellers reduce model creation time to typically one week, source: Granitx.

The simulation of processes that involve humans requires elements that mimic human decision-making and intelligence. This is, for example, the case in ship evacuation simulation. The trend is to equip each simulated human with a certain perception and reasoning capability. Such multi-agent systems have drifted into practical applications and are likely to become increasingly important for a variety of simulations relevant to ship design. Deere et al. (2008) present recent work at Greenwich University, which is amongst the leading groups in this field. They have applied their code maritimeEXODUS to evaluate ship layouts from a human factors perspective, choosing a naval vessel to demonstrate the process.

Faster model generation

In an ideal world, a 3D CAD model is initiated at the early design phase and expanded as the design develops. This central 3D CAD model serves as the starting point for assorted simulations where the required input data and analysis meshes are generated, largely automatically, from the model by suitable interface/grid generation software. The reality in our industry is somewhat different: despite the widely documented and (in principle) accepted advantages of 3D models in the total process chain, most shipyards still often employ 2D CAD for basic structural design, because this is perceived to be cheaper than the creation of a 3D model. One argument for 2D drawings is that the software is cheaper and easier to use. Another argument is that 3D models for different applications have different levels of detail and also often different data structures. For many years, it was difficult or impossible to re-use data from a 3D CAD model developed during basic design later on in detailed (production) design. Such software is only now starting to emerge.

If a 3D model exists, the model is frequently not suitable for use in simulation software. Each simulation requires certain model characteristics tailored to balance computational effort and accuracy of results. Frequent practice is to create input models for simulations (and optimisation) manually. All major CAD vendors in our industry are working to improve the

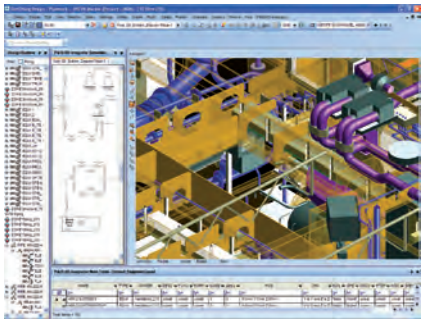


Figure 4: Parametric design saves time and money, source: AVEVA.

interfaces between 3D CAD models for basic design and simulation (particularly FEA) tools. Despite undeniable progress, fully automatic transfer does not yet appear in sight. However, semi-automatic generation of these data is feasible, e.g. Wilken et al. (2008). In this case, the geometry is imported from the CAD model and a pre-processor ensures suitable grid generation. The main problem lies in the necessary abstraction of a global model for FEA. In the FEA model, stiffeners are not modelled geometrically, but attributed to plate elements using a variety of possibilities (truss elements, beam elements, increased plate thickness, orthotropic material properties, etc.). Further, the detail of a suitable FEA model depends on the application to which it will be put and the results it will be required to produce. High-level (expert) domain knowledge is thus required to generate a suitable model and the same is true for CFD simulation models. We therefore expect grid generators to remain semi-automatic for some time to come.

Rapid model creation, modification and validation are key industry requirements and CAD developers have been able to accelerate this process by various techniques. Virtually all commercial CAD tools employ some sort of parametric modeller. Increasingly, simple functions such as automatic generation of repetitive parts are enhanced by knowledge-based support. An example of this is the automatic adjustment of scantlings or insertion of additional stiffeners if required by classification rules due changes of, for example, double-bottom heights, Dumez et al. (2008). Best practice is to create a 3D CAD model of a ship, typically in one week; subsequent FEA model generation for simple models is then largely automatic and grids can be generated within minutes.

Virtual prototyping

Simulation and virtual reality (VR) engines may be combined if ergonomics are important. VR may combine physical mock-ups (e.g. operating consoles) with virtual models of screens, larger environments within the vessel, etc. Human testers or virtual mannequins can then be studied performing ship-operation tasks at the design stage. Le Therisien and Mais (2008) give several examples of these simulations made by DCNS in France.

One application of virtual prototyping is the simulation of operations. DNCS simulated the flight-deck operations of a new aircraft carrier: catapult launching, landings, maintenance and fuelling. The simulation served not only to estimate the time required for individual tasks, but also to identify inconsistencies early in the design process. Another application concerned the set-up of operational premises: here the goal was to integrate the various components of a room and to check functional and ergonomic performance at full scale. The interactive examination of complex premises allows multi-disciplinary teams (architects, ergonomists, crew, etc) to evaluate the design. For example, the complex interaction of a team of sailors during berthing operations of a frigate identified problems of accessibility and mutual blocking of team members. As a final application, a workstation for the new FREMM frigates was evaluated. In an immersive space, the real armchair of the operator was placed in the virtual environment. The operator was then monitored performing several specific tasks. Since all objects of the workstation were movable in real time, the optimal placement of displays and controls was found relatively quickly, avoiding the necessity of producing several physical mock-ups. DCNS reported that in their experience, the savings from detecting design errors early in the design process outweigh the investment costs for the dedicated hardware and software required for the virtual prototyping. *NA*

Foran hits new heights

Sener holds FORUM conferences every other year. The fifth, FORUM 2008, was held in Oviedo on 11 to 13 June. A report by Eric Tupper.

This year's Sener FORUM was opened by Jorge Unda, a managing director of Sener, who welcomed over 100 delegates from 18 countries. In welcoming the delegates he said that the increased attendance, compared with previous conferences, showed the growing number of organisations using Foran. He went on to describe the general Sener Group for which, in 2007 turnover was €791 million, with 4503 employees.

PYMAR

The next speaker was the invited lecturer, Antonio Sanchez-Jauregui of PYMAR who described this private Spanish company, incorporated by some 24 small and medium-sized Spanish shipbuilders in 1985. The shipyards are the shareholders and there is no dividend share out. The aim was to improve competitiveness of the yards through initiatives including technical/R&D, finance/tax, production, purchasing. To help financially with contracts the Fondo Patrimonial de Garantias (FPG) was set up in 1988 as an asset guarantee fund to issue guarantees based on risk assessments. Guarantees cover yards during construction and shipowners after delivery. In December 2007 the value of FPG was €255 million. So far guarantees issued have an aggregate value of €2953 million.

In the technical/R&D area La Fundacion Centro Tecnologico (SOERMAR) was set up in 2002 to improve members' competitiveness through the promotion, development and participation in research and to provide technical support for new projects and innovative designs. SOERMAR co-operates with the EU and other Spanish organisations. It has agreements with several classification societies and with the Spanish ship Model Basin. Projects include studies on LPG and chemical carriers, drag reduction using special paints and bubble generation and a seismic research vessel prototype.

Although well regarded by the Government PYMAR receives no money from them.

The remainder of the speakers dealt either with developments in, or applications of Foran.

Multi-site Foran

One presentation was by Colin Sear and Jim McLauchlan of BAE Systems and related to the Royal Navy new aircraft carrier project. After outlining the overall BAE Systems set up – 97,500 employees worldwide and sales of over £15.7 billion in 2007 - they explained that the naval sector capability covered Surface Fleet Solutions (more than 4000 employees) and Submarine Solutions (over 3450); both involved in the carrier project. The old CAD system was over 20 years old and, as a result of changes over the years, had become complex. After a long study BAE Systems chose Foran. This will enable the number of bespoke systems and interfaces to be reduced. Benefits include the facts that it is a marine based system with a single database. This is one of the higher volume Foran implementations (over 400 positions at the peak) with consequent risks which Sener is helping to deal with. BAE Systems, Babcocks, VT and many contractors have to share data. VT uses Tribon so that provides one interface problem. So far 600 users have had training in Foran.

Technical challenges include multi-site library translation/alignment, multi-discipline outputs, transfer of model data/geometry between sites, interfacing Foran with business systems. Successes include improved modelling efficiency, data integrity and multi-discipline integration; intuitive module interfaces leading to reduced training timescale; reduced infrastructure complexity. There has been successful implementation of core Foran functionality with positive reception by users and management. There is real potential to contribute to improved engineering efficiency and scheduling and Foran is the preferred tool for future projects. There are still improvements to be made in collaboration with Sener. BAE Systems Type 45 and Astute projects will continue with the old system as the effort to apply Foran retrospectively would be too great.

The latest Sener FORUM for Foran explained a developing solution for CAD/CAM.

FORUM: a gathering that is becoming an industry institution.

