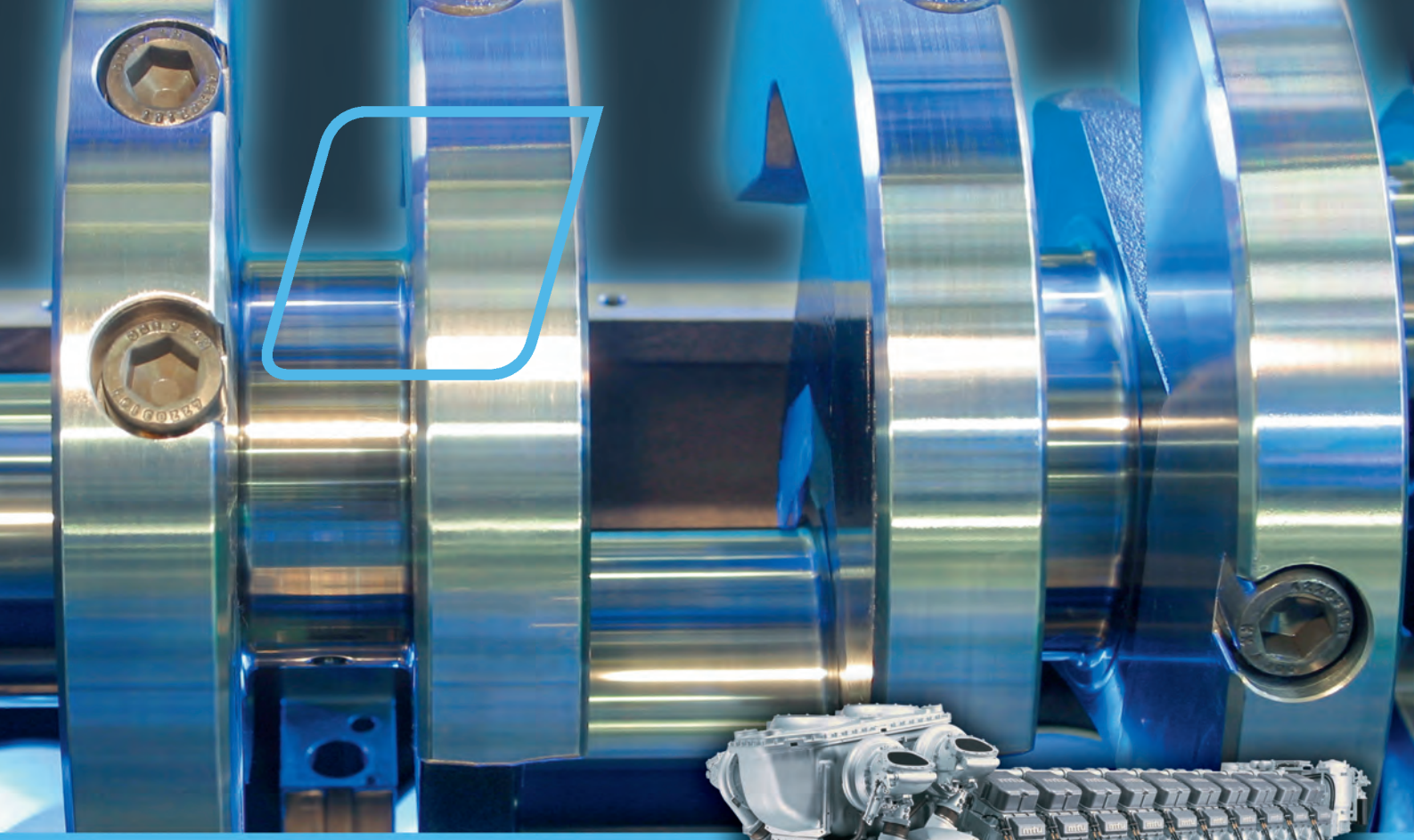
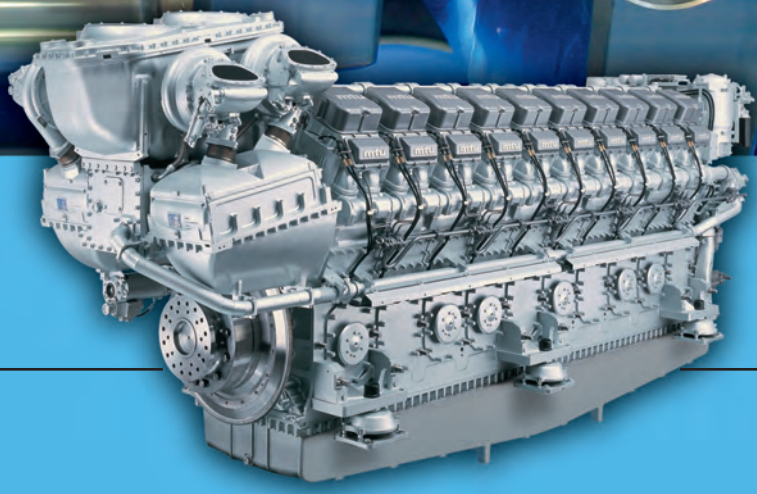
THE NAVAL ARCHITECT

FEBRUARY
2005





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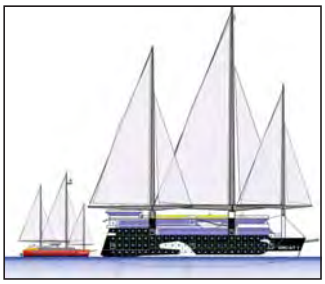

Seeing cruising in a new light: impressions of 24.38m and 73.15m sailing cruise catamarans planned by Alain Guigan and to be fitted with his novel Baldakin economy cabin concept - ideal for those seeking adventure-style holidays. The larger version is even designed to launch VSTOL lightweight aircraft from the upper deck. Further details appear in our cruise liner feature, which begins on page 72.

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SD14: a model of success

TRADITIONALLY, this column has commented on current events in our global industry or peered forward to examine what might lie ahead. For once, we are allowing ourselves the luxury of looking backwards, but not too far, at what was both a UK and international saga of success. The subject is the SD14 standard cargo ship, whose complete history is faithfully recorded in a newly published book *SD14*: *The Full Story**.

Although born during the start of Britain's sad decline as a constructor of merchant ships, the SD14 Liberty Replacement will unquestionably win a gold medal for both effort and success. The phenomenon of that eminently simple design, first marketed in 1966 for a figure - incredible though it seems today - of under £1 million (extras were available for those wanting them), has largely been forgotten by many in today's frenetic boom-and-bust world of modern high-technology shipbuilding. By 1988, an amazing total of 211 had been completed (or 228 if all derivatives are included), and more than 50 examples are still believed to be tramping the seas.

Every single one is illustrated in colour with a detailed caption, in this excellent and comprehensive book, which is a sequel to the same author's *SD14: The Great British Shipbuilding Success Story* (1976). Detailed specifications and plans appear at the end.

For those of lesser years, the Liberty Replacement movement of the late 1960s, 1970s, and early 1980s aimed to replicate the success of the original Liberty ships, hastily (sometimes too hastily) assembled during the Second World War in US yards (to a British design by J L Thompson, from Sunderland!). Twenty years after their creation, when quite a number were - despite their original short-term aim - still in operation, enterprising builders around the world decided a market existed for more modern equivalents that could be sold to, mainly, Greek owners who were running most remaining Liberties but who had limited finance to pay for new ships.

Just one of many SD14 successes: *Rupert de Larrinaga*, completed in 1969 at A&P's Southwick yard, was operated on liner services by the UK owner Larrinaga Steamship. As with so many examples of this standard design, she was modified - her accommodation block was enlarged to suit a British crew!

Around 30 designs were promoted worldwide but only two achieved outstanding success: the SD14, from the Sunderland yards of Austin & Pickersgill (Southwick and and South Docks), and the Freedom, conceived by the celebrated Canadian/Bermudan consultancy G T R Campbell and built (mostly) by IHI in Japan - believed to be around 250 in all.

The book, which provides much illuminating detail and insight into the complete SD14 project (the initials stand for shelter deck, not standard design, as some erroneously think, and the 14 for 14,000dwt although, as the author notes, later it became evident that 15,000dwt was within the design's capabilities), will be meat and drink to all those who want to recall those possibly happier days when the UK held a stronger, if diminishing, place in the world order. The fascinating text, which explains the economy-with-quality philosophy adopted and how A&P was the only yard that succeeded in achieving such an economic price, has been written by someone supremely qualified to comment.

John Lingwood will be well-known to readers of RINA's annual *Significant Ships* series as compiler of all 15 editions, the newest of which (2004) is due out this month. In his previous incarnation, John was chief estimator at Austin & Pickersgill and was in on the project at its birth. He recalls attending a very select meeting with managing director Ken Douglas when the idea was first mooted. A team of only seven or eight was asked to produce a formal tender in two weeks! It was the first time that the yard had considered series production of one design although the Southwick yard was well equipped for it.

From completion of the first example, *Nicola*, in February 1968, for General Freighters Corp (Mavroleon Brothers, who actually owned the yard through London & Overseas Freighters), the SD14 went from strength to strength. Some were built under licence, notably at the Compania Comercio & Navegacao (CCN) yard in Rio de Janeiro, Brazil, and although the design was billed as standard, there were many variants and extensions. These included liner types, also the larger SD15, SD18, and Prinasa-121, and even a little-known planned cargo/passenger version; nevertheless it was the basic SD14 in tramp form that achieved most fame.

Its profile, the adoption of straight lines wherever possible, with unattractive corrugated deckhouse sides, a bridge with three or five rectangular windows, straight-backed funnel, and union-purchase derrick outfit (what are derricks, today's naval architectural student may well ask?!) soon became a familiar face in ports worldwide. Several vessels were fitted with Velle patent swinging derricks, others with heavy-lift derricks, and others again with cranes. Later models featured a modified bow with a more vertical entrance. There is, of course, no such thing as a totally standard ship, and it is noteworthy that throughout the series, a total of 14 engine models were installed, although the Sulzer 5RD68 was the initial choice on the basis of simplicity and reliability.

The SD14 arrived at just the right time to cover the huge changes in shipping as the industry switched towards unitised (and especially containerised) cargoes and can be said to have been an unconditional success. The only sorry tailpiece to the whole story was the later closure of Austin & Pickersgill - and the advanced Sunderland Shipbuilders covered Pallion yard on the opposite bank of the river Wear - through political machinations by the then British Conservative government as a sop to the European Union - a move which some will never forgive. A&P had recently invested huge sums in new facilities to make it one of the most modern shipyards.

What technical lessons can be learnt from this historic series? Today's naval architects may find it a sobering thought that the complete design was created without computers (but working from previous hulls) by only two or three men in the yard design office, plus two estimators, in the total time of two weeks! The author told *The Naval Architect* that a later simple 26,000dwt bulk carrier, with the help of modern technology, took a year to finalise!

Those dreaming of replicating the SD14's success can take heart that multipurpose ships still have a role to play, as witnessed by the 26,000dwt/30,000dwt Rickmers, Columbia, and Chipolbrok ships very recently built in China at various yards (*Cape Darby, Significant Ships of 2001*). Perhaps the moral of this happy saga is that if you have the right design at the right time and price, success is already partly achieved. If today's shipbuilding costs continue to rise inexorably, then maybe 21st century versions of ships such as the SD14 will once again find a market.

* *SD14: The Full Story*, by John Lingwood, MRINA. Published by Ships in Focus Publications, 18 Franklands, Longton, Preston PR4 5PD, UK. 256 pages. Hardback. £29.50 plus postage. ISBN 1 901703 64 9.

New class of container ship christened

AT the end of January a new class of container ship was christened at Hamburg's Überseebrücke terminal. This Hansa Hamburg Shipping-owned 1600TEU feeder ship was named *Eilbek*.

The vessel was built in Papenburg, Germany, by Meyer Werft − a yard normally associated with passenger ships but recently in need of work of any kind. By June 2005, this yard will have completed the vessel's three sisters, *Reinbek*, *Flottbek*, and *Barmbek*. The vessels will sail under the German flag and will be registered at the port of Hamburg.

The first of its class, *Eilbeck* meets the highest ice-class specification, Finnish/Swedish 1A Super. Safety was a major priority in the design of this vessel: separate cargo holds cater for dangerous goods and the fuel tanks are located well inside the ship and not between the twin hulls.

Unusually, *Eilbek* also has its own passenger deck with cabins for up to eight passengers. Cruising at a top speed of 20knots, the vessel's maiden voyage will be to Canada under the auspices of a charter contract with Lykes Lines, a subsidiary of the CP Ships Group.

While *Eilbek* is owned and financed by an investment fund set up by issuing house Hansa Hamburg Shipping, she will be technically and commercially managed by traditional Hamburg-based shipping companies Wappen Reederei GmbH & Co KG and Knöhr & Burchard respectively.

The 5700TEU *CMA CGM Rossini*, delivered in August 2004 by Samsung to the French owner CMA CGM, is classed by BV. New software from the French society helps to minimise fatigue-cracking in such large hulls.

WORLD'S LARGEST SPADE RUDDER INSTALLED - The world's largest full spade rudder, engineered by Becker Marine Systems, has been recently been successfully installed on the first of a series of 8400TEU container vessels currently building at Daewoo Shipbuilding & Marine Engineering (DSME) in South Korea (*The Naval Architect*, September 2004, page 64). The vessel is owned by Norddeutsche Vermögen and will be chartered to Hapag-Lloyd. The installed twisted TLKSR rudder measures 67m^2 and is designed for a speed of about 26knots.

In 2005, Becker Marine Systems will supply more than 36 TLKSR rudders for large and fast vessels worldwide. This includes four 8400TEU container vessels (for Mediterranean Shipping Corporation), two 7900TEU vessels (for Malaysia International Shipping Corporation), four 4500TEU vessels (for Niederelbe Schiffahrtsgesellschaft mbH & Co KG), six 4250TEU ships (for Rickmers Reederei), and three 4200lane metre ro-pax vessels (for Finnlines). Furthermore, an additional 25 TLKSR deliveries are already contracted for 2006.

Becker's TLKSR twisted leading edge rudders are designed to avoid rudder-induced cavitation erosion that can damage conventional semi-spade rudders on these fast vessel types. These rudders provide many advantages, such as avoidance of rudder cavitation erosion, significantly reduced weight, increased manoeuvrability and lower fuel consumption through reduced drag and better propulsion efficiency.

The most recent TLKSR order comes from Hyundai Heavy Industries, Korea, which is building a vessel for ER Schiffahrt GmbH of Hamburg. This series of nine 8200TEU container vessels will also be installed with 67m^2 TLKSR rudders.

WARPING ANALYSIS CURES FATIGUE CRACKING ON CONTAINER SHIPS - Bureau Veritas has been able to check large new container liner designs against the most recent developments in sophisticated fatigue analysis during the very preliminary design stage, and during the engineering detailed development. Its latest software tools for structural and fatigue analysis allow the society to meet all class requirements in terms of scantling and connection details, and also help to achieve the best compromise in term of cost/benefit for both owner and shipyard. An example of this in action is at CMA CGM Newbuilding, which was able to decrease the fatigue restraints of 5770TEU container ships built by Samsung in 2004, without any additional structural requirements.

Fatigue is a complex phenomena which requires careful feed-back experience analysis and continuous development of dedicated calculation methods and tools. Bureau Veritas has invested accordingly for a long time in this field, and its experience in practice highlights the undeniable effects of design optimisation and safety benefits shared by both shipowners and shipyards.

MARINE REDUCTION GEARS PRODUCTION IN INDIA - Finnish company Wärtsilä will extend its range of marine reduction gears and begin manufacturing these products in Khopoli, India. Production will start on the same site as Wärtsilä's existing factory. The value of the investment is approximately €1 million.

Wärtsilä has designed and manufactured reduction gears since 1990 in Rubbestadsneset, Norway. The new unit in Khopol will have 20 employees and will operate in parallel with the factory in Norway.

The new gears are at the lower end of the output range. Along with the existing gears, the Wärtsilä gear portfolio will cover the whole range of the power outputs needed by the market. The factory in India will allow Wärtsilä to expand its business volume in the growing Asian shipbuilding market.

PLANT EXPANSION IN CHINA - Volvo Penta has increased its Chinese engine plant, which will raise production capacity to around 10,000 engines annually. The plant, located in Wuxi, 100km west of Shanghai, is jointly owned by Volvo Penta and its Chinese partner, Wuxi Diesel Engine Works.

Established in 2000, the plant assembles diesel engines delivered as CKD kits, mainly from Volvo's engine plant in Sweden. Certain local components are also included in production.

Operations have gradually expanded and the new plant was officially opened in January this year. This means that factory floor space now amounts to 7000m^2. For more information about marine news in China, please see the feature that begins on page 88.

PEOPLE

RUPERT HARE has recently been appointed managing director of Houlder Ltd, the design and engineering company. In addition, **FREDERIC PERDRIX** and **PETER KELLY** have taken on executive operations of the business. The latter has also been promoted to operations director.

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Afterbody slamming in cruise liners and container ships

Cruise and container ships, with their relatively flat afterbodies and low deadrise angles, are particularly vulnerable to afterbody slamming. John Carlton, global head of marine technology at Lloyd's Register, explains the factors behind and the magnitude of this phenomenon.

THE slamming phenomenon related to ships in heavy weather is relatively well understood in terms of forebody slamming, but comparatively little work has been done on the corresponding case of afterbody slamming. An understanding of this latter class of slamming action is, nevertheless, important for some types of ship and particularly so for cruise liners and container ships.

In the case of forebody slamming, the seminal work was done in the 1930s by Wagner, who was interested in the phenomenon in the context of seaplane floats. He deduced a relationship of the form:

$$C_p = 1 + 0.25\,\pi^2 \cot^2\varphi$$

where C_p is the slamming pressure coefficient and φ is the deadrise angle of the float. This relationship is shown in Fig 1, from which it can be seen that the slamming pressure rises asymptotically as the deadrise angle tends to zero. Subsequent work by a number of researchers has attempted to enhance this relationship to make it applicable to ships' hull forms in varying sea states.

Commonly, these initiatives have resulted in the addition of a hull-form factor term taking into account the differences between seaplane float and ship forebody geometry. Ochi and Motter derived an alternative analytical approach, presented in 1973 (Ref 1), whereby the forebody slamming pressure could be estimated. Subsequently, with the more widespread use of computational fluid dynamics (CFD) techniques, good correlation has been achieved between experiment and numerical predictions, as can be seen, for example, in Ref 2. A further characteristic of forebody slamming is that the probability of its occurrence tends to increase as the ship speed increases, thereby providing an option to slow down in order to attenuate slamming activity.

With regard to afterbody slamming, the situation is rather different, however, with the underlying influence of the $\cot^2\varphi$ remaining significant. Consequently, the flatness of an afterbody from immediately forward of the propulsors to the transom plays an important role in the likelihood of encountering this phenomenon. Ship types which tend towards this hull form are cruise vessels and the larger container liners, with their relatively wide, flat and shallow-immersed afterbodies.

For these ship types, recent examples have included cases where the local deadrise angles are close to zero and, therefore, the probability of slamming occurrence has tended to become high, whereas earlier examples which included small amounts of deadrise, typically 3deg or 4deg, have not significantly suffered from afterbody slamming. However, it would be a mistake to assume that the propensity towards afterbody slamming is a simple function of deadrise angle.

Full-scale experience has shown that it is a far more complex relationship involving afterbody hull topography, velocities and direction of the wave system impinging on the ship, speed and relative direction of the ship, and draught of the ship in the region of the stern immediately forward of the transom.

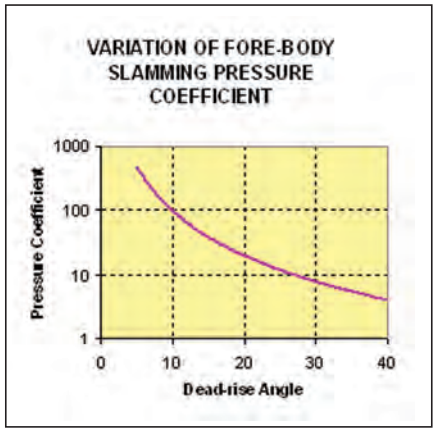

Fig 1. Slamming pressure coefficient, according to Wagner.

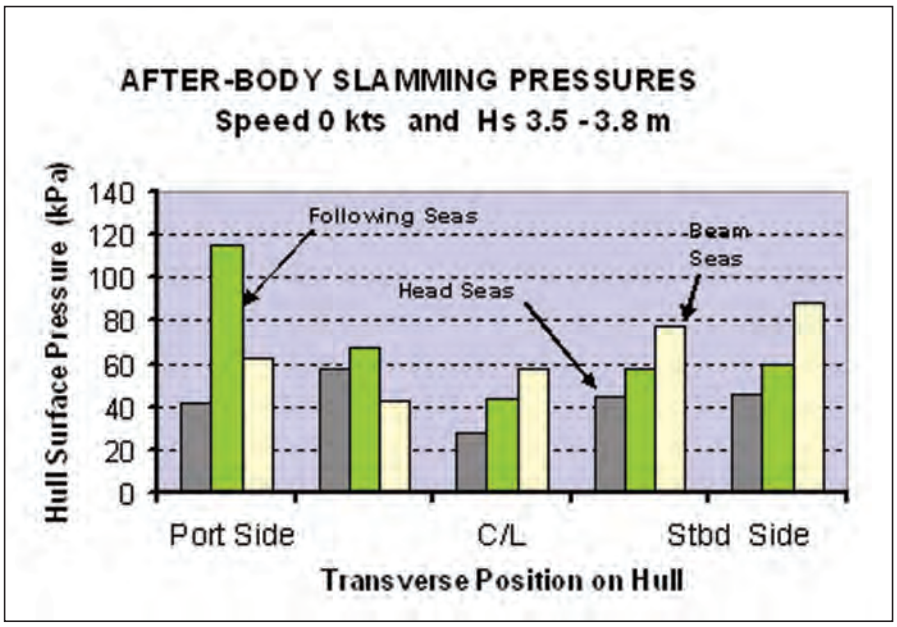

Fig 2. Typical distribution of slamming pressure across a ship's afterbody.

Prevalence at low ship speeds

In contrast to forebody slamming, afterbody slamming tends to be more prevalent at low ship speeds. This is because when the ship speed increases, the entrained wave train induced by the hull tends to increase and in so doing provides a measure of protection for the afterbody against

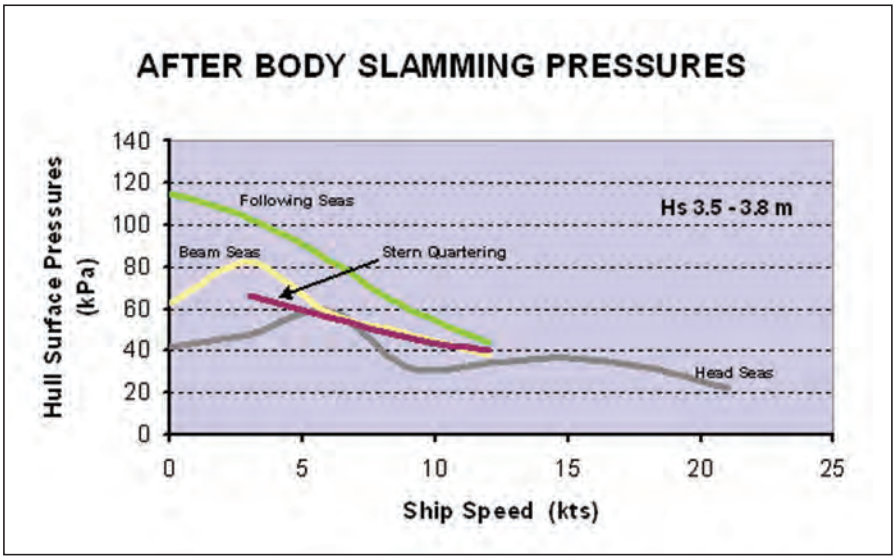

Fig 3. Effect of sea direction and ship speed on slamming pressure.

the environmental wave system. Consequently, it has been found that there is a threshold value of ship speed, often in the region of 8knots or 9knots, above which the frequency of slamming encounters tends to reduce considerably.

Dynamics of an environmental wave system acting on a ship is a function of both the surface waves and the underlying swell. Full-scale trials have shown that the greatest whipping stresses in cruise ships, for example, are induced in the ship structure when the effective wave action is coming from the beam around to the stern.

This is in contrast to the wave bending stresses which maximise when the swell component is more generally aligned fore and aft. It has also been noted at full scale that the greatest instantaneous pressures on wide-transom, low-deadrise afterbodies tend to occur around the periphery of the ship structure rather than along the centreline region. Fig 2 shows this characteristic behaviour.

The full-scale measurement of afterbody slamming characteristics is not easy when using practical numbers of pressure sensors, due to the relatively random nature of the location of the slamming impact. Measurements have indicated, however, that full-scale impact pressures can reach values of the order of 250kPa. The characteristic of the pressure signature is that of a short time base steeply rising and decaying pressure impulse. The time base of the pressure spike can be as short at 0.1sec or less, but is normally within a range up to 0.5sec.

The magnitude of the pressure impulse for a given ship is principally a function of ship speed and relative sea direction. Fig 3 illustrates this for a particular ship when operating in sea states having significant wave heights in the region of 3.5m to 3.8m. However, with regard to the area over which such a pressure acts on the hull surface, relatively little is known at present and, therefore, in design and analysis it is necessary to undertake parametric studies over a set of probable surface areas which appear reasonable, based on previous observations made at full scale.

Impulsive excitation to hull structure

An afterbody slamming signature gives rise to a significant impulsive excitation to the hull structure. This excitation has been found to

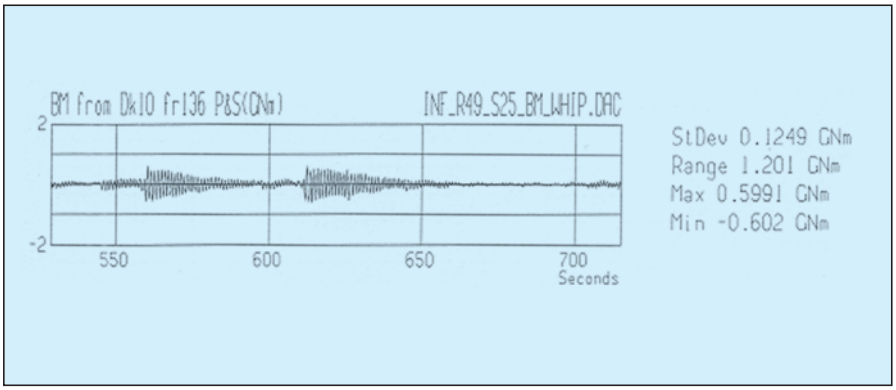

Fig 4. Typical whipping component of deck bending stress.

mostly excite the two-node vertical hull mode of vibration, which for large cruise ships and Panamax container ships is often in the region of 0.6Hz to 1Hz. Furthermore, the first cycle of the whipping stress when measured on the upper decks is found to be compressive; Fig 4 shows a typical vibration signature in which the whipping component has been isolated from the other dynamic strain signatures. From this figure, it can be seen that the whipping component of the signature was very lightly damped due to the ship structural characteristics; in this case, having a damping ratio of 0.02, leading to some 30 cycles or 40 cycles of whipping signature.

Such a low damping characteristic can be troublesome, particularly if the slamming impact frequency is high. Again, full-scale measurements have shown that this can sometimes be the case, with instances recorded of three to four slams/minute with perhaps one major slam amongst these in following seas, and around one slam/minute in head seas, with the latter rising perhaps to three slams/minute in extreme sea conditions.

When undertaking model or full-scale measurements of an afterbody slamming phenomenon, it is important to consider the duration of the measurement programme. Short-duration measurements can seriously under-estimate the magnitude and number of impacts that a ship will experience. Consequently, the results of a measurement programme should always be corrected statistically in order to derive a long-term estimate of the slamming phenomenon. The reason why this is important is because the magnitude of full-scale whipping stresses, being a tertiary component of stress, have been measured as comprising a substantial proportion of the overall bending stresses induced in the ship structure during normal operation in a seaway.

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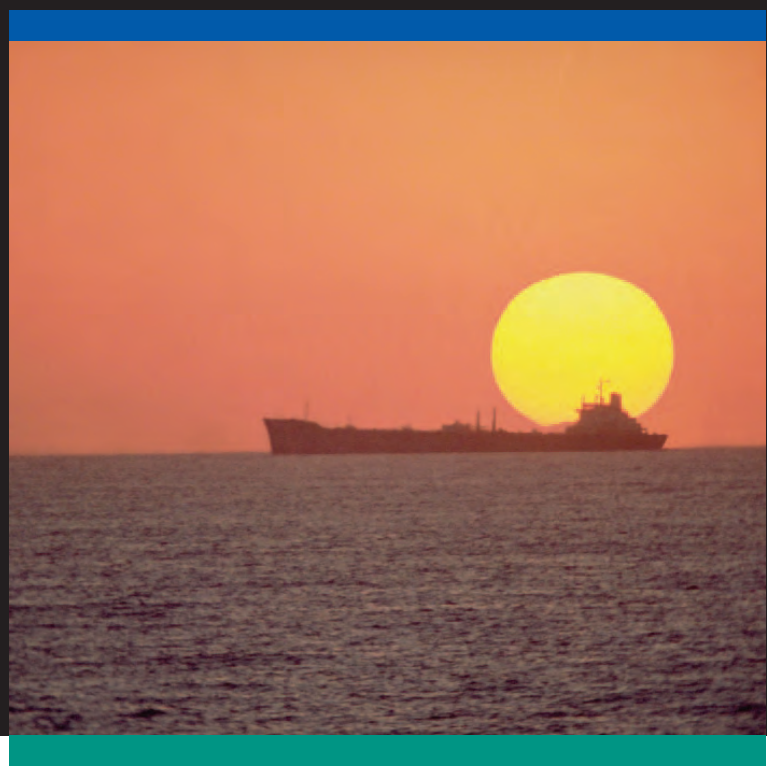

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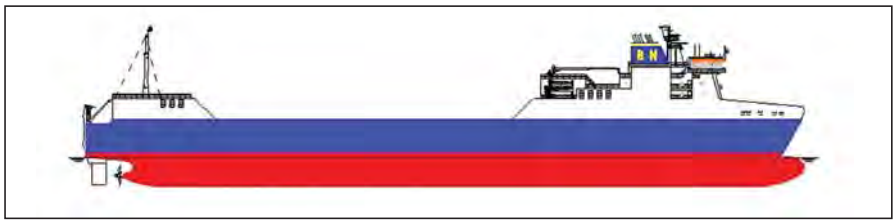
Merged Finnish yards in gear for new ships

Despite a recent shortage of orders, Finland's shipbuilding industry has been revived by technically interesting contracts from Russia for ice-strengthened designs, thus reviving a dormant source of work, as well as new orders for cruise and ferry tonnage. This country continues to be supported by a wealth of first-class equipment and service providers, whose products are exported worldwide. Most of this report has been specially written for *The Naval Architect* by Henrik Segercrantz.



An artist's impression of the three 15,000dwt ro-ro ships for StoraEnso's paper transport operation, ordered by B&N Nordsjöfrakt from the Rauma yard. They are particularly designed to load this operator's special containers for paper products, SECUs.

The new 48,300gt Tallink cruise ferry, to be built at the Rauma site. This is the third ship to be constructed there for this operator, and will be larger than the previous two.

An impression of the new compact Panamax-size cruise ship to be built at Helsinki for Norwegian Cruise Line.

THE new Aker Finnyards, officially in operation from the beginning of this year, consists of the merged Kvaerner Masa-Yards and Aker Finnyards shipbuilding companies. With three shipyards, in Turku, Helsinki, and Rauma, one single company will now handle all larger-ship newbuilding projects in Finland, and at the current time, orderbook successes and prospects are looking much more encouraging than they were some months ago.

Headed by Yrjö Julin, the 'new' organisation is an integrated part of the Norwegian Aker Yards ASA group, which, headed by Karl-Erik Kjelstad, was listed on the Oslo stock exchange last summer. A reduction of the workforce by some 315 people in all, from a total of around 4500 people, was finalised in January. The combined revenue of the merged companies is expected to be some €1 billion.

Recent activities at Aker Finnyards' shipyard in Rauma include delivery of the *Birka Paradise* cruise ship for Birka Line (page 72 of this issue), and the yard is currently engaged in building a third *Hamina*-class fast surface combatant for the Finnish Navy. In January, a firm contract was signed with the Swedish B&N Nordsjöfrakt for building three interesting 15,000dwt ro-ro container carriers for approximately €150 million in all (the letter of intent was reported in *The Naval Architect* November 2004). The trio is intended for operation between Kemi and Oulu in the Gulf of Bothnia in Finland and Gothenburg in Sweden. B&N is in the process of concluding a 15-year charter agreement for the vessels with the leading paper manufacturer Stora Enso. All three vessels, planned for delivery in 2006, are 188m long, and 26m wide, and each can load 155 special-size SECUs (Stora Enso Container Units) with end and side doors; these are mainly designed for loading paper products.

Last October, Aker Finnyards signed a contract for building a third cruise-ferry for the Estonian Tallink Group, for delivery in spring 2006. This vessel will be larger than the previous two, as revealed in the accompanying table, and the contract is worth €165 million. The Rauma yard has already delivered two near-sisters to Tallink, *Romantika* in 2002 and *Victoria* last year.

In December, the Turku yard handed over Color Line's giant cruise-ferry *Color Fantasy* (see special article elsewhere in this feature), and is now engaged in building two of the world's currently largest cruise ships,160,000gt, for Royal Caribbean International. A contract for the second ship, worth some EUR570 million, was signed last September, and delivery is expected in May 2006 and spring 2007 respectively. The name of the first ship in this *Freedom* series, which are lengthened versions of the previous *Voyager* ship series, will be *Freedom of the Seas*.

Meanwhile, the Helsinki shipyard is currently building an icebreaking supply and standby vessel for Russian shipping company FESCO, for delivery in May this year. Last August, Russian mining company Norilsk Nickel placed an order for a 14,500dwt Arctic container vessel, due for delivery in spring 2006, and in December, a letter of intent valid to end-February 2005 was signed with Star Cruises' NCL for an 89,000gt Panamax-size cruise liner for delivery from the Helsinki yard in spring

TECHNICAL PARTICULARS
NEW TALLINK CRUISE-FERRY

	New ferry	*Victoria*
Route	Helsinki - Tallinn*	Stockholm - Tallinn
Length	212.00m	192.90m
Breadth	29.00m	29.00m
Gross	48,300gt	40,000gt
Passenger capacity	2800	2500
Number of cabins	900	740
Private cars and freight units	1130lane metres	1000lane metres
The new vessel also has extensive conference facilities.		
Propulsion machinery	4 diesel engines	4 diesel engines
Total machinery power	26,240kW	26,240kW
Speed, service	22.00knots	22.00knots

* *Romantika*, currently operating on this route, will start cruising between Stockholm and Tallinn when the new ship is delivered.

2007. This order is subject to documentation and certain conditions being fulfilled before becoming effective, including the securing of specified financing.

The value of this latter contract to Aker Yards is in the range of €350-€400 million and it includes an option for a second ship, for delivery in early 2008, to be decided on by the end of August 2005. The new ship will be somewhat larger than *Norwegian Jewel* (92,250gt) under construction at the Meyer yard in Germany and its new sister, announced concurrently with that of Aker Finnyards. It will have around 2430 lower berths (compared with 2384 for the Meyer newbuilding) and more than 840 cabins, with all the outside ones fitted with private balconies. The client is not new for Aker Finnyards - in 1988, the Turku yard built *Seaward* for NCL.

In addition, last summer Aker Finnyards entered into a conditional contract with FS Ocean Club Ltd for an approximately 42,500gt luxury residential ship to be operated by Four Seasons Hotels and Resorts. The construction of this ship, worth €276 million, is anticipated to take 24 months to complete, and will commence when sales targets for the 'residences' have been reached, which is expected to occur before July 2005. The agreement includes an option, to be exercised within the year 2005.

The company is also working on a refurbishment and lengthening project of Royal Caribbean Cruise Line's Helsinki-built *Enchantment of the Seas*, together with Keppel Verolme Shipyard in Rotterdam. This project is considered strategically important for Aker Finnyards in a growing cruise ship refurbishment market.