New approach

Another paper was presented by Fernando Alonso of Sener, who said that the initial design model is very important as most of the cost of a design is committed at that stage. The need is to study many different arrangements in a short time and the ship general arrangement (GA) is a vital tool. Traditionally, the GA has been produced using 2D techniques which, do not allow reusing the GA data for other calculations. Sener is developing a new GA tool (FGA module) combining the traditional 2D techniques with a powerful new set of tools for the definition and management of 3D compartments. This tool takes advantage of work carried out in the EU-funded Intership Subprojects on early design, I-3 (Integrated concept) and I-4 (Methods and tools). [See *The Naval Architect* April 2008]

The new tool will provide a 3D definition of the design model facilitating the reuse of the GA data in naval architecture calculations and in later design stages. It incorporates functions to perform a preliminary layout of the ship main equipment and accommodation items and it will be fully integrated with the rest of the Foran modules.

Military simulation

Carlos Malheiros of the Brazilian Navy discussed the application of a single 3D animated model to achieve an optimum integration of design and production by modelling the ship and shipyard facilities. Either the design or the shipyard facilities may need to be modified. For example, the lifting capacity in the yard may limit the size of unit that can be prefabricated. It may be necessary to delay some outfitting or change block boundaries. The paper presented the results of a production simulation of a landing craft using the CAD/CAM software of Foran and its modules. In the case of the landing craft five blocks were used and the model checked for interferences in the workshop, in transfer to the berth, at launch and docking. The simulation ended with a landing of men and a tank on a shore. The exercise showed that Foran was suitable for this type of simulation although some improvements, relating to interfaces with other design processes, are needed. One advantage of simulation is that it provides a vehicle for all those involved to communicate with each other.

Collaborative Engineering

Carlos Gonzalez of Sener said that the need to cut lead-times and design costs, combined with more complex ship designs, required the improvement of the engineering model. Also, shipyards have smaller design teams and increasingly outsource important design packages leading to a more collaborative engineering environment. This requires the co-ordination of groups working simultaneously on the same project at a number of locations worldwide. Whilst data must be available to all, the centre must retain control. The paper focused on the concurrent design solution as the evolution of the basic technologies such as databases and communications points to a more efficient solution for remote environments using database replication techniques. From the yard's point of view, other issues arise such as the control of access to restricted areas of the project both for confidentiality reasons and the maturity of the information.

Foran has gone to synchronous replication to reduce inconsistencies in data; each transaction is applied instantaneously at all sites; if it can't be applied at one it is rolled back at the others. Whilst Foran V60R2.0 provides for replication, V60R3.0 will optimise the synchronous solution and extend it to many sites. This will guarantee consistency of information which is the key consideration.

Aluminium at Fjellstrand

Ragnar Albrethson said that Fjellstrand at Omastrand, Norway, was one of the first yards to use Foran. This modern shipyard develops, markets and builds technically advanced high speed passenger and car carrying catamaran ferries in aluminium. It has delivered about 150 catamarans to shipowners in 37 countries. The paper dealt with two projects – Ferrycat 120 and a special vessel for ROV operation. Units for the former, which is double ended and has a speed of 22knots and space for 120 cars and 400 passengers, were built in several locations in Norway and Sweden and the assembled in Fjellstrand. Several views showed corresponding CAD views compared with actual photographs. These showed how realistic the CAD representation can be. The second vessel was claimed to be the most environmentally friendly ship ever built. Its main uses are on coastal surveillance and as an environmental research ship. There is a tunnel between the twin hulls for recovering the ROV through a moonpool. Foran was used only for the structure and not for the piping. It was felt that the effort of modelling of pipework could not be justified for a one off ship.

Structural Database

A paper presented by Philippe Renard

The Royal Institution of Naval Architects

WATERJET PROPULSION 5

HamiltonJet

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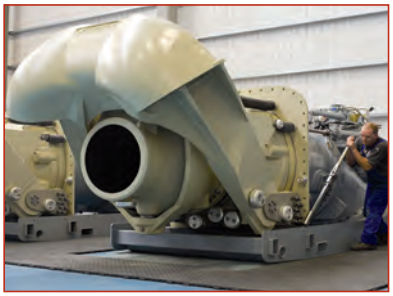
Second Announcement & Call for Papers



This international conference continues the very successful series of RINA events looking at developments in waterjet propulsion.

Waterjets are now accepted as a proven technology, particularly for high speed craft and they are increasing their penetration into small craft, leisure, workboat, patrol and military markets. Today, waterjets are becoming the preferred propulsion choice where high efficiency, enhanced manoeuvrability, shallow draft capability and low maintenance are key requirements. Continuing developments now include very large units of 30MW capacity and the use of waterjets for high speed boost propulsion.

As the technology matures, designers need better tools to help predict the performance and efficiency of these systems across a wide range of operating conditions. Computational fluid dynamics is an increasingly powerful tool which has become almost universal, but traditional model testing and trials measurements are still required to confirm critical results.

Designers and manufacturers also continue to seek to reduce noise, wake and wash as well as optimise the strength and weight of the various mechanical components and to improve reliability, reduce installation time and maintenance.

RINA invites papers on all aspects of waterjet design, production and operation, from designers, researchers, manufacturers and operators. Topics may include the following:

- Simulation for research and design
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- New designs and applications
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of Bureau Veritas dealt with condition assessment of ships from 3D models. The HCM format, equivalent to a ship's digital 3D model, arose from an EC project. Various commercial tools are now being derived using the same HCM format. All make surveys and repairs easier. Measurement data, mainly of thickness, are entered automatically. Other data recorded includes coating condition, crack length and location. The data remains in the system providing a history of changes in hull state. For existing ships, for which a 3D model was not generated during design, a simplified model suffices. The speaker noted that although the model is in 3D it is often easier to enter data through a 2D interface.

The aim is to improve the safety of ships in service. The model does not calculate stress levels. If these are required the classification Society can calculate them from the model using finite element analysis. For the future it is envisaged that robots, about one metre long and provided with strong magnets, will be used to take thickness measurements.

Developed Designs

Juan Garcia de la Vega, Sener, reviewed the organisation, capability and aims of the Marine Engineering Unit of Sener and some recent Foran projects. This showed that Sener not only develop Foran but also use it. Services are provided to 68 shipyards in 21 countries; to 98 shipowners in 15 countries and there are more than 1100 ships under Sener's design in operation. It is hoped to increase Sener's involvement in the early stages of ship consultancy and in design concept. Since 2005, 63% of work was on detail design, 26% on classification and basic design and only 8% on conceptual and contractual. Designs outlined included an anchor handling TSV, a 4000 tonnes passenger sailing ship, a 165m ro-pax ferry, a 250,000 ft^3 reefer, two chemical vessels and a SWATH passenger ship. These examples show what a wide variety of work is covered.

Production Management

Jaime Rivas of Seatech Consulting said that quality and timely delivery of a project are very important. More data is not necessarily better – it must be tailored to the need and unnecessary data wastes time. He described an IT system connected to the Foran system database, managing Foran information, adding specific company information and serving all these together through the company structure. This makes possible increases in productivity and quality. Elements added to the Foran database are workflow definition and management, reporting and querying, document system, alerts and warnings, data acquisition. Security safeguards can be built in, e.g. encryption and limiting access to authorised people.

The application is 100% in Java, and with web access, allowing access from any web browser.

Hull Structure Design

Francisco Castillo of Sener outlined a number of changes to the Hull Software system which will be implemented in V60R3.0. He said that a new welding management approach is one of the biggest improvements. There will be automatic calculation of weld lengths, classification of welding by different criteria and welding information output to reports and drawings. Foran has all the information to know if parts are in contact and these contacts are used as a basis for representing marking information. Contacts will be used to associate welding attributes (material, throat, leg, etc) and compute welding information. Different welding procedures are assigned to different contact types.

Other improvements involved performance, profiles and bracket definition, mounting marks, DXF geometry and FEM links. FHINFO can now produce symbolic profile sketches with real geometry for notches and macro holes. There will be new options for calculating section modulus and moment of inertia for transverse sections. In NEST there is the possibility of floating license for automatic plate nesting.

Aker works with Citrix

Ronny Grytten, Aker Yards Sovikness, spoke of the yard's experience in using the Citrix solution. The need was to connect four Aker facilities in Norway to 24 users in three other countries, with the six in India routed through Amsterdam. He described the equipment and lines the system used and how it has been developed. Overall experience is that it is approximately 20%-30% slower than working directly on server; line capacity is not important; the challenge is to have enough memory/power on the workstation; commands that change graphics are much slower (e.g. lengthen a pipe); it is important to have defined small zones in each project. Improvements Aker would like include better, more user friendly, visual 3D; means to move components more easily from project to project (Sissq is slow and difficult); better documentation on installing and running Citrix on Foran.