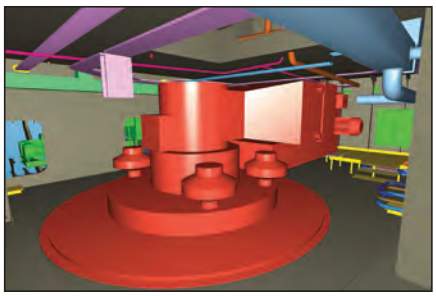
In addition to Aker Finnyards' three shipyards, there are two subsidiaries; Piikkiö Works Oy, manufacturing prefabricated cabin units, and the newly established Aker Arctic Technology Inc, a company which will continue the work of the current Arctic Technology Centre, now a fully Aker Finnyards-owned division.

Yard work keeps Elomatic busy

ELOMATIC Marine Engineering, part of the Finnish engineering consultancy Elomatic, has been kept busy with a number of major ship design and yard supervision tasks in Finland, Germany, and Korea. In 2003, at Meyer Werft in Germany, Elomatic assisted Royal Caribbean Cruise Line with supervision of construction of the hull and other parts for the *Radiance*-class cruise liners. Earlier, at Chantiers de l'Atlantique, Elomatic had carried out design and supervising work tasks for Crystal Cruises. At Lloyd Werft, Elomatic also participated in supervision of steelwork for NCL's cruise ship *Pride of America*.

Large projects continue today, with supervisory work on the two 93,000gt newbuildings for Star Cruises' Norwegian Cruise Line (NCL), to be completed at Meyer Werft this year and in 2006. Here, Elomatic's task is again to supervise hull construction for the owner.

In South Korea, work with supervision of LNG carrier construction continues. This includes assisting the owner, and working as a member of the NYK site team, with tasks on a series of LNG carriers under construction at Samsung Heavy Industries for three Japanese owners. Elomatic is responsible for all electrical issues, covering power, automation, control, and navigation.



Elomatic is designing machinery spaces - including this room housing the Azipod equipment - for the Norilsk Arctic container ship in 3D, using Nupas-Cadmatic software. This vessel is under construction at Aker Finnyards.

Elomatic has also lately been involved in with some major design tasks for Aker Finnyards, completing construction design drawings on both on the cruise-ferry *Color Fantasy* and *Freedom of the Seas* - the first Ultra Voyager (now re-named the *Freedom* class) cruise ship, also on the Arctic container ship for Norilsk Nickel, and on the lengthening/re-vitalisation project for *Enchantment of the Seas*.

Kone Corp buys back MacGregor

AS reported in our cargo-handling feature in this issue, Kone Cargotec, the cargo-handling sector of Kone Corporation, announced last December that it will purchase the entire share capital of MacGregor International AB from Swedish Industri Kapital and Gambro AB, for a debt-free price of around €186 million. The deal is subject to approval by the relevant competition authorities. In 1998, Industri Kapital bought 60% of MacGregor from Incentive (today Gambro). Incentive bought MacGregor from Kone in 1993. 'The acquisition of MacGregor by Kone Cargotec is a compliment to our long history of accomplishments in the global market of marine cargo care and cargo flow solutions', states Hans Pettersson, president and chief executive officer at MacGregor.

Kone, a global service and engineering company, has announced a plan to divide into two separately listed companies, Kone Corp and Cargotec Corp on 1 June, 2005. Should the demerger be carried out, MacGregor will be included in Cargotec, in accordance with Kone's de-merger plan. Today, Kone Corporation consists of Kone Elevators & Escalators and Kone Cargotec. Kone Cargotec comprises two business areas, Kalmar and Hiab; Kalmar specialises in container, trailer, and heavy industrial handling while Hiab is a leading provider of on-road load-handling solutions.

MacGregor will form the marine cargo handling division within Kone Cargotec, complementing the operations of Kalmar and Hiab. According to Kone Cargotec president Carl-Gustaf Bergström, among the main reasons for acquiring MacGregor are its strong presence in Asia, a global service network producing after-sales revenues equal to 30% of total sales, and a business concept focusing on moving downstream in the value chain, which is similar to Kone Cargotec's strategy. Kone Cargotec's annual net sales will rise to approximately €2 billion through this acquisition, and it is already expected to have a positive impact on Kone Cargotec's financial result in 2005.

In connection with the announcement, MacGregor stated that the company has, during the past two years, undergone extensive restructuring and has implemented improvement programmes resulting in increased profitability.

In 2004, net sales at MacGregor, which employs 935 people and whose products include hatch covers, cranes, cargo-securing systems, ro-ro equipment, shipboard elevators and escalators, also galleys, were expected to total €370 million. Operating income, before goodwill amortisation and non-recurring costs, is expected to amount to €22 million, or 5.9% of net sales.

Kone and MacGregor have enjoyed a long-term alliance and leading status for the manufacture and service of marine elevators and escalators, especially for cruise ships.

Color Fantasy: largest and most luxurious ever

What is probably the largest and most luxurious cruise-ferry ever has very recently been delivered by Kvaerner Masa-Yards (today Aker Finnyards) at its Turku site to the Norwegian operator Color Line.

Probably the largest-ever cruise-ferry: the highly luxurious 75,000gt *Color Fantasy,* newly introduced on Color Line's well-established service between Oslo and Kiel. The voyage time is 19.5 hours with a 5.5 hour turnaround.

THE massive 74,600gt *Color Fantasy*, which will sail on Color Line's well-established Oslo-Kiel service, is actually being promoted as 'the world's largest cruise ship with a car deck'; she can be compared with the 1990-built - also a product of Masa-Yards - *Silja Serenade* (58,000gt) and the Fincantieri-built *Pride of Rotterdam*, 59,925gt, completed in 2001.

Color Fantasy was built for NKr2.5billion at the Turku site of Kvaerner Masa-Yards - today rebranded as Aker Finnyards as part of an international yard re-organisation following Aker's acquisition of Kvaerner. Approximately 15 years ago, Masa-Yards built an earlier ferry for Color Line, *Kronprins Harald*. Some 600,000 passengers currently use the Oslo-to-Kiel service, but this figure is anticipated to rise substantially with the introduction of *Color Fantasy*.

The ferry's name was chosen to reflect Color Line's plan to build an international brand in Europe, and certainly the facilities on board have been designed to reflect a highly luxurious experience for travellers. These include more than 10 restaurants and night clubs, a conference centre for 850 people, the Aqualand water centre, a 160m-long internal promenade overlooked by two tiers of cabins - a novel feature first employed by Kvaerner Masa in 1990 on the *Silja Serenade* and subsequently used on the builder's *Voyager*-class cruise liners, and a large exhibition area - actually the upper car deck level.

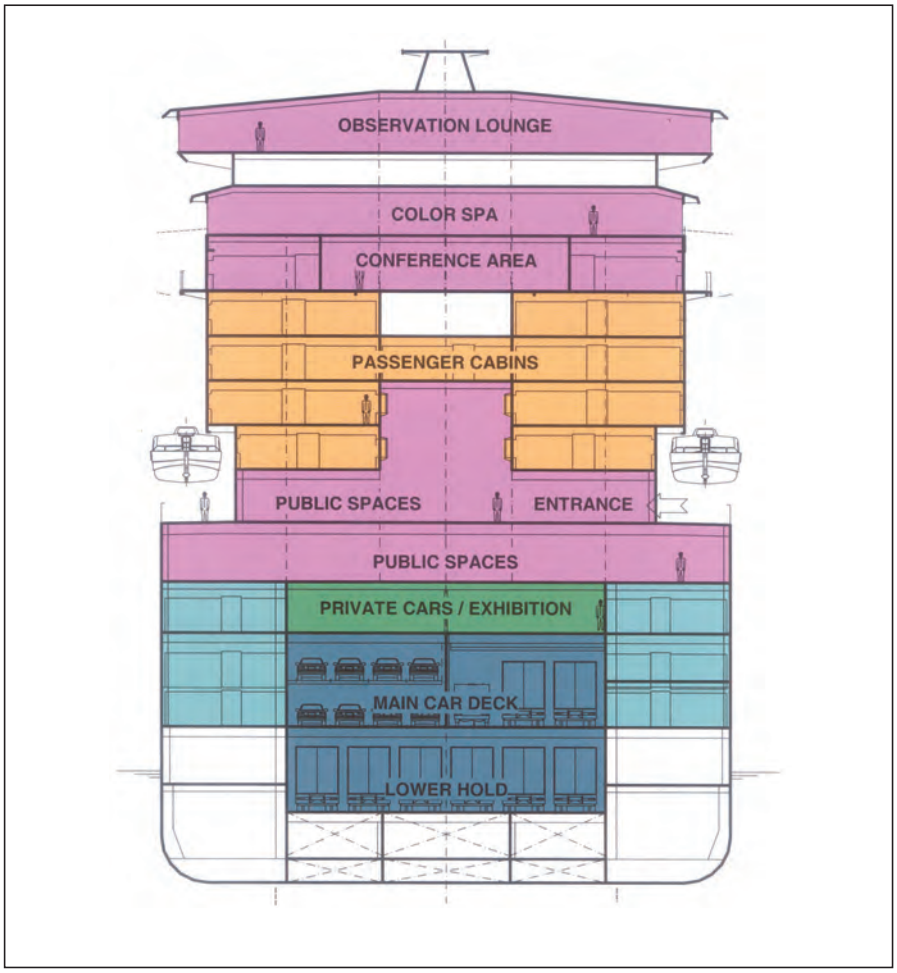
Studies and model tests

Prior to model tests of the brand-new hull, the form was developed using the shipyard's own

TECHNICAL PARTICULARS
COLOR FANTASY

Length, oa	223.90m
Length, bp	202.66m
Breadth, moulded	35.00m
Depth, to deck 3 (main ro-ro deck)	9.50m/9.70m
Depth, to deck 7	21.90m
Draught, design	6.80m
Draught, scantling	7.00m
Gross	approx 75,000gt
Deadweight	5000dwt
Passengers	2750
Passenger cabins	
Outside	492
Atrium	120
Inside	356
Total	968
Crew	250
Crew cabins	248
Trailers	
Deck 3	1030lane metres
Deck 2	240lane metres
Cars	
Deck 3	292
Deck 4 (hoistable)	258
Deck 5	200
Total	750
Main engines	4 x Wärtsilä 8L46B
Output	4 x 7800kW
Speed, service, 90% MCR, 15% sea margin	22.10knots
Classification	Det Norske Veritas +1A1, ICE 1B, Carferry A, E0, NAUT-OC, RP, Clean, F-M, Comf-V(1)

A cross-section through *Color Fantasy*, showing principal features of the new cruise-ferry.



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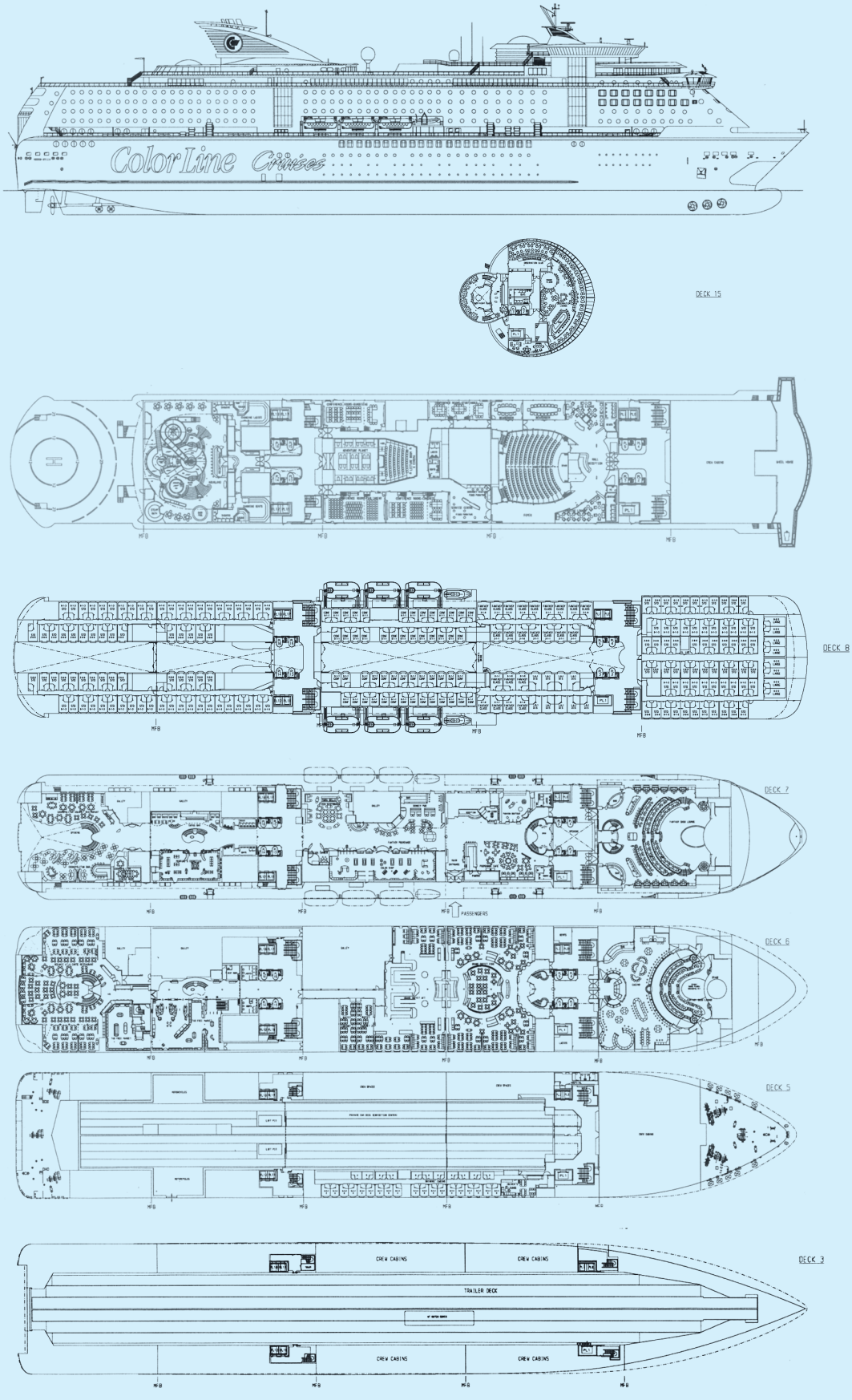
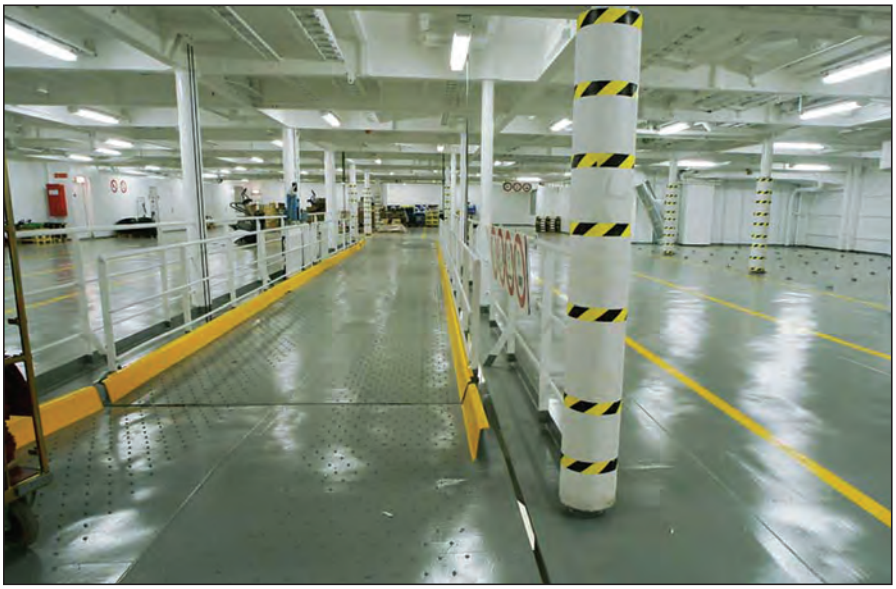
* for a 293 m vessel with 24 knots

ABB

General arrangement plans of the new 75,000gt cruise-ferry *Color Fantasy*, built by Kvaerner Masa-Yards (now Aker Finnyards) for Color Line.





Part of the upper car deck, accessed by a MacGregor ramp and a side-shell door, can be converted to an exhibition area if necessary.

The main ro-ro deck, showing the MacGregor hoistable platforms. Apart from the normal end access ramps, two panels amidships are also arranged to tilt in either direction to form additional ramps.

MacGregor refrigeration package for new cruise-ferry

AS well as an extensive ro-ro equipment package, MacGregor also supplied *Color Fantasy's* refrigeration machinery for cooling provisions stores, catering areas, and equipment such as counters and refrigerators. The direct-expansion plant uses the green HFC refrigerant R404A, and employs six compact condensing units based on semi-hermetic-type piston compressors. Each of the three circuits (sub-zero temperatures; positive temperatures; catering circuit) employs two condenser units mounted on a common frame, one running and one on stand-by. The positive and the negative condensing units have one compressor each and the catering condensing units have two compressors each.

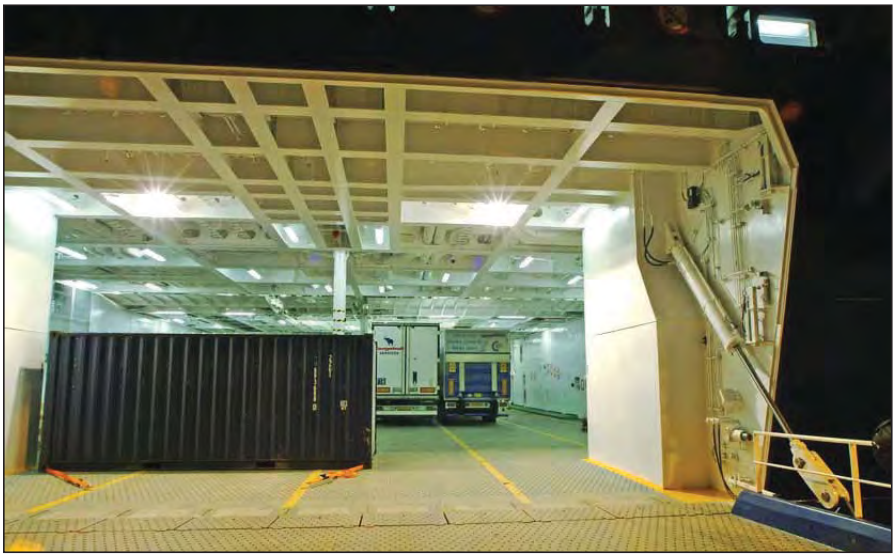
This is a new type of compressor specifically designed for the ferry market. MacGregor has supplied refrigeration machinery to many cruise ships, and the benefit of this experience has been used to meet the requirements of a ferry service with regular maintenance opportunities. The negative circuit serves four freezer rooms on deck 2. The positive circuit cools 12 chilled rooms on deck 2, and around 20 varied pieces of refrigerated equipment in the preparation galley on deck 2. The catering circuit cools four chilled rooms in the main galley on deck 6, and around 120 varied pieces of equipment in the crew galley on deck 5 and on decks 6-7.

CFD software, which although not determining absolute values, proved an excellent tool for comparing hull form version for lower resistance and minimum wave formation. Much effort was expended in minimising resistance, optimising the propellers' working environment, and creating a better wakefield. The special wave-damping afterbody, part of the yard's well-established under-flow hull type, features a semi-tunnel.

Model tests were carried out at MARIN, in The Netherlands, where, in addition to normal testing, comprehensive seakeeping studies were performed, particularly since the Oslo-Kiel route is exposed to the North Sea for part of the voyage. Some 44% of the route is also in shallow water - between 20m and 50m depth, which has an influence on the ferry's hydrodynamics. Model tests also ensured efficient integration of the three 2200kW Rolls-Royce bow thrusters and the twin 1000kW stern thrusters - the latter had to fit in with the propeller shaftlines and brackets. Harbour manoeuvres for both Oslo and Kiel were carried out on the simulator at Force Technology, Denmark (formerly the Danish Maritime Institute) in association with Color Line's navigating officers.

Several possible arrangements of the diesel-mechanical propulsion plant with its twin Rolls-Royce Kamewa CP propellers were separately tested in the cavitation tank at Kristinehamn, Sweden, prior to selection of the best layout to suit the challenging limits of DNV's Comfort Class. Due to restrictions on noise and vibrations in the public rooms and cabins, propeller tip loading had to be reduced from what would have been regarded as optimal as to the power efficiency. All this work, considering the size of *Color Fantasy*, had to be carried out in a very short time schedule (the ferry was completed in just under two years from the order being placed in December 2002), and as such, the ship is considered a prototype by its builder.

A special problem was the design of the Oceanic à la carte restaurant, located immediately above the propellers, and much effort was put into ensuring a noise-free environment here; full use was made of earlier shipyard experience. Similar problems arose with the general layout of a vessel which is essentially a cruise liner with vehicle decks, and in particular the upper car level (Deck 5), where part of this 20m wide space (the forward half of a four-fire-zone area) is planned to double as an exhibition area. Here, SOLAS



Principal vehicle access to the ferry is over this combined stern door/ramp into the main deck. From here, a lift takes trailers to the lower garage, and cars can be stowed on hoistable platforms or on the fixed deck above, which is served by a hoistable ramp, also by a sideshell door.

regulations had to be fulfilled as if for passenger areas, including escape routes and ventilation ducts.

This deck, which has a total space for 200 cars, is reached by ramp from Deck 3 or from an exclusive sideshell door, considered to be especially useful for exhibitors with stand equipment and large items for display. Below, on Deck 3, is the main watertight deck, laid out for six lanes of vehicles and equating to 1030 lane metres or 292 cars. Drive-through access is provided - in Olso, the ferry will use the bow door/visor, and in Kiel, a wide stern door/ramp. Wide side casings are used for both crew cabins and storage space, and a row of pillars and casings runs down the centreline. *Color Fantasy's* ro-ro access package was designed by MacGregor.

The new ferry includes features from IMO's new ISPS security code. As a result, there are two levels of restricted access to certain areas, as well as requirements for locked doors, also video surveillance and passenger scanning.

Stores and linen containers in lower garage

Deck 3 has an upper level, Deck 4, comprising hoistable platforms suitable for 2100mm high vehicles. The platforms and ramps are adjustable to suit various cargo mixes. Below the main deck is a further short garage, mainly designed for trailers and containers and totalling 240 lane metres; this is accessed by a vertical lift supplied by MacGregor. Both deck 3 and the lower garage are enclosed within B/5 longitudinal bulkheads, outboard of which on the main deck are a number of cabins.

Special parts of the lower garage on the starboard side are reserved for two service containers: one forward for linen, and the other aft for provisions. Access is provided via a short ramp at the forward end to a dedicated linen lift, and at the aft end, again via a ramp, to provisions stores and a food preparation area, prior to its transfer to the main hot and cold galleys on Deck 6.

Color Line will make use of a large quantity of food prepared ashore, to keep the galley size within manageable limits. There is an additional lift specially planned to take tax-free products to the shops. Stores and linen containers are taken up on the trailer lift to the main deck and replaced in Oslo only. Waste chutes from all decks lead to two compression stations on the main ro-ro deck, from where all waste is taken ashore for disposal. This equipment, supplied as a package by the German specialist Deerberg, is described on page 26.

These arrangements have been carefully planned to suit *Color Fantasy's* schedule - 19.5 hours at sea on the Oslo to Kiel route, but with 5.5 hours for loading and discharging. The ferry is scheduled to depart at 1300h from each terminal, arriving at 0900h the following morning - timings which should give passengers a relaxed voyage without any early or late transfers.

A further important notation for *Color Fantasy* is the DNV Clean Class, the most critical aspect of which is the positioning of all fuel tanks inboard. Marine diesel oil can be used by all engines, and certainly by the diesel-alternators when in port to avoid any black smoke.

Since there will be a large amount of heating and extensive ducting required, fan coils in each cabin were not considered practical, and therefore an ABB Automation Technologies double ducting system is fitted in the public spaces and cabins. Koja Marine delivered ventilation systems for the vehicle deck, centred on a room on Deck 5.

Quality public spaces and cabins

The two interior consultants employed for the extensive public spaces were Tillberg and Falkum Design, but several Finnish companies, including Europlan Engineering, Orsap, Hermann's Project Design, and Trapiol, plus Spencer Contract, from Italy, were involved in outfitting specific areas under turnkey contracts. A principal - and revolutionary - feature first pioneered on *Silja Serenade* and later used on the *Voyager*-class cruise ships is a high internal promenade, overlooked by cabins. Special folding fire bulkheads can be deployed in an emergency; these stow into the longitudinal walls. Passenger flow, planned to be straightforward, is centred on two main stairway halls, each with ample lift capacity from the main ro-ro deck.

The main passenger spaces with food service, shops, and entertainment are located on two decks about the main and upper car levels. They are grouped along the internal promenade - the principal focal point onboard.

continued

Passengers on the new cruise-ferry will be able to take advantage of an extensive enclosed pool and water area on Deck 12.

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For a Scandinavian-owned ferry, a sauna is an obligatory feature, and *Color Fantasy* features one in the forward health spa area.

Although Color Line expects to order much of its food pre-prepared ashore, the new ferry still has extensive galley and preparation areas (the latter adjacent to the stores container park in the lower vehicle garage). All outfitting was handled under a turnkey package by Loipart, in association with MacGregor refrigerated rooms.

***Color Fantasy* continues the feature pioneered by Kvaerner Masa-Yards of an internal promenade, around which are positioned restaurants and shops, also an internet café. Some cabins overlook this interesting space.**

All passenger cabins, fitted with Evac vacuum toilets, are located in the superstructure in the decks above the public spaces. Above the cabins are the conference areas, swimming pool, spa and health centre, also rooms for teenagers and children. All these are topped by a near-circular forward observation lounge, from where magnificent vistas can be seen.

An interesting feature of the ferry's profile is the inclusion of many large porthole-style windows in the modular cabins built by the Kvaerner Masa Piikkiö Works. *Color Fantasy* is fitted with a travelling window cleaning system manufactured by PIA Engineering. Higher-grade cabins (275 in total) have flat-screen TV sets, while the rest have normal sets. One reason for choosing the flat-screen models was that they could be fitted in the cabins! Another interesting innovation is, in four-berth cabins, that the upper beds are recessed into the ceiling rather than folded up against the wall in the traditional manner. A maritime atmosphere has been created by using a number of wooden objects throughout the ship.

Aqualand - an innovative water feature

In addition to the usual range of luxurious amenities that today's cruise-ferry passenger can expect, *Color Fantasy* has the novel Aqualand area. This comprises a 22m long and 2.2m wide river - the Stream River Pool, in the form of an open figure-of-eight and with an island in the centre. Passengers can swim in water circulated by pumps and might even experience a volcano in action - actually produced by steam in association with a light display! Aqualand has been a special project developed by the owner in association with Aker Finnyards. A further feature is a golf simulator, with both a driving range and a putting area.

A turnkey contract for outfitting of the atrium and the à la carte restaurant, as well as all catering and galley rooms and equipment, also the provision handling areas and the areas for waste handling, was awarded to the Finnish specialist in this field, Loipart.

Lifesaving equipment comprises six Umoe Schat-Harding lifeboats, two rescue boats, and a set of Viking escape slides. Sliding watertight doors throughout the ship were provided by Tebul. Passenger comfort during rough weather should be ensured by a set of Rolls-Royce Brown Bros fin stabilisers.

Quartet of Wärtsilä main engines

The main machinery plant is centred on four 7800kW Wärtsilä 8L46B medium-speed engines driving twin Rolls-Royce Kamewa CP propellers through Vulkan couplings and Renk gearboxes. From each gearbox is driven a large ABB 6000kVA alternator; these are principally planned for use when the ship is manoeuvring, when electrical consumption could be high - up to 8600kVA on the five thrusters. An additional four 2450kVA Wärtsilä/ABB diesel alternators,

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One of the four Viking vertical-chute escape systems on *Color Fantasy* being tested.

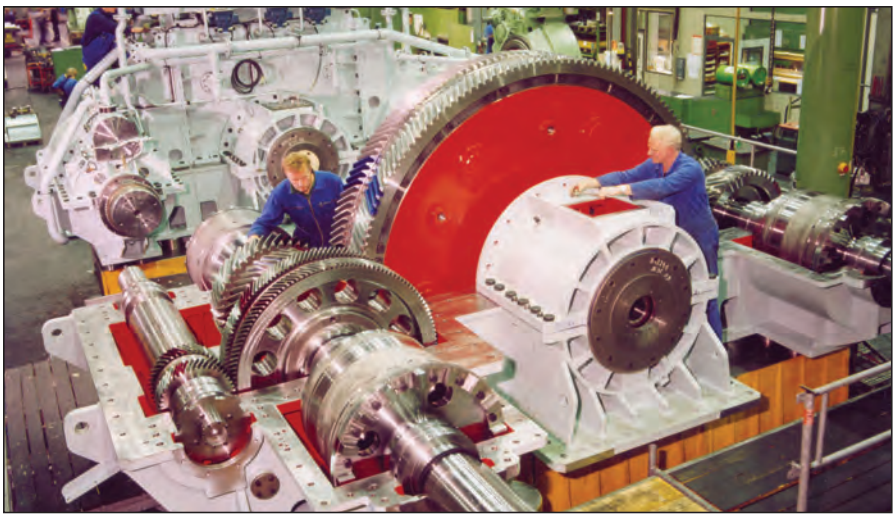
using 6L26B engines, are also installed. The complete plant is operated and monitored by a CAE Valmarine integrated automation system.

Every effort has been made to ensure efficient noise and vibration damping. The propulsion engines do not include Wärtsilä's common-rail fuel injection feature since this was still in the prototype stage when the machinery was ordered. Nevertheless, they do conform to the DNV Clean and Comfort 1 classes and thus have certain adjustments that can be locked in required positions to ensure no black smoke and polluting gas emissions. All fuel is carried in deeptanks located above the double bottom.

The bridge is divided into two separate functional areas, with a separate safety centre aft of the enclosed space. The centre includes consoles covering all watertight doors, fire doors and all fire alarms throughout the ferry, and bow door leakage. An Onboard Napa software unit will assist with any stability problems in an emergency and will monitor void spaces for leaks. The Marioff sprinkler system in the accommodation and the local machinery space system can be operated from here, as can the Heien-Larssen/Unitor foam system. The bridge layout, with its console front featuring two chairs, meets DNV Naut-OC standards.

An option for a sister ship remains in force until the end of 2005. Aker Finnyards enjoyed good cooperation with Color Line throughout the project, which was completed in just under two years from contract signing.

Seen here in the Renk factory at Augsburg is one of the two NDSQL-3800 gearboxes which combine the output from each pair of 7800kW Wärtsilä main engines. Each gearbox has a power take-off included for driving a 6000kVA ABB alternator, principally to be used during manoeuvring.



Color Line was the first company to test Hamworthy's innovative C2G engineroom pump, and *Color Fantasy* is among the first vessels to benefit from the completely revised design, which offers light weight, compact dimensions, and reduced service time. Versions are available in spacer-coupled and close-coupled variants - spacer coupling is standard, and allows overhaul without removing the drive motor. Those pumps shown here on the new ferry are amongst the 30 supplied for fresh and sea water cooling, air conditioning, bilge, ballast, and firefighting duty.

Aker Finnyards

Together we are more

Kvaerner Masa-Yards and Aker finnyards seal their merger, and continue working as one company. The new Aker Finnyards, part of Aker Yards, is amongst world leading designers and builders of cruise vessels and ferries as well as other technically complex vessels. After this marriage, the new Aker Finnyards creates competitive advantages and adds value for all customers, stronger than ever.

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Comprehensive waste management onboard *Color Fantasy*

A COMPLETE waste management package was designed for *Color Fantasy* by the German specialist in this field, Deerberg Systems. This is based on the safe and clean disposal of solid waste, food waste, and recyclable materials, with solid waste collected amidships through a central chute with feeding stations on various decks, while glass is dropped down a separate chute at the aft end of the ship for crushing and later reprocessing. For food waste, *Color Fantasy* is equipped with the latest Deerberg Devatec vacuum technology, with five feeding stations throughout the vessel. Waste is fed into a hopper and is then transported by vacuum through a processing unit to a dedicated container made of stainless steel and equipped with cooling machinery to prevent the creation of any odours. Compactors are also installed on the ferry for compressing paper, plastic, and tins.

All chutes are fabricated from stainless steel and fulfil the latest standards on noise and security, being isolated from the hull structure to prevent any noise transfer to accommodation areas. Each chute is equipped with a dedicated cleaning system.

Waste ends up in containers located at the side of the main vehicle deck for easy transport off and on the ferry. Waste and re-cycling containers are removed ashore by the crew in both Oslo and Kiel; here, they are picked up by a lorry equipped for container transport and taken to a special depot.

Left. All rubbish generated on board ends up in one of two waste stations on the main ro-ro deck and taken ashore. The plant was supplied by the German specialist in this field, Deerberg.

Above. The solid-waste container on the main car deck. It is approximately 12m³ in volume and is connected to a snail press (towards the right of the picture) which compresses waste into the container.

Below. *Color Fantasy* is equipped with five Devatec feeding stations for food waste (one is seen here), located on different decks and in various parts of the ferry. The feeding funnel can be seen integrated into the work surface, with the control box underneath; the latter houses the electronic control and a knife gate valve for vacuum release. By pressing a button, the vacuum is released and food waste in the funnel is transported to the processing station.

Left. This processing unit is the heart of the Devatec system for handling waste food. Here, the different vacuum feed lines are united and solids are separated from air. Waste is then shredded and de-watered by an internal screw press. The de-wastered waste is transported to the chilled food waste container.

Above. Located on the car deck is the special stainless steel container for storing food waste collected during a voyage. Approximately 10m³ in volume, it is cooled to approximately 8°C to prevent the creation of odours.

Left. Individual waste bins being emptied into a chute by a crew member. In this case, he is feeding glass into the dedicated chute for this material, which is sent ashore for recycling.

Ask us about …

… good vibrations

Knowing how critical noise and vibration performance is for the reputation of a cruise liner, DNV was honoured to be trusted with the important task of ensuring the first-class comfort onboard *Jewel of the Seas*. Together with the yard and owner DNV has carried out analyses and tests. Verification measurements onboard have proven that the ship's noise and vibration levels are very low, leaving *Jewel of the Seas* to good vibrations from music and entertainment alone.

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MANAGING RISK

Aker Arctic Technology to continue the work of MARC

A NEW company, Aker Arctic Technology Inc (AARC), was established on December 30 by Aker Finnyards, with a shareholding of 62.5%, together with Finnish companies Wärtsilä, ABB Oy, and Norwegian Aker Kvaerner (former Kvaerner Oil & Gas) through Aker Kvaerner Engineering & Technology AS, each with an ownership of 12.5%. The purpose of the company is to continue the work of the Masa-Yards Arctic Technology Centre (MARC), for many years a leading light in development of icegoing ships as well as related design, consulting, and model and full-scale testing work.

Agreement has been reached with the city of Helsinki to build a new, and larger, ice model basin in the Vuosaari area, next to the new port under construction. Aker Arctic Technology intends to begin operations early in 2006 and estimates the investment to be about €10 million, with initial net sales anticipated to be in the range of €2-€3 million.

The new company will offer clients AARC's current design and testing services, but will also market and sell complete ice-going ship projects. Mikko Niini has been appointed president of Aker Arctic Technology; previously he was in charge of the sales activities in the former CIS countries of Kvaerner Masa-Yards. According to Niini, the company has great possibilities to expand its Arctic business when operations are not tied to a specific shipyard. 'There is a great demand for our services today. Our model testing work for outside clients have increased over several years, and we are now at maximum capacity. Most contracts relate to the development of Arctic offshore operations in Russia,' he reports.

An impression of Aker Arctic Technology's new model-testing facility for icebrakers and ice-going ships, currently under construction in Helsinki and planned to begin operations early in 2006.