Outfitting and electrical

Javier Berbes, of Sener, presented a paper with the FDEFIN module as the main core of the outfitting development efforts aimed at creating a modern application where all the tasks related to Foran outfitting standard management, previously in DEFIN, FMODEL and FPIPE, are grouped. The structure is more flexible and user friendly. A new set of tools is being implemented to improve the connectivity among equipment and pipe segments making modifications easier. For initial design a new express equipment definition and positioning command will speed up the production of initial arrangement proposals. In the field of outfitting production the new feature for exporting the complete piping spool information to an XML format file will open new ways of accessing this information for external applications and fabrication postprocessors.

In electrical design the cable routing functionality is being extended with ability to route cables partially, with options to modify and copy routes.

Global Shape Modelling

Emidio Cennererilli, of Think 3, which was set up 30 years ago in Italy but which now has 100,000 software licences worldwide and a €40 million turnover, presented the Rapid Precision Modification (RPM) concept, which enables a designer to sketch a new character line on a digitally rendered product with the system displaying a new iteration of the design within minutes. This rapid feedback compresses the time between cycles making innovation easier.

Effectively it provides real time working. GSM can be used with FDESIGN.

Naval architecture education

Cassiano de Souza of the Federal University of Rio de Janeiro described the experiences of the university since January 2007 when it arranged licences for Foran. The Naval Architecture and Ocean Engineering Department has 450 undergraduates and 250 graduate students. The FORAN-GICON project was set up with the Brazilian Navy to increase ability to use advanced tools in ship design. Part of this project is to develop the interfaces between Foran and a process simulation system (Delmia) and a project management system (Primavera). There are 12 workstations in the Design and Process Simulation Laboratory (LABSEN, 2006) with a team of 20 people.

Strategic development plan

Rafael de Gongora of Sener explained that the development strategy for Foran is based on foreseeing ship design tendencies, adaptation to technological innovations and fulfilment of client requirements. It is intended to solve real ship design problems. The number of modules is to be reduced for greater efficiency. Localisation is being improved – people like information in their own language, drawings must be available locally and individual users need to incorporate their own rules and standards (e.g. from different classification societies). New developments will mean less manual interventions; faster hull form generation; a new approach for spaces definition and management; all naval architectural calculations incorporated into one module; constant updating to meet new international regulations; universal configuration control able to be configured to local requirements; improvements in the 3D model definition and changes reflected in the 2D drawings (if modifications needed are major the change may not be economic). The Virtual Reality (VR) capability is to be improved with a new VR engine and user interface and compatibility with other VR tools.

Some modifications will be issued as part of V60R3.0 (Q4, 2008) but most, including the VR improvements, will be in V70 R1.0 (Q4, 2009). It was judged that there are enough changes to warrant a new version of Foran. V70 R2.0 is planned for Q4, 2010.

Closure

Luis Garcia of Sener closed the conference, congratulating the speakers on the quality of their presentations. There is an increasing demand for Sener's services and it is trying to adjust their facilities to meet that demand. The business plan envisages concentrating on concept and basic design of technologically advanced ships. It is important that Sener make use of the latest technology in order to maintain the high reputation it enjoys throughout the world. *NA*

The Royal Institution of Naval Architects

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Dr Kenneth W FISHER, FRINA

The RINA is pleased to announce another opportunity to attend Kenneth Fisher's highly successful three day training programme. The course is primarily designed for project managers who handle day-to-day relations with other parties, people who form contracts and senior managers who monitor contract-related cash flow for marine related projects. Those attending the course will be better able to identify the pitfalls and traps experienced within the industry, and be more prepared to identify all the costs,schedule changes and to properly assign responsibilty for those changes and effects. This will save companies considerable sums in each major contrtact.

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Meshing with Nauticus

Nauticus Early Design package from DNV finds an enthusiastic new user and adds functionality.

BMT Engineering International, based in Newcastle, UK, has purchased DNV Software's Nauticus Early Design package. The BMT Group subsidiary plans to utilise the software as part of its design service for newbuildings and innovative concept designs.

Recently BMT formed a joint venture with Hong Kong-based Titron (see *The Naval Architect*, June 2008, pp18-19) to expand its ship design, engineering and project management services in China.

BMT Titron has invested heavily in ship designs suitable for Chinese build and is currently in discussion with shipyards to develop the vessels.

For BMT, this design will be one of the first applications for Nauticus Early Design. According to DNV, Nauticus Early Design is 'a unique solution for early design of ship structures'. It is based on Intergraph's database-driven ship design system, SmartMarine, combined with DNV Software's Nauticus Hull for Class rule checks and detailed strength assessment.

The system uses a common 3D concept model of the ship, which allows for automated production of classification and key plan drawings.

BMT Engineering International's technical director, Jim Knott, said the investment in Nauticus Early Design would enable the production of full, accurate design packages from the designer to the shipyard, with greatly improved efficiency.

Following the implementation of the system in BMT's Newcastle offices late last year, a series of training courses have been undertaken by BMT's design staff as part of a fast-track process to get Nauticus Early Design into full production with BMT Engineering International.

Updated package

The most significant update in the new release of Nauticus Early Design is in the interface from CAD-CAE to both 2D and 3D strength analysis.

DNV said the release met important goals; from one 3D CAD model it was now possible to create the drawing and carry out rule check, FE and hydrodynamic analysis.

The 2D two-way interface with rule check has also been updated. The rule check is carried out according to Common Structural Rules. This means that a user can choose to let the system update the properties in the 3D CAD model according to the rules, if this is required.

The interface with 3D strength analysis is based on .xml transfer. An .xml file is created in Nauticus Early Design and transformed. The transformed structures pass some automatic and manual idealisation for use in GeniE. In order to choose which part of the model to transfer to CAE, the user can select the global models, regions, local models or individual selected structures.

Nauticus Early Design will transfer the geometry, attributes and names. There are built-in rules for idealisation, and more rules will be applied at a later stage as user experience is gained. Already, the final .xml file is imported into GeniE.

In order to create a usable mesh, the GeniE engineer has to use their FE experience to simplify the model further.

The work involved depends on the CAD model and will vary from project to project.

From the GeniE concept model, engineers can run HydroD for hydrodynamic or hydrostatic analysis.

The model transferred to GeniE will contain the geometry, plate and beam names, and all relevant properties such as:

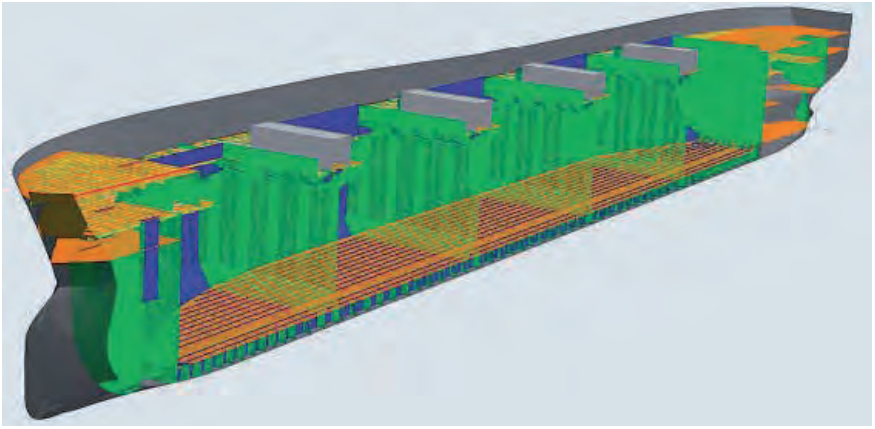
- Plate thickness
- Beam section properties
- Beam eccentricities
- Material

Engineers can run global or local analysis. The analysis result is post-processed with tools within Nauticus Hull finite element analysis. These tools cover strength, buckling and fatigue result processing.

DNV said future releases of Nauticus Early Design and Nauticus Hull would have common tools for ship data and compartments.

Improvements would be found in strength assessment in the user environment, additional export to CAD.xml (for transformation to finite element analysis), the fact that section scantlings importing would be able to read profile changes, in early design drawings, and in the Brix Explorer, where there would be a major graphical user interface redesign. *NA*

BMT's model in Nauticus Early Design.



Applied hydrodynamics

Specialising in propulsion analysis, propeller design and speed prediction, US company HydroComp says most of its research projects make their way into its commercially-available software.

The nature of HydroComp's research and development is, the company says, 'typically not experimental'; rather it focuses on the implementation of published experimental work. Where many companies focus on codes of increasing complexity, in line with the evolution of CFD, for example, HydroComp says it 'anchors itself to empirically-based prediction techniques'.

Donald MacPherson, HydroComp Inc. technical director, says: 'The empirical design tools – model testing, systematic series, and sea trials – appear to be off of almost everyone's R&D radar, yet these are still the real workhorses of practical hydrodynamics today. This may change in the future, I grant you, but not yet.'

Research into propulsor performance is one area of particular interest for HydroComp. 'The ultimate goal of any of our projects is to perform prediction calculations with greater accuracy and reliability, and to do things we could not do before,' notes Mr MacPherson. 'In addition to extending and improving our software, we also try to make this information available to the general marine community through a variety of published papers, reports and newsletters.' HydroComp's website has a Knowledge Library which contains these technical publications and white papers. A periodic technical newsletter – the Marine Performance Technology Exchange – also delivers commentary on applicable hydrodynamic topics to the industry.

The most recent of HydroComp's propulsor R&D efforts [1] dealt with the prediction of propeller wetted inertia and added mass used in vibration analysis. The study had two principal purposes – a review of traditional estimate formulae, and development of new prediction models for both wetted inertia and added mass.

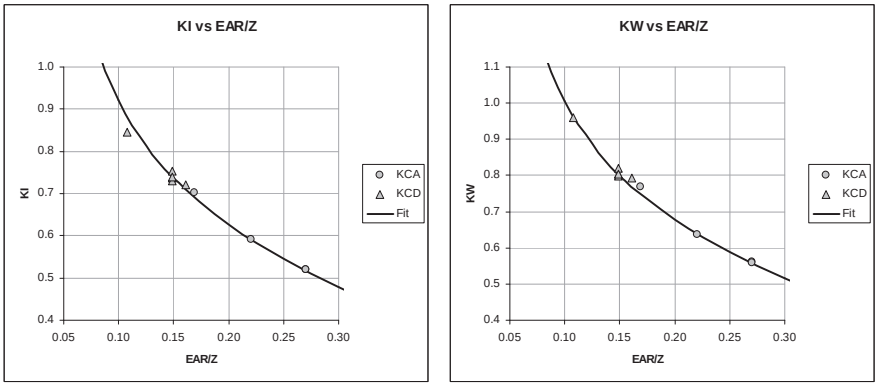


Figure 1 – Validation of new wetted inertia and added mass coefficients.

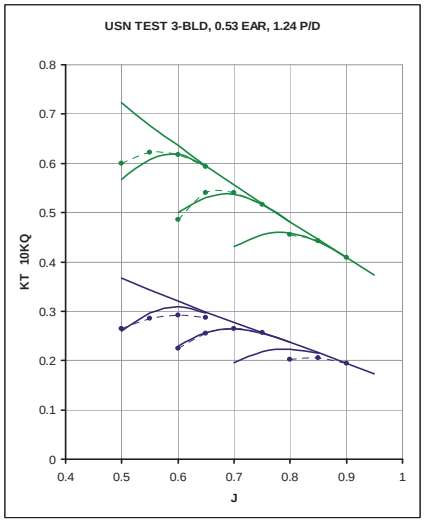


Figure 2 – Validation plot of cavitation breakdown algorithm.

The investigation found that some of the oft-quoted estimate formulae were very unstable, with potential for significant error. Re-analysis of available test data subsequently led to the development of a proposed new estimate formula with improved accuracy and stability. It also provides a new prediction for estimation of added mass when the propeller is either locked or rotating.

Cavitation breakdown

Large merchant ship propellers are designed with the intent of minimising or eliminating significant cavitation and its associated thrust breakdown. Commercial inboard propellers found on the majority of motor yachts and service craft, however, often operate with significant levels of cavitation where thrust breakdown is a frequent occurrence. As engine power density continues to rise, we should expect inboard propellers to risk greater levels of cavitation. Designers of these craft must understand the effect of cavitation on inboard propeller performance, and include the analysis of cavitation as part of their speed-power prediction and propeller selection.

Existing models for the prediction of thrust breakdown, however, only offer rough measures of the effect of excess cavitation on thrust and torque. They are generally inadequate to insure reliable prediction of performance in the critical 'trans-cavitating' regime where contemporary heavily loaded propellers often function.

One of HydroComp's most significant recent R&D projects [2] reached the first milestone in efforts to develop new performance models for the prediction of thrust and torque breakdown. According to the company, the new cavitation model demonstrated improved prediction of trans-cavitating performance for commercial inboard propellers, and is already being implemented across HydroComp's software product line. Future work will extend the model to consider the effect of cupping, camber, shaft angle, and alternate propeller geometries.

Waterjet performance

The successful selection of a waterjet for a high-speed marine vehicle requires a system-wide analysis of that jet's performance across the vessel's entire range of speeds. Selecting a waterjet based on a single top-speed design point often results in poor vessel behaviour, notably in acceleration, heavy seas or at the planing 'hump-speed' regime.

Conventional waterjet selection practices typically involve graphically plotting the 'speed-thrust-power' relationships and matching them to vessel resistance. This approach, however, does nothing to expose information about the boat's performance, or whether the particular waterjet model is the best choice for the application. Further, the analysis of equilibrium engine revs/min is notably absent from this process, yet it is vital. Only by extending the 'speed-thrust-power' analysis to include the proper selection of impeller, engine revs/min and transmission can one define a truly successful system.

An extended research programme led to a new parametric model of waterjet performance based on a set of 'universal waterjet coefficients' [3] [4]. These coefficients describe both the 'speed-thrust-power' relationships and the equally important 'power-revs/min' relationships. The performance of any commercial waterjet can be defined and predicted with these coefficients, providing the critical part of an off-design system analysis, including equilibrium revs/min, thrust, torque, and power. The references include a sample consulting project conducted by HydroComp that conclusively demonstrates how potential problems can be averted and systems optimised through the use of this new calculation methodology.

Cupped propellers

A widely used technique to correct and enhance vessel performance is propeller 'cup' – a curvature applied to the trailing edge of a propeller blade. Although cupping has become a regular procedure in small propeller shops, it has traditionally been applied without any systematic rules or quantifiable understanding of its effect on performance. The traditional definitions of cup (e.g. light, heavy) vary greatly from one company to the next, and even from one project to the next within the same company. It was the goal of this R&D project to develop a consistent quantifiable definition of cup geometry for practical use in industry, as well as a new performance model that can be used in propeller calculations.

Follow-on unpublished work led to refinements in the application of the performance model, resulting in prediction accuracy that was below the error range of the original test data. Improvements in the prediction of cavitation breakdown were also addressed in this supplemental study.

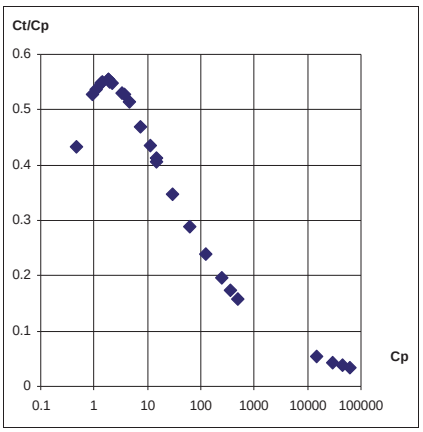
Unpublished R&D

Few propellers in service operate in the smooth axial water flow that is used in laboratories to test propellers. Predicted values for thrust deduction – one of the hull-propulsor interaction coefficients – typically contains part of the correction to account for shaft angle, and the associated inclined flow into the propeller. Thrust deduction alone, however, is inadequate to model the real performance of propellers properly in inclined flow, particularly for heavily-loaded propellers with significant levels of cavitation.

HydroComp studies have led to the development of a new calculation technique to better model a propeller's inclined flow performance. These new calculations more realistically predict not only the real thrust and torque loading on the propeller, but also the nature and magnitude of cavitation breakdown caused by the higher peak cavitation due to the inclined flow.

Accurate propulsion prediction becomes a challenge when propeller designs move away from standard propeller series (e.g. B-series) and

Figure 3 – New waterjet coefficient exposing propulsor efficiency.