The current (old) ice model basin is AARC's second such facility, and has been in operation since 1983. The organisation has gathered an unique knowledge base from designing and constructing icebreakers and ice-going vessels. It is claimed that no other facility in the world has such a large full-scale test correlation database, which is the one most important asset for accurately predicting real-world physics from model testing. The track record includes some 180 full-scale field tests and expeditions, 300 model test series, and 160 published papers at conferences and in journals.

The size of the current model test basin (seen here) is 77.3m length, 6.5m width, and 2.3m depth. The new basin at Vuosaari will be of similar size, but it will be 8m wide to allow better modelling of offshore operations.

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Liquid-cooled drives for re-modelled *Seili*

SINCE March 2004, the Finnish Maritime Administration waterways service vessel *Seili*, which earned a place in history as the first ship to be fitted with an ABB Azipod propulsion plant (*The Naval Architect* June 1992, page E307), has been sailing again in the Gulf of Finland, powered with Vacon liquid-cooled main propulsion drives. During a nine-month rebuilding project at the Aslemetals yard in Olkiluoto, near Rauma, *Seili* was modified into a genuine multi-purpose vessel.

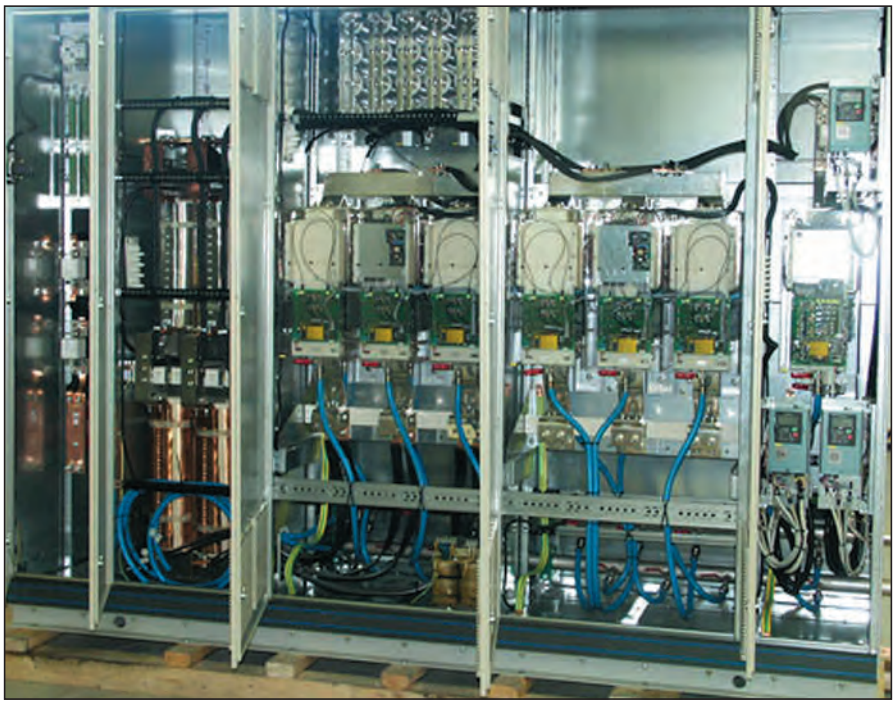
After altering and lengthening the vessel with a new hull section 7.8m long (to make a new waterline length of 48.60m), the ship is now capable of oil-spill response functions, with two 98m^3 collecting tanks, and is believed to be the first in the world capable of oil collection in icy conditions. *Seili* can also be used for icebreaking as well as for various transport and supporting pilot functions in heavy ice conditions.

A major feature of the rebuild was the installation of two electrically powered mechanical Z-drive propulsion systems in place of the original prototype 1500kW Azipod (unfortunately, at the time this project started, ice-classed Compact Azipods were not available). This improves vessel movement and guarantees sufficient power needed for towing and winter navigation, irrespective of ice conditions.

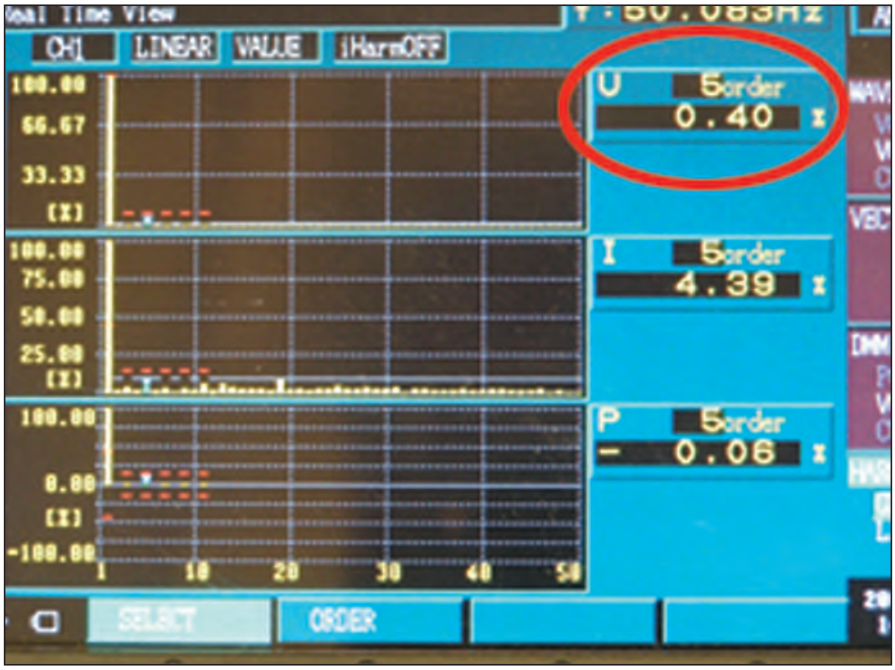
The new main propulsion plant is controlled by liquid-cooled drives from the Finnish specialist Vacon, with a total power of 2.3MW. Two regenerative liquid-cooled NXP drives are controlling the main propulsion equipment and six NXP drives manage the steering gear. A new dynamic positioning system allows *Seili* to maintain position automatically without anchoring.

The Finnish Maritime Administration chose Vacon's regenerative liquid-cooled drives as they are claimed to require only modest space for assembly, and no additional filters are needed onboard to ensure power quality. In Vacon drives, harmonic voltage distortion with full load has been under 2% - below the general level of 5%.

Vacon regenerative drives have been developed especially for applications requiring continuous braking. The concept produces practically harmonic-free energy that can be fed back into the supply; it also actively compensates the supply's power factor.



One of the cabinets for the main propulsion converters including (from left) input section with fuses, net filter, net drive, motor drive, and brake chopper. Everything is included within the 3000mm-wide cabinet.



The Hioki measuring device in action during sea trials. Note the harmonic voltage at the fifth overtone.

Generator power close to converter power

Onboard *Seili*, three 820kVA Caterpillar generators (3 x 800kW) produce a total of 2460kVA. As the converter load has a power factor close to 1, the continuous generator output is approximately 2400kW. The two propulsion drives have a power of 1100kW each, and the steering gears include six drives in total with a power of 15kW each.

Two of the steering gear drives are continuously powering hydraulic oil pumps and the other four are actually turning the steering gears. The hotel load is approximately 150kW.

In a crash stop, the propulsion drives will hit the current limit and consume a total of 2 x 1100kW; steering gears are at full load (90kW), and the lights will flicker. This is not surprising, as the propulsion, steering and hotel load reach the maximum total available generator power.

Normally, generators are chosen to be at least 1.5 times the power needed, to avoid blackouts in extreme situations. On *Seili*, the case is different. Both the generators and the propulsion system were chosen on the basis that they are as large as possible within the resources available. Therefore, frequency converters were required for the main consumers (ie, the main propulsion motors) because the power factor would be high and because the current flow would be controlled.

The use of frequency converters would normally cause problems in harmonics and EMC issues. To avoid building a separate clean power net for 400V, it was decided that a 690V/400V

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CH1 LINEAR

Order	(V)	Order	(V)	Order	(V)
1	-----	18	0.42	35	0.26
2	1.24	19	0.90	36	0.02
3	1.13	20	0.17	37	0.41
4	0.43	21	0.26	38	0.05
5	9.49	22	0.17	39	0.04
6	0.43	23	0.19	40	0.05
7	8.03	24	0.11	41	0.17
8	0.34	25	0.26	42	0.05
9	0.49	26	0.18	43	0.04
10	0.32	27	0.10	44	0.03
11	3.02	28	0.13	45	0.04
12	0.79	29	0.35	46	0.04
13	1.44	30	0.08	47	0.10
14	1.99	31	0.21	48	0.02
15	1.26	32	0.05	49	0.07
16	0.76	33	0.08	50	0.04
17	0.80	34	0.03	THD	1.94 (%)

Fig 1. Harmonics voltage distortion.

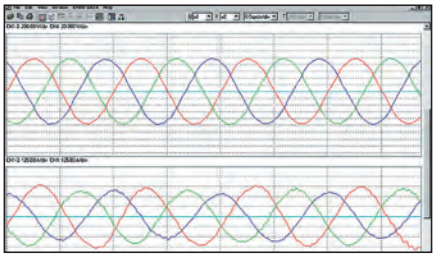

Fig 3. The waveforms show that the harmonic content both in current and in voltage is extremely low.

File Edit View Window EVENT DATA Help

CH1 LINEAR

Order	(A)	Order	(A)	Order	(A)
1	258.73	18	1.51	35	0.07
2	3.77	19	0.45	36	0.02
3	2.03	20	0.40	37	0.08
4	0.41	21	0.22	38	0.01
5	3.71	22	0.21	39	0.01
6	0.45	23	0.24	40	0.00
7	3.85	24	0.13	41	0.04
8	0.36	25	0.08	42	0.01
9	0.46	26	0.13	43	0.01
10	0.43	27	0.10	44	0.01
11	0.80	28	0.08	45	0.01
12	0.35	29	0.16	46	0.01
13	0.97	30	0.04	47	0.02
14	0.79	31	0.09	48	0.01
15	0.45	32	0.03	49	0.02
16	0.85	33	0.03	50	0.01
17	3.18	34	0.04	THD	3.09 (%)

Fig 2. Harmonics current distortion.

transformer would be used instead. This would only be possible if the harmonic content of the 690V net was low, because sensitive navigation equipment, among others, will not otherwise work properly. Owing to the Vacon regenerative drive technology, the power factor is ~1, harmonic voltage distortion is below 2%, and current distortion is around 3%.

As seen also in the wave forms (Fig 3), the harmonic content both in current and in voltage is extremely low. Additionally, the Vacon drives will limit the output current if the load exceeds the limit, as would be the case in a crash stop situation due to hydrodynamic forces.

Since power flow back from the load in a network with a small consumption and no rigid grid is a difficult problem, the *Seili* solution contains additional features. According to the propeller manufacturer, about 140kW was expected to be the maximum back power for each propeller. This could occur both in the fast deceleration of the propeller rotation speed due to the inertia of the mechanics, and due to worst-case hydrodynamic forces.

This caused no problem, as there were regenerative (full four-quadrant) drives onboard, so all power generated by the propeller could be fed back to the net. In a worst-case scenario, though, the back power would exceed the hotel load. Hence, a decision was made to additionally install brake choppers and resistors onboard.

The brake choppers were ordinary small inverter units with software, connected to the DC-bus inside the main propulsion drives. All inverter units in the system (net drive, motor drive, and brake chopper) had a control of their own, individual software, and parameters.

Together, they also provided sufficient measuring of the power flow in different situations. The net drive had a parameter for 'back power', which was set to a value of 0kW; therefore, all back power would raise the DC-bus voltage, cause the choppers to operate and consequently, the power to be used by the resistors. When the kWh counter in the brake chopper drive was checked, it could be seen that the brake is hardly needed.

The major part of the kWh reading had already been gathered at an early stage at sea trials with crash stops. Therefore, it can be concluded that unnecessary back power can be avoided with carefully chosen parameter settings in the motor drive.

Deliberate rolling mode

Icebreakers often use 'rolling' on purpose to increase effectiveness, but on *Seili*, one of the operating modes is to tilt her on purpose, to compensate rolling resulting from waves at the side. This is to allow the oil-gathering system to work with full capacity in rough seas. This kind of operation requires the propulsion units to be turned partly against each other and to operate in alternating sequences. Such action will periodically generate a significant amount of hydrodynamic forces to one of the units. In other words, when one of the units runs for a couple of seconds with full power, the other is not working at all, but the water flow will partly try to rotate the propeller. This, together with energy released by the inertia, will cause some back power. If these two propeller drives had a common DC-bus (which is not the case today), energy could flow between the drives, and the resistors would be needed even less often.

Icy conditions cause special care to be taken in dimensioning mechanical parts, since all eventualities need to be taken into account. Luckily, a frequency converter also provides protection against torque shocks. A converter will immediately adjust the torque to a lower level if the propeller blade hits some hard ice. This protects the gear and the propeller from damage.

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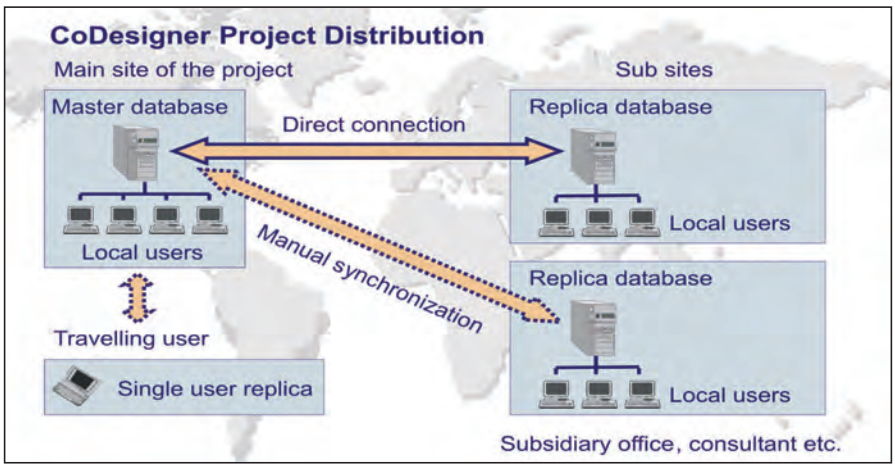
Remote working improved for Nupas-Cadmatic

LAST year, Cadmatic released version 5.0 of its Nupas-Cadmatic 3D ship design software tool. This new version of the 3D CAD/CAE/CAM package has some 60 new features and 160 other user-based improvements. Major attractions include development regarding concurrent and remote project work, system usage and administration, as well as user-friendliness. Version 5.0 now offers the possibility of remote project design work from several different locations. 'This opens up totally new business opportunities for our clients, in their ways of handling large projects, and an ability to easily distribute the work globally', reports Matti Juntunen, Cadmatic's vice-president.

Version 5.0 has been enchanced with a totally new COS object storage-data architecture, as a solid base for shared data. A common component library, project set-up, and project data, including 3D models and documents, are now stored in databases hosted by a database server. Since the system is built for ship design, the database architecture is optimised for handling 3D design data.

The new CoDesigner module handles automatic database replication and other technical details centrally, without need for interaction by remote design locations. A separate check-in/check-out function should make the system robust and safe, as only one designer can modify a particular object at a given time. 3D project information can be easily shared with the internet based eBrowser tool.



A main CoDesigner module of the new version 5.0 of Nupas-Cadmatic co-ordinates design activities in a global ship design project.

Also, the Nupas-Cadmatic Hull Server feature is new in version 5.0. This keeps the logistic database continuously up to date with the 3D model. It is also used to create models of construction parts that can be viewed with a new Hull Viewer component.

Today, Nupas-Cadmatic supports direct data exchange from Napa Oy's Steel module, making it possible to re-use it directly for further detailed and production engineering. Nupas-Cadmatic is currently used on some 1200 workstations within the shipbuilding industry. In 2004, several new licences were sold globally, including in Europe, Korea, China, Russia, Japan, Brazil, Chile, and Singapore.

Azipods move ahead strongly

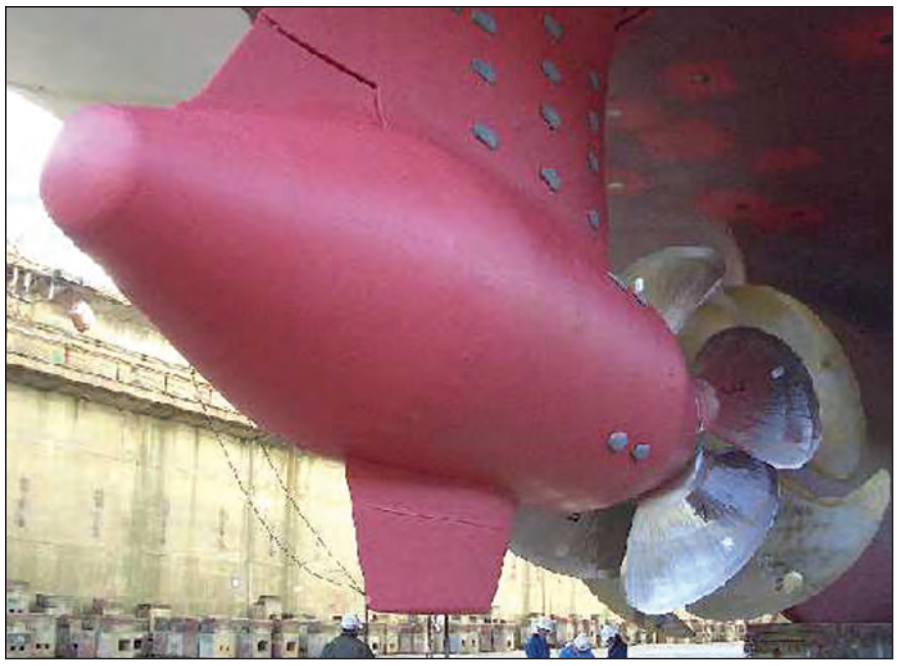
LAST autumn, new contracts worth some €70 million were announced by ABB Marine for its Azipod electric azimuthing propulsion concept. Among these was one for Royal Caribbean Cruise Line's second Ultra Voyager ship, which will be powered by three 14MW cycloconverter-controlled Azipods; ABB will additionally supply six main alternators of 17.6MVA (12.3MW) each, the 11kV switchboard, four 3.4MW bow thruster motors, and 18 transformers.

A highly significant contract in China involves two new train ferries for Sinorail Bohai Train Ferry, under construction at Tianjin Xingang Shipyard for delivery in 2006 (discussed in a separate article in this issue). Each of these will be powered by an ABB medium-voltage plant centred on two-plus-two alternators, and twin PWM-DTC frequency-controlled Compact Azipod units rated at 4088kW (the Compact version of the Azipod is specially designed for smaller installations under 5000kW). ABB also secured an Azipod order for Norilsk Nickel's new Arctic container ship, ordered recently at Aker Finnyards (see article elsewhere in this feature). ABB deliveries for this interesting vessel include one 13MW Azipod propulsion unit, medium-voltage power generation, and distribution systems.

At October last year, a total of 141 Azipod propulsion units had been ordered since the system's launch in 1990, with an accumulated 1.3 million running hours recorded by August 2004. The Azipod concept, originally developed by ABB in cooperation with Kvaerner Masa-Yards, was acquired by ABB in 1997 and currently forms the Propulsion Units division within ABB's marine operations, which has full responsibility for the concept and all functions, including system development, engineering, as well as sales and manufacturing. The more recent Compact model has chalked up some 40 orders, while last year saw the first sea-going example of the CRP Azipod for larger, high-power vessels. This is on the Shin Nihonkai ferry *Hamanasu*, which is presented in the newly published *Significant Ships of 2004*.

Two CRP Azipod propulsion units were delivered in 2004, one each to *Hamanasu* and her sister *Akashia*, built by Mitsubishi Heavy Industries. Despite the fact that these are ferries, the concept was originally created to power giant container liners without the need to have two propeller shafts. The 34,000gt (international) vessels (208.00m length and 26.00m wide) have space for 820 passengers, plus 158 trailers and 65 private cars. Each ferry is fitted with an electrically driven 17.6MW FP Azipod unit, working in tandem with a mechanically powered CP propeller fitted with a hub vortex-free cap. ABB also delivered the control systems, as well as 27MW, 6.6kV power generation and distribution systems. Maximum ship speed is 34knots with a service speed of 30.5knots, which makes it possible to maintain a daily ferry service on the 573nm route between Maizuru or Tsuruga (on Honshu island's Japan Sea coast) and Otaru, near Sapporo on Hokkaido Island, to the north.

The pioneering single-propeller-shaft ro-pax sister ferries *Hamanasu* and *Akashia* are the first vessels to be fitted with CRP Azipod propulsion. Each is operating on a long-haul route at a service speed of 30.50knots.

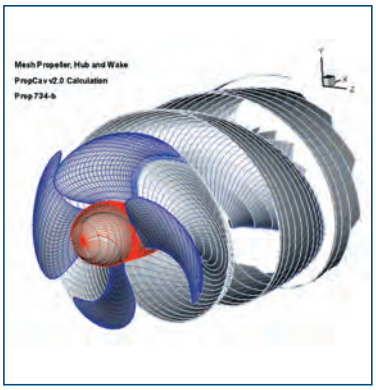


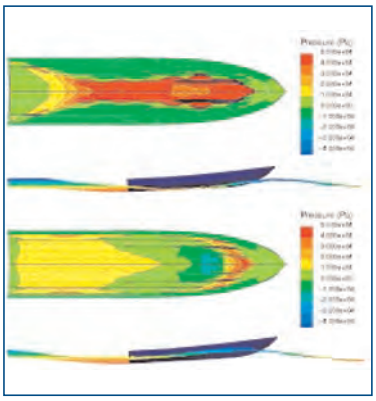
The diameter of the four-bladed main CP propeller on each of the new Shin Nihonkai ferries is 5.6m. Behind it, the Azipod propeller has a diameter of 4.8m and has five blades.

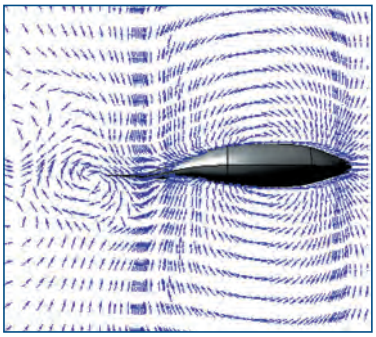
Experience with CRP Azipods

There are two main reasons for owners to consider contra-rotating propulsion. One is improved efficiency by being able to absorb rotational losses with the contra-rotating aft propeller. Contra-rotating propulsion also gives the benefit of thrust load distribution over a larger number of propeller blades, in a confined space. The added total blade area results in improved cavitation characteristics, by which more power can be fed into a CRP propulsion system with smaller diameter propellers. This is especially important for powerful shallow-draught vessels. Without diameter restrictions, a third reason is achieving a system with less noise and

The Royal Institution of Naval Architects







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Marine CFD 2005

The Fourth International Conference on Marine Computational Fluid Dynamics

30 - 31 March 2005, Southampton, UK

Second Notice

The International Conference on Marine Computational Fluid Dynamics and associated workshops offer delegates the opportunity to meet and hear from the leading industry and research experts in this field from around the world.

Computational fluid dynamics is a powerful tool for solving complex hydrodynamic problems. CFD offers the designer cost and flexibility advantages compared with model testing. However, many still see their use as more of an 'art' than a science, and the province of specialists. A lot of work is going into making CFD a universal design tool.

Marine CFD 2005 will focus on the application of CFD techniques to hull hydrodynamics, marine propulsors (propellers, pods, waterjets, etc), hull/propulsor interaction, and ship aerodynamics for conventional and unconventional ship design. The programme includes software workshops which will give the delegates a chance to participate in and discuss demonstrations of the latest CFD software. The Institution invites papers on:

- Practical applications of CFD techniques to marine design
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- Developments in adaptation grid generation
- Coupling of CAD and CFD software
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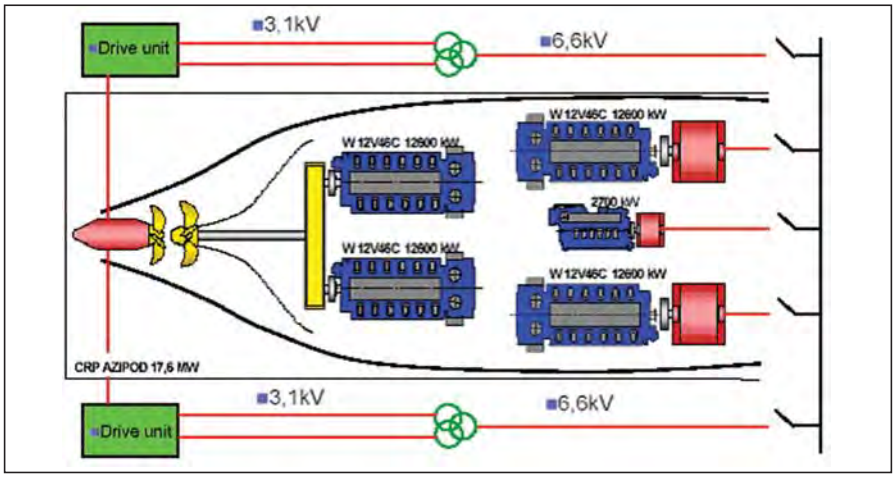
cavitation, as used in naval applications. Additonally, by using an azimuthing electric propulsion unit aft, manoeuvring characteristics are much improved.

Recently published results from tests with the new Japanese sisters show that with a power split of 55% for the forward propeller and 45% of the aft, the maximum speed exceeded the targeted 32knots. Running the main propeller at full power and the Azipod with half power, above 95% of the maximum speed was reached. Running the main propeller at full power and the Azipod propeller windmilling resulted in a ship speed of 25.70knots - almost 80% of maximum speed. Using the Azipod only resulted in a ship speed of 22.30knots.

Sea trials confirmed the extensive model test findings from MHI's model basin in Nagasaki. After three months of operation on their intended route, the owner has learned that the new vessels, for the same 24 hour service, will save some 20% in fuel costs compared to the older twin-shaft diesel-driven sisters *Suzuran* and *Suisen*, which operated temporarily on the route (*Suzuran* was presented in *Significant Ships of 1996*). These ferries, which in 1998 were retrofitted with M O Tech PBCFs (propeller boss cap fins), have service speeds of 29.40knots but a 15% smaller transportation capacity than the new ships.



The total propulsion power of each of the new Japanese ferries is 42.8MW, with 60% (25.2MW), distributed on the forward propeller and 40% (17.6MW) on the Azipod.

New Evac waste-water technology

A NEW series of standard membrane waste water treatment units for ships with a crew of 10 people or more has been launched by Evac, today part of the French Zodiac Group. The Evac membrane bioreactor is based on the Japanese Kubota flat-sheet membrane technology with flat-sheet micro-filtration membranes, developed specifically for waste-water treatment. Evac claims it chose this technology due to its reliability and cost-efficiency for ship applications. An Evac MBR unit can be directly combined with the company's well-established vacuum collection system to provide a total waste-water management package.

According to Evac, biological waste-water treatment is the most economical way of treating highly concentrated shipboard black and grey water; soluble organics, the company says, cannot be removed directly by filtration or any other particle-removal method. Evac MBR technology has been successfully operating onboard a UK Royal Navy Type 23 frigate.

For large cruise ships, a larger-capacity Zebra bioreactor has been developed. Waste-water concentration and flow, peak flow characteristics, bioreactor sludge concentration, retention times, and pre-filtration all combine to set the parameters for bioreactor sizing. With the Zebra, Evac is working with clients to find the most optimum way of combining membrane bioreactors with advanced electro-coagulation technology. The aim is to achieve a reasonable investment cost combined with low lifecycle costs. A Zebra technology pilot unit is currently in operation on a Baltic ferry.

A typical Evac MBR membrane bioreactor waste-water treatment unit. This uses Kubota flat-sheet membrane technology and flat-sheet micro-filtration techniques.

Half a million vacuum toilets

During 2004, Evac passed the milestone of 500,000 delivered vacuum toilets, which is said to be more than three-quarters of all vacuum toilets on the marine market. Vacuum tanks with vacuum pumps are making a return to extensive toilet-system installations thanks to new pump technologies. On a large cruise ship, vacuum pumps are clearly the most economical way of collecting black water. In addition to a large number of orders for cruise ship and ferries (including those for the new MSC cruise ships being built by Chantiers de l'Atlantique, the newly delivered cruise-ferry *Color Fantasy*, and the latest Tallink ferry being built by Aker Finnyards, Royal Caribbean's *Freedom* series, and Carnival ships being built by Fincantieri), Evac has secured many cargo vessel orders and deliveries to Korea, Japan, and China, and also for naval ships, including collecting systems and waste-water treatment plants.

The Royal Institution of Naval Architects

Recycling of Ships and other Marine Structures

4-5 May 2005, London

First Notice & Call for Papers

The disposal of ships and other marine structures raises a wide variety of issues. Recent high-profile cases in the developed world such as the US Navy's so-called "Ghost Ships" and the Brent Spar oil platform have highlighted some potential issues associated with disposal, mostly identified by persons or organisations raising environmental concerns.

However, at present, the vast majority of ships are broken up on beaches in Asia where concerns have been raised either with regard to the lack of environmental or safety legislation or the degree with which it is enforced by the recycling states. As a result of this, the activity, in the way it is carried out by some recycling facilities in those countries, is now regarded by the International Labour Organisation (ILO) as one of the most dangerous in the world. There are calls to ensure that more facilities become capable of breaking up and recycling ships both cleanly and safely, in both Europe and Asia. The need for yards of this type in Asia exists as the vast majority of the scrap steel extracted from ships finds a ready market in the construction industry and the various components of the ships (auxiliary engines, batteries, hydrocarbons, brass fittings, copper, household fittings such as wash basins, taps, toilets and showers etc) are re-sold for further use.

There is a requirement for all single hulled oil tankers to be replaced by 2010. This is expected to lead to a massive increase in the number of ships requiring disposal, magnifying the problems faced today. There are also approximately 200 decommissioned ships, the so-called "Ghost Ships", owned by the US government awaiting disposal in James River, Virginia.

The 1972 London Convention and the OSPAR Convention of 1998 have effectively ruled out the disposal respectively of ships and oil and gas platforms by dumping at sea. This means that methods must be found to dismantle them safely and cleanly on shore.

CONTENTS:

Papers are invited on the following topics:

- Assessments of the future demand for recycling
- The economic and environmental case for recycling. Can the developed world compete?
- Design for recycling: Use of easily recyclable materials, creating and keeping an inventory of potentially hazardous materials and taking measures to facilitate the removal and disposal of these materials.
- Regulatory matters: International and National regulations and their enforcement, industry guidelines and voluntary codes of practice.
- Controlling the environmental impact of recycling.
- Working conditions in recycling facilities
- New technologies and methods of recycling.

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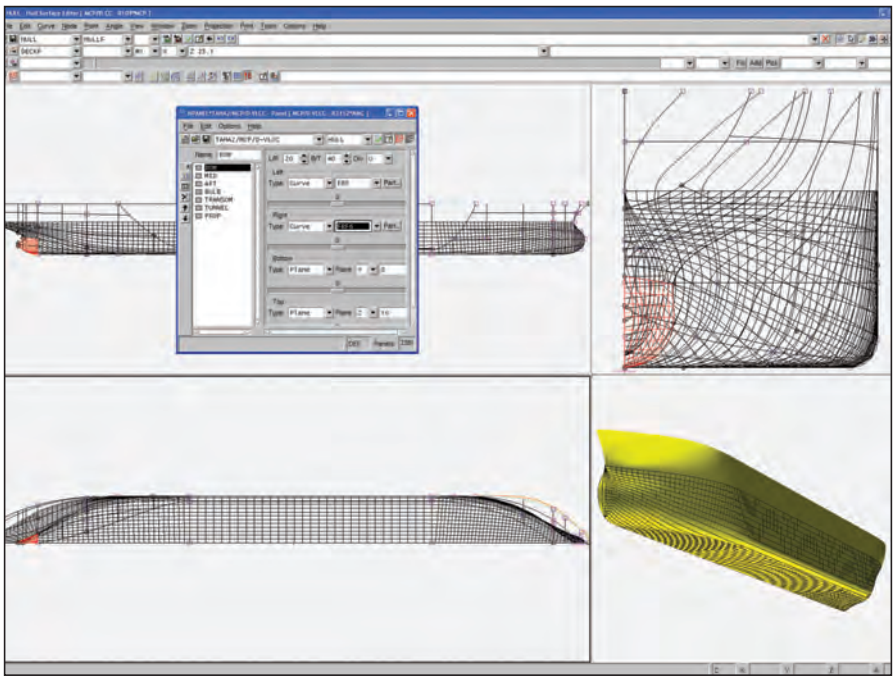
NAPA software chosen by Hyundai Heavy Industries

IN December last year, Finnish software specialist Napa Ltd won a prestigious order when Hyundai Heavy Industries, after a thorough evaluation and comparison process, decided to choose the NAPA software system for basic design at its large Ulsan shipyard. According to Matti Salo, Napa's president, 'Hyundai's Ulsan yard has tested NAPA for a few year with some licences, and has now decided to use the system as the platform in all important disciplines of initial and basic ship design phases in the early ship design process'. The company hopes to have the same success with other Korean yards.

Napa Ltd has witnessed large growth in Asia, where many leading yards now use it, including Samsung Heavy Industries, which increased its number of licences last year. Napa's net sales in 2004 reached some €7.5 million. The company employs more than 50 people in Finland and in its own representative offices in Japan, China, and Korea.



A typical display from the NAPA hull-surface editor.

The NAPA package has recently been enhanced by several new features, including a CFD wave resistance subsystem, which can calculate calm water resistance due to wave formation, also the wave system of a symmetric hull form moving at constant speed.

Product news from NAPA

The latest version of NAPA was released in November. Among the features are new NAPA Manager applications. This is a process-handling tool that organises complex tasks into a hierarchy having a predefined execution order and specified dependencies. Completely new Manager tools are those for contract design, MARPOL studies and damage generation, bulk carrier inner-bottom design, grain cargo space design and calculation, longitudinal strength analyser, study of flooding angles, tonnage calculation, and ballast exchange sequencing.

This new NAPA release also includes additions, such as facilities to calculate damage stability in accordance with the Revised Text of SOLAS Chapter II-1, and the Revised Text of Annex I of MARPOL, including the new Regulation 21 on oil outflow performance. The Freeboard Calculation Manager comprises functions for determining minimum freeboards, according to the adoption of the amendments to the protocol of 1988 relating to the International Convention on Load Lines 1966 [MSC143(77)].

NAPA's hydrodynamic systems are further enhanced by the addition of the CFD Wave Resistance subsystem. The CFD Wave Resistance calculation task calculates the calm water resistance due to wave formation and the wave system of a symmetric hull form moving at constant speed. The NAPA Steel module has also been developed, with new export capabilities. The first implementations of the Tribon interface have shown that considerable savings in working hours spent in detail design can be obtained. Furthermore, a new interface is available to Nupas-Cadmatic Hull.

Onboard-Napa Ltd recently released its new upgraded user interface for the Onboard-NAPA tanker version. This new version is intended for chemical, product, and crude oil tankers. It includes a new way of monitoring cargo operations while simultaneously allowing the planning of new conditions. The new balancing features provide the user with a unique way of finding the optimum solutions for complex cargo and ballast operations, while taking into account the restrictions pertaining to stability and longitudinal strength.

Shipbuilding enters new Arctic era with FESCO icebreaker/standby ship

AFTER a long gap, Finnish shipbuilding is swinging back into building ice-going ships for Russian waters. Since the numerous icebreaker projects from the Soviet Union in the 1980s and earlier, political changes resulted in a complete halt of newbuilding ship orders from Finland, including orders for icebreakers at the Helsinki yard. Until recently, the last huge projects of that type were the two nuclear-powered icebreakers *Taymyr* and *Vaygach*, delivered in the late 1980s for operation on the Yenisey River. Those ships were still ordered as part of a bilateral barter trade programme of that time, and today, Aker Finnyards Helsinki shipyard is once again re-starting on equally interesting shipbuilding projects for Russia.

One of two Azipods being lifted into position on the new FESCO icebreaker/offshore supply ship *Fesco Sakhalin*, during outfitting in the covered newbuilding dock at Aker Finnyards' Helsinki site.