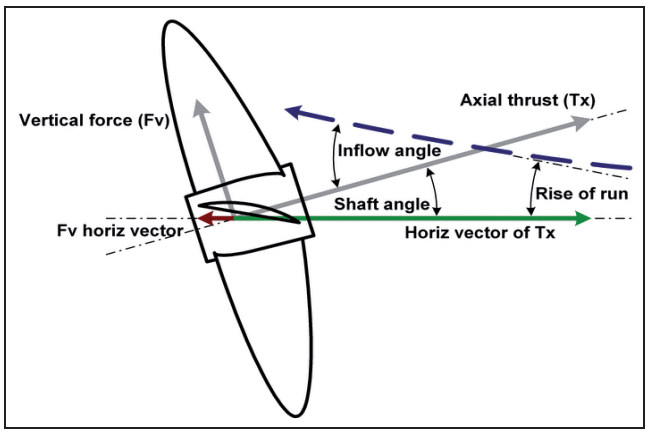


Figure 4 – Considerations of oblique flow effects.

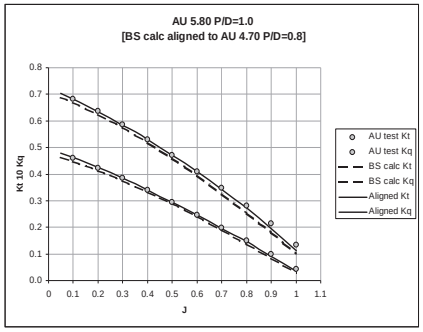


Figure 5 – Validation of propeller 'aligned prediction'.

towards duty-specific custom designs. In order to address this challenge, HydroComp undertook an internal R&D project to develop a propeller 'aligned prediction' capability for NavCad. Propeller aligned prediction combines both a standard propeller series and model test data for the improved prediction of thrust and torque for a non-series propeller.

The technique calculates a set of 'correlation coefficients' that compare user-defined KT/KQ curves for a representative non-series propeller to the prediction from a standard series calculation. Armed with a single propeller model test report, users of NavCad can predict the performance of non-series propellers of different parameters. The accompanying two plot illustrates how a B-series prediction can be 'aligned' by an AU propeller model (4 blades, 0.70 EAR, 0.90 P/D) for the prediction of a 5 bladed AU propeller of different EAR (0.80) and P/D (1.0). *NA*

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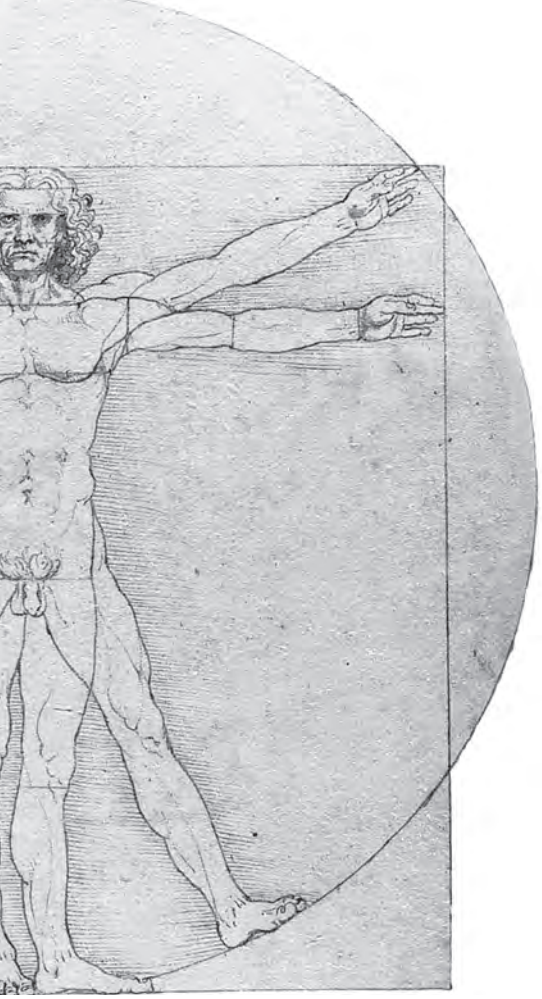
[5] MacPherson, D.M., 'Small Propeller Cup: A Proposed Geometry Standard and a New Performance Model', SNAME Propellers/Shafting '97 Symposium, 1997.



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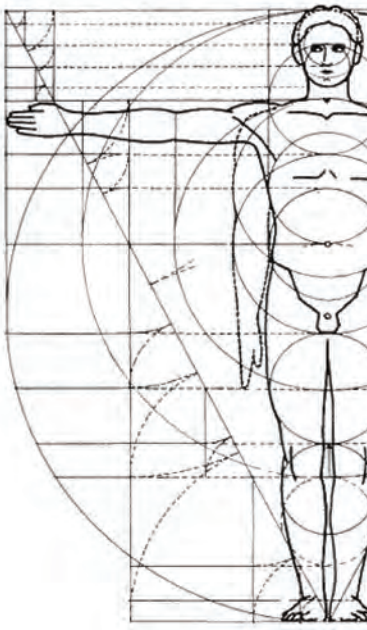

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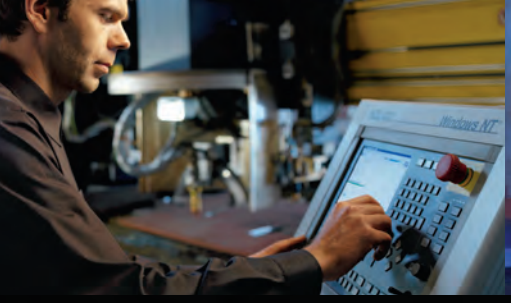

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Managing welding induced distortion

Despite its being the main process for joining steel parts for ships over the last 60 years, the use of welding still presents a number of problems for the shipbuilding industry. George Bruce reports.

Welding techniques and equipment have developed considerably since the process was first used, and the results have become much more reliable, and efficient. Emphasis has usually been placed on maximising the speed of welding, as this is considered a key productivity indicator. Emphasis has also been placed, with clear justification because of its importance, on weld quality to ensure a satisfactory end product and to avoid any reworking.

However, the distortion that can be caused by the process of welding remains a significant problem for the industry, especially when thin plate (generally defined as less than 8mm in thickness) is used. The problems therefore affect small ships, many naval combatants and the lighter structures (for example decks and superstructures) on many larger ships. The problems of distortion are also encountered on prototype ships, where there is no reliable past data on which to base assessment of the potential distortion problems.

Figure 1: Pulling steel assemblies into position.

Research Efforts

The need for research into distortion problems can be demonstrated by consideration of the rework – both recognised and hidden – which forms part of the total steelwork man-hours in ship production. The rework inherent in steel assembly is only partly recognised by the recording of man-hours spent rectifying deformed plates. From a review of collaborating shipyards and others,

Figure 2: Joining steel units – 'routine rework'.

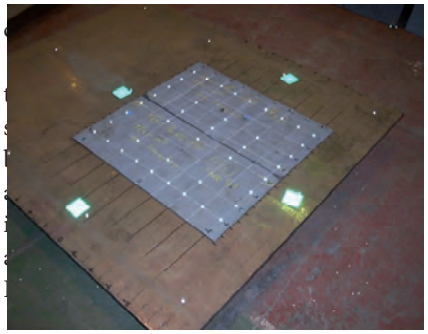

Figure 3: Experimental photogrammetry work station, showing reflective targets on the plates to be welded and the four control targets.

Built in rework, that is part of the normal hours, is a major element in the overall steel work hours in many shipyards and includes routine processes. Examples are fairing and alignment of steel structures using hydraulic jacks or welded attachments and their removal. Figures 1 and 2 illustrate this in different shipyards, using chain pulls to force plates into alignment and also welded attachments across welded joints to ensure productivity figures for shipyards of poor and good performance show that the worst yards use four times as many (or sometimes much more than four times) the man-hours of the best.

That is to say, by eliminating the work content (whether recorded as rework or not), which is associated with aligning

Disclaimer: The information on which this article is based has been drawn from research projects, in which the author has been a participant. These have been supported by Shipbuilders & Shiprepairers Association, by the Department of Trade and Industry (now The Department for Business, Enterprise & Regulatory Reform) and by the Engineering and Physical Sciences Research Council. Industrial partners include BAE Systems, VT Shipbuilding, Corus Steel (now part of Tata). However, the opinions expressed above are the author's own.

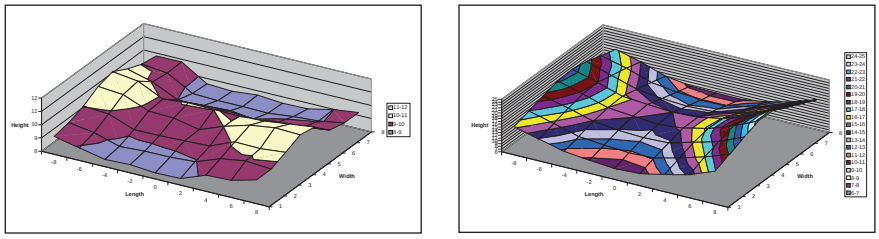

Figure 4: Showing experimental distortion. The first plot shows the plates after welding, the second the initial condition. The heights in millimetres are represented by the colour coding. The vertical scale is exaggerated.

structures that do not immediately fit together, a significant reduction in overall steel man-hours is possible.

Production Processes

The larger shipbuilding companies generally suffer less from distortion problems than smaller shipyards. This is partly due to their use of thicker plates for the larger ships (typically 15mm to 30mm). Thicker plate does not suffer from the same problems of distortion, as is explained later.

The development of shipbuilding technology, in particular for series production of (more or less) standard ships, has been based on the use of specialised work stations. Each work station is focused on the production of a single stage for a specific interim product. The classic example is the panel line, which has a series of work stations. The work stations, usually linked by a conveyor system, are designed to align, tack and then weld steel plates, then stiffeners. Apart from some local process improvements, the panel line has remained effectively the same for the past 40 years.

The use of panel lines is effective in the production of very large welding output, and also produces high welding productivity. Applied to thick plates, for larger ships, panel lines have significantly improved productivity. Arguably, they are one of the key elements in the huge output of large ships that underpins current world trade. However, for smaller ships and thinner plates, the panel line often does not avoid distortion. The productivity, in terms of weld throughput, comes at a cost in the need for rectification of distortion.

Work stations can provide a rich source of data, on production times, and quality of output - which can include distortion data. By analysing the data, the shipbuilding company can identify production parameters that tend to minimise the effects of distortion. Essentially empirically, the shipyard can build up a detailed picture of distortion effects. The data can be used to try and design structures, and their production processes, which should minimise distortion.

The detailed process analysis carried out in the development, and subsequent refinement of specialised work stations allows a close look to be taken at the results. The repetitive nature of the work allows the build up of significant databases of results and the processes can then be fine tuned to give the best results.

As a minimum, the data can assist in predicting when distortion can be expected, so that reworking measures can be prepared and time allowed for rework in the planning and scheduling of production.

Process analysis

The use of work study techniques allows any production process, particularly steel assembly and welding, but extending to outfitting needs to be considered in detail. The overall production is conventionally broken down, through the work breakdown structure applied to the ship, into small and short term elements. The breakdown into elements, generally referred to as interim products, simplifies the planning and scheduling of a shipbuilding contract. Each interim product can then be analysed in detail and the set of production procedures needed can be identified.

The analysis identifies every action required to produce the interim products, and is defined in terms of five functions. These are:

- Operations – which add value, for example fitting, welding, and painting.
- Inspections - which ensure that the operations have been completed correctly.
- Transports - moving or manipulating parts and assemblies to be ready for operations
- Storages - intended locating of parts or assemblies to be ready for operations.
- Delays – unintended waits by materials, machines or people.

Once the process analysis has been carried out, the production can be reviewed to identify the potential for reducing the elapsed time, combinations of storage and transport and the reduction of delays. The reduction in the need for in process inspections can also be considered, as a means of reducing time taken. However the reduction in inspections does depend on the outputs of the production processes being reliable and consistently correct.

The analysis will give an opportunity to make immediate improvements, and also to acquire data on the detailed operations of the shipyard. The data can then be used to support further analysis and the development of improved processes.

Data collection

Data on the shape of a final interim product, for example a flat, stiffened, plate panel can be collected on completion. There is usually a short storage period before the panel moves to a subsequent stage of production, and this can be used for various inspections. These can be extended to more detailed measurements than are usually made.

In many cases, collecting detailed data on distortion from the workshop floor during production can be very difficult. It is important, in trying to understand how distortion develops, to collect in-process data. If this is done, then the effects of distortion can be identified as the panel progresses from work station to work station. The problems occur primarily because of the understandable pressure to maintain production schedules which do not allow time for the required measurements. There are also difficulties to access the panels, and to take accurate measurements using any conventional techniques.

Finally, the data collection is relatively expensive in personnel time, and therefore labour cost. The personnel engaged in data collection, will in many cases be considered to be non productive by the shipyard management.

Photogrammetry

Conventional measurement techniques cannot solve the specific consideration

Making Waves

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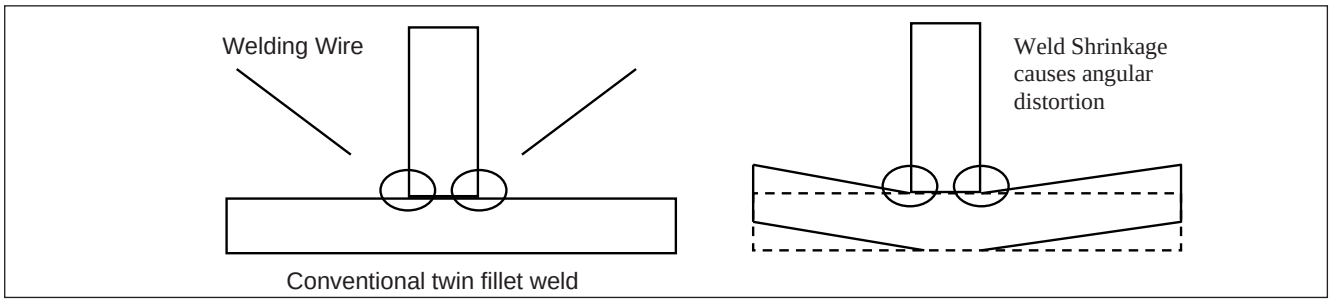

Figure 5: How twin fillet welding causes distortion, especially in thin plates.

of the collection of problematic data on distortion due to welding. Use of measuring tapes is not sufficiently accurate and is labour intensive. Any physical gauge for measurement has similar problems. As the panel (to continue that example) progresses the addition of stiffeners, both primary and secondary, further exacerbates the measurement problem.

Two measurement techniques have been developed relatively recently that show a lot of promise in dealing with the difficulties of in-process inspections. The first is laser scanning. This has been applied to many industries, and is most often used in surveying of geographical features and buildings. A rotating laser is used to create a 'point cloud' of coordinates for the features being scanned. These are then digitally transformed into an image. For the marine industry, its most likely application of real benefit is in the outfitting of confined spaces, where an image of a compartment and everything in it can be generated within a few minutes. A further application is in repair and conversion of ships, where an accurate picture of existing equipment and structure is very valuable.

However, the laser process is relatively expensive and an alternative is digital photogrammetry. This uses a conventional digital camera allied to specialist software. The camera is used to take a series of pictures of the object to be measured, from convenient locations. The object has reflective targets attached, which are coded. Further, permanent targets are installed in the workshop space as controls.

A series of photographs is taken and the data is used by the software to create a three-dimensional model of the object. The process takes a few minutes and, in a workshop environment, is relatively non-intrusive. With some process analysis applied to the photogrammetry and the attachment of targets, a workshop can be prepared so that in process measurements can be made easily and relatively low cost.

Photogrammetry is in use in a few shipyards, and has been applied for example to measurement of the accuracy of flat steel and to the circularity of submarines. A few shipyards have also explored its use for more complex shapes. It offers a means of collecting sufficient accuracy data, at different stages of steelwork assembly, to provide an adequate database for the prediction methods described later.

Figure 3 shows an experimental set up for photogrammetry, as part of the distortion research.

Empirical management

Shipyards building series ships that also have a reasonable database have been able to improve their accuracy considerably. Blocks can be completed with sufficient accuracy to allow them to be fitted onto the ship in the building dock without any adjustment or trimming, saving considerable time.

By collecting data and measuring the effects of welding in terms of distortion, an empirical database can be developed, which will give a useful indication of likely distortion.

This ability to use past data to inform current production and allow the planning of methods to mitigate distortion is a major factor in the astonishing improvements in productivity, which the mainstream shipbuilding industry has seen over the last five decades. The most efficient shipbuilders are able to produce large, complex and three dimensional structural blocks that are sufficiently precise to mate directly to their neighbours in a building dock.

However, many shipbuilders do still suffer from the distortion problem.

Effects of distortion

There are a number of consequences when distortion due to welding occurs. First, where it results in unacceptable departures from specification, for example in decks, it results in rework. The end result is a deck acceptable to the owner, but at an often considerable cost to the shipbuilder. Distortion can be a significant cause of disputes as to what is acceptable as a contract nears completion. It may also result in delays in accepting ships and in delayed payments.