Double-acting icebreaking supply/standby vessel for FESCO

Currently being outfitted at Helsinki is a combined icebreaker, offshore supply, and standby vessel for the Far-Eastern Shipping Co (FESCO). This €65 million (approximately) vessel is due for delivery in May this year and is expected to work at the Orlan production platform in the Sakhalin-1 offshore field, which is operated by Exxon Neftegas, an affiliate of ExxonMobil. Tasks will include clearing of grounded rubble ice around the gravity-based concrete platform, and guaranteeing supply and standby operations.

The ship has a length oa of 99.90m and a deadweight of 3950dwt. She is fitted with two azimuthing electric propulsion units of the now familiar ABB Azipod type, each with a power of 6.5MW. ABB has also delivered the three main generators as well as switchboards, transformers, and the two bow thruster motors. Primary power comes from three eight-cylinder Wärtsilä 38 main engines each with an output of 5800kW at 600rev/min, and a six-cylinder Wärtsilä 20 engine of 1080kW at 1000rev/min to power a harbour/emergency generating set.

The hull design is based on the Kvaerner Masa-Yards/ABB double-acting principle, which has been developed and patented by the Arctic Technology Centre and already employed on a few ships including the 106,000dwt tankers *Tempera* and *Mastera* (*Significant Ships of 2003*). With this hull form, a vessel penetrates the most difficult ice conditions with the ship's stern first, powered by azimuthing electric propulsion. This technique reduces power demand, and the bow can be optimised for efficient operation in ice-free conditions. No ship with conventional bow icebreaking would be capable of approaching the platform through the rubble, claims the designers, which will now be done by slowly moving against it with the stern first. Final ice trials with the vessel will take place in the Sakhalin area.

TECHNICAL PARTICULARS
FESCO ICEBREAKER/STANDBY SHIP

Length oa	99.90m
Length, at dwl	93.50m
Depth, to main deck	11.00m
Draught, max	7.50m
Deadweight	3950dwt
Machinery	Diesel-electric
Propulsion	2 x 6.5MW Azipods
Speed	15.00knots
Classification	Det Norske Veritas

Marioff busy as sprinkler systems become mandatory

THE deadline for sprinkler systems on passenger ships is approaching. By October 1, 2005, all passenger ships, except the smallest ones, must be equipped with an approved sprinkler system and, in addition to the mandatory CO_2 or other total flooding system, a local-application system for high-risk areas in machinery spaces.

Marioff Corp, pioneer of the water-mist extinguishing concept, has been kept busy over recent years, installing the company's successful Hi-Fog high-pressure water protection system as retrofits. This work has often been done by Marioff on a turnkey basis. Since 2000, some 200 retrofit installations have been completed. Retrofit work has proved relatively simple, as the Hi-Fog's small-diameter pipes have been easily fitted above deckheads, even on old vessels, where this space usually is very limited. Also, the light weight of components has been a benefit for both installers and owners.

On the newbuilding side, Marioff has been able to maintain a very high market share, with several new cruise ship orders. Recent deliveries include, among others, those to *Color Fantasy*, *Birka Paradise*, and the newest cruise liners built for Carnival and Royal Caribbean. Over the years, Hi-Fog fire protection systems have been extensively tested to verify their suppression effectiveness in a variety of fire scenarios. Since 1991, some 6000 full-scale fire tests have been conducted, both at outside fire laboratories, at the Finnish VTT research organisation, and at Marioff's own fire laboratory. Marioff, which has subsidiaries in eight countries for sales and service, and employs some 300 people, has recently inaugurated new training facilities at its new headquarters.

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More LNG orders for Wärtsilä dual-fuel engines

A KEY breakthrough into the Korean LNG carrier market was secured last November by the world-leading Finnish enginebuilder Wärtsilä: as reported in *The Naval Architect* January 2005 (pages 3 and 4), the company won an order for 16 engines to power a series of four 155,000m³ dual-fuel/diesel-electric LNG carriers for BP Shipping, to be built at Hyundai Heavy Industries (Ulsan) and Hyundai Samho Heavy Industries.

The ships are scheduled for delivery from mid-2007 onwards, and each will be equipped with two 12 and two nine-cylinder Wärtsilä 50DF dual-fuel engines with an aggregate output of 39.9MW. These orders include an option to supply another 16 dual-fuel engines for four optional vessels.

In October last year, Wärtsilä announced that it had successfully modified its 50DF engine to be able also to burn heavy fuel in the diesel mode instead of diesel oil. This is good news for owners in their efforts to lower fuel costs; the option is available for engines built after August 1, 2005, meaning that the BP LNG carrier engines will be the first with this feature. Until now, 50DF dual-fuel engines have had the ability to run either on gas with a small quantity of marine diesel oil pilot fuel in 'gas mode', or on marine diesel oil alone in 'diesel mode'. Wärtsilä has also recently introduced double-wall gas piping on the 50DF engine to simplify engineroom installation and to reduce costs.

'The dual-fuel-electric machinery concept is far ahead of the competition in terms of environment-friendliness, reliability, redundancy, maintainability, fuel flexibility, as well as operating economy and safety,' claims Mikael Mäkinen, group vice-president, Wärtsilä Ship Power. 'The recent introduction of heavy oil for the engine's 'diesel mode' further enhances fuel flexibility and provides operators with a high degree of control over operating costs under fluctuating gas and liquid fuel prices'.

Seen here on trials is the 74,500m³ *Gaz de France Energy*, which pioneered the trend towards non-steam-turbine-powered ships, and is the first LNG carrier with Wärtsilä 50DF dual-fuel engines. This ship is also the first to feature the new GTT CS1 membrane cargo containment system.

An impression of the 153,000m³ LNG carriers *Provalys* and *Gaselys*, which will also be powered by Wärtsilä dual-fuel engines in a diesel-electric arrangement.

More orders for French LNG carriers

At the end of last year, the world-leading Wärtsilä received a further important new dual-fuel order - for three 12-cylinder (12V50DF) and one 6-cylinder (6L50DF) 50DF engines, with a total power of 39.9MW, for the third diesel-electric ship at Chantiers de l'Atlantique, in Saint-Nazaire, France. This package will power the 153,500m³ diesel-electric LNG carrier *Gaselys*, under construction at this yard, for operation by a joint-venture between Gaz de France and Nippon Yusen Kaisha (NYK). The ship, ordered a few months ago, will be delivered in October 2006. The 12-cylinder engines each develop 11,400kW at 514rev/min and the six-cylinder engine has a power of 5700kW. They will be built at Wärtsilä's Trieste factory for delivery in October this year.

Including this order, Wärtsilä has now received dual-fuel engine orders for seven ships and has options for four more ships. In 2002, Wärtsilä received its first LNG carrier order for four six-cylinder 6L50DF engines, with an aggregate output of 22.8MW, for Gaz de France's pioneering 74,500m³ so-called Medmax ship *Gaz de France Energy* (presented in the newly published *Significant Ships of 2004*), also from Chantiers de l'Atlantique.

Gaz de France Energy is the first LNG carrier featuring the new dual-fuel-electric propulsion system. A service speed of 16.00knots can be achieved with three of the four generating sets, with a service speed of 17.50knots at 22.8MW power. Natural boil-off gas complemented by forced boil-off gas will serve as fuel in normal operating conditions. In case no gas is available, the engines will run on marine diesel oil.

A further four engines were delivered to Chantiers de l'Atlantique last month for installation on the 153,500m³ dual-fuel-electric LNG carrier *Provalys*, sister to *Gaselys*. This ship will be delivered at the end of this year, with an identical set of Wärtsilä's dual-fuel engines as those just ordered.

Boost for new machinery for LNG carriers

Until recently, steam turbines, burning the natural gas that boils off from a ship's cargo tanks during a voyage, have been the only practical propulsion machinery option for LNG carriers (as discussed in *The Naval Architect's* special September 2004 supplement *Design and Operation of Gas Carriers*). Their low fuel efficiency has, however, already made virtually all other shipping segments switch to diesel-powered ships. As a consequence, engineers with steam turbine skills are becoming in short supply, which is a worry for many LNG carrier operators.

Dual-fuel-electric machinery requires significantly less engineroom space than a steam turbine installation, resulting in both increased fuel efficiency and increased cargo capacity. Maintenance is simplified as generator sets can be taken off line and maintained on passage, while machinery redundancy is enhanced, thus cutting the risk of a power failure.

The Wärtsilä 50DF engine uses low-pressure natural gas as primary fuel. In order to trigger ignition, a very small quantity of liquid fuel is injected when running on gas. As a secondary fuel, marine diesel oil or heavy fuel oil (the latter on newer models) can be used. Switching from primary to secondary fuel can be carried out automatically at any engine load.

LevelDatic WIM: detecting water ingress on bulk carriers

THE Finnish developer and manufacturer of remote level gauging and draught measuring systems, SF-Control Oy, has recently developed an intelligent water-ingress detection system for bulk carriers. LevelDatic WIM does not only locate water but also provides information on how water levels change in a cargo hold for various types of bulk cargo, both absorbent and non-absorbent types.

The LevelDatic WIM is a stand-alone system, which has been type-approved by all major class societies. For ballast water exchange and management, the information from this sensor can be included in existing LevelDatic LD80S or LD100S remote tank level and draught monitoring to provide complete information for managing bulk carrier safety during ballasting operations.

As opposed to most other bulker systems, LevelDatic WIM is claimed not only to fulfil the IMO SOLAS Chapter XII Regulation 12 requirements in full, but to provide, in addition to the stipulated pre-alarm and main alarm, also the means to continuously monitor and display any change in the water level in every cargo hold, void space, and empty ballast tank. These levels are shown in an alarm display unit on the navigating bridge. One of these systems has recently been retrofitted to the bulk carrier *Kontula*, owned by ESL Shipping. To date, no problems have been reported with the system.

The LevelDatic alarm panel (for a standard system) is at the left of this shared console. The water level in any tank can be continuously monitored.

Technical features

LevelDatic WIM incorporates all the same safety features found in other LevelDatic systems. The system consists of one or more LevelDatic 80S type-approved cabinets, depending on the number of holds, void spaces, and empty ballast tanks to be monitored. From each cabinet, air pipes run to the holds, dry voids, and empty ballast tanks in protected enclosures on deck or in top wing tanks. In holds, protective pipes are fitted for the air pipes. These protective pipes are specially made for water ingress detection, and a patent is pending on the design. Void spaces and empty ballast tanks use the same type of piping as on other ships fitted with LevelDatic.

The alarm unit, preferable with a display, is fitted on the navigation bridge. In LevelDatic 80S, and consequently in LevelDatic WIM, there are no sensors, moving parts, or cables in the cargo holds, voids or ballast tanks, to avoid any damage. In the rare event of a sensor failure, changing the unit is easy and quick because the sensors are in the cabinets. No calibration of a new sensor is needed nor any no re-booting of the system after a change.

The protective pipes are fitted at the aft bulkhead in the cargo holds, either at the centreline or on both port and starboard side at the bulkhead, as required by the water ingress detection regulations. Water ingress can generate a hydrostatic pressure, but this can be detected, and any change monitored on-line continuously with LevelDatic WIM.

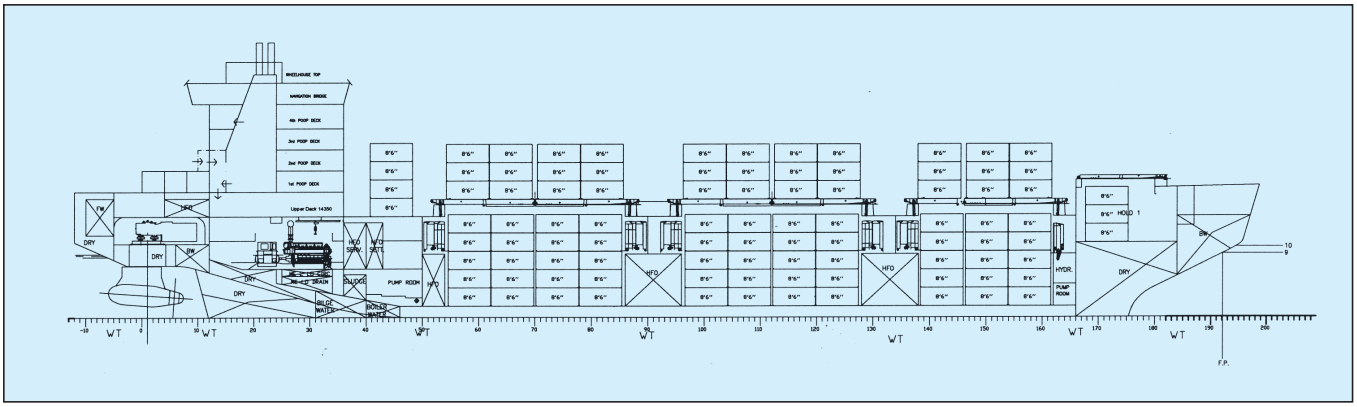
A new type of protection pipe has been developed by SF-Control, to improve water detection capabilities in absorbent bulk cargoes in a LevelDatic WIM installation; it can also be used with high-density non-absorbent materials. The pipe can easily be cleaned using water.

More than 1000 standard systems in operation

Since 1987, more than 1000 LevelDatic standard tank systems have been delivered. Their accuracy and reliability is said to be well-proven and recognised by major owners. Usually, LevelDatic provides on-line continuous information on actual levels in spaces for ballast water, fresh water, grey water, fuel, lubricating oil, and sludge. In addition, draughts are measured at the bow, port and starboard midships, and aft.

For many cruise and passenger ships, LevelDatic is also used for detecting and monitoring possible water ingress in void spaces, compartments, and empty tanks. Following any serious casualty, such as grounding, collision, explosion or fire, LevelDatic can provide immediate information on the extent of structural damage by detecting any leakage and monitoring any changes.

Together with Onboard-Napa Oy, SF-Control has developed the DFC concept, which is special decision support application for flooding control. In a DFC system, LevelDatic provides on-line continuous level and water ingress information from all tanks, voids, and compartments monitored, plus draught information, to the Onboard-Napa software. Based on this information, Onboard-Napa calculates the initial damage stability and the progress of damage stability as a situation develops.



A profile of the new 14,500dwt Arctic container ship for Norilsk Nickel. Although export cargoes are mainly based on modular TEU sizes, no cellular guides will be fitted, and cargo handling at Dudinka will be mainly performed by mobile cranes due to the special flood conditions at that port.

Double-acting Arctic container ship to speed Russian nickel exports

LAST August, a contract, worth €70 million, was signed with MMC Norilsk Nickel for the construction of a 14,500dwt Arctic container vessel for operation on the Northern Sea Route - a further landmark in the move by Russia to renew its Arctic fleet with new-generation designs. This ship will be the latest to utilise the Kvaerner Masa/ABB double-acting principle developed by the Arctic Technology Centre (MARC), whereby the hull travels astern into heavy ice. The operator plans to transport nickel semi-finished products and export materials from Dudinka, on the river of Yenisey, to Murmansk. MMC Norilsk Nickel Group, which is believed to be the world's largest producer of nickel, is in the process of improving its transportation logistics to secure on-time and cost-effective transport.

The Arctic Technology Centre did several feasibility studies and model tests in its ice basin in order to find out the best economical and technological solutions. This vessel is a prototype for a new series, which is intended to replace the current SA-15 class vessels (built by the Valmet yard in Finland) that have been in successful use for the last 20 years. Norilsk hopes to have up to six new ships in operation by 2009.

Assembly and outfitting will be carried out at the Helsinki yard for delivery in February 2006.

TECHNICAL PARTICULARS
NORILSK ARCTIC CARGO SHIP

Length, oa	168.60m
Breadth	23.10m
Draaught, dwl	9.00m
Deadweight	14,500dwt
TEU containers	650
Gross	16,000gt
Icebreaking capacity	1.5m level ice (with a snow layer of 200mm)
Machinery	diesel-electric, azimuthing electric propulsion
Main engines	3 x Wärtsilä 12V32
Output	3 x 6000kW
Propeller	1 x 13MW Azipod
Classification	Russian Maritime Register of Shipping Ice Class LU 7

An impression of the new Norilsk diesel-electric Arctic container ship. Employment of the double-acting principle will allow astern icebreaking without icebreaker support in level ice up to 1.5m thickness.

The cargo part of the hull (forward of the engineroom bulkhead) was originally subcontracted to Aker Finnyards group member Aker Tulcea, in Romania, but recently a decision has been made to move this work to Aker Ostsee in Warnemünde, Germany. Blocks for the aft part of the ship will be fabricated by the group's steelwork factory at the Turku yard.

This will be the first cargo ship actually owned by Norilsk Nickel, since currently, sea transport is handled by the Murmansk Shipping Co, which also operates the icebreakers in the area. Using its double-acting features, it will be able to operate independently without icebreaker assistance - stern-first in double-acting mode - in most ice conditions prevailing on the Dudinka-Murmansk route.

Norilsk Nickel is in the process of unitising its nickel transport operation. Pre-rolled nickel plates on flats/frames of standard size will be loaded in Norilsk onto pallets, sized to fit TEU dimensions, from where they will be transported by train to the port of Dudinka by the Yenisey River, for further travel by sea to Murmansk and elsewhere.

The intention is to cut turnaround times by using vertically loaded cellular vessels. Regular traffic time schedules should be maintained, and much time will be saved by not having to wait for icebreaker assistance. Estimates suggest that transport costs could be halved - today, a normal round trip on that route is approximately 17 days.

The ship is fitted with one tweendeck, since, on return legs, there is still much general cargo, machinery, and rolling goods that need to be transported in sheltered conditions. Due to the existence of these decks, no vertical cell guides are installed, despite the fact that the loading system is based on cellular-type vertical handling. Instead, the hull's longitudinal bulkheads act as supports.

Because of this arrangement, no deck cranes will be installed, instead mobile Liebherr container cranes will be used in the port of Dudinka - new cranes are already in service and more are believed to be on order. Another reason for the choice of mobile cranes is that during spring floods that affect this port, water levels rise by around 20m, and all equipment has to be evacuated to nearby hills.

This interesting new flagship should be delivered from the Helsinki yard in February 2006, with final handover after ice trials in the Kara Sea.

Heavy fuel alternative for dual-fuel engine

LNG carrier operators are being offered more choice in fuel cost savings by Wärtsilä Corporation, which is improving its 50DF dual-fuel engine to allow heavy fuel oil (HFO) use in 'diesel mode'. The Finnish group says enhancing an engine's capability will make the dual-fuel-electric machinery concept for LNG carriers more attractive to a wider range of potential customers.

Up to now, Wärtsilä 50DF dual-fuel engines have been able to run, either on gas with a small quantity of marine diesel oil (MDO) pilot fuel in 'gas mode' or on MDO alone in 'diesel mode'. Now, the company means to offer this greater fuel flexibility on all those engines produced from August 2005.

Earlier this year, the supplier introduced double-wall gas piping on the Wärtsilä 50DF dual-fuel engine in order to simplify engineroom installation and to reduce costs. As explained in *The Naval Architect's* special new supplement *Design and Operation of Gas Carriers*, the dual-fuel/-diesel-electric machinery concept for LNG carriers, applying multiple dual-fuel engines in combination with electric propulsion motors, appears to offer one means of breaking the dominance of steam turbine installations in LNG shipping.

Wärtsilä Corp, PO Box 244, Vaasa, Finland. Tel: +358 10709 1439.
www.wartsila.com

Canadian bearings for Princess cruise liner

A new cruise ship being built for Princess Cruises at the Fincantieri shipyard in Monfalcone, Italy is to be fitted with Compac propeller shaft bearings, supplied by Thordon Bearings Inc, of Burlington, Canada. This vessel, the seventh Princess Cruises liner to be equipped with water-lubricated Compac bearings since 1998, will carry tapered single-key design bearings. These can be withdrawn easily from the bronze carrier for inspection and re-installed with the shaft still in place, according to Thordon.

The company claims that the elastomeric polymer alloy bearings for the 642mm diameter propeller shafts should promote hydrodynamic operation at low shaft speeds. This is a pollution-free system using seawater to ensure sufficient flow for both bearing lubrication and cooling. The concept eliminates oil from the sterntube, so avoiding pollution risk through sterntube leaks.

Thordon Bearings Inc, 3225 Mainway Drive, Burlington, Ontario L7M 1A6, Canada. Tel: +1 905 335 1440.
Fax: +1 905 335 4033.
www.thordonbearings.com

New lifts for inland waterways ships

A new passenger lift system for inland waterway ships with a hydraulically raisable wheelhouse has been developed by Airborne Elevators, part of the Dutch company Airborne Group. The new lift, which allows crew members to travel from the saloon directly to the wheelhouse without venturing outside, includes what Airborne claims is an unique concept. This is a movable elevator trunk, which enters the wheelhouse through an automatically operated hatch when the lift reaches that level. When the lift car is below, the trunk moves down, closing the wheelhouse deck hatch. The lift can be used whether or not the wheelhouse is raised.

Raisable wheelhouses are a common feature of inland waterway vessels in Europe. Regulations in The Netherlands require that visibility from the wheelhouse is clear 350m ahead of a ship when it is loaded.

Where the new lift is installed in tankers, the lift car is gastight, as required by regulation and here, Airborne has developed an extremely compact gastight sliding door because of space constraints when installing the lift.

Airborne Elevators, Airborne Systems BV, PO Box 442, 8440 AK Heerenveen, The Netherlands. Tel: +31 513 684 44. Fax: +31 513 684815.
E-mail: e.heybroek@airborneelevators.com
www.airborneelevators.com

More tankers have JLMD oil recovery piping fitted

In the battle to eliminate major incidents of marine pollution, French shipping company Socatra plans to fit its whole tanker fleet with a fuel and cargo recovery system developed by JLMD Ecologic Group SA. The JLMD system, first featured in *The Naval Architect* September 2003, page 128, comprises a set of pipes pre-installed in cargo and fuel tanks with outlets in a vessel's hull for emergency recovery of potential pollutants in case of sinking or grounding. It was fitted aboard a first Socatra ship last autumn (2004). The 30,600gt double-hull tanker *Nizon*, constructed by STX Shipbuilding in South Korea, is chartered to the oil group Total. A second tanker, *Kerlaz*, named in Barcelona in early November, has also been equipped with the JLMD system, while a third Socatra vessel, *Kermaria*, is scheduled to follow suit at the end of December this year.

Nizon was only the second ship to be fitted with the system, the first being *Valtamed*, constructed in South Korea for Navigazione Montanari and chartered to Tamoil. A total of 30 ships should have been equipped with the JLMD recovery system by the end of 2005, and up to 50 oil tankers are awaiting fitting or retrofitting, reports the Nice-based JLMD Ecologic Group.

JLMD Ecologic Group SA, 3 rue Paradis, 06000 Nice, France.
Tel: +33 4 97 11 09 10.
Fax: +33 4 93 16 28 40.
www.jlmdsystem.com

Combined throwing line and lifting strop

A versatile new piece of shipboard rescue equipment comprising a combined throwing line and lifting strop has been introduced by marine safety specialist Ocean Safety Ltd, of Southampton, England. The Kim throwing and recovery strop allows rescuers to establish contact with a man overboard and to recover him from the water without resorting to extra equipment. It brings together a 30m floating, high-strength line packed into a compact, high-visibility bag bearing clearly printed instructions on use, with a padded recovery strop in a neat single package for accurate deployment. Repacking after use is said to be simple and speedy, with ample bag space for the line and easy return to storage positions of the wrist loop and strop.

Ocean Safety Ltd, Saxon Wharf, Lower York Street, Southampton SO14 5QF, UK. Tel: +44 23 8072 0800. E-mail: mail@oceansafety.com
www.oceansafety.com

Engine exhaust-gas analyser

A number of UK and Scandinavian ferries are already taking advantage of 'compact', cost-effective ship exhaust-monitoring systems being supplied by Enviro Technology Services plc, of Stroud, England.

In answer to problems associated with checking emissions from engine exhaust lines, Enviro Technology is offering to provide its advanced and complete Opsis M1040 and M1050 analysers, already certified for ship monitoring applications by Det Norske Veritas. The chemi-luminescent M1040 unit for NO monitoring is designed to operate well with diesel engine applications. An optional converter allows measurement of NO_2 and NOx while an optional sensor, incorporated in the dilution probe, will provide O_2 measurements, says the supplier.

Employing the fluorescent technique, the M1050 analyser can measure SO_2 and also offers the O_2 option. Both systems come with a sample pump, sample line, and dilution probe, and make use of a stainless steel sample probe with particulate papers to avoid clogging.

Enviro Technology Services plc, Kingfisher Business Park, London Road, Stroud, GL5 2BY, UK.
Tel: +44 1453 733200.
Fax: +44 1453 733200.
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Press-fitting pipe systems

A wide range of ships, from ferries and cruise liners to tankers are now being fitted with piping systems developed especially for the marine sector by specialist plumbing company Viega GmbH & Co KG, of Attendorn, Germany. Viega offers four pipe systems aimed at specific common areas of installation for marine applications. Its Profipress copper piping, in sizes from 12mm to 108mm, is suitable for all rising and distribution pipes aboard ship. Viega's multi-layer composite Santa Fosta flexible piping, which is diffusion-proof and compatible with the company's metal systems, is installed from the coil, and provides a more economical solution for toilet and wash basin connections. In addition, Viega has the copper-nickel Seapress and stainless steel Sanpress Inox piping aimed at fire-extinguishing and sprinkler systems.

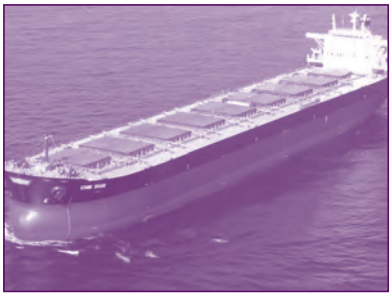
Pipe soldering or welding is eliminated with the Viega products because each features the

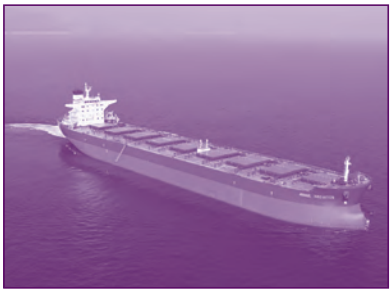
The Royal Institution of Naval Architects

Design and Operation of Bulk Carriers

18 - 19 October 2005, RINA HQ, London, UK

First Notice & Call for Papers





Since they were developed in the 1950s, bulk carriers have provided a crucial service to world commodities' transportation. Some 5,000 bulk carriers trade around the world.

Following a spate of losses of bulk carriers in the early 1990s, IMO in November 1997 adopted new regulations in SOLAS containing specific safety requirements for bulk carriers. In December 2004, the Maritime Safety Committee adopted a new text for SOLAS chapter XII, incorporating revisions to some regulations and new requirements relating to double-side skin bulk carriers. The International Association of Classification Societies are also developing a set of unified requirements for the classification of bulk carriers. This conference will bring together designers, regulators, class societies and operators to discuss these, and other, aspects of bulk carrier design and operation.

Papers are invited on all subjects related to bulk carriers, including the following topics:

- Pros & Cons of Double Skin Tankers
- Designing to meet New Regulations
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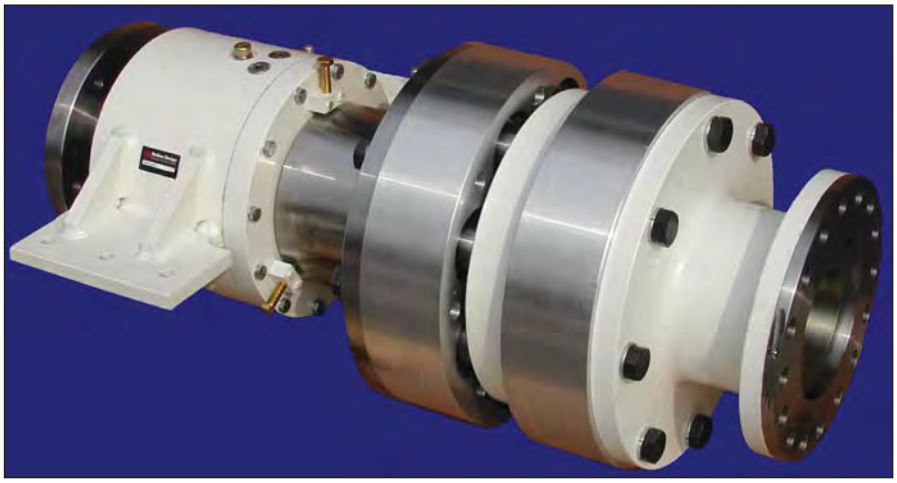
Viega Sanpress Inox is a useful press-fitting system for drinking water, fire extinguishing, and sprinkler lines. Sizes range from 15mm to 54mm.



An example of the new PS thrust block from Rubber Design, which in cooperation with the company's ERD coupling, is designed to shrink levels of noise transmission through a hull.

cold-press fitting technique, sealed by a special press-fitting tool with an articulated jaw. This claims to allow press-fitting in the tightest corners, as well as improving safety by avoiding work with naked flames, and cutting installation time by around a third. Another special feature is the inclusion of SC-Contur special shapes in the crimp of the sealing elements so that any missed connections are revealed during water testing. Among vessels already fitted with Viega piping systems are Royal Caribbean International's liner *Serenade of the Seas*, the container ship *Maersk Vigo* from the A P Möller fleet, the tanker *Furenäs*, of Furetank Rederi AB, and the TT-Line ferry *Peter Pan*.

Viega GmbH & Co KG, Postfach 430/440, 57428 Attendorn, Germany.
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German automation for Korean-built ships

Under a collaboration agreement, SAM Electronics GmbH, of Hamburg, Germany, is supplying the South Korean yard STX, with an extensive range of automated equipment for installation aboard a range of new vessels. Equipment will be supplied by SAM in association with Lyngsø Marine, of Denmark, with whom the German company has a partnership agreement. STX, based at Chinae and with an engine works not far away, is already assembling locally ISO 9001-certified systems covering engine safety, electronic governor, and alarm monitoring modules as part of integrated propulsion units. STX retains responsibility for their testing, sea trials, and class acceptance, too.

The first new ship to be so fitted under this new agreement, the 30,600gt tanker *Nizon* (see item elsewhere in the section), has an automated bridge manoeuvring system, along with machinery alarm and monitoring facilities. STX is also fitting SAM automated systems to engines to be installed in ships at other Korean yards, as well as for engines to be exported to Chinese, Indian, and Romanian shipyards. In September 2004, STX Shipbuilding had an orderbook for 99 product, chemical, and oil tankers worth around US$3 billion for the next three years.

SAM Electronics GmbH, Behringstrasse 120, 22763 Hamburg, Germany.
Tel: +49 40 8825-0.
Fax: +49 40 8825 4000.
www.sam-electronics.de

New thrust block to help lower noise levels

Rubber Design BV claims to have taken a major step in reducing hull vibration and structure-borne engine and gearbox noise with its development of a range of compact PS thrust blocks in combination with its ERD marine couplings. Structure-borne noise is transmitted quickly through a hull, causing disturbing resonance in areas of the vessel beyond the engineroom, which can result in discomfort and problems on board. The new thrust block prevents the propeller thrust load being absorbed by the engine and a close-coupled gearbox, thus allowing an optimised flexible mounting system of engine and gearbox to be used.

This should isolate any vibration and shrink volume of noise transmitted through the hull. For very high loads, the new thrust block can be provided with integrated water-cooling to maintain thrust block oil at an ideal temperature for optimum performance and longevity.

Rubber Design BV, PO Box 15, Industrieweg 21, 2995 ZG Heerjansdam, The Netherlands.
Tel: +31 78 6778778.
Fax: +31 78 6771038.
www.rubberdesign.nl

The mobile gravimeter CHEKAN-AM

The mobile gravimeter CHEKAN-AM is the fourth generation of the marine gravimetric system, which for 30 years have been manufactured by CSRI Elektropribor, based in Russia. The gravimeter is intended for detailed marine gravimetric survey of gas and oil zones, as well as regional airborne surveys.

The system allows measurement of gravity increments with respect to the initial reference gravimetric station; external real-time navigation data acquisition from a satellite navigation system or an inertial navigation

Fig. 1

system; as well as real-time calculation, indication, storage, and output of gravimetric and navigation data.

The mobile gravimeter has a dynamic measurement range of 15Gal, a limiting error of 1mGal, a resolution of 0.01mGal, and a recording frequency of 1Hz-10Hz. Its interface is RS-232, while the unit measures 460mm x 700mm, and weighs 50kg. The system's power supply is 220V, 50Hz, and consumes 700W. The gravimeter has been designed as a single unit which includes a gravity sensor, gyrostabilizer, as well as various devices and modules that enable the gravimetric sensor and the gyrostabilizer to function (Figure 1).

The gravimetric sensor is based on a double quartz elastic system (DQES) which consists of two torsions placed in the horizontal plane at an angle of 180degs relative to each other. The DQES output magnitude is a turning angle j of the pendulum lever which changes as the gravity increments.

The DQES housing is filled with silicone liquid to provide damping, temperature compensation, and pressure insulation (Figure 2). The DQES is contained in a microprocessor-controlled thermostat,

Fig. 2

built on Peltier-effect semiconductor modules. As the ambient temperature changes from -5°C to +30°C, the thermostat allows the required inner temperature to be maintained within an error margin of 0.1°C.

Tilt angles of the pendulum deflection are measured by an autocollimation-type OptoElectronic Converter with the photodetector based on two Charge Couple Devices (CCD) of linear type. An LED is

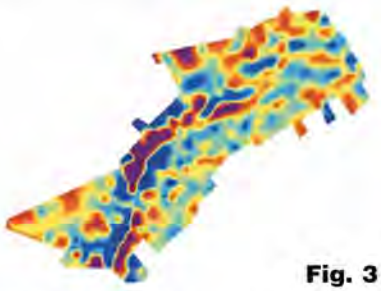


Fig. 3

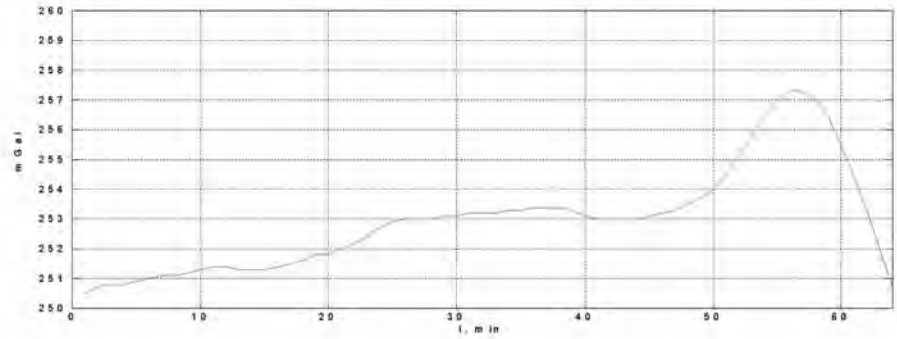
used as an emitting source operating in the pulse mode to allow for synchronisation of the gravity data output with an external source of information, including the GPS receiver.

The dynamic range of the measurement is no less than 15Gal, which makes it possible to carry out gravimetric surveys all over the world, even during rough sea conditions, without the measurement range readjustment.

The gyrostabilizer is compatible with all modern marine inertial navigation systems and the system includes single-degree-of-freedom floated gyros with gas bearings of practically unlimited service life, miniature accelerometers with built-in electronics, and digital gearless servo drives.
Single-channel microcontrollers on the inner gimbal of the gyrostabilizer are intended to supply power to the gyros, receive, and then digitize the accelerometer signals used to correct the position of the gyro precession axis, form the gyrovertical, and also to control the gyro torquers. Two single-channel microcontrollers are used to control the torquers. All the controllers are built on Siemens processors and interconnected via a CAN-interface.

In 1999, the first CHEKAN mobile gravimeter was installed on a research vessel carrying out marine seismic work, for a gravity survey in the hunt for oil and gas. A Bouger gravity anomaly map is shown in Figure 3.

A high level of correlation between the gravimetric measurements and the seismic profile proved that the methods of gravimetric survey showed considerable promise for locating gas and oil zones on the shelf (Figure 4). A number of gravimeters have been delivered all over the world and are currently in operation.



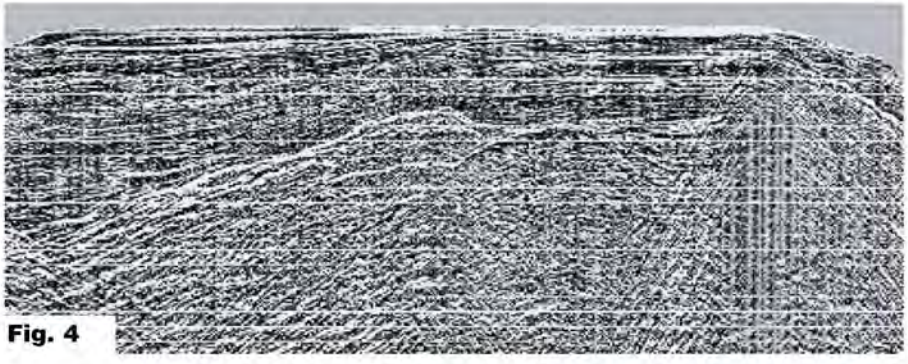


Fig. 4

FROM FUNDAMENTAL RESEARCH AND DEVELOPMENT TO MANUFACTURING AND MAINTENANCE OF ITS PRODUCTS

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Effects of mis-alignment on welded hopper knuckle connections

Helena Polezhaeva*, from Lloyd's Register, reports on R&D work, some of it carried out in Russia at the Krylov Institute, on the critical weld connections between hopper-tank sloping plating and the inner bottom on certain classes of ship.

THE welded connection between a hopper-tank sloping plating and the inner bottom plating for double-hull tankers and floating production, storage and offloading units (FPSOs) has always been a matter of concern, because of the very high local stress concentrations in this area. Considerable efforts have been made to optimise the design of the connection and to improve the fabrication process, with the intention of achieving quality welds and accurate alignment during construction. Research previously carried out by Lloyd's Register provides a review of current shipbuilding practices for alignment and tolerances for angled joints (Ref 1).

This article describes the results of an experimental and numerical research programme carried out by Lloyd's Register, aimed at defining the effect of mis-alignment on stress concentrations in way of angled joints with various geometrical parameters. The experimental work was performed by the Krylov Research Institute, in St Petersburg, Russia, under contract.

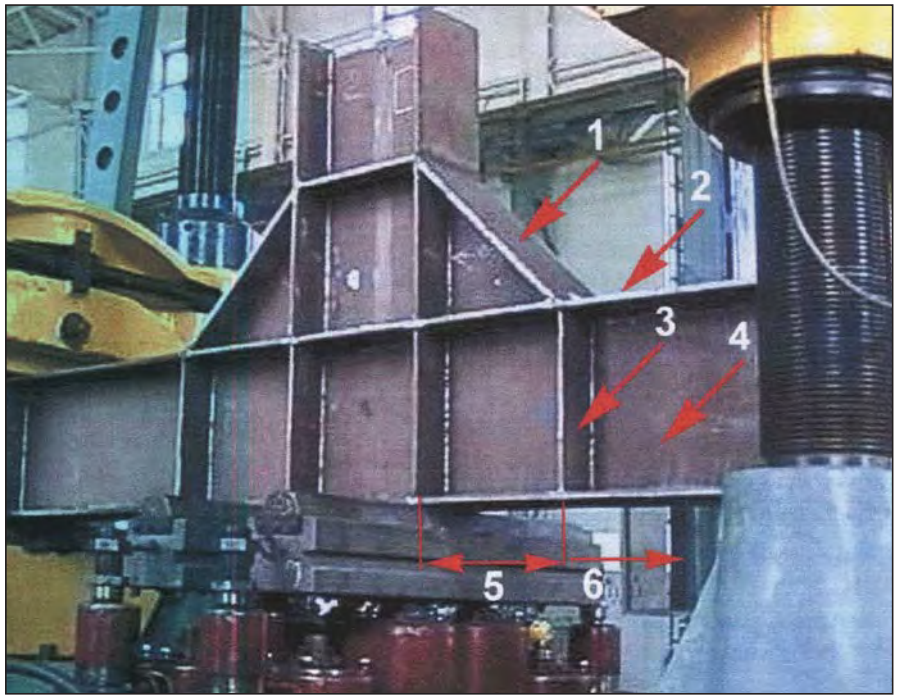


Fig 1. The experimental set-up for hopper knuckle connection: 1 - sloping plate; 2 - inner bottom plate; 3 - longitudinal girder; 4 - floor; 5, 6 - outer bottom plate.

Test models

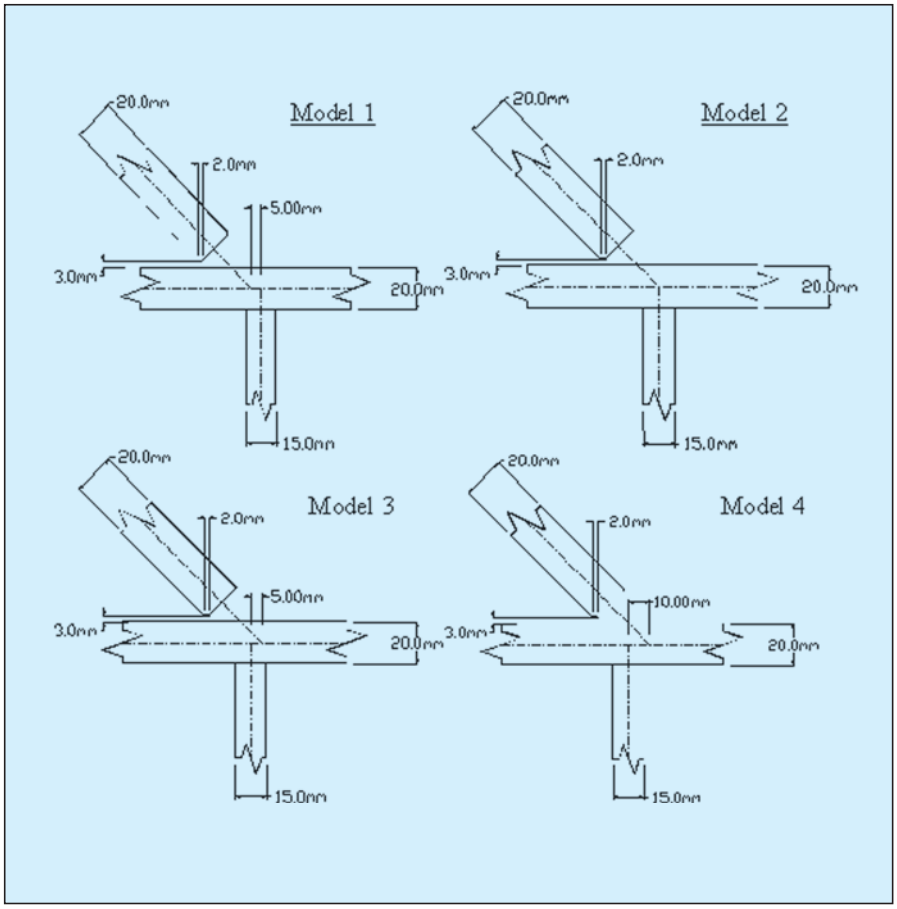
Four full-scale models of a hopper knuckle connection with various degrees of in-built offset were subjected to static loading and then tested under constant amplitude cyclic load. The structural models were fabricated from Grade A normal strength hull steel with a minimum yield stress of 235MPa. The experimental set-up and structural detail are presented in Fig 1.

Four plating alignments are shown in Fig 2. Full penetration welds were provided between the sloping plating and the inner bottom plating, and between the inner bottom plating and the longitudinal girder.

All tests took place under laboratory conditions at room temperature. The maximum applied load for the static and fatigue tests was approximately 870kN. The applied load ratio for all fatigue tests was equal to 0.1. The fatigue tests for the hopper knuckle connections were carried out on a bending pulsating machine with a loading frequency of approximately 1.4Hz. All four models were initially subjected to a static load to obtain strain and stress distributions at critical locations.

Strains were measured at the centreline and at the edge of the inner bottom plating for each model. The hot spot stress at the weld toe

Fig 2. Offset scenarios for four full-scale models of hopper knuckle connection.



* Helena Polezhaeva, BEng, MSc, PhD, MRINA, senior project engineer, Lloyd's Register.

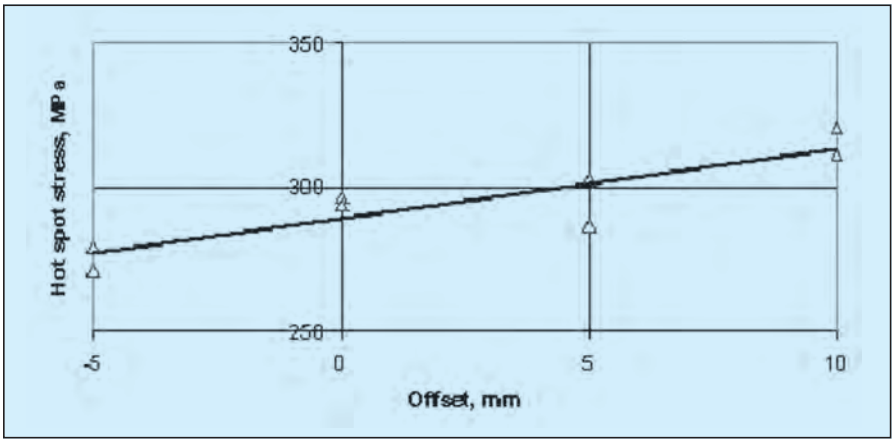


Fig 3. Hot spot stress at the weld toe for various offset scenarios.

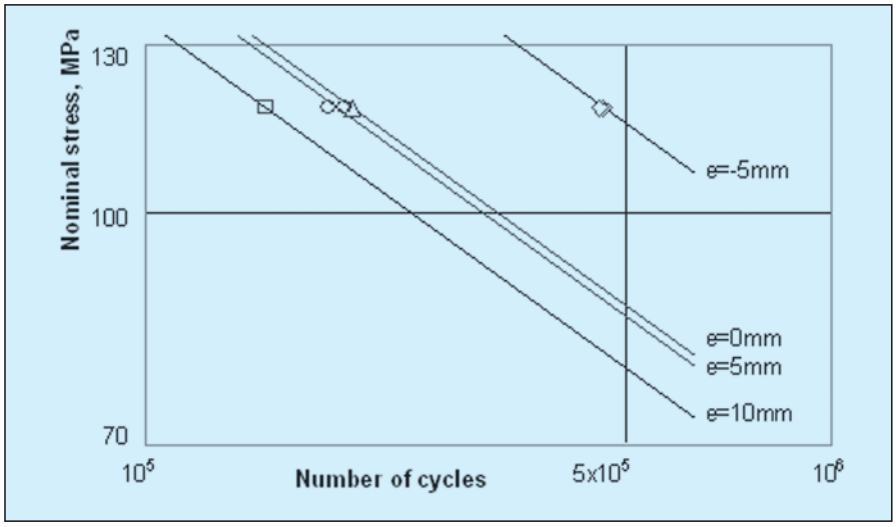


Fig 4. Nominal stress against number of cycles before the crack propagated through the thickness of inner bottom plating.

was obtained by linearly extrapolating the stress values measured at 0.5t and 1.5t away from the weld, where t is the thickness of the inner bottom plate. The centreline hot spot stress is shown in Fig 3 for each offset scenario. Eight experimental points relate to four models with two knuckle connections each.

Fatigue test results

In all models, a crack was initially registered at the welded connection of the sloping plate to the inner bottom plate. A fatigue crack always occurred at the location where the transverse structure (floor) was welded to the inner bottom plating and longitudinal girder.

The fatigue test results are given in Fig 4 in terms of nominal stress and number of cycles to failure in double logarithmic co-ordinates. Failure is identified as the number of cycles before a crack propagates through the thickness of inner bottom plating. The slope of S-N curves for each offset scenario is assumed to be m=3.

The initiation and propagation of cracks were monitored during the tests. Fig 5 shows the crack patterns for the model, with no offset between the sloping plate and the longitudinal girder.

Finite-element study

A top-down procedure was used to perform a finite-element analysis of the hopper knuckle test model. Global shell element modelling of a hopper knuckle structural detail was performed using LR STRAND (Lloyd's Register's in-house finite-element package). Deflections and rotations from this model were transferred to the boundaries of a local solid-element model.

The local solid element model of the hopper knuckle detail was created using the Pro/MECHANICA package (Ref 2).

Fig 5. Crack pattern for model with no offset.

Transverse fillet welds of 5mm leg length, connecting the sloping plate and the longitudinal girder to the inner bottom plate, were modelled using wedge solid elements.

Analysis of the hopper knuckle welded connection was carried out with -10mm, -5mm, 0mm, 5mm, 10mm, and 20mm offsets between the sloping plate and the longitudinal girder.

Results

The results of the experimental and numerical studies are presented as normalised stress at the weld toe versus normalised offset in Figs 6 and 7. Results are given for the model's centreline (floor location) and edge, respectively. Stress at the critical location is normalised with respect to the stress obtained with zero offset. The offset is normalised with respect to the thickness of the longitudinal girder t_l.

The dashed line in Fig 7 shows results from a 2-D model used in a previous study (Ref 3). The finite-element model of hopper knuckle connection was created and analysis was performed using a simplified assumption of plane stress condition.

As seen from Fig 6, for the floor location, the normalised stress could be described using a linear function of normalised offset.

The following conclusions refer to stress at the edge location:

- stress at the weld toe increases as offset changes from 0mm to -10mm and from +5mm to +10mm, and reduces when offset changes from 0mm to 5mm (Fig 7). This trend was observed when a 2-D model was used to describe effect of misalignment
- it is considered that the 2-D approach is valid for locations halfway between the floors if the distance between the floors is large enough
- stress at the floor location is significantly higher than that at the edges and therefore it was decided to focus on the floor location for further investigation
- it was confirmed that results obtained for the model with free edges are applicable to a continuous structure.

Normalised stress at the floor location will be referred to in the following sections as the 'stress concentration factor due to misalignment', K_e.

Effect of mis-alignment

Distance between floors

A selection of finite-element analyses was repeated for a number of increased model

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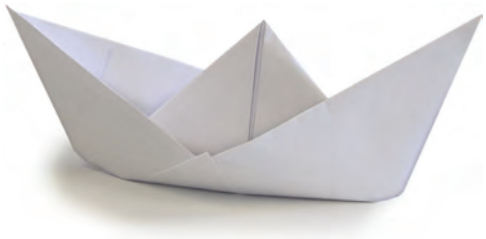

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widths (or distances between floors). It was found that the effect of mis-alignment reduces when the distance between floors increases. It was also shown that use of the stress concentration factor, K_e, obtained in the study, will lead to a conservative estimate of the hot-spot stress.

Thickness

The effects of inner bottom, longitudinal girder and sloping plate thicknesses were investigated using finite element analysis.

The expression for K_e was derived as a linear function of normalised offset as follows:

$$K_e=1.0+0.06\ {}^{e}/_{t_1}=1.0+0.08\cdot{}^{e}/_{t_1}\cdot{}^{t_1}/_{t_2}=1.0+0.08\cdot{}^{e}/_{t_2}$$

where t_1 is the thickness of the longitudinal girder and t_2 is the thickness of the inner bottom plating. It was found that the effect of mis-alignment is almost independent of the longitudinal girder and sloping plate thicknesses, if K_e is expressed as function of ${}^{e}/_{t_2}$.

Sloping plate angle

Numerical top-down analyses were performed including shell and solid element models with various offset and sloping plate angle of 60deg.

It was shown that the effect of mis-alignment is almost independent of sloping plate angle (within a range of 45deg to 60deg), providing K_e is expressed as function of ${}^{e}/_{t_2}$.

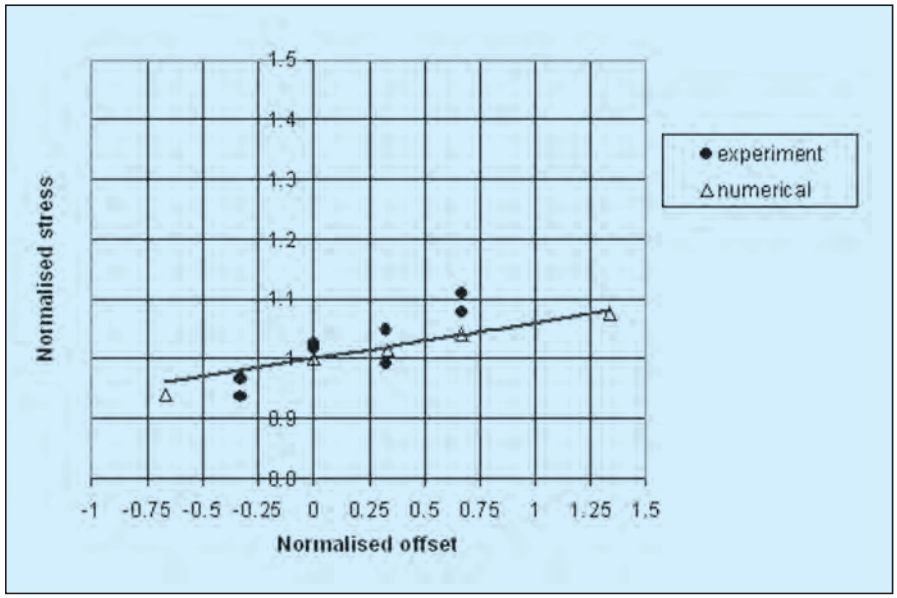

Fig 6. Normalised stress at the weld toe versus normalised offset at the floor location.

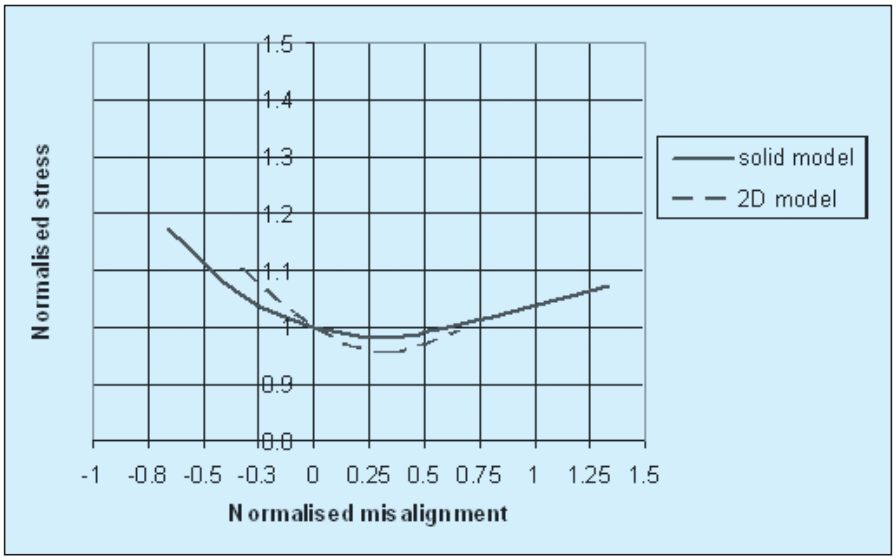

Fig 7. Normalised stress at the weld toe versus normalised offset at the edge location.

Conclusions

- In hopper knuckle details subjected to bending, the maximum stress concentration along a weld connecting the inner bottom to the sloping plate always occurs at the location where the transverse structure (floor) is welded to the inner bottom plate. According to results from finite-element analyses, the stress concentration factor K_e at the weld toe due to an offset between the sloping plate and the longitudinal girder is a linear function of the normalised offset ${}^{e}/_{t_2}$. Thus $K_e=1.0+0.08\ {}^{e}/_{t_2}$, where t_2 is the thickness of inner bottom plating
- it is suggested that the 2-D approach and results described in earlier research are only valid for the locations halfway between the floors if the distance between the floors is sufficiently large
- it was confirmed that the equation for the stress concentration factor due to misalignment gives a conservative estimate for a realistic range of floor spacings
- it was found that the effect of mis alignment is almost independent of longitudinal girder and sloping plate thicknesses
- change of sloping plate angle (within range of 45deg to 60deg) has little effect on stress concentration factor due to mis alignment.

Recommendations

For the given dimensions, stress at the critical location is reduced by 2% if an offset of $-t_1/3$ is used, and is increased by 2% if an offset of $+t_1/3$ is used. Respectively, this translates to a 6% increase and reduction in fatigue life. It is noted that $\pm\ t_1/3$ is the maximum allowable tolerance recommended by IACS (Ref 4).

Change within construction tolerance limits is not significant, hence the International Association of Classification Societies' recommendation that median line alignment be considered valid.

Lloyd's Register is continuously seeking to improve the fatigue performance of structural components from both a structural design and a fabrication point of view. With this in mind, it has carried out several experimental programmes over the past few years. These include fatigue tests of cruciform and inclined transverse fillet welded specimens to investigate the effect of weld dressing, and fatigue tests of cruciform specimens to investigate the effects of gap and penetration. Lloyd's Register, in co-operation with Odense Shipyard, in Denmark, is currently undertaking fatigue tests of plain material and butt-welded joints to investigate the effect of thickness in high-tensile steels on fatigue performance.

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New-generation cranes evolved by the MacGregor group

For many years, the MacGregor group has been a leader in shipboard crane design. In this special introductory article to our annual cranes and cargo-handling feature compiled by Richard Higgs, the company's newest designs and developments in various sectors - container, heavy-lift, bulk, and hose-handling - are analysed.

The first installation of MacGregor's new GLH heavy-lift crane was the pair of 320tonne units, each with 35tonne whip hoists, on the new 30,000dwt multi-purpose heavy-lift ship *Wladyslaw Orkan* delivered to Chipolbrok by Shanghai Shipyard.

OVER the past decade, the cranes business of MacGregor International AB. has carried out extensive design development to its wide range of shipboard cranes, targeting operators' varying needs. MacGregor Cranes first examined its container-handling designs where the GL series had become established as a leader with models covering the range of 25tonnes-50tonnes and above; following this, emphasis was diverted to specialised cranes for grab-handling and today an efficient range is marketed. MacGregor's new GLB two-rope unit is appropriate for most bulk carriers, while its four-rope K-series crane suits heavy-duty operations needing a high number of working hours annually.

The company has also turned its hand to developing deck cranes to meet the needs of operators wishing to handle heavy lifts, and the completely new GLH series is designed to cover a safe working load (SWL) range from 100tonnes-350tonnes. These cranes benefited from the same basic philosophy developed during long experience with the GL container models. The main difference is that a heavy-lift crane is much more complicated as it incorporates a higher degree of redundancy, such as a double-pump system.

Because these are such large units, great care was taken during their design to ensure that they could successfully operate with varying loads. As well as handling heavy weights, a GLH unit can also be fitted with a whip hoist, supplied to suit any SWL required, but usually 45tonnes, to enable full container-handling flexibility. Machinery has good weather protection, and the design has a low centre of gravity - a factor often of great importance.

The first GLH units entered service just over a year ago, on the 30,000dwt multi-purpose heavy-lift ship *Wladyslaw Orkan*, the first of a series of four vessels ordered by the Polish/Chinese owner Chipolbrok from Shanghai Shipyard, in China. As well as a pair of 320tonne GLH cranes with 35tonne whip hoist, each ship also carries a standard pair of GL cranes each of 50tonnes.

Wladyslaw Orkan's GLH units are able to work in tandem to handle lifts of over 600tonnes, each one able to achieve its rated 320tonne lift at a 16m outreach. The lifting moment for these Chipolbrok cranes represents a significant 6500tonne metres. In addition to the Chipolbrok business, MacGregor will soon complete a new order for four shipsets of GLH cranes for the Japanese operator Hinode Line.

In a bid to boost its share of global crane sales, MacGregor says it has geared up production to build the GLH heavy-lift range also new-generation GLB-2 bulk handling cranes (discussed below) at its Chinese factory, Lüzhou Machine Works in Nanjing, China.

Bulk carrier interest

For MacGregor Cranes, the bulk carrier segment of greatest interest encompasses ships up to Handymax size - today around 57,000dwt, on which, in almost all cases, cranes are fitted. In rare instances, cranes are also installed aboard larger Panamax vessels. The Handymax segment can be divided into two basic types: pure standard bulk carriers, and special bulk carriers. Each of these categories has different crane requirements, particularly for operating times and duty cycles.

The company is able to offer solutions both with proven standard crane types and units designed to meet the requirements of more specialised vessels. The range includes three principal crane types: GLB-2, GL-2, and K-2. These all use the same design philosophy and are claimed to have proven reliability and efficiency.

The GLB-2 model was specifically developed for installation aboard standard bulk carriers up to Handymax size. MacGregor's latest innovation in crane design, it is available with safe working loads of 25tonnes or 36tonnes in hook duty, and 20tonnes or 28tonnes when fitted with a grab, at outreaches of from 18m to 30m. Since the introduction of the GLB-2 in 2003, MacGregor has sold some 60 of them.

To date, around 1420 of the GL-2 type crane have been delivered, representing 90% of MacGregor's present overall crane production. The GL-2 is an updated version of its previous multi-purpose G-2 unit, of which some 3500 were delivered, many of them still in daily service. This can be used on any type of vessel for any kind of duty, but in the bulk carrier sector, it is often installed when an SWL higher than 30tonnes is demanded. The SWL for the GL-2 is up to 60tonnes in hook mode, at an outreach of up to 40m.

MacGregor's K-4 crane is a top-of-the-range unit designed specifically for bulk handling operations with a dedicated grab. With 90 units installed worldwide to date, it is particularly suited for high-duty cycles where the crane's performance is critical to the successful operation of a ship.

The '4' in the K-4 type designation indicates it is a four-rope model, employing two holding ropes and two opening/closing ropes for mechanical grabs. Recent developments on the K-4 include raising its SWL capability to handle lifts of between 40tonnes and 50tonnes, and the incorporation of new features,

including improved positioning performance and the ability to log details of a crane's actual operation.

New developments for bulk transloading operations

During the past few years MacGregor has seen an increasing demand for cranes to be used for transloading operations - transferring bulk cargoes to and from large bulkers with draughts that prevent them going alongside, fully loaded. Transloading can be carried out off terminals handling any type of bulk cargo such as ore products, coal, or fertilisers. Typically, these terminals require a high safe working load.

Such operations need a heavy-duty design, which means a crane designed to operate 24hours a day and for up to 5000hours to 6000 hours annually; by comparison, a standard bulk cargo crane is usually designed for around 500hours to 1000hours working time annually. MacGregor's K-4 unit has proved ideal for this kind of added workload.

The K-4 is controlled by the company's well-tried CC2000 system, providing an opportunity to optimise operation, as well as to analyse performance later. Today, the CC2000 is installed in more than 2000 cranes around the world. To further optimise the operation in terms of outreach and positioning performance, the K-4 unit can be mounted on an eccentric platform.

Meanwhile, MacGregor is working closely with other transloading system suppliers to find an optimised total solution. Future R&D in this field will focus on increased capacity for both SWL and speeds, improved lifetime, and optional features to further improve the crane's operation.

These three eccentrically mounted MacGregor K30/28-4 cranes (30tonnes each) are mounted on the 64,640dwt bulk carrier *Erawan*, owned by China Navigation Co. This vessel is being used as a transshipment terminal in Papua New Guinea handling copper concentrates, and the cranes' combined capacity of 10,000tonnes/24h can be put to good use.

Hose-handling crane success at Korean shipyards

MacGregor Cranes has secured a record level of orders for its hose-handling and general-purpose cranes: the division had more than 300 of these models in its orderbook in December 2004, covering deliveries up to 2008. The volume of hose-handling unit orders secured not only reflects the buoyancy of the tanker market, but also the claimed success of MacGregor in selling the advantages of this proven product. Ninety per cent of such crane deliveries are destined for Korean shipyards, where they are being installed on an ever-increasing number of new tankers and products carriers.

The current orderbook includes some 100 hose-handling cranes especially adapted for use on LNG carriers. Typically, these vessels require longer outreaches than the standard, but without needing increased lifting capacity. Outreaches up to 25m are common, and remote controls are often required, operated either by cables or wireless handsets. Stainless-steel wire ropes and/or couplings and fittings for hydraulic hoses are also often specified.

Last year, MacGregor Cranes delivered the first shipsets of its newly developed cold-climate service cranes. These units were designed to operate at temperatures down to -30°C and incorporate specially selected materials and components, as well as complying with special steel construction requirements to remain operational at such low temperatures. Other key features include extra electric heaters and special lubricants to ensure that the cranes remain functional in those conditions. With Russian oil exports becoming increasingly important, MacGregor has also developed a service crane design suitable for operation in temperatures down to -45°C.

At the end of 2004, MacGregor held more than 300 contracts for hose-handling and service cranes, covering deliveries up to 2008. Those shown here are in a Korean yard. Some of these are specially modified for installation on LNG carriers or for cold-climate operations.

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Major expansion in Chinese crane production for TTS

NORWEGIAN crane builder TTS Marine ASA has announced it plans to take a major step into China's rapidly growing shipbuilding sector with an agreement to form a new joint venture in northern China. In a deal with Dalian New Shipbuilding Heavy Industry Co, TTS, based in Bergen, has agreed to establish TTS Bo Hai Co Ltd, a 50:50-owned joint business to manufacture a wide range of cranes for Chinese shipyards.

In addition, the Norwegian company plans this year to double the 60 cranes currently produced at its existing Chinese subsidiary, TTS Marine Shanghai Co Ltd, in Shanghai. Sales there will now be concentrated on export to other Asian shipbuilding markets.

As a result of increasing competition in the marine cranes market and, in view of its Chinese expansion, TTS is streamlining its European operations to focus on new product development, service, and after-sales activities. Re-organisation to reflect the new emphasis at its Norwegian businesses in Bergen and Kristiansand has already led to some workforce layoffs there.

TTS' new Chinese joint-venture partner is an offshoot of the country's northern state-controlled shipbuilding company China State Industrial Corporation. Each partner is investing around NKr10 million as share capital in the new business.

Bo Hai, which in Chinese means 'great ocean', is to employ a 23-strong workforce, including engineers, fitters, and sales and administrative staff, at a 4500m^2 crane plant being set up in Dalian - heart of China's important northern shipbuilding region, second only to operations further south around Shanghai. The new venture will begin recruiting a local workforce when company registration is complete in March this year. TTS Marine president and chief executive officer Johannes D Neteland will become TTS Bo Hai chairman, with Li Dali taking executive control as general manager. Production in Dalian, set to begin by the end of 2005, is due to expand to include smaller cargo and service cranes.

Today, China has a share of well over 10% of the world's shipbuilding market, and, as is well known, aims to become global leader by 2015. In 2004, the Chinese ship cranes market was worth around NKr500 million, a value expected to triple by 2015, predicts TTS.

Before it launched the TTS Marine Shanghai crane building subsidiary in 2001, the Norwegian group already operated in China through an earlier joint venture, Shanghai-based TTS Hua Hai Ships Equipment Co Ltd. This 50:50 venture with China State Shipbuilding Co (the organisation which controls shipbuilding in the southern part of the country), develops and manufactures marine hatch covers and ro-ro equipment. TTS reported this venture has seen a 'substantial improvement' in business with an orderbook worth NKr230 million at the start of 2005. This enterprise, which employs 50 people, is focused on engineering and sales, and outsources all its production to local subcontractors.

The re-organisation in Norway has meant each plant now specialises in particular business areas. The Bergen plant will handle crane delivery and development activities, while the Kristiansand operation will, in future, will provide after-sales services and deliver industrial products as well a selected range of crane products, including a recently developed range of cylinder-luffed cargo cranes.

In autumn 2004, TTS expanded its product range through acquisition of the German crane division of Lübecker Maschinenbau Gesellschaft GmbH. In particular, this move has given TTS access to the wire-luffed cargo crane sector and ensures a considerable market for service and spare parts for these products. LMG, which employs 21, supplies German shipowners, many of whom contract vessels from Chinese shipyards.

TTS cargo cranes for Indonesian-built bulkers

The former Lübecker Maschinenbau Gesellschaft GmbH crane plant in Lübeck, has won its first order for wire-luffed cargo cranes since Norway's TTS Marine ASA bought the cranes division of the German company in autumn last year, as reported above. This new German subsidiary, named TTS-LMG Marine Cranes GmbH, has signed a contract to deliver two ship sets of deck cranes for two new bulk carriers being constructed at the PT PAL shipyard in Surabaya, Indonesia.

These 50,000dwt double-skin STAR-50 designs have been ordered by the German owner Lauterjung. Each ship will be equipped with a set of four wire-luffing cranes of the KL 35/28t - 25/28m type, equipped with controls for operation with a motor grab.

Key components for the cranes, such as the cab, hydraulic power pack, and electric motors, will be shipped directly from the Lübeck plant to TTS' Indonesian sub-contractor for final assembly and testing. Local subcontractors will supply the steelwork and handle assembly. The first vessel is due for delivery by the beginning of 2006, with the second around four months later, and both ships are expected to go into a charter immediately.

Flexibility the key to efficient self-loading and discharge designs

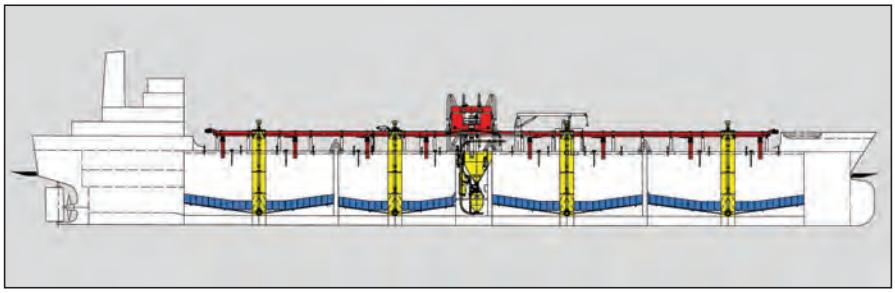
TODAY, flexibility is a key requirement for cement loading and unloading systems being fitted to both new and converted vessels. Efforts to respond to such market demands have led to the continuous development of features of Nordströms-type self-loading/unloading equipment delivered by Swedish dry bulk handling specialist BMH Marine AB.

Among recent supply contracts won by the Helsingborg-based company is an order for BMH's latest design of cement handling system for a 20,200dwt new ship under construction at Labroy Shipbuilding & Engineering Pte Ltd, in Singapore. The package being installed aboard the vessel (145m length overall) will allow loading rates of 1000tonne/h by mechanical means and 400tonne/h using pneumatic equipment; discharge capacities will be 4 x 300tonne/h by pneumatic gear and 450tonne/h with the mechanical arrangement. This ship is being built for Belden Shipping and is due for commercial operation from mid-2006.

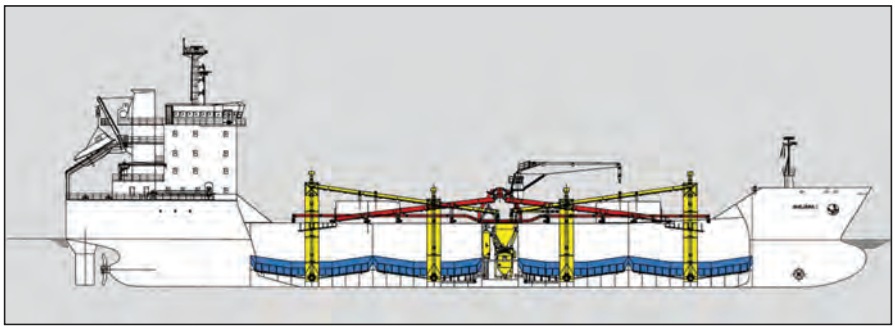
High flexibility of the handling system is demanded to cope with today's quickly changing flow of cement trading combined with the need for efficient loading and discharge at many different ports with varying reception systems. Another cement carrier already in the Belden Shipping fleet, the 28,500dwt *Alcem Lugait*, is also equipped with a Nordströms handling system.

The company's cement loading/discharge concept comprises a range of mechanical and/or pneumatic conveyors, according to the functions and handling rates required. To date, BMH has equipped 82 vessels with systems with capacities ranging up to 1600tonne/h.

Other recent deals signed by the Swedish supplier include orders from Turkish company Yardimci Shipping Inc for self-loading/unloading systems to equip three cement carriers to be built at the owner's own yard in that country. The first contract, sealed early in 2004, is to equip a 9000dwt vessel with a 800tonne/h mechanical loading arrangement (600tonne/h pneumatic), and a discharge unloading rate of 2 x 250tonne/h, also pneumatically. The other two ships are each of 6000dwt capacity.



A plan of the BMH Marine Nordströms materials handling system for *Tabernacle Prince*, currently being converted into a 20,000dwt cement carrier at China's Chengxi Shipyard for the Sri Lankan operator Samudra Cement Co Lanka (Pte) Ltd.



A profile of the new 9000dwt cement carrier *Melissa 1*, under construction at the Yardimci Shipyard in Turkey for the Yardimci group. This ship will be able to load cargo at a rate of 800tonne/h mechanically or 600tonne/h pneumatically. Discharge rate will be 2 x 250tonne/h by pneumatic means.

A further Nordströms handling system is due to be installed on *Tabernacle Prince*, a 20,000dwt ship currently being converted at the Chengxi Shipyard in China for Samudra Cement Co Lanka (Pte) Ltd, of Sri Lanka. This system's rated loading capacities are 1000tonne/h mechanical (400tonne/h pneumatic) with a pneumatic unloading capacity of 450tonne/h.

BMH also recently won another contract, this time to supply a Nordströms gravity-type self-discharging system for a 28,400dwt re-modelled vessel ordered by H J Hartmann at J J Sietas Schiffswerft, in Germany. This equipment, with an unloading capacity of 3000tonne/h, includes hydraulically operated basket gates in combination with hold belt conveyors and a C-shape conveyor for raising aggregates cargo onto an 85m-long boom conveyor for discharge ashore.

Nordströms self-loading/unloading systems for dry bulk carriers come in three main configurations: gravity, cement handling, and top reclaiming. They can be used for shifting a range of cargoes, including coal, cement, iron ore, aggregates and other free-flowing dry bulk commodities. At the present time, BMH has installed gravity-type equipment in 35 vessels of up to 96,000dwt with unloading rates of up to 6000tonne/h. Examples include the 96,000dwt *Western Bridge* and the 77,500dwt *Yeoman Burn*, both presented in *Significant Ships of 1991*.

Kone acquires MacGregor - for the second time

MARINE cargo handling group MacGregor International AB has been acquired by global service and engineering company Kone Corp for the second time in MacGregor's 67-year history. This time, Kone Corp, based at Espoo, Finland, has paid around €186 million to buy MacGregor from its joint owners, Swedish private equity firm Industri Kapital and healthcare company Gambro AB. MacGregor's crane headquarters, at Örnsköldsvik, Sweden, will form the marine division of the group's cargo handling offshoot Kone Cargotec.

In the past two years, MacGregor has undergone extensive restructuring and has implemented several improvement programmes, resulting in increased profitability. The group is expected to achieve a 2004 operating profit of €22 million on annual net sales of €370 million.

Its products range from deck cranes to cargo securing systems, hatch covers, shipboard lifts, escalators, galley outfits, and stores refrigeration plant, also ro-ro equipment. MacGregor, which employs 935 people, has maintained a longtime alliance with Kone for the production and service of marine lifts and escalators, and the partners are currently a leading supplier of cruise ship lifts.

New union to market small service cranes

FORMER marine crane supplier European Crane Services Ltd has joined forces with CranePower GmbH, of Salzburg, Austria, to sell the Palfinger equipment range around the world. UK-based ECS was reformed as a company in September 2004, after closing earlier in the year, when it agreed an exclusive contract to represent CranePower in more than 40 countries, reports ECS director Robb Gilbert. After formally retiring from the business, he was approached by CranePower managing director Heinz Kissel to return to work in partnership with the Austrian crane maker.

'With CranePower, which emerged as a management buyout in 2000 of Palfinger Marine, needing to expand its market worldwide, and ECS looking for a quality marine crane to satisfy its well-established client base, it did not take long for the parties to get together', explained Mr Gilbert.

ECS has already signed several agency agreements for CranePower's equipment abroad with existing agencies in countries including Romania, Egypt, Pakistan, Bangladesh, and Afghanistan. In addition, ECS has won several new orders and, in January was due to have a new website up and running. This site will allow naval architects to download all technical information on the Palfinger/CranePower product range in either PFF or DXF form; the site also has links with the Salzburg plant and its new foreign distributors.

Over 15 years, ECS, formerly based in Maidstone, England, built up a successful record selling 1000 European marine cranes around the globe. The company felt there was a market for purpose-built marine cranes, rather than the compromise of modified truck cranes. So far, working with existing UK agent Outreach plc, ECS has attracted fresh business including the sale of a 120tonne-metre knuckleboom crane for a 25.5m-long Holyhead Towing vessel built by Hepworth Shipyard, at Paull.

Other orders include the supply of a small knuckleboom unit for a support vessel being constructed by South Boats on the Isle of Wight.

MacGregor package for Japanese-built multipurpose ships

FOUR 12,500dwt multi-purpose/container ships being built for Swiss operator Enzian Shipping at Japan's Kyokuyo Shipyard will be equipped with complete cargo access, handling and securing packages from the MacGregor Group. These versatile vessels, designed to carry both containers and bulk cargoes, are being supplied with complete MacGregor hatch cover sets for both weather deck and tweendecks, also deck cranes and securing systems. All four ships are due for delivery this year.

Each shipset of cranes comprises two GL 8019/4530/4033-3 models. The company is also providing a 17m 'team beam' for each vessel, capable of a 144tonne safe working load (SWL), as well as one 40ft frame spreader with a 36tonne SWL and a 20ft frame spreader with a 50tonne SWL. This equipment will be used for loading and discharging containers as well as for handling hatch cover panels.

The new vessels' holds will not be fitted with cellguides, so MacGregor is using terminal pressure stacker lashing (TPS) equipment. This TPS-1 design permits safe handling of containers in line with OSHA safety requirements; it also allows flexible and unrestricted independent loading and discharging of both 20ft and 40ft containers, without the need to reduce weight, in accordance with Germanischer Lloyd requirements.

One special feature included aboard the new Enzian ships is portable stoppers of different heights, arranged around the weather deck panels to ease handling of hatch covers by the ship cranes.

Expanded four-rope grab cranes from Tsuji

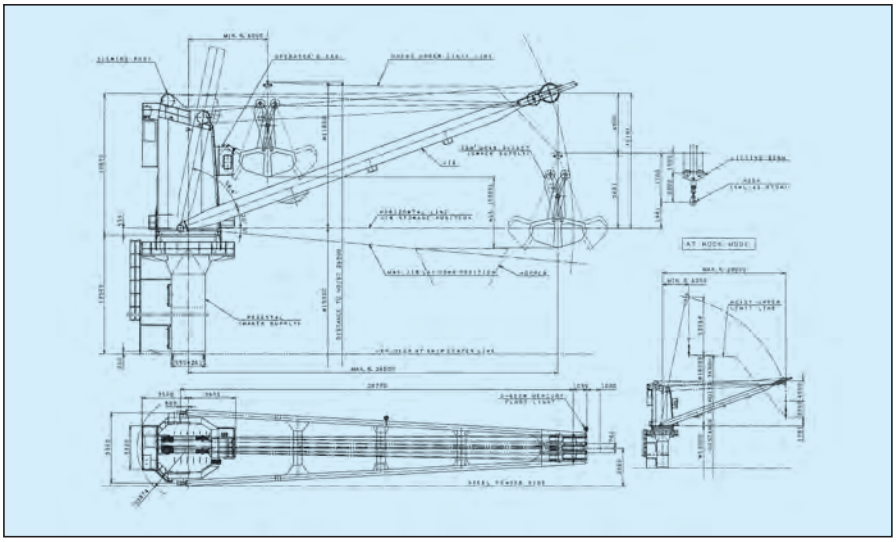
JAPANESE deck crane builder Tsuji Heavy Industries Co Ltd has extended the range of its recently developed heavy-duty inverter frequency-controlled four-rope deck cranes with the addition of a larger 45tonne capacity unit. Last year Sasebo-based Tsuji announced a string of orders for the specialised heavy-duty BEIS-series grab cranes, normally capable of lifting loads between 30tonnes and 40tonnes. Now, it has signed a contract to supply longtime customer IMC Shipping, of Singapore, with two sets plus options of a 45tonne capacity heavy-duty size. Tsuji believes this is the first time that a 45tonne crane of this type will be manufactured.

IMC, which has already ordered two sets of the lower capacity inverter-controlled four-rope deck cranes from Tsuji, is due to take delivery of the heavier lift sets at the end of this year. The latest cranes are destined to be installed aboard a barge to be used mainly for carrying coal. The BEIS-series four-rope cranes, based on the company's experience with inverter frequency-controlled gantry and wood-chip cranes, are specified when continuous heavy-duty loading and unloading with grab buckets is expected to be frequent and over an extended period of time.

Tsuji, which launched the world's largest deck crane and hatch cover factory at Zhangjiagang near Shanghai in November 2003, announced it plans further large-scale investment at the site this year. The Tsuji Heavy Industries (Jiangsu) plant, on the banks of the Yangtze River, which also fabricates port cranes, ship sections (see article elsewhere in this issue), and civil engineering structures, was due in mid-2004 to double its monthly process rate of summer 2003 to 10,000tonnes of steel. By spring 2005, that monthly production level is now set to rise to 13,000tonnes. The factory's 1300-strong Chinese workforce is due to increase to 2000 by late this year, led by a 50-strong management team from the company's Japanese head office. Expansion of the Chinese facility will include the addition of a new hatch cover line, doubling the already huge production of covers there.

The plant was recently awarded an Approval for Welding certificate by Germanischer Lloyd; a Products and Works Recognition certificate from Bureau Veritas; and ISO 9001:2000 approval from Lloyd's Register.

Plans of Tsuji's newly developed BEIS-series 45tonne heavy-duty inverter frequency-controlled crane. Although mainly designed for grab work, it can also be rigged for hook use.



New multifunction bridge launched

AT a recent trade fair (Rotterdam Maritime), Alewijnse Marine Systems presented its totally new multifunctional bridge concept. Features of the ALVAS multifunctional bridge include integrated workstations for X-band and S-band ARPA radars, conning, ECDIS, DP/DT, AMS, and process automation.

This bridge was designed for one-man operation and is fully compliant with all classification society requirements; it is based on a redundant network concept. ALVAS functions with supplier-independent equipment and can be integrated seamlessly with the following systems: GPS/DGPS, gyro compass, speed log, autopilot, echosounder, anemometer, weather fax, AIS, VDR, and main engine control, also with closed-circuit TV. Indeed, every thinkable automation system on board can be integrated into an ALVAS platform, claims Alewijnse Marine Systems, which can supply a full package from design up to and including service and maintenance.

Goal-based standards and bulk carrier safety top MSC agenda

BIMCO joined IMO member states and observers at the 79th session of the Maritime Safety Committee (MSC 79), which met in London from December 1-10. Several issues of importance were discussed, including goal-based construction standards, bulk carrier structures, and passenger ship safety.

IMO's Maritime Safety Committee has begun developing goal-based construction standards (GBS) as a foundation for future international regulations. These are expected to help classification societies develop definitive prescriptive standards that can be applied and implemented consistently worldwide. Furthermore, GBS should ensure that ship structures and designs comply with various regulations at each stage of construction, maintenance, and operation.

The GBS Working Group presented its basic principles for these models, principles which are meant to be applicable to all goal-based standards to be developed by IMO. In addition, the group reached general agreement on a framework for GBS - a five-tier system where IMO's standards will consist of Tiers I, II, and III; Tiers IV and V will be developed by classification societies, other recognized organizations, and industry organisations.

The Working Group developed Tier I goals and working descriptions, limiting consideration to new constructions of all ships. Tier I goals do not address operations or maintenance of ships in service, but rather safety and environment-friendliness with respect to structural integrity and strength, dismantling and recycling, and the need for design and construction to provide for safe access, inspection, and proper maintenance. They include provisions regarding operating and environmental conditions, and specified design life. In addition, the group developed 12 Tier II functional requirements. For Tier II, only bulk carriers and tankers were considered at this early stage.

On this basis, the Committee agreed to a number of basic points on which further work on these standards will proceed. The standards should be broad, over-arching goals, against which ship safety will be verified at design and construction stages, and during operation. For the time being, goal-based standards will be kept separate from formal safety assessment. The Committee will now ask the Marine Environmental Protection Committee (MEPC) to consider the environmental aspects of the goal-based standards, taking the Working Group's recommendations into account.

Regulatory amendments

The MSC also considered amendments to a number of regulations currently in effect, including the SOLAS Convention, the International Safety Management Code (ISM Code), and the International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (IBC Code). Although the Committee had previously agreed that SOLAS amendments would only enter into force once every four years, this rule was temporarily suspended to allow the adopted SOLAS amendments to enter into force on July 1 2006. The IBC Code amendments will enter into force on January 1 2007, while the ISM amendments will enter into force on July 1 2006.

In addition to these amendments to mandatory regulations, the Committee discussed changes to several non-mandatory IMO instruments, such as the Code of Safety for Diving Systems, and the Code of Safety for Special-Purpose Ships (SPS Code). Most of these amendments will come into effect on July 1 2006.

Bulk Carriers - SOLAS Chapter XII

A number of amendments to SOLAS Ch XII relating to bulk carrier safety were adopted, many of them emanating from the various FSA studies performed since 1998. Most amendments were agreed at the last MSC meeting in May 2004 where, amongst others, a former decision on mandating double-side skins for new bulk carriers was revoked.

A new Paragraph 5 to Regulation 6 had been submitted by the UK, proposing that the side-shell structure of single-side-skin bulk carriers should have built-in redundancy, preventing the collapse of the side shell in case of one single frame being detached. Although there was some sympathy of the underlying principles, it gave rise to some concern, since no impact assessment had been performed and thus actual consequences measured in added steel weight very uncertain. However, based on a verbal intervention from Greece, the proposed paragraph was amended as follows:

'In bulk carriers of 150m in length and upwards carrying solid bulk cargoes having a density of 1000 kg/m^3 and above constructed on or after [date of entry into force of the amendment]:

1. The structure of the cargo hold shall be such that all contemplated cargoes can be loaded and discharged by standard loading/discharge equipment and procedures without damage which may compromise the safety of the structure

2. Effective continuity between the side-shell structure and the rest of the hull structure shall be assured

3. The structure of the cargo area shall be such that single failure of one stiffening structural member will not lead to immediate consequential failure of other structural items potentially leading to the collapse of the entire stiffened panels'.

In spite of one or two industry interventions, adoption of the amendments was rushed through. Industry's concern with the new paragraph is basically that the text is very open to interpretation and that no impact assessment has been performed. More specifically the concerns are:

Ref 1. Standard discharge equipment and procedures include heavy grabs (up to 35tonnes empty) and the use of bulldozers and front-end loaders. It is a well known fact that the most vulnerable structure in single-side-skin bulk carriers is the hold frames and lower frame brackets, and that these structural elements are often damaged during discharge. The use of hydraulic hammers, or simply using the grab of a bulldozer - to free stuck cargo from the frames - is quite common during discharge of coal and coke. This naturally raises the question: does this imply that new bulk carriers must be of double-side-skin construction?

Ref 2. Again, does this call for a double-side-skin structure?

Ref 3. This subparagraph is of particular concern. The original UK proposal addressed only the single side-shell, but now all stiffeners are to be taken into account. Since SOLAS does not contain a definition of a stiffener, one must assume that it will apply to both primary stiffeners, ie, girders, floors, and web frames as well as to secondary stiffeners such as frames and longitudinals. Panels must likewise be assumed to include tanktop, hopper side, top side, and bulkhead. Since the subparagraph specifically addresses collapse of a stiffening element, it will probably not be acceptable simply to increase the strength of the stiffening element. Instead, structural redundancy seems the only way out, which will lead to a substantial increase in steel weight.

Moreover, as it will be known to those members managing bulk carriers, the International Association of Classification Societies (IACS) is in the process of finalising a package of common structural rules for bulk carriers. An enormous amount of time and money has been put into that project, and it will be interesting to learn what impact these amendments may have on this project.

Other SOLAS Chapter XII amendments

The committee adopted Standards and Criteria for Side Structures of Bulk Carriers with Single Side-skins and Standards for Owners' Inspection and Maintenance of Bulk Carrier Hatch Covers, both of which will be incorporated under SOLAS Chapter XII. Finally, a new Regulation 14 will ban older bulk carriers from sailing with any hold(s) empty at a full draught unless certain conditions are fulfilled. In addition, the committee agreed to require the application of coatings to dedicated seawater ballast tanks in accordance with the standards of the national administration in question.

Construction drawings

The committee approved the new SOLAS regulation II-1/3-7 on construction drawings on

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board and ashore for adoption at MSC 80. An MSC circular on as-built construction drawings to be maintained on board the ship and ashore was also approved.

Water level detectors
A new SOLAS regulation on water level detectors for single-hold cargo ships other than bulk carriers was also approved for adoption at MSC 80. Furthermore, the committee adopted performance standards for water-level detectors on bulk carriers and on single-hold cargo ships other than bulk carriers

Dangerous goods, solid cargoes, and containers
The Code of Safe Practice for Solid Bulk Cargoes (BC Code) was adopted and the Committee endorsed the timetable for mandatory application of the code through SOLAS Chapters VI and VII.

Ballast water exchange
At its last meeting, the MSC asked the Navigation Sub-Committee to examine when non-compliance with ballast water exchange regulations would be acceptable under SOLAS regulation V/22. However, the sub-committee was unable to agree on circumstances calling for such a deviation. At this session, the Committee was able to agree on amendments with regard to transitory non-compliance, providing requirements for propeller immersion, minimum draught and/or trim and bridge visibility. These will be put forth for adoption at MSC 81.

Passenger ship safety

The committee addressed a number of important issues related to the safety of large passenger ships. First and foremost, the MSC discussed the actual definition of 'large passenger ship'. This issue led some delegations to point out that such a definition would be problematic if it were based solely on ship length, breadth, draught, and gross tonnage, or in terms of the number of passengers.

In fact, using such fixed parameters has previously led to the design and construction of so-called 'paragraph' ships - vessels built to lengths and tonnages just below the required level to comply with a new rule. Hence, the committee agreed that the initiative in itself should focus on safety issues and is not, therefore, solely related to the physical characteristics of a ship. Therefore, the committee agreed to delete the word 'large' from the title.

The committee also discussed the important aspect of the 'timeframe for time to recover', which should incorporate both a time to recover from survival craft and an overall timeframe for rescue. A maximum of five days was set, after which persons cannot be expected to remain in survival craft.

The guiding philosophy of this work is that future passenger ships should be designed for improved survivability so that, in the event of a casualty, persons can stay safely on board as the ship proceeds to port. Therefore, the committee stressed that casualty thresholds must stipulate the amount of damage a ship must be able to withstand and still safely return to port under its own power. If a casualty threshold is exceeded, the ship must remain habitable for a minimum time of three hours to allow for safe and orderly abandonment. The Working Group on this issue will now continue to develop relevant parameters for the application of any proposed requirements and recommendations.

Flag-state issues

Issues related to flag states were prominent on the MSC agenda. For example, as many IMO member states have failed to provide preliminary information on casualties to the IMO, the committee requested that national rescue authorities be reminded of the IMO's earlier request for such details. A procedure was also considered which would allow flag states to exchange safety information on vessels changing flags, which will be described in an IMO Circular on the Transfer of Ships between States.

Furthermore, the Committee agreed that IMO should ask the International Labour Organisation to provide any relevant Port State Control (PSC) data, and it also discussed the development of a distance-learning package aimed at effectively training PSC officers. Since members of the Paris Memorandum of Understanding have already developed such a package, IMO hopes to make this training material available to member states. At the same time, the committee considered a proposal that the FSI Sub-Committee carry out in-depth analyses of annual PSC reports. In order to further this work, the committee agreed that IMO should work with the Paris MoU PSC task force to prepare a submission to the next sub-committee meeting.

The Lloyd's Register-Fairplay World Fleet Database was also discussed by the Committee, which agreed that the development of IMO's Global Integrated Information System (GISIS) required accurate analysing tools, such as a world fleet database. Therefore, the FSI Sub-Committee will undertake further discussion of the Lloyd's-Fairplay proposal at its next meeting. The sub-committee will identify the added value of the proposal, clarify the financial aspects, and indicate the data necessary to assist companies in complying with safety, security, and pollution-prevention requirements. Aspects such as accessibility and existing potential data sources will also be examined by the FSI Sub-Committee.

Other business
A number of other relevant issues were addressed by the MSC as well. One of these was a Ship Master's Guide on Water Ingress Monitors and Early Abandonment, developed by BIMCO's Marine Committee. Other topics included the following:

Extension of the BLU Code
For this session of MSC, the UK, IFSMA, and BIMCO had submitted a proposal to amend the BLU Code for safe loading and discharge of bulk carriers by deleting the words 'excluding grain' and extending application of the Code to ships carrying grain. All cargo ships would then have the same level of protection from unsafe loading or discharge. The committee placed this proposal as a high-priority item on the Dangerous Goods, Solid Cargoes, and Containers Sub-Committee's work programme, with a target completion date of 2006. Next step will now be to also take a closer look at the *BLU Manual*, a guideline produced for the use of terminal representatives, to ensure consistency between the two guidelines.

Human element
IMO is currently considering the 'human element' in terms of the development of, implementation of, and compliance with IMO instruments. These considerations address what IMO can do to assist seafarers in the prevention of accidents and injuries. In this regard, the Joint MSC/MEPC Working Group on Human Element will not only prepare a strategy to address the human element, but also discuss the draft guidelines on shipboard occupational health and safety programmes.

The ISM Code
An Independent Experts Group, of which BIMCO is a member, has been established to study the impact of the ISM Code. The Committee requested that an interim report on the Group's activities be submitted for consideration at its next session.

Maritime Security
The Committee considered a number of issues related to enhancing maritime safety, many of which will be discussed in a separate BIMCO article dedicated to this issue. Likewise, a special article on the amendments to SOLAS Chapter XII is contemplated.

The 80th session of the MSC will take place from May 11-20 this year.

This report is compiled in association with BIMCO (The Baltic and International Maritime Council).

New Baltic cruise ship *Birka Paradise*

IN November last year, Aker Finnyards' Rauma yard handed over *Birka Paradise* to Finnish operator Birka Line Abp. At 34,748gt and with a total passenger capacity of 1800, *Birka Paradise* is the second cruise ship in the company's fleet - *Birka Princess*, now operating between Stockholm, Mariehamn, Turku and Tallinn, was built in 1986 by the then Valmet yard (re-modelled in 1999 by Lloyd Werft). The new completion, valued at €155 million, is intended for regular year-round cruise traffic between Stockholm and Mariehamn. Differing from the numerous passenger-car ferries travelling between Finland and Sweden, *Birka Paradise* is a pure cruise ship with no car decks.

She has a length of 177m and is 28m wide, with a design draught of 6.5m. Five of the 11 decks in total are dedicated for passenger accommodation - 734 passenger cabins and suites, on decks 7, 8, 9, 4, and deck 2, plus 181 single-berth crew cabins, concentrated on deck 3. All cabins were supplied by Shippax.

In order to create a Caribbean-like atmosphere onboard, the Paradise Beach sun deck, on deck 10, is glass-covered and has a 95kW artificial sun-lamp arrangement, keeping the air temperature at some 30°C. The sun deck also features palm trees and wind machinery, although in summer, the glass roof can be opened. On the sun deck, there is one pool and two jacuzzies, as well as a spa section, with bars and restaurants in the close vicinity.

In all, the ship has nine restaurants and cafes, several bars, and two nightclubs with dancing floors. Amenities include the Havanna Cigar Club on deck 6 and on deck 5 the Café Brazil and Club Copacabana night club aft, fitted with a stage, with a small casino nearby. There is also a large Conference Centre for 400 people, on deck 6, and a very large tax-free shopping centre, on deck 5, possible when sailing on the Åland route.

Two main passenger staircases are located onboard. The six passenger lifts, each with a capacity for 15 persons, as well as the four 1600kg/19-person service lifts, have all been supplied by MacGregor.

Internal architects involved in the *Birka Paradise* project were Partner-ShipDesign, Germany, Petter Yran & Bjorn Storbraaten, Norway, as well as Finnish architect Lasse Heikkinen. The Finnish consultancy Deltamarin completed the hull classification drawings as well as other detailed design tasks of the vessel, including the entire outfitting design.

***Birka Paradise* at sea. She has been built to the highest Finnish/Swedish ice class, and many environment-friendly technical features are included.**

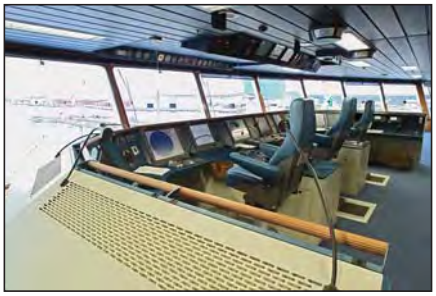
The Paradise Lounge is one of many high-quality passenger amenities on board.

Highest Finnish-Swedish ice class

To ensure efficient year-round operations, *Birka Paradise* is built to comply with Finnish-Swedish 1A Super ice class, and thus has suitably reinforced propulsion machinery, based on a conventional diesel-mechanical plant. Total main engine power is 24,400kW. Four Wärtsilä 6L46B diesel engines, (each 5850kW) drive two Rolls-Royce CP propellers through Renk gearboxes, to give a service speed of 21knots. Auxiliary power is supplied by four diesel alternators - Wärtsilä WD6L32 engines each of 2760kW at 750rev/min driving 3312kVA Leroy-Somer alternators. Main switchboards are manufactured by ABB.

The ship is installed with two oil-fired steam boilers, supplied by Aalborg Industries, each with an output of 6000kg/h at 7bar, but exhaust-gas economisers are also fitted - two 1000kg/h Unex G-115 models on the main engines and a Unex G-134 800 kg/h unit on each of the four auxiliary engines' exhaust lines.

Fuel and lubricating oil separators are supplied by Alfa Laval, with Marinfloc models for bilge water. Alfa Laval has also supplied the fresh-water evaporators, while remote tank gauging is supplied by SF-Control. Heel control is handled by two pairs of Frank Mohn anti-heeling systems, and one pair of B+V Industrietechnik fin stabilisers should help to ensure passenger comfort in rough weather.



On *Birka Paradise's* bridge, an Atlas NACOS integrated bridge system is installed for for one-man operation.

The ship has two 1500kW Rolls-Royce tunnel thrusters fitted forward and one 1000kW thruster aft.

Lifesaving apparatus is arranged on deck 5, with four partially enclosed 150-person lifeboats supplied by Schat-Harding and four

MES stations with chutes manufactured by Viking Life-Saving Equipment. There are also two Schat-Harding fast rescue boats.

Birka Paradise has an Atlas NACOS 35-4 integrated bridge system designed for one-man operation, while the integrated automation system is from CAE Valmarine. A computer for loading and for other onboard technical duties has been supplied by Napa with its Onboard-Napa system. Fire detection system is supplied by Consilium Marine and the CO_2 engineroom fire extinguishing system by Unitor AS. Extended local water fog accommodation sprinkler systems are supplied by Marioff and the water fire extinguishing systems were installed by the yard.

York Novenco has delivered the complete air conditioning and ventilation arrangement, with cabins and public areas served by a central single-duct constant air volume (CAV) system. In the accommodation and public areas, a total of 30 're-heat' air conditioning units are arranged in eight fan rooms; these can handle a total air volume of around 400,000m^3/h. Total cooling chiller capacity is 5782kW and heating capacity 5940kW.

The four Wärtsilä 6L46B main diesel engines are split over two fore and aft rooms, with two engines in each. Relatively long shafts from the forward engines link to the Renk combining gearboxes through a bulkhead. Diesel-alternators are positioned alongside each forward engine, as shown here.

DNV Clean Design and Comfort Class 1 specifications

Birka Paradise is built to very high standards, fulfilling both DNV's Clean Design as well as very strict Comfort Class 1 requirements. The Clean Design rule defines several environmental solutions as to the ship design, and the Comfort Class 1 rule states high requirements for a noiseless and vibration-free environment for the passengers. Catalytic exhaust-gas cleaning is fitted to all diesel engines.

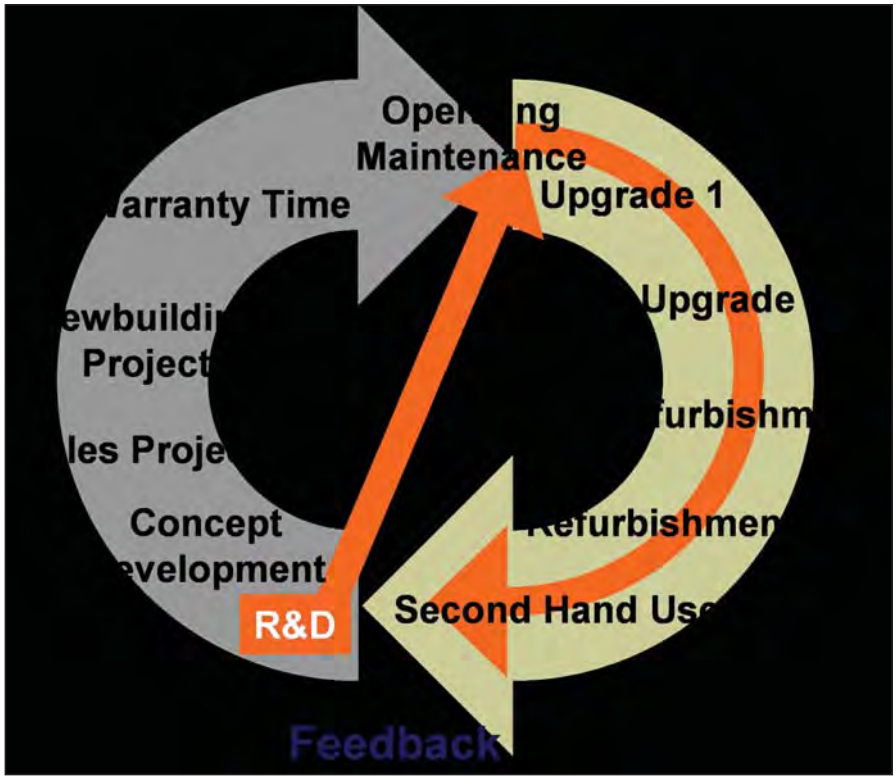
A waste disposal plant, supplied by Deerberg Systems, consists of a waste compactor, two waste shredders, and one crusher. All onboard waste is taken care of, with rubbish sorted for recycling; non-recyclable products are burned in heating plants ashore, and water waste is pumped ashore for cleaning in the city waterworks of Stockholm and Mariehamn.

Piikkiö Works extends into turnkey producer

THE Finnish specialist in modular cabins and bathrooms, Piikkiö Works Oy, a member of the Aker Finnyards group with factories at Piikkiö and Paimio, secured a number of new orders last year, to ensure deliveries long into year 2006. These include an important order for 1050 modular cabins for Tallink's new cruise-ferry under construction at Aker Finnyards' Rauma yard; this order includes turnkey delivery of the entire cabin area.

Currently, the company is producing cabins for both of the *Freedom*-class cruise ships, under construction at Aker Finnyards' Turku yard, with more than 2600 cabins for each vessel. A total of 196 cabins are also being built for the lengthened hull section of Royal Caribbean's *Enchantment of the Seas*.

A prevailing and most interesting trend of development work for this company is the modularisation not only of a cabin but of the whole cabin area, including cabin, corridor and service space, in order to achieve lightweight construction and also to make major conversion easier during the lifecycle of a ship. Today, Piikkiö Works has established a special customer service department with the aim of offering lifecycle solutions for owners. This department will focus on concept development in collaboration with owners, life-cycle design, cabin and bathroom condition surveys, repair solutions, and spare parts service.



Today, Piikkiö Works is extending life-cycle thinking in its production, with modularisation not only of a cabin but of the whole area around it and by fully utilising operational experience in its new cabin concepts.

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Imaginative modular accommodation system for economical cruising

THE Swiss-designed Baldakin Modular Accommodation System (BMAS) has been created to simplify design and reduce the cost of short-stay collective accommodation, and is particularly useful for cruise ships - and especially smaller catamaran types, according to its creator Alain Guigan. Passengers on a budget or seeking adventure-style holidays are expected to be the initial target sector. The imaginative Baldakin capsule (BC) is a modern version of the antique baldaquin, which consisted of a structure in the form of a canopy, supported by pillars, placed over a bed. The baldaquin bed could be fully enclosed, to ensure privacy, by means of curtains attached to it.

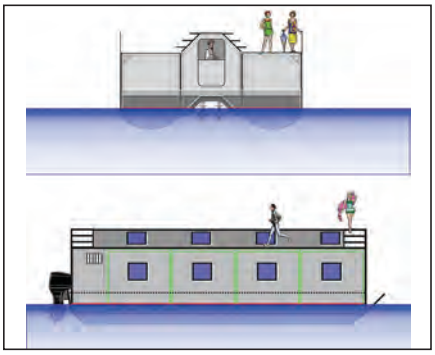
Mr Guigan is currently trying to secure a patent, trade mark, and copyright protections, and is seeking partners interested in licensing or integrating the BMAS in their designs, or otherwise in investing time, work and/or money in the BMAS project.

Basically, a BMAS unit is composed of the assembly of a number of standardised BCs, ie, prefabricated, compact, sound-insulated 'private quarters' (bedroom and bathroom), where two-to-four persons can sleep and relax. An unusual protruding angled front gives the BC enough depth to allow for full-length beds and a comfortable bathroom.

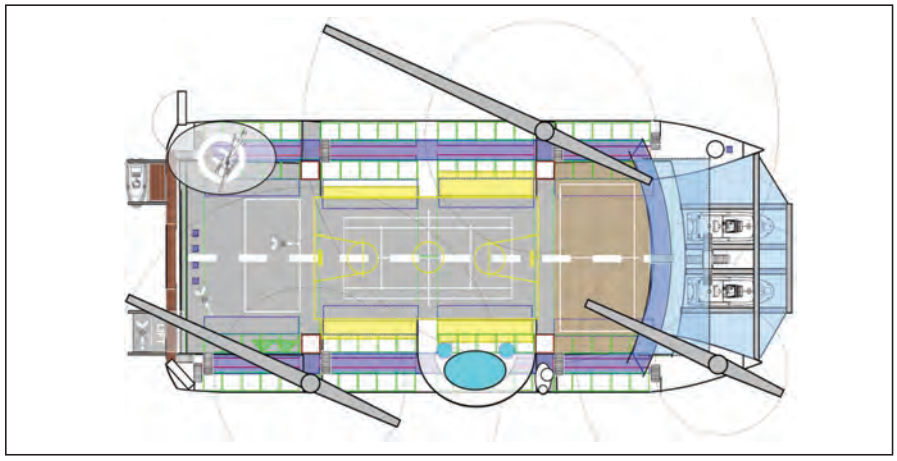
This feature also provides for a heightened entrance to the BC. This allows passengers to walk a few steps down into the BC, giving the user the unusual impression of walking down into a 'nest' - similar to stepping down from the cockpit into a cabin of a sailing boat.

This difference of level, associated with the angled design of the front part, also allows for a narrower corridor between BCs. Indeed, from around 1.2m wide, up to waist-level (ie, approximately 90cm over the walking path, where the width is not as important), it becomes wider, reaching some 2.4m at eye level, giving the impression of a wider corridor.

Typically, four or five BCs are fitted side-by-side in a 40ft ISO container frame, thereby forming a Baldakin Module (BM) housing eight to 20 persons (depending on occupancy). The idea of converting ISO containers to living quarters is not new, and has been successfully implemented by many manufacturers (being pioneered by Portakabin).



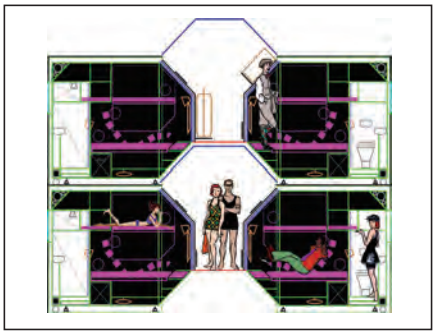
An artist's impression of an alternative use for the Baldakin concept: a 40ft MultiBarge accommodation module that could be employed as a 32-person float-off safety unit for bulk carriers or offshore structures.



An artist's impression of the plan view of a sailing 73.1m Baldakin Explorer catamaran, carrying up to 880 passengers, showing the landing and take off runway for light aircraft, also the games pitches, and the MultiRig asymmetric masts.

However, the BMAS approach is said to bring the concept one step forward, by fitting a number of similar, prefabricated BCs side-by-side into a 20ft or 40ft ISO container frame, which allows the construction of more rational, and therefore cheaper, living quarters. This allows the combination of two BMs face-to-face, reaching a width of only 7.3m, including the built-in central corridor.

The combination of BCs and/or BMs, on one or several levels, allows speedy and easy construction of very compact, economical, collective short-stay accommodation facilities such as could be fitted on river cruisers, floating hotels, nautical resorts, cruise catamarans, and overnight ferries, when complemented with the usual shared facilities.



Cross-section of a typical catamaran, showing the face-to-face combination of two twin BCs on two levels, with the central variable-width corridor and the BCs' protruding angled front.

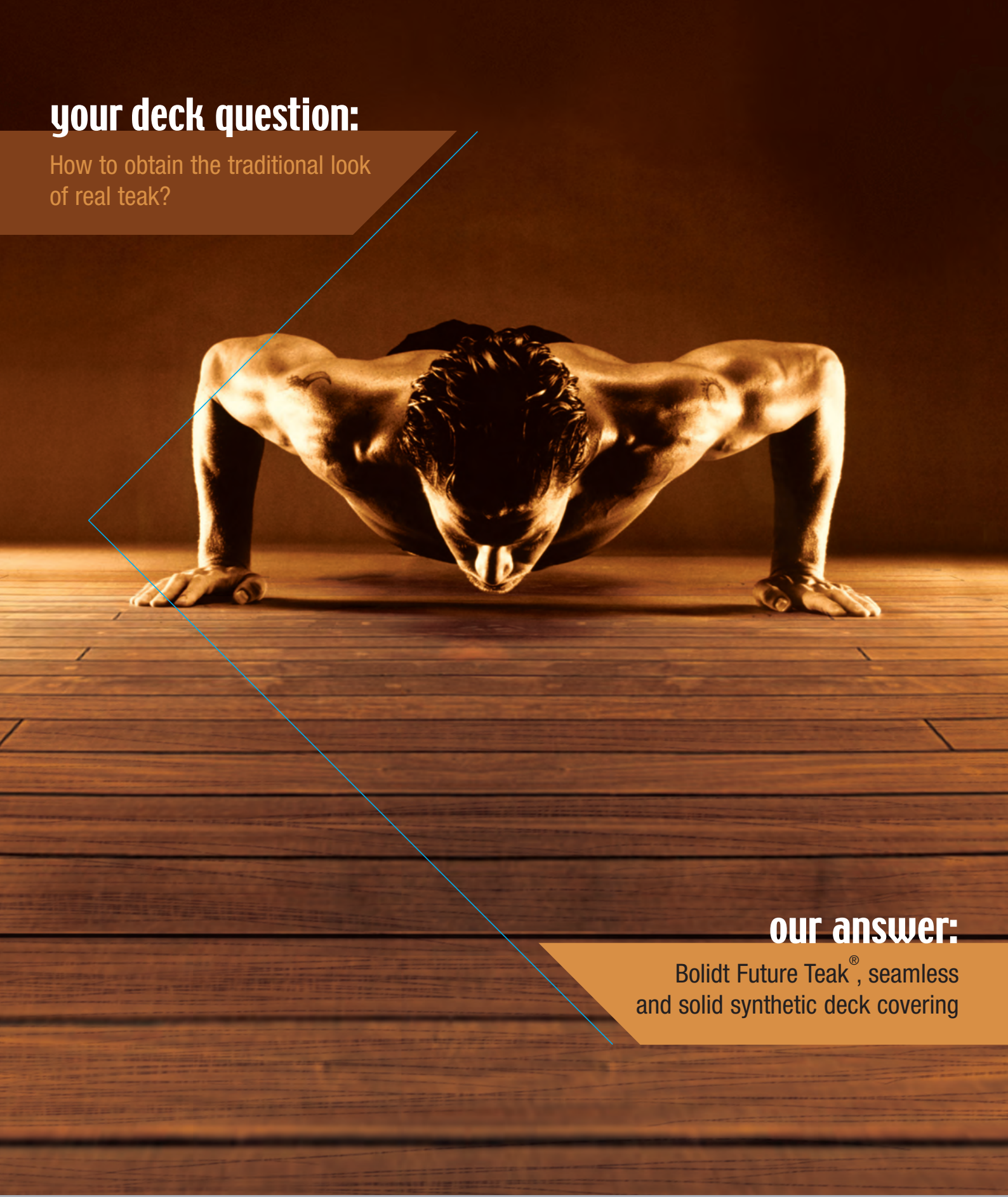
Catamarans to complement the concept

To complement his ideas, Mr Guigan has designed two Explorer cruise catamarans. His Baldakin Explorer 24.3m catamaran, for example, holds 10 BCs, making it an ideal proposal for a crew of six, taking care of up to 28 passengers, for charter, with a floating classroom, live-aboard amenities, and an extra-large central multi-purpose room. The BCs can be cleaned easily with the assistance of a semi-automatic Baldakin 'Servant', employed in the corridor.

The larger Baldakin Explorer 73.1m catamaran can carry a crew of between 120 and 240, catering for between 320 and 640 passengers, and could offer a whole range of indoor and outdoor activities, previously unseen on traditional cruise vessels. For example, passengers will even be able to learn flying and aerial exploration, in the vessel's capacity as the first civilian ultra-light aircraft carrier, with a 60m long runway, allowing landing and take-off of gyroplanes and other VSTOL ultra-light aircraft (and non-VSTOL ultra-lights, if a simplified catapult and arresting cable are installed). These proposed catamarans can be powered by diesel engines or sail, for example, using the MultiRig rigging system, an asymmetrical combination of three free-standing, semi-balanced Balestron rotating rigs, possibly controlled by computer, also invented by Alain Guigan.

Alternative possibilities as float-off safety modules

To offer cheaper accommodation is not the BMAS' only aim, since the BMAS, and its alternative MultiBarge application, can also contribute to safety in mainstream shipping, it is claimed. By offering a self-floating unit, which can, for example, be used as a practical float-off accommodation module (FOAM) on offshore installations as well as on bulk carriers and other types of commercial and naval vessels, a BMAS could provide an alternative to free-fall lifeboats (as recommended in Capt Dennis Barber's article published in the February 2003 issue of *The Naval Architect*, page 54).



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Disabled-access holiday ship to be built by Merwede

THE Zonnebloem, a volunteer organisation that works with the handicapped in The Netherlands, has chosen Merwede Shipyard to build a new holiday ship for its members, as briefly reported in our January issue, page 4. The contract was signed by both parties on at the beginning of November last year, at the shipyard in Hardinxveld-Giessendam. The plan is to start work this spring, and it is hoped that the first holiday makers will be able to board the ship - which will provide space for 2850 sick and handicapped passengers a year, almost 600 more than the current Zonnebloem ship - in March 2006. Merwede Shipyard has a great deal of experience in building river cruise ships and in the past has built another vessel for sick and handicapped passengers.

With the new ship, Zonnebloem will be able to continue to organise sailing holidays for the sick and handicapped. The current, almost 20-year-old, Zonnebloem ship no longer meets current requirements. The new larger design will meet all contemporary quality needs in the area of privacy, comfort, hygiene, sanitary facilities, and working conditions, and will be fitted with modern features.

A computer-generated image of the proposed 115.00m holiday ship building for the Zonnebloem organisation by Merwede Shipyard.

TECHNICAL PARTICULARS
HOLIDAY SHIP

Length, oa	115.00m
Length, wl	111.13m
Breadth, oa	11.50m
Breadth mld	11.10m
Depth moulded	3.70m
Draught (max with ballast) approx	1.70m
Air draught (draught= 1.70m)	8.80m
Air draught (draught= 1.70m) (including sun awning)	approx 9.85m
Speed	min 22km/h
Passengers	69
Volunteers	66
Crew	15

There will be, for example, single as well as double cabins for passengers. Cabins will be larger, and for every two people there will be a bathroom with a shower and toilet. The new ship is also faster and more manoeuvrable.

The vessel is designed as a passenger ship for inland voyages, and will be propelled by two rudder-propeller installations, as well as meeting the requirements for accommodating physically disabled passengers, also volunteers and crew. Both the hull and superstructure of the vessel will be built in steel.

The lower deck accommodates engineroom, crew cabins, volunteer cabins, the captain's cabin, engineers' office, stores, technical spaces, crew recreation room, wheelchair store, a laundry/linen room, sewage treatment plant area, refuse store, hydrophore area, emergency generator, and bow thruster room. Above this, the main deck will be outfitted with an electric equipment room, rinsing areas, public toilet/shower cabins, linen stores, passenger cabins, bathroom, AC room, hall with entrance, and a medical room.

Above this level again, a saloon deck houses the aft mooring deck (lowered), the restaurant, hot and cold kitchen with dishwashing area, dry provision store, refrigerated stores, TV/smoking room, main entrance hall with reception, shop, beauty salon, public toilets, office, pantry, lounge with bar, and a fore mooring deck. A top sun deck contains the wheelhouse with all the navigation and communication equipment, as well as a passenger outdoor area with sun awnings and windscreens.

A watertight bulkhead arrangement will comply with the damage stability requirements, for single and two-compartment flooding, of the NSI (Netherlands Shipping Inspectorate).

Electrical and automation gear for new Grand-class liner

AN order has been received from Italian shipbuilder Fincantieri to equip the latest ship in the Grand-class series with Siemens power, propulsion, and automation technology. This vessel, which is being built for Carnival Corp, brings Princess Cruise ships - built by Fincantieri - with a Siemens package to five. The order is worth approximately €14 million and the ship is expected to be handed over in May 2006.

The new liner is being fitted with a diesel-electric propulsion system, a power supply system, and a Siship Imac 55 automation system for controlling and monitoring all onboard functions. Power distribution will be arranged using the new NX Air medium-voltage switchgear. For system and operator protection, Siprotec 4 digital malfunction units will be used. A power management system is also integrated and connected via an open interface with the vessel's automation plant.

The diesel-electric main propulsion system will have an output of 2 x 21MW, and its two propellers should generate very little noise and vibration. Emissions should also be reduced when the diesel-alternators are operated within their rated load range.

The propulsion concept is based on Siemens' Simar Drive Synchro, in which a synchronous motor is fed via a supply-side converter, a DC link, and a converter at the machine end, with a digital dynamic closed-loop control system, Simadyn D, controlling the drives. Due to Siemens 'transvector' control, the closed-loop control characteristics of the synchronous drives are said to be improved.

Propulsion motors are equipped with winding systems that are offset by 30deg and are each fed by a converter; this is aimed at increasing availability. If one winding phase develops a fault, 55% of the rated torque of the motor is retained.

Six synchronous main generators, with a total output of 81.6MVA for electrical energy, will also be supplied by Siemens, and for power distribution, a new energy management technique will be used onboard, said to be for the first time anywhere. The central feature of this is the NX Air medium-voltage switchgear, which provides 40kA of current at 11kV. During normal operation, all generators feed a connected medium-voltage bus.

In addition, the energy management system has an open interface for link-up to the Siship Imac 55 ship automation unit. This performs all monitoring, alarm and control functions onboard the ship. Process controls take place via the decentralised units that are connected via local networks to reduce the amount of cabling and to raise the fail-safe level.

The system gathers and processes data from around 15,000 measuring points which are distributed all over the ship. At 15 workstations, the entire process can be controlled with 350 mimic diagrams. This user interface works with Windows and allows users to access information at any time.

New Costa sister ordered at Sestri Ponente yard

AT the beginning of January, Costa Crociere SpA and Fincantieri SpA announced they had reached an agreement to build a new 112,000gt cruise liner. This new order will offset the transfer of *Costa Tropicale*, one of 11 ships currently operating under Costa, that will be sold in October 2005 to P&O Cruises Australia, one of 12 member companies of the Carnival Corp Group.

The new Concordia-class ship ordered by Costa Crociere, which has yet to be named, is scheduled to be delivered in the spring of 2007. This order will allow Costa to set a claimed company record as Europe's most modern fleet. The new ship will be built at the Fincantieri shipyard in Sestri Ponente (Genoa), for a total investment of €475 million. It will be a sister to *Costa Concordia*, currently under construction in Sestri Ponente, and scheduled to become part of the Costa fleet by the end of spring in 2006.

Thus, Costa Crociere has doubled the number of ships currently on order from Fincantieri, further consolidating its relationship with the Italian shipyard. The overall value of the projects commissioned to Fincantieri-Sestri Ponente by Costa from 2000 to 2004 has increased to nearly €2 billion.

Costa Concordia and her future sister will measure 112,000gt with a length of 290m and a total capacity of 3800 passengers (3000 lower berths). More than 60% of the 1500 cabins will include a private balcony or window. The two new ships will be built to operate year-round in the Mediterranean, and thus all their various characteristics will be designed for winter holidays. Such features include greater tonnage and stability to ensure comfortable winter sailing, an enormous 1900m² 'wellness' area, extending over two decks - claimed as one of the largest ever on any cruise ship, and the possibility of covering two of the four swimming pools so that they can be used throughout the year, regardless of the weather conditions.

This Concordia-class liner brings the total number of vessels under construction for Costa Crociere SpA to four, the other two being for AIDA Cruises, the German operator that became part of Costa in November 2004. Meanwhile, Fincantieri is also working on Carnival's new Pinnacle project, to develop a super-large cruise liner of 200,000gt, as reported in *The Naval Architect* November 2004, page 4.

New waste compactor

Dry waste material collected onboard four new tankers being built for the Swedish shipping company Broström will be disposed of in an unique multi-chamber marine compactor designed by Uson Marine AB. This separates plastics, cardboard, and metal, and the waste is compacted and baled for storage until the vessel arrives in port. The CE-marked unit is equipped with a 5tonne press, and waste volume is said to be reduced from the equivalent of 700litres to 125litres. A dead-man's-hand grip prevents the equipment from moving when a ship rolls, and its electro-mechanical drive eliminates the need for hydraulic oils. The multi-chamber compactor can be adapted to add chambers for sack and or tin disposal. Broström is installing this equipment so that its new ships can comply with a DNV Clean Sea notation.

This new multi-chamber compactor from Uson Marine is being fitted on a quartet of new tankers for Broström, so that the ships can comply with a DNV Clean Sea notation.

Uson Marine AB, PO Box 10715,
SE-121 29 Stockholm, Sweden
Tel: +46 8 556 717 00.
Fax: +46 8 556 717 01.
E-mail: uson@usonmarine.se
www.usonmarine.se

PVC-free wall coverings

Gislaved Folie AB, of Gislaved, Sweden, has introduced a new range of PVC-free marine wall decoration surface material called Gislaved Choice. Made of durable, scratch-resistant, chemical-resistant HMP, the flame-resistant foil comes in a variety of colours, patterns, and textures; it is said to offer the attractions previously only achieved with traditional PVC materials.equal to those offered with PVC-based materials. Gislaved Choice can also be applied to a range of substrates, and an important feature is its ability to be repaired. The product conforms to SOLAS 74 and IMO requirements, also those of the European Union.

A typical cabin outfitted using Gislaved Choice foil laminate. This is claimed as the first PVC-free product able to equate the durability and appearance of PVC.

Gislaved Folie, Box 518, SE-332 28,
Sweden. Tel: +46 371 837 00.
Fax: +46 371 143 66.
E-mail: ronald.krautz@gifol.se www.gifol.se

Improved sealing profiles

Improved sealing and extended gasket temperature capacity benefits are promised from an extended range of extruded silicone-sponge profiles now being offered to the marine sector by Silicone Fabrication Services Ltd. This company, based in Luton, England, has increased its range of off-the-shelf shapes or tailor-made gaskets made from the SFS sponge, which is claimed to be softer than normal silicone extrusions to provide superior sealing against weak substrates with lower closure force. The working temperature range is from - 60°C to + 200°C.

Silicone Fabrication Services Ltd,
Unit E, Kingsway Industrial Estate,
Kingsway, Luton, UK.
Tel: +44 1582 412697.
Fax: +44 1582 412277.
E-mail:sfs.ltd@btinternet.com

ISO 18072: limit-state assessment of ship structures

Prof Jeom Kee Paik, FRINA, from the Department of Naval Architecture and Ocean Engineering, Pusan National University, Korea, and convenor of the working group for ISO 18072, outlines a proposed new tool to complement class society rules, which aims to further minimise casualties and loss of life at sea. It could also be applied in the offshore sector.

IN May 2003, ISO TC 8/SC 8 on Ships and Marine Technology - Ship Structures established a Working Group to develop the ISO code 18072 (the group consists of experts from 13 ISO P-member countries worldwide). A year later, in May 2004, the Committee Draft (CD) of the International Standard was completed by the Working Group and approved by the ISO TC 8/SC 8. The Working Group is now at the stage of making the Draft International Standard (DIS).

ISO (International Organisation for Standardisation) is a network of the national standards institutes of 146 countries, on the basis of one member for each, with a central secretariat in Geneva, Switzerland, which coordinates the system. It is the world's largest developer of standards. Although ISO's principal activity is the development of technical standards, such standards also have important economic and social repercussions. ISO standards make a positive difference, not just to engineers and manufacturers for whom they solve basic problems in production and distribution, but to society as a whole.

ISO is a non-governmental organisation: its members are not, as is the case in the United Nations system, delegations of national governments. Nevertheless, ISO occupies a special position between the public and private sectors. This is because, on the one hand, many of its member institutes are part of the governmental structure of their countries, or are mandated by their government. On the other hand, other members have their roots uniquely in the private sector, having been set up by national partnerships of industry associations.

Therefore, ISO is able to act as a bridging organisation, in which a consensus can be reached on solutions that meet both the requirements of business and the broader needs of society, such as the needs of stakeholder groups like consumers and users.

The International Standards which ISO develops can be very useful. They are useful to industrial and business organisations of all types, to governments and other regulatory bodies, to trade officials, to conformity assessment professionals, to suppliers and customers of products and services in both public and private sectors, and, ultimately, to people in general in their roles as consumers and end-users.

ISO standards contribute to making the development, manufacturing and supply of products and services more efficient, safer and cleaner. They make trade between countries easier and fairer. They provide governments with a technical base for health, safety and environmental legislation. They aid in transferring technology to developing countries. ISO standards also serve to safeguard consumers, and users in general, of products and services - as well as, it could be claimed, to make their lives simpler.

Among 225 technical committees (TC), TC8 deals with ships and marine technology, while TC67 deals with materials, equipment and offshore structures for petroleum, petrochemical, and natural gas industries. TC8 consists of an advisory group (AG) and 11 sub-committees (SC):

TC8/SC1 Lifesaving and fire protection
TC8/SC2 Marine environment protection
TC8/SC3 Piping and machinery
TC8/SC4 Outfitting and deck machinery
TC8/SC5 Ships' bridge layout
TC8/SC6 Navigation
TC8/SC7 Inland navigation vessels
TC8/SC8 Structures
TC8/SC9 General requirements
TC8/SC10 Computer applications
TC8/SC11 Intermodal and short shipping

Aims and scope of ISO 18072

It is now well recognized that a limit state design (LSD, also called LRFD: Load and Resistance Factor Design) approach is much better than an allowable working stress design (WSD or ASD) approach. The WSD approach relies on restricting stress levels to a proportion of the material yield strength through the use of a simple safety factor. This provides a convenient tool by which to gauge structure size but, unfortunately, it does not provide a means by which the true capacity of a structural component can be quantified.

Consequently, the structural reliability (safety) of such vessels cannot be ascertained without recourse to limit-state principles. Without some measure of structural reliability, it is difficult to convince society that the sizing formulations are not a contributor to any structural failure or total losses.

Logically, since the application of limit-state principles is required to determine realistic ship strength and reliability, it is natural to adopt the same approach for sizing. This has been the approach adopted for more than 20 years in the design of many land-based structures and more recently in the design of fixed offshore structures, whether constructed of steel or concrete.

In addition to these benefits of limit-state principles for reliability assessment, the development of LSD standards has provided a means by which structural configurations can be optimised with respect to safety. Thus, those structural components for which knowledge on strength is inadequate or demonstrates significant variability require relatively larger safety margins that are provided directly by a LSD approach.

Ship structures are now the only major structural form for which an LSD approach is not regularly applied in design yet, although it is appreciated that classification societies are currently developing common rules based on the LSD approach for structural design of tankers and bulk carriers. Such efforts to develop the common rules through the JTP (Joint Tanker Project) and JBP (Joint Bulker Project) began sometime after the Working Group 3 of ISO TC8/SC8 began its work.

Ships outside national standards bodies

Ships belong to one of the few industries in which sizes of structures and structural components are not developed by national standards bodies or their equivalent. Historically, these have been the British Standards Institution, American Institute of Steel Construction, Canadian Standards Association, American Petroleum Institute (API), and contemporaneously, Comité Européen de Normalisation (CEN) – European Committee for Standardization, and International Organisation for Standardisation (ISO).

On the other hand, the offshore industry, which is as equally open as the shipping industry to media scrutiny, initially adopted design standards developed by API, which is an accredited body in accordance with the requirements of American National Standards Institute. Further, 'API standards meetings are open to all materially affected parties, and participation by these parties in the standards development process is encouraged'. However, since 1991, API and the major oil companies have been participating in the development of international standards through the ISO process. The ISO process is subject to several rounds of scrutiny and review and, as a result, it takes a minimum of some 3.5 years to issue an ISO standard from the time work begins.

Harnessing the offshore approach

In seeking to identify a suitable framework for the development of ship-structure limit state guidance, that offered by the offshore industry's approach to standards development appeared entirely appropriate. Thus, early in 2003, a New Work Item (NWI) was submitted by the author to ISO under the auspices of TC8/SC8 - Ships and Marine Technology - Ship Structures. The NWI was approved, and the resulting working group, WG 3, held its first meeting in San Diego in August 2003 during ISSC (International Ship & Offshore Structures Congress).

The original work plan for WG3 had been to develop a document concerned with 'ship structures - requirements for their ultimate limit state assessment'. However, at the first meeting of the WG, although it was accepted that such a document was clearly required, attendees felt that a higher level document was initially necessary.

Hence the WG work programme was modified to begin with a general requirements (GR) document, to be followed in turn by specific sets of requirements for ultimate limit state (ULS) assessment, fatigue limit state (FLS) assessment, and accidental limit state (ALS) assessment, namely:

- ISO 18072: Ships and marine technology - Ship structures - Part 1 General requirements for their limit state assessment
- ISO 18072-2: Ships and marine technology - Ship structures - Part 2 Requirements for their ultimate limit state assessment

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- ISO 18072-3: Ships and marine technology - Ship structures - Part 3 Requirements for their fatigue limit state assessment
- ISO 18072-4: Ships and marine technology - Ship structures - Part 4 Requirements for their accidental limit state assessment.

The WG endorsed the philosophy encompassed in the NWI that the proposed requirements would not intend to be a substitute for class rules, which are the basis for sizing scantlings, and that their prime purpose was to be a means by which the ULS, FLS and ALS of structural components, and the global ship system could be assessed. The assessment formulations to be prescribed are also expected to cover the forms of damage normally encountered in aged ship structures as induced by corrosion, fatigue, and local impacts.

Furthermore, the Working Group 3 deals with Parts 1 & 2 only, while separate working groups need to be established to develop Parts 3 & 4. The ISO 18072 Committee Draft for Part 1 has been completed and approved, and thus it is now in the process of making Draft International Standards (DIS). Meanwhile, the ISO 18072-2 Committee Draft for Part 2 is under development and it is supposed to appear by early 2005.

Principles of limit-state assessment

The performance of a structure and its components shall be described on the basis of specified limit states that separate desired states for the structure from its undesired states. Exceedance of a limit state may be either reversible or irreversible. For the reversible case, removal of the cause of the exceedance allows the structure to return to a desired state. For the irreversible case, damage in the form of permanent set, if localised, may be replaceable.

Limit states may be classified into four categories:

- serviceability limit states (SLS) which represent exceedance of criteria governing normal functional or operational use
- ultimate limit states (ULS) which represent the failure of the structure and its components, usually when subsequent to maximum or near maximum values of actions or action effects
- fatigue limit states (FLS), which represent damage accumulation (usually cracking damage) under repetitive actions
- accidental limit states (ALS) which represent situations of accidental or abnormal events.

In limit state assessment, the various limit states shall be considered against different safety levels, the actual safety level to be attained for a particular type of limit state being a function of its perceived consequences and ease of recovery from that state to be incorporated in strength assessment.

Serviceability limit states

SLS for ships and ship-shaped offshore structures include:

- unacceptable deformations which affect the efficient use of structural or non-structural components or the functioning of equipment relying on them
- local damage (including corrosion and cracking) which reduces the durability of the structure or affects the efficiency of structural or non-structural components
- excessive vibration or noise which can cause discomfort to personnel or affect the proper functioning of equipment (especially if resonance occurs)
- motions that exceed the limitations of equipment
- deformations which may spoil the aesthetic appearance of the structure.

The assessment criteria associated with SLS shall typically be based on deflections or vibration limits during normal use. In reality, excessive deformation of a structure shall also be indicative of excessive vibration or noise, and so certain inter-relationship may exist among the strength criteria being defined but used separately for convenience.

The SLS criteria shall be defined by the operator of a structure, or by established practice, the primary aim being efficient and economical in-service performance without complaints from on-board personnel or excessive routine maintenance. The acceptable limits necessarily depend on the type, mission, and arrangement of the structure. Further, in defining such limits, other disciplines such as machinery designers shall also be consulted.

Ultimate limit states

ULS for ships and ship-shaped offshore structures include:

- loss of static equilibrium in part or all of the global structure, often considered as a rigid body (eg, overturning or capsizing)
- structural instability in part or all of the global structure resulting from buckling and plastic collapse of the structural components
- attainment of the maximum ultimate strength of the structure or its components by any combination of buckling, yielding, rupture or fracture
- excessive deformations
- sinking as a result of hull girder collapse
- loss of station-keeping as a consequence of structural instability (in case of ship-shaped offshore structures).

ULS typically occur under maximum or near-maximum action effects and result in either local or global failure. Before local failure leads to global failure, the ratio of applied action effects to maximum action effects corresponding to global failure shall be determined.

Fatigue limit states

FLS for ships and ship-shaped offshore structures shall refer to cumulative crack damage due to repetitive actions, typically arising from wave actions and cargo loading and unloading. The intention of FLS assessment shall be to ensure that the structure has adequate fatigue life. The FLS assessment should form the basis for planning inspection and maintenance programmes during the design service life of a structure.

Structural failure modes associated with cracks may be classified into three groups, namely brittle facture, ductile fracture, and rupture. When the strain at a fracture of material is very small, it is called brittle fracture. In steel structures made of ductile material with adequately high fracture toughness, however, the fracture strain can be comparatively large. When the material is broken by 'necking' associated with large plastic flow, it is called rupture. As a failure mode, ductile fracture is an intermediate phenomenon between brittle fracture and rupture.

Accidental limit states

ALS for ships and ship-shaped offshore structures potentially relate to:

- serious injury or loss of life
- pollution of the environment
- damage and loss of property or financial exposure.

The intention of this limit state is to ensure that the structure shall be able to tolerate specified accidental and abnormal events and, where damage occurs, subsequently maintains structural integrity for a sufficient period under specified environmental conditions to enable the following to take place, as relevant:

- evacuation of personnel from the structure
- control over movement or motion of the structure
- temporary repairs
- firefighting
- minimising outflow of cargo or stored material subsequent to environmental damage or pollution.

Different types of accidental or abnormal events may require different methodologies or different levels of the same methodology to analyse structural resistance during and following such events. In ship accidental or abnormal events, the primary concern of ALS assessment is to maintain watertight compartments, contain dangerous or polluting cargoes (eg, chemicals, bulk oil, or liquefied gas), and ensure the integrity of reactor compartments of nuclear-powered ships.

Outline of ISO 18072: Part 1. General requirements

International Standard ISO 18072 constitutes a common basis covering the aspects which address the limit-state assessments of ship structures. It uses the limit-state approach rather than the allowable (working) stress approach since it is now well recognised that the former is a more rational basis than the latter for determining true safety margins of structures, including land-based structures, offshore structures, and ships, to name a few. The ability to correctly determine the safety margin is a key to the ability to design a safe, yet economical structure.

Shipbuilders, classification societies, shipowners, operators, and marine insurers have experienced difficulties due to the inconsistency of safety measures based on working stress concepts. Such difficulties are manifested through the different levels of safety margin obtained for a nominally identical ship structure when performing assessments in accordance with class guidelines.

The series of ISO 18072 standards is intended to serve as a basis for defining a consistent and realistic level of safety margin for ship structures.

It may ultimately be applicable to ship-shaped offshore structures. An ability to more rationally assess the true margin of safety will also lead to improvements in related regulations and design requirements as well. Through its application, the intention is to achieve levels of structural integrity appropriate for manned and unmanned ship structures and ship-shaped offshore structures, whatever the nature or combination of the materials used.

ISO 18072 addresses general requirements for the standardisation of strength assessment of ships and ship-shaped offshore structures based on four types of limit states, namely, serviceability limit state (SLS), ultimate limit state (ULS), fatigue limit state (FLS), and accidental limit state (ALS), while the other parts of ISO 18072 will address specific requirements for the different types of limit states.

The assessments in accordance with these limit states necessarily require definitions of loading, analysis, materials, construction standards, and in-service inspections; these are prescribed as appropriate in each part of ISO 18072.

Dimensions and scantlings not included

It is clear that a strength assessment is closely related to structural design. However, the initial determination of structural dimensions and scantlings are not included in this International Standard - it being presumed that procedures and guidelines for the same are provided in detail elsewhere, such as in the relevant rules and regulations of classification societies or regulatory bodies' requirements.

While ISO 18072 has been prepared in accordance with the principles described in ISO 2394 [1] and ISO 19900 [2], such principles have been extended as necessary to deal with those specific to ships and ship-shaped offshore structures.

Perspectives of ISO 18072

Total losses of merchant ships continue to occur regardless of continuous effort to prevent such casualties. Since the 1980s, more than 200 large merchant ships sank when they were in operation, and more than 1000 seafarers lost their lives in the incidents.

It is thought that the primary cause of such casualties is due to structural failure in rough seas and weather because the ship's safety level becomes reduced during later life, even though it was considered to be adequate at the design stage.

To minimise or prevent such casualties, therefore, it is of crucial importance to establish standard guidelines for the strength assessment of new or aged ships, which can determine the real safety level of ships' structures in a qualitative and reliable manner.

In the event of a ship casualty, an argument between the owner and insurance company, which sometimes goes to court, often occurs in identifying the cause(s) of the casualty. In such cases, the availability of standard guidelines on the strength assessment of ships would provide the means to determine a realistic safety level for the ship and to determine the cause of the casualty from a structural failure and strength point of view. This could therefore assist in the resolution of such disputes.

Classification societies have developed structural design rules for ships based on their own experience and studies, and this has essentially resulted in various different sets of design and strength assessment guidelines on offer from various societies. As a result, the assessed safety level even for an identically designed ship structure varies according to which class society strength assessment guidelines have been used in the determination.

During the last two decades, IACS has devoted effort to the development of a unified code or unification of different guidelines. In this regard, one important achievement of IACS activities is a unified code development for a ship's longitudinal strength assessment. However, a significant disadvantage of the IACS longitudinal strength assessment guideline, as well as existing class rules, is that they are primarily based upon the allowable stress design (ASD) approach, together with a buckling strength check adjusted by a simple plasticity correction of structural components. This cannot determine the real safety margin of a ship structure. For such purposes, the limit state assessment method, as represented by ISO 18072, would be a useful alternative.

Certainly, it is very much appreciated that classification societies have recognized the necessity of establishing common design rules based on limit state approach and are now developing limit state-based rules for sizing and dimensioning merchant vessel structures.

In the field of offshore platforms and land-based structures, most strength assessment guidelines have now been established based on the ultimate-strength limit-state approach rather than the allowable stress method. In particular, the ISO code series 19900-19905 provides standard guidelines for the limit-state assessment of offshore platforms. ISO 2394 provides general guidelines for the limit-state safety and reliability assessment of steel structures.

ISO 18072 will provide international standards for the limit-state assessment of merchant ship structures. The most advanced technologies in limit state design will be used in the standards. The working groups to be established to progress the development will be composed of specialists from around the world, including those from IACS member countries.

As new advanced technologies become available, any existing ISO code can be readily updated as soon as the first version appears. Depending on the extent of any revision, this can appear either as an amendment (up to two are permitted) or as a revised code. It is intended that a new working group will be established for the purpose of preparing such revisions. This is standard practice in ISO code development.

It is hoped that ISO 18072 will contribute significantly to minimising and/or preventing loss of life and the financial exposure caused by ship structural casualties. Also, ISO 18072 will work as a complementary tool to unified design rules of classification societies since it will provide guidelines for limit-state assessment of ships in terms of strength modelling techniques related to geometric/material properties, boundary conditions, loading conditions, finite-element mesh size, fabrication-induced initial imperfections, and structural degradation due to age.

References

1. ISO 2394, General Principles on Reliability for Structures, 1998.
2. ISO 19900, Petroleum and Natural Gas Industries - General Requirements for Offshore Structures, 2002.

Construction begins on new train ferries for Bohai Strait

IN *The Naval Architect* February 2002 edition (page 26), two projects for new train ferries in China were reported. One was a design to link the mainland port of Haikou to the island of Hainan in the southern part of the country; that vessel, *Yue Hai Tie 1 Hao*, which was designed by MARIC, is now in operation (*Significant Ships of 2003*) on the 12.5nm route across the Qiongzhou Strait. The second project was for a new fleet of ferries to initiate a brand-new service across the Bohai Strait in the northeast - a much longer distance of some 80nm, between Yantai and Dalian.

The aim is not only to shorten the lengthy coastal road route between two important cities but also to form a new link - as Sinorail Bohai Train Ferry - in the national rail network between the North East and the Yangtze River delta. Both the study and design for a Bohai Strait train ferry have been carried out by SDARI - Shanghai Merchant Ship Design & Research Institute, and a contract for two vessels for the service's first phase are today being constructed at Tianjin Xingang Shipyard. Steel cutting started in December 2004.

An artist's impression of the train/vehicle/passenger ferries designed by SDARI to operate a new railway link service across the Bohai Strait in north-eastern China.

TECHNICAL PARTICULARS
BOHAI STRAIT FERRIES

Length, oa	182.60m
Length, bp	164.60m
Breadth, moulded	24.80m
Depth, to main deck	9.00m
Depth, to upper deck	15.00m
Draught	5.80m
Deadweight	approx 7000dwt
Cargo capacity, main deck	765lane metres
Cargo capacity, upper deck	450lane metres
Passengers	480
Crew	57+6
Main engines (diesel-alternators)	4 x 3000kW
Propellers	2 x 4MW Compact Azipods
Speed, service	18.00knots
Classification	China Classification Society

Each ferry can transport vehicles and passengers as well as trains. On the main (train) deck, a total of 50 freight wagons - with a total weight of 4000tonnes - can be loaded on five recessed tracks. Trains will be loaded and discharged over a linkspan at the stern. In addition, there is space (approximately 450lane metres) for road vehicles on part of the deck above; up to 50 lorries and 25 cars can be stowed here. Vehicles enter and exit through a starboard gate at the open aft end. Both trains and trucks will be lashed onboard by a securing system approved by the China Classification Society and national authorities.

Cabins for 480 passengers are arranged on A and B decks. Entrance is through a walkway at the starboard side on the upper deck. The new ferry has been designed according to the requirements of SOLAS for a ro-ro/passenger ship, and various measures are therefore adopted for safety at sea and in port.

As we noted in February 2002, these interesting new vessels might be powered by azimuthing pods, and indeed this is now confirmed. The Finnish company ABB will supply a medium-voltage electrical power package (briefly reported in our January Trade and Equipment News section) comprising two 4MW Compact Azipod propulsion units and four 3000kW diesel-alternators (6.6kV and 440V networks). This plant will give the new ferries very good manoeuvrability, speedy mooring operations, low noise and vibration, energy savings, and environment-friendly credentials.

A pair of folding fin stabilisers should be able to reduce rolling motion by approximately 85% in rough seas. In addition, an Intering air-activated heel-control system will keep a smooth connection between ferry and linkspan during cargo operations. Vertical escape slides will be fitted in place of traditional lifeboats.

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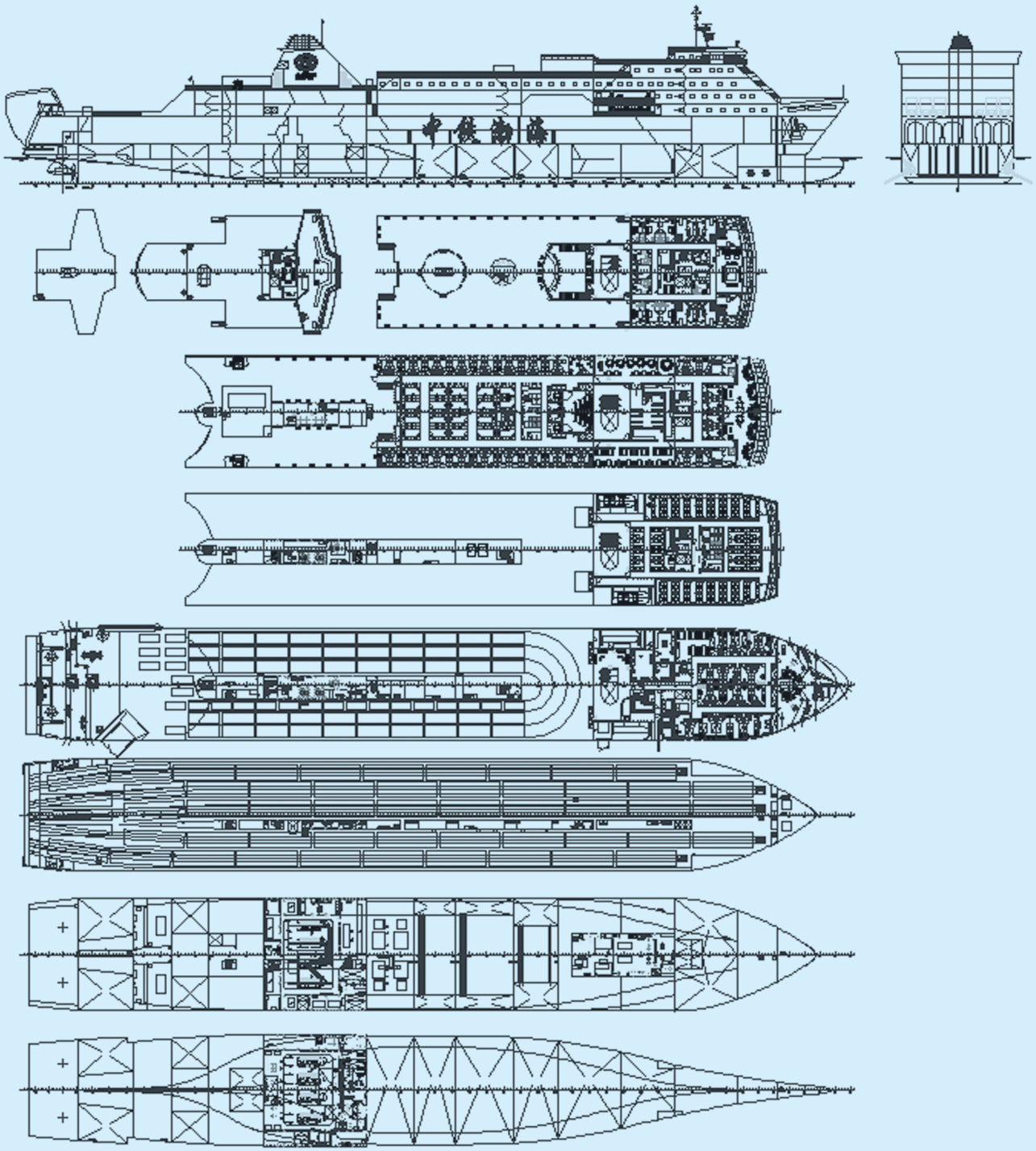
General arrangement plans of the new 7000dwt train/vehicle/passenger ferries being built by Tianjin Xingang Shipyard for Sinorail Bohai Train Ferry. They will be powered by twin ABB Compact Azipods.



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Shen Hua: a new dredger for Chinese port operation

IN January 2003, the Dutch company Vosta LMG received an order from Hudong-Zhonghua Shipyard for the design and supply of all dredging components for a new trailing suction hopper dredger, to be built for the Chinese Harbour Authority at Huanghua Port. This vessel was handed over on November 11 2004, after successful dredging trials in the Yangtze estuary.

Shen Hua has now started work, maintaining the required depth of the waterway entrance to Huanghua. This port, located on the north-east coast of China, belongs to the Shen Hua Group and is the main hub for worldwide export of coal from mines in the northern part of China.

Vosta LMG's order covered a complete engineering package and delivery of the dredging components for this 5000m³ trailing suction hopper design. The company also had complete technical responsibility for *Shen Hua*.

This new vessel is a twin-screw design with CP propellers and two free-hanging rudders. The accommodation block with wheelhouse is arranged at the forward end and can accommodate up to 45 crew members. Behind this is a hopper of the semi-closed type with centre box keelson and transverse saddles. Spoil can be dumped through 10 conical bottom valves - arranged in two rows - or discharged via a bow coupling through a shore pipeline. *Shen Hua* is equipped with two 900mm diameter trailing suction pipes.

The shape and the equipment of the hopper is claimed to represent a new way of construction, developed by Vosta LMG. The hopper itself has smooth walls, and the bottom valves are arranged in two rows. The unloading equipment, bottom valves, and jet water system for diluting the load are said to allow quick discharge of the hopper even without conventional bottom flaps with wide openings. Due to its geometry and specific design, the Vosta LMG system of bottom valves should also ensure better sealing of the hopper than other systems, for example, bottom flaps.

***Shen Hua* is a new 5000m³ trailing suction hopper dredger recently delivered by Hudong-Zhonghua Shipyard to the Chinese Harbour Authority at Huanghua Port for maintenance work.**

TECHNICAL PARTICULARS
SHEN HUA

Length, oa	122.00m
Breadth	22.00m
Depth	7.70m
Draught (on dredging freeboard)	6.90m
Dredging depth	26.00m
Deadweight	7530dwt
Hopper capacity	5000m³
Trailing suction pipe diameter	2 x 900mm
Power installed	10,870kW
Speed	14.30knots
Complement	45 persons
Classification	China Classification Society

In order to benefit construction in series, a number of dredging components, such as side suction pipes, hoisting frames, bottom valves, and overflow weirs, are of proven serial design. The lines of the ship, however, have been optimised to suit particular applications and different propulsion and dredging concepts. Two tailor-made dredge pumps are installed in a special pump room and are driven directly from the two main propulsion engines.

Both trailing suction pipes are equipped with the latest in draghead design. These active models combine high excavation capabilities for loosening compacted soil at Huanghua Port with optimised hydraulic properties for mixture transportation. Controlling the draghead visor angle to the ground can optimise production.

Advanced monitoring and control

The Vosta LMG Dredge Control & Monitoring System (DCMS) for *Shen Hua* employs a concept with various local interfaces. An ergonomically arranged operating panel includes conventional operating elements as well as modern process control via screen, keyboard, and trackball, not only to control but also to visualise and report on the entire dredging process. Thus, pumps and valves should be able to operate with maximum efficiency and optimised discharge rates. Amongst other parameters, mixture concentration, mixture flow, and pressure on the suction side are also taken into account for complete optimisation of the dredging process.

Moreover, various automatic functions and sequences, such as swinging out the suction pipes and activating valves into the required working mode, will be of great help to the dredge-master in achieving quick and safe operation. Besides the process-visualising system, a graphic suction-pipe position indicator shows the exact position of each pipe. This is integrated into the entire system in the same way as the loading computer for exact monitoring of hopper loading condition.

New Chinese hatch cover factory for MacGregor

CAPITALISING on its experience of production partnerships in China, the MacGregor Group has established a new joint venture hatch-cover manufacturing plant in Nantong.

In response to growing demand for shipboard equipment from Asia's rapidly expanding shipbuilding industries, MacGregor, today headquartered in Finland but with a crane factory at Örnsköldsvik, Sweden, joined forces with a newly formed local company, Rainbow Heavy Industry Co. The new plant, which was due for completion in October 2004, is located 120km from Shanghai in Nantong's economic and development zone beside the Yangtze River.

It features two hatch cover production lines, each measuring 252m x 3 m with a lifting capacity of 100tonnes. In addition, the factory has a separate temperature- and humidity-controlled surface treatment line with an automatic grit recycling line. The new plant, being run by Rainbow, is set to employ a workforce of 300. Although manufacturing at the new facility is concentrated on hatch covers, the plant is also capable of fabricating steel structures for the civil engineering industry.

MacGregor has been building marine cranes in China since the late 1980s at Lüzhou Machine Works in Nanjing, a site owned by the China State Shipbuilding Corporation (CSSC). The Swedish supplier has seen output there grow to more than 100 cranes a year.

MacGregor formed its first hatch cover joint venture partnership in China in 1996 with Nantong Ocean Iron & Steel Company (NOISCO), and the joint business opened a purpose-built hatch cover factory in Nantong two years later. Today, this facility is run by Nantong COSCO Ship Steel Structure Co (NCSC) in partnership with MacGregor. In 2001, the Swedish firm set up another venture, Haida-MacGregor Jiangyin Sealing Limited Liability Co with leading Chinese marine seal manufacturer, Jiangyin HaiFa Industrial Co Ltd. MacGregor's recent manufacturing success in China through local alliances is likely to lead to further deals and joint production ventures there in future, says the company.

New thruster plant established

A WHOLLY-owned, state-of-the-art factory for transverse thrusters in Wuxi, China, is to be set up by Wärtsilä. Production will start in mid-2005. The name of the company is Wärtsilä Propulsion (Wuxi) Co Ltd.

The new facility will produce Lips-brand transverse thrusters and will serve the global shipbuilding market. Wärtsilä will also complete its portfolio by adding new sizes of transverse thrusters giving better market coverage. Value of the factory investment is €6.6 million. The site will employ some 120 employees, with a step-by-step approach according to volume development.

Acquisition strengthens Imtech's Chinese hand

The Rotterdam-based technical service provider in the field of information and communication technology, also electrical and mechanical engineering, Imtech NV, claims an increasingly strong position in the Chinese shipbuilding market. The company recently agreed to acquire from the German shipbuilder HDW the subsidiary HDW-Hagenuk Schiffstechnik, which already has good connections in China. HDW-Hagenuk is a specialised distributor and systems integrator for electrical, automation, security, navigation and communication layouts; the company also has a design and assembly capability.

HDW-Hagenuk holds a 38% stake in a Chinese joint venture, together with two Chinese partners, for electrical switchgear production and services in Shanghai, and is currently working on more than 20 ship projects. Imtech itself is working on around 10 projects.

Expansion at Tsuji's Chinese hatch cover and section factory

EXACTLY one year after Tsuji's Chinese plant started operation in November 2003, the go-ahead was given for further large-scale investments in the facility, to reach a monthly processing capacity of 13,000tonnes of steel by summer 2005. The main products manufactured at this plant (which was reported in more detail in our February 2004 edition, page 78) are hatch covers and ship sections.

Preparations have started to almost double hatch cover manufacturing capacity, already claimed to be the largest in the world, by adding a complete new line. For ship sections and hatch covers, the respective shipyards supply all steel material, and to increase efficient discharge of these continuous and large quantities of steel, construction has begun on a new pier stretching 65m into the Yangtze River.

The number of Chinese workers, already exceeding 1300, is expected to increase to 2000 by late 2005, to be headed by a 50-strong management team from Tsuji's Japanese main office. The new facility has recently been awarded an Approval for Welding certificate from Germanischer Lloyd, Products and Works Recognition from Bureau Veritas, and ISO 9001:2000 approval from Lloyd's Register.

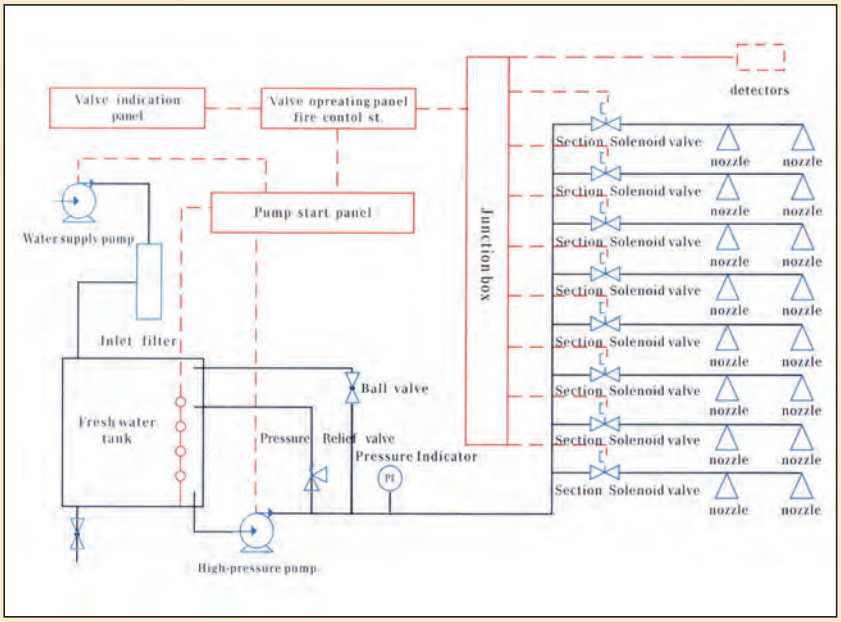
Last year, the company contracted complete bridge/accommodation superstructures for 10 Panamax bulk carriers being built at Universal Shipbuilding, in Japan, and the first set is to be delivered this month. In addition, large orders have been received for the fabrication of ship sections for other Japanese yards, such as Imabari Shipbuilding, Mitsubishi Heavy Industries, Tsuneishi Shipbuilding, Sanoyas Hishino Meisho, Mitsui Shipbuilding, and Namura Shipbuilding, as well as Universal. Large size sections can weigh up to 830tonnes, and Tsuji expects that in the future demand for even larger modules will arise. By using a roll-on/roll-off method, sections of 3000tonnes will be able to be shipped out.

With the shipbuilding industry booming, many Korean yards have decided to follow their Japanese counterparts by outsourcing the manufacturing of hatch covers. Recent months have seen Tsuji receiving orders of close to 30 shipsets of hatch covers for large bulk and container carriers being built in Korea for owners worldwide.

Tsuji has increased fabrication capacity at its Chinese facility, and today, complete superstructures of up to 830tonnes can be constructed, all so far for export. Weight is only constrained by crane capacity at receiving yards.

This schematic diagram shows a typical layout using the new high-pressure water-mist firefighting system developed by the Chinese company Shanghai Aohan Marine. The Aohan-Safe design is claimed as more effective than gas at extinguishing fires and the water flow rate less than that using a sprinkler arrangement; operating pressure is between 80bar and 140bar, and the mist droplet diameter is between 50µm and 100µm. It is particularly relevant for areas where high temperatures are involved, for example, in parts of machinery spaces, such as diesel-alternator and boiler rooms (where a water-mist system will soon become mandatory for certain areas). The mist cools down the surface of equipment, prevents re-ignition, and does less damage than sprinklers. All components are said to be highly reliable and convenient to both install and maintain. Operation can be automatic or manual.

Shanghai Aohan Marine holds certificates from Lloyd's Register and the EC, and orders have been secured from, amongst others, Jiangnan Shipyard (Group) Co and Hudong-Zhonghua Shipbuilding. Good cooperation is also said to be enjoyed with leading Chinese owners, such as COSCO.



LETTER TO THE EDITOR

Reform of fishing vessel regulations

Sir - Canada is undertaking a major regulatory reform process aimed at modernising its domestic shipping requirements. As part of this process, the country is reviewing the Torremolinos Protocol as a possible basis for Canadian large fishing-vessel regulations. During the evaluation of this information, an area which was found to be absent in our industry was the use of F-rated divisions as structural fire-protection materials.

The technical performance standards for such divisions have been part of the Torremolinos vernacular for a number of years, but North American builders have not embraced their use, making local experience with these boundaries difficult to find. We are looking for input on vessel construction arrangements, which have been found to satisfy the exacting requirements of the Fire Test Procedures Code (FTP Code) and ask that anybody who has such experience to contact the undersigned.

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Vertical bending moments induced by abnormal waves

This work is a follow-up of a previous investigation that explored the possibility of using freak, abnormal, or episodic waves as additional wave load conditions to be considered in the design of ship and offshore platforms. In the previous work, a procedure was developed and implemented to adopt deterministic time series of wave elevation, which may include abnormal waves, as reference design conditions to calculate the wave-induced structural loads on ships. An application example was presented for a container ship subjected to a wave trace that was measured in the central North Sea during a severe storm*.

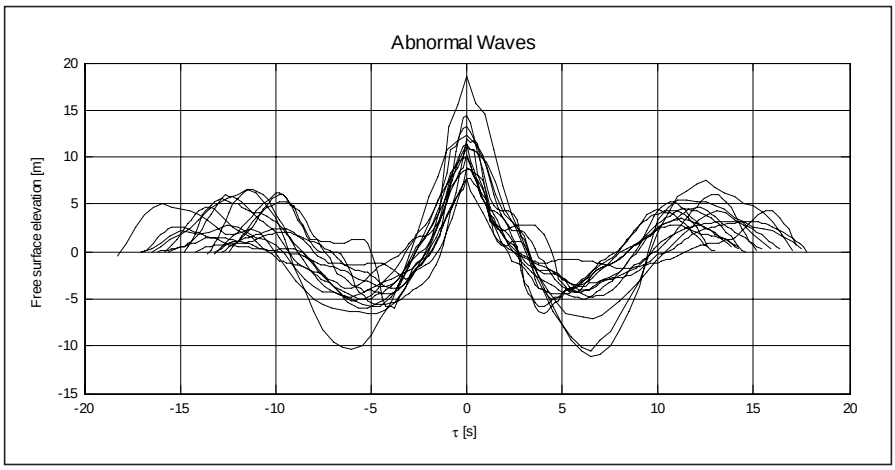

Fig 1. Time trace around the abnormal wave event.

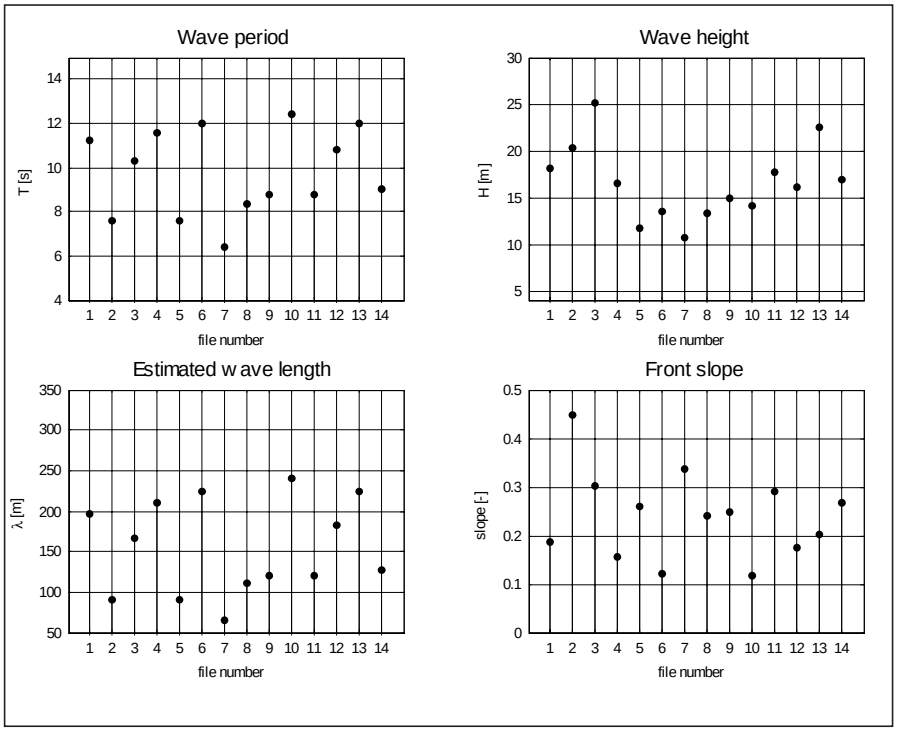

Fig 2. Wave properties for data from North Alwyn, Draupner, and Camille.

TODAY, the definition of wave-induced structural loads for the design of ship structures is, in most cases, still based on empirical formulae from classification societies. However, as computers become faster and cheaper, there is a tendency to apply procedures based on direct calculations to define the design wave loads. These procedures rely on hydrodynamic models derived from first principles, together with a proper stochastic characterisation of the waves and of the ship responses. There are several advantages from using these more advanced methods: eventually, the design wave loads will be more accurate and tailored for the specific ship characteristics, novel ship concepts can be assessed (while empirical formulae are in principle valid for existing ships only), and, besides global structural loads, it is possible to obtain consistent hydrodynamic load distributions for finite-element calculations.

For the linear case, the maximum wave-induced structural loads during a long period of time can be efficiently calculated applying linear potential flow hydrodynamic models in the frequency domain, together with spectral analysis and a weighted summation of short-term Rayleigh distributions of the maxima (Guedes Soares and Moan, 1991). However, at least for ships with small block coefficient, wave-induced structural loads are highly non-linear.

In these cases the linear procedure cannot be applied and the design wave loads must be determined by time-domain non-linear codes, together with appropriate extreme value distributions. Several approaches have been proposed and currently it is not clear if any one is better than the others. A review of such methods has been presented by Guedes Soares *et al* (2004a).

Although the methodologies referred in the previous paragraph take into account the stochastic nature of the waves encountered by a ship during its life, apparently conditions associated with the encounter of the ship with abnormal waves are not taken into account. This is because the probabilistic models describing the waves do not seem to consider the abnormal waves.

However, there are some reports from accidents that resulted from the encounter with waves that were much larger than those of the seastate in which they occurred. It is also believed by some authors that such abnormal waves were responsible by the mysterious vanishing of some ships. For this reason Faulkner and Buckley (1997) suggest that the methods to determine the design loads should be revised to account for the effects of the abnormal waves on the ship structure.

Fonseca and Guedes Soares (2001) proposed a method to calculate the structural loads induced by deterministic wave traces of abnormal waves, where the ship responses are calculated by a non-linear time-domain seakeeping code. The methodology was applied to a container ship encountering a wave sequence that includes an abnormal wave with a height of 26m. This wave

*Extracts from the paper 'Vertical bending moments induced by a set of abnormal waves on a container ship', presented by N Fonseca, C Guedes Soares and R Pascoal, Technical University of Lisbon, Portugal, at The Royal Institution of Naval Architects' international conferenece on Design and Operation for Abnormal Conditions 3, held in London on January 26-27, 2005.

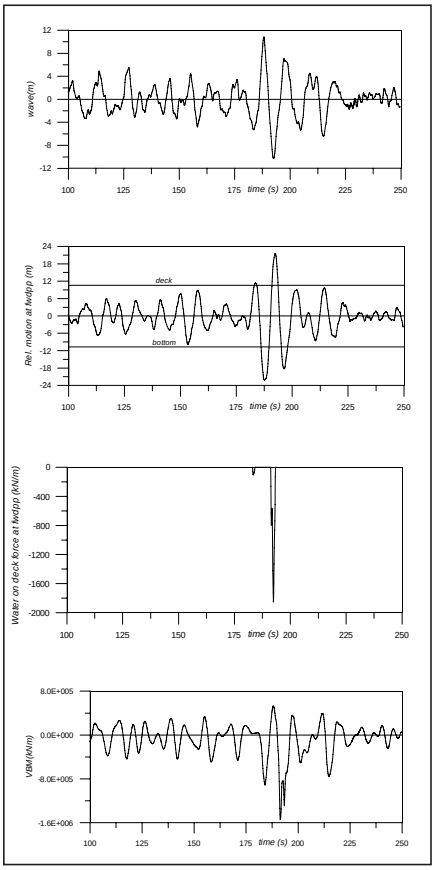

Fig 3. Simulation of ship responses in head waves. Wave trace number 41 (from Camille hurricane).

trace was measured in the North Sea during a severe storm. In this case it was found that the maximum sagging moment in the abnormal wave is between the linear and the non-linear long-term prediction for the ship operating in the North Sea during a period of 20 years.

The same methodology was applied by Clauss *et al* (2004) and Guedes Soares *et al* (2004b) to investigate the structural wave loads on a FPSO induced by deterministic rogue waves. This work included numerical and experimental investigations. Comparisons between experiments and simulations showed that the numerical model is able to represent remarkably well the wave-induced bending moment at midships in the highly non-linear waves, including the asymmetry of the sagging and hogging peaks.

In the present paper, the same procedure is applied to obtain the wave-induced structural loads on the same container ship, but a systematic investigation is carried out by using a large set of wave traces. These traces have been measured at different occasions and different places, and they include abnormal waves. In this way, it is possible to assess the influence of the abnormal wave height, wavelength, and shape on the wave-induced structural loads. It is also possible to produce some statistics regarding the ship responses and structural loads induced by abnormal waves.

The time traces used herein originate from the Gulf of Mexico, during hurricane Camille on August 17 1969, from the Draupner platform in the Central North Sea, when it was struck by a storm from December 31 1994 to January 1 1995 (this is a trace containing the wave that has become known as a 'New Year Wave'), and from North Alwyn in the Northern North Sea, relative to a lengthy storm - November 16-22 1997.

The wave data, as such, have been analysed by Guedes Soares *et al* (2003) and Guedes Soares *et al* (2004c) to determine the existence, and to characterise the properties of the abnormal waves thereof. Those files that include a wave with an abnormality index (AI) greater than two have been used herein. The AI was defined by the ratio between maximum wave height and significant wave height for the record, be they calculated using the down-crossing or up-crossing definition.

Calculation method

Representation of the wave field

The calculation of the structural loads induced by wave traces of abnormal waves is based on a time-domain seakeeping code, however the first step is in fact the calculation of the exciting forces induced by the wave field that includes the wave trace. To do so, it is necessary to derive a representation in the time and space domains of the incident wave field, which is consistent with the time history of the wave elevation defined at a particular point in space.

The time record is transformed from time to frequency domain by a Fast Fourier Transform (FFT) algorithm. The frequency domain representation of the time signal is then used to simulate the original time history of the wave elevation. Deep-water waves in unidirectional seas and zero current are assumed. Furthermore, it is assumed that the kinematics of the waves may be represented by superposition of linear and harmonic wave components. With the wave trace decomposed into harmonics and assuming linear superposition, it is possible to calculate the wave-exciting forces on the ship. Details of the procedure may be found in Fonseca and Guedes Soares (2001).

The application of the linearity assumption and superposition principle to represent very large and steep waves may seem to be inadequate; however one should keep in mind that the focus here is on the global responses of the ship and not local responses. It is known that non-linear wave effects are important if one needs to represent local flow effects, such as, for instance, relative motions at the bow, but the global responses are less sensitive to higher-order effects on the wave elevation. In fact, the procedure presented here was applied to investigate the vertical motions and bending moments on a FPSO subjected to wave traces of abnormal waves and the comparisons with experimental data showed remarkably good agreement (Guedes Soares *et al*, 2004).

The quality of the simulated wave elevation compared with the original time series depends on the time interval that is Fourier-analysed and the number of harmonics that is used in the simulation. On the other hand, the computational effort of the seakeeping code increases with the number of harmonic components.

For the present problem, the interest lies on assessment of the ship responses to the abnormal wave, which is inserted in the wave signal. The simulation of ship responses must start before the large wave is encountered, such that the transient effects induced by the wave field are correctly represented.

The hydrodynamic transient effects are usually felt for a period smaller than one minute, thus if one considers a period of two minutes before the abnormal wave and one minute after that, it is ensured that all transient effects are taken into account. The number of harmonic components needed to represent correctly three minutes of the wave record is perfectly compatible with the seakeeping code.

Seakeeping code

Regarding the time domain seakeeping code (Fonseca and Guedes Soares 1998a, 1998b), the method assumes that the non-linear contribution for the vertical bending moment is dominated by hydrostatic and Froude-Krilov forces, thus these components depend on the instantaneous hull wetted surface. The exciting forces due to the incident waves are decomposed into a diffraction part and the Froude-Krilov part.

The diffraction part, which is related to the scattering of the incident wave field due to the presence of the moving ship, is kept linear. Since this is a linear problem and the exciting waves are known *a priori*, it can be solved in the frequency domain and the resulting transfer functions be used to generate a time history of the diffraction heave force and pitch moment. The Froude-Krilov part is related to the incident wave potential and results from the integration at each time step of the associated pressure over the wetted surface of the hull under the undisturbed wave profile.

Radiation forces are represented in the time domain by infinite frequency-added masses, radiation-restoring coefficients, and convolution integrals of memory functions. The convolution integrals represent the effects of the whole past history of the motion, accounting for the memory effects due to the radiated waves. Both the radiation and diffraction coefficients in the frequency domain are calculated by a strip method.

The vertical forces associated with green water on deck, which occurs when the relative motion is larger than the freeboard, are calculated using the momentum method (Buchner, 1995). The mass of water on deck is proportional to the height of water on the deck, which is given by the difference between the relative motion and the freeboard.

According to the classification of the Committee VI.1 of the International Ship and Offshore Structures Committee (Jensen *et al*, 2000), this code is based on a 'partially nonlinear method'. This means that the equations of motions and loads combine linear and non-linear terms. The mentioned Committee has reviewed the methods available to calculate non-linear ship motions and loads in large amplitude waves and concluded that, for practical applications, the methods that were more appropriate are the ones based on approaches similar to the one described above.

Calculation examples

Wave traces

The procedure presented in the previous section is used to calculate the responses of a container ship to several wave traces that include abnormal waves. These wave traces were measured in different places and occasions, which is described in the next paragraphs. In this work, an abnormal

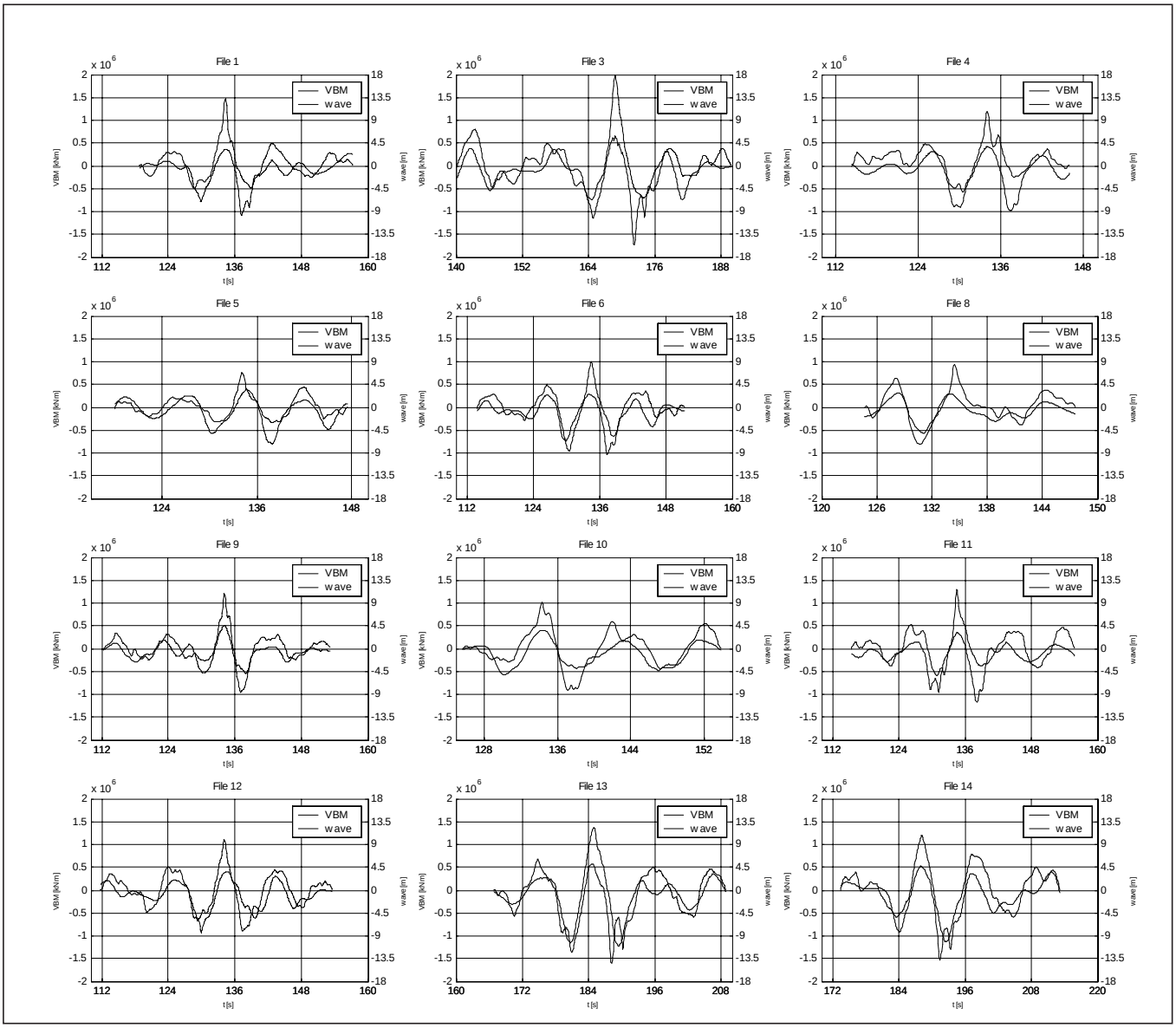

Fig 4. Simulations of the wave elevation around the abnormal waves and corresponding vertical bending moment at midship.

wave is defined when the ratio between its height and the significant wave height of the corresponding wave record is larger than 2. Additionally, only waves with heights larger than 10m are considered.

During the passage of hurricane Camille in the Gulf of Mexico, on August 17, 1969, wave data was registered by a wave-measurement system installed on a platform fixed in waters of 100m. Original data, sensed by an induction wave staff, was recorded continuously on magnetic tape until the measurement system was damaged (Earle, 1975).

The digitised time sequence used herein contained approximately 12 hours of surface elevation at a 0.5sec sampling period. Earle showed the degree of non-stationarity of the data. The significant wave height of the signal changes approximately 0.8m/h. These data have been further analysed by Guedes Soares *et al* (2004) and, therein, abnormal waves were identified. Some of the segments determined to contain abnormal waves with high crests have been used herein, namely segment numbers, 37 and 41, which correspond to the end of the elevation time trace, just before the wave staff broke.

From the Draupner jacket platform, a time trace which contains a very high wave crest was first reported by Haver and Karunakaran (1998). The platform is positioned in the Central North Sea and the water depth at the measurement site was 70m. The sensor was laser based and the samples are 0.4687573sec apart (recorded during the New Year Wave previously referred to). It was registered in a time series lasting 20min that started at 15h 20min of the second day.

North Alwyn has also provided some time series containing abnormal waves with high crests. The data was collected by laser-based sensor equipment installed on a fixed jacket platform positioned in the Northern North Sea. The data that has been used is from the November 1997 storm referred to previously.

From this storm, there are 421 files, each corresponding to 20min of data sampled at 5Hz and with 2min of pause between files, thus providing an almost continuous throughput. From the set of files, those identified to contain abnormal waves (Guedes Soares *et al* 2003) have been used.

Table 1 presents the number attributed to each wave trace, grouped according to the three different sources. Altogether, 14 wave traces that include abnormal waves were analysed and used for time domain simulations of the ship responses. Fig 1 shows the time histories of the wave traces around the abnormal wave event. It can be observed that the group of wave traces looks symmetric around the large crests, however the symmetry is not found in each wave trace