Distortion can result in structures that are out of alignment. In the case of longitudinal structures, this is critical for ship hull strength. Correction, by remedial efforts, such as localised heating is possible. Correction by brute force is also found, as has been illustrated in the first two figures. Adjacent units are sometimes dragged into alignment by the application of steel supports and hydraulic jacking.

What is not known, and indeed is difficult, if not impossible to measure, is the residual stress left in the plate, which may be a combination of pre-existing stresses and the results of the processing as the structure was assembled and welded. This may have long term consequences for the ship structure, but the potential for problems may not be apparent on completion of the ship.

Causes of distortion

The basic distortion mechanism is well known. Essentially, the heat input from welding (and also from any other

thermal process such as cutting) causes initial, local expansion of the metal. As metal cools, there is shrinkage. Where the heating is not uniform, the plate will distort. In some cases there is a thermal gradient through the plate thickness which exacerbates the effects. Existing residual stresses in the plates are also acted upon by the processing and may be a cause of distortion.

A weld in a thin plate will therefore cause a distortion of the plate. Figure 4 shows the measured results in an experimental plate, where tow plates have been seam welded. The figure shows the heights of control points on the plate before and after welding and clearly shows the 'saddle' effect.

When stiffeners are added to the plate, there is further distortion. The standard procedure for welding stiffeners is a twin fillet weld. The attachment of stiffeners to ships' plating represents the major part of the welding carried out. Depending on ship size, the twin fillet, stiffener welds will represent 60% to 80% of the total welding effort. As such, it has been the focus of much effort in the development of higher speed welding processes. This improves productivity, again as weld length is a classic measure, and the time taken to weld a metre is an easy parameter to measure productivity.

The weld configuration is shown in Figure 5, and it could not be better designed to cause distortion. Heating is confined to the top surface of the plate, so a thermal gradient is created. The result is a distortion of the plate between each pair of stiffeners, and the result is shown in Figure 6. This ripple is an accepted sight on ships. Aesthetic considerations apart, it cannot be beneficial for the underwater form of the ship and must contribute to increased power requirements by a small percentage.

Although welding is a prime cause of distortion, other effects can be noted. The causes can reasonably be divided into four basic categories. These are people, processes, materials and design.

The 'people' cause is straightforward to explain but more difficult to control. Essentially it is the extent to which the workforce pay close attention to and follow specified process parameters. Deviations from the specified requirements are not uncommon, usually in misguided efforts to speed production and 'improve' welds. The likely effect is increased heat input and distortion. Incorrect weld process settings, speeds, sequences are among potential problems.

Design can be a cause of distortion, especially where large welds are specified in thin plates. Twin fillet welds, the mainstream means of attaching stiffeners to plate panels, are almost guaranteed to result in distortion.

Processes can be selected to minimise the potential for distortion. This may require an emphasis on distortion avoidance rather than sheer welding speed. This is not apparent as a desirable effort to many managements, largely because the rework caused by distortion is largely hidden in the routine man-hours expended at later processes. In particular, the joining of blocks in a building dock can be very time consuming, may affect a contract delivery or increase man-hours, and may affect subsequent contracts as well.

Materials are the least predictable input to distortion. The crucial issue is residual distortion, as a result of the steel production process, especially rolling. The stresses left in the plates are not detectable (indeed are not looked for), but are believed to be the root cause of distortion which is not in the form expected.

Rectification methods

The occurrence of distortion is sufficiently accepted as a regular effect in the shipbuilding industry for there to be a considerable effort dedicated to its correction. A number of systems have been developed to remove distortion, generally by local heating of the plate surface. Heating can be in lines, often along the line of stiffeners on the opposite side of the plate. Line heating of plates, often with water cooling to accelerate the effects, is used to correct distortion and also in some shipyards to shape complex curved steel plates as part of the production process. Spot heating is also used.

The objective is to create a thermal gradient opposite to the original cause of the distortion, thus reversing the effect. As with the development of empirical procedures to minimise distortion, the use of such heating methods is developed empirically, boiling up a local knowledge of how the mechanism works. Over time, the remedial measures can become very effective. However it is important not to lose sight of the reality that despite the success of the correction, this is all rework and therefore an additional cost to the shipbuilder.

The use of an oxy-gas flame is common for correction, typically for thicker plate (here defined as above 8mm thick). The straightening effect is generated by heating the top surface while the bottom is cooler. As the plate then cools, tension will tend to straighten the plate. However, when treating thin plate, it is very easy to heat right through the thickness of the plate. This may cause plate buckling, and it is also possible that any stiffeners in the heat affected area may also suffer from distortion. In part, the cause is in the time taken to heat the steel to an appropriate temperature using oxy-gas heating. The heated zone is larger and the temperature gradient will result in the surrounding material also being heated, exacerbating the distortion problem.

Other problems in using gas heating for correction of plate distortion include the need for operator skills, the simple fact that the process is a cost that adds no value to the ship, and common use of water for accelerated cooling, which requires disposal systems in addition to the potential for plate buckling. An additional issue is the potential effect on the mechanical properties of the steel.

Alternatives include some proprietary systems, such as the use of induction heating. This is a process that provides a significantly greater degree of control of the heat input. Combined with a data base of the past result, this can deliver an effective tool to remedy the distortion effects. However, it is still an expense that ideally would not be incurred.

Induction heating relies on an electrical current induced into the work piece causing eddy currents which, because of the electrical resistance of the steel, result in a heating effect. The shape of the induction coil, and the power, determine the size and depth of the heat affected area. The induction coil is essentially a water-cooled inductor through which the primary current flows. The power is provided from a frequency convertor.

The key benefit claimed for the induction heating process is controllability. The heating effect takes place more rapidly, is more focussed so is restricted to a small area, compared to oxy-gas heating. The heating is also automatically timed, so that especially where a database of effects can be built up, the process is close to being automated.

The result is stated to be an increase in effectiveness compared to gas flame, with a higher proportion of correction-achieving tolerance. The process is also claimed to reduce the time taken considerably, in particular by eliminating the need to attach and then remove fittings (e.g. 'strongbacks') as part of the correction process.

Likely effects

A means of reliably predicting the expected distortion for a particular structural assembly, using specified welding and other production processes, is sought after by shipbuilders. Although empirical methods are in common use, they do not necessarily take into account all the potential causal factors because of the complexity. Not only are there many potential causes of distortion; how the different effects interact is not known.

Prediction of weld induced distortion using Artificial Neural Networks (ANN) has been demonstrated on a small scale. Work is now in progress to extend this prediction to larger panel structures and then to ship assemblies.

For the ANN approach to be effective and the results to be reliable, a large data set is needed. An effective and fast means of collecting this data is required, which does not interfere with the production process. A method using digital photogrammetry is being developed to measure the surface conditions of the fabricated part at each stage of the production process. This information can be used to build up a picture of when the distortion occurs and will highlight areas for improvement to minimise the overall distortion.

The data collected is fed into the ANN for analysis and to build a model of the construction process. The ANN will be trained on the production data and will learn the fabrication process, with its output being distortion prediction and production process improvement.

Conclusions

Distortion due to welding remains a difficult problem, especially for builders of smaller ships and any structures using thin steel plates. It is a consistent problem for all shipbuilders on decks and minor structures. In the longer term, distorted structures can lead to accelerated corrosion, where water pools remain on the structure.

The whole issue of stresses that may be left due to distortion correction is yet to be studied. However, it may be a serious long term problem for ships, in particular for light scantlings and where designs are optimised for steel weight. It is by no means certain that the designers' structural ambitions are actually met by the reality of production.

There is a definite need to find a means to predict distortion, considering both the design of the structure and the production processes used. The research work discussed has demonstrated that photogrammetry can provide an effective means of measuring the way steel distorts during production, leading to a useable database of the effects, related to production parameters.

The use of artificial neural networks has been shown, at the experimental level, to have considerable promise in predicting future distortion using a relatively small sample. This is encouraging in the potential application of the two methods to prototype ships

At an experimental level the method is showing considerable promise. Combined with the use of photogrammetry for collection of dimensional data there is good potential for prediction of the distortion due to welding and therefore to be able to reduce its effects. *NA*

Figure 6: A distorted deck edge, caused by both plate joining and fillet welded stiffeners.

Nautic-Al theme from Alcoa

Alcoa has selected the aluminium sheet and plate it supplies for marine applications as its first 'branded' offering to market.

Market-leading aluminium supplier Alcoa has launched 'Nautic-Al', aimed at shipbuilders and shipowners ready to build vessels using aluminium, where hitherto the material has simply been marketed under its 5xxx serial number.

Aluminium hit a four month price peak in early July, at $3,229 a tonne, just $100 shy of its May 2006 record high of $3,310 a tonne, but Alcoa emphasised that its step was not related to pricing, with the branding exercise being planned since early 2008, and other offerings due to be rolled out specific to the road tanker and treadplate sectors in the months to come.

Initially, the Nautic-Al brand has been registered for marketing in Europe, although trademark applications have also been registered elsewhere, with the intention being that the brand will be marketed worldwide.

'Many of today's best performing vessels, large and small, are constructed from Alcoa aluminium', said the supplier. 'With a specific weight about one third that of steel, an aluminium hull and superstructure typically weighs less than half as much as a steel one of equivalent strength. This lightness translates into greater capacity, speed or fuel economy and range, as well as inherently superior manoeuvrability.'

Alcoa European marketing manager for transportation, Andrea Tonin, said: 'Ever since we developed strain-hardened 5xxx series alloys to provide the exceptional strength, workability and corrosion resistance that marine applications require, aluminium has been the material of choice for forward-looking designers wherever durability, economy of operation and construction, responsiveness or sheer speed are priorities. The Nautic-Al brand will firmly position Alcoa aluminium at the forefront of all designers' future thinking.'

Alcoa said an aluminium hull would survive significantly higher ultimate loads than a comparable GRP (glass reinforced plastic) hull and, since aluminium was less brittle, there was less risk of hull penetration.

'Aluminium has far greater structural efficiency (stiffness-to-density ratio) than steel – and with magnesium as the major alloying element, the fatigue strength of Nautic-Al products is among the highest of all aluminium alloys,' said the company. 'These qualities make the material especially suited for the construction of modern day fast ferries, workboats, small naval vessels and super yachts.

'With a microstructure designed for excellent corrosion resistance in the harshest marine environments, aluminium sheets can be used without additional protection such as painting or sacrificial anodes. They are, however, suitable for a wide range of surface treatments where required.'

Alcoa Nautic-Al alloys were quick to weld using GMA-W, GTA-W or Friction Stir Welding (FSW) processes, the supplier said; not only did aluminium resist distortion during welding better than steel, but the welds themselves were highly ductile for subsequent cold forming. 'Taken together, these factors deliver considerable cost advantages for the constructor.' *NA*

The luxury yacht *Tribù* is a typical example of modern day shipbuilding technology employing Alcoa aluminium construction materials. (Photograph courtesy of Mondo Marine, Italy)

Energy compression from Atlas Copco

Atlas Copco has launched a new range of oil-injected compressors for shipbuildings, drydock and blasting applications that is claimed to be more energy efficient than its predecessors.

The new GA oil-injected air compressors from Atlas Copco range in power from 90kW to 160kW, and are said to use up to 11% less electrical power than the previous GA range, with the largest, the GA 160 VSD, breaking eight performance records in terms of overall energy requirements; energy consumption of individual elements and lifetime of replacement parts.

Operating at pressures ranging between 3.5bar and 14bar the equipment comes complete with an integrated water separator optimised in its Specific Energy Requirement (SER) of 350Joule/litre, according to ISO 1217 edition 3 annex C (1996). It is thus claimed to be the first oil-injected compressor in the world to integrate the water separator into the compressed air cooling system, reducing the internal pressure by 50%. This design change contributes two per cent to the overall compressor energy efficiency.

The new range of GA oil-injected air compressors from Atlas Copco.

The new GA VSD compressor is also claimed as offering the widest free air delivery (FAD) turndown range in the market – at least 18% wider than that of comparable models available. The compressor is also able to operate in ambient temperatures of up to 55ºC and operates at a maximum noise level of 71dBA (compared to the previous market reference at 75dBA).

The range also features Atlas Copco's first air compressor to offer VSD-controlled cooling fans, which adjust their speed to fluctuate cooling needs. This is claimed to reduce energy requirements by up to 59% compared with the fixed-speed fans used by other suppliers.

The optimised screw element design has resulted in a drop of 5%-6% of energy requirements as compared to the previous screw design. *NA*

Napoli dozen can be refitted for purpose

Ships suffering the same structural defect as *Napoli* in way of their enginerooms could be strengthened to an acceptable level while in service.

The 12 containerships identified as featuring less than acceptable hull girder strength in way of their enginerooms after the Marine Accident Investigation Board's report on MSC *Napoli* can be brought up to an acceptable standard without needing to be drydocked, according to class body Det Norske Veritas.

DNV head of section for bulk carriers and containerships, Roald Vårheim's emphasised that the DNV-classed *Napoli* had not been built to DNV rules, having been a class transfer from Bureau Veritas in 2002. He said that, 'if current DNV Rules had been applied' on its construction in 1991, *Napoli's* bottom and inner bottom plates would have been 1mm thicker than was, in fact, the case, to increase its hull girder section in way of the engineroom.

DNV, like other class bodies, has developed a screening procedure for container vessels more than 2500TEU and at least two cargo bays aft of the superstructure. Twelve vessels have then been detected as below acceptable criteria, while 10 more have to be further calculated / investigated.

According to a DNV spokesman: 'To continue to operate these 12 vessels without any operational reduction, like less cargo onboard, additional intercostal flatbar stiffeners have to be added. We are only talking about the engineroom bulkhead area, and we are talking about a very restricted number of stiffeners. There is no need to drydock these vessels. Required repair as described above can be performed while in service.' *NA*

Stricken ship – but ships suffering the same structural defect as MSC *Napoli* could be strengthened while in service.

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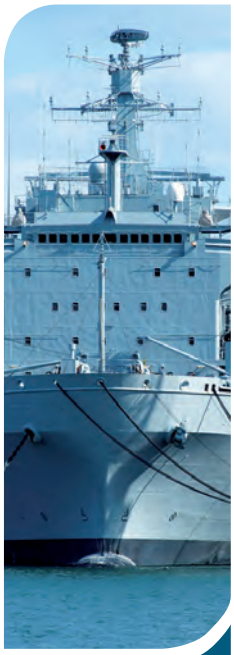

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The Maritime and Coastguard Agency (MCA) is internationally acknowledged by governments and maritime organisations as a world authority on marine safety. The responsibilities of its surveyors embrace all aspects of maritime safety, including the setting, monitoring and enforcing of standards of safety and pollution prevention on all UK vessels, working for the raising of standards internationally and enforcing international standards on foreign ships visiting UK ports.

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For an informal discussion, please contact Amir Esmiley on 02380 329329, Paul Townsend on 02380 329523 or Phil White on 02380 329511.

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For an application form, please visit our website www.mcga.gov.uk or contact the MCA Recruitment Hotline on 02380 329308, or email sarah.young@mcga.gov.uk

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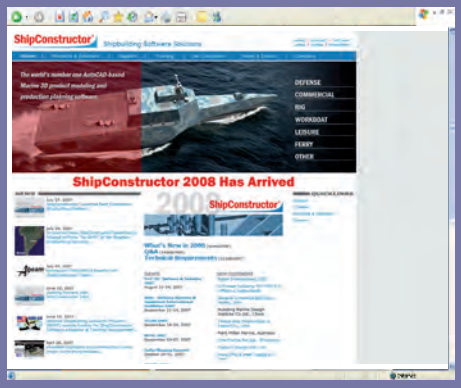

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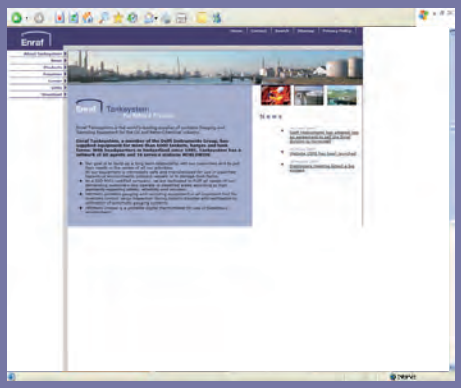

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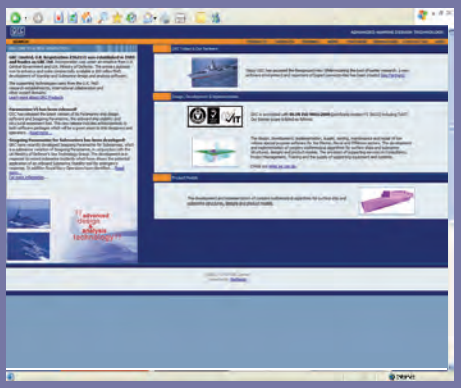

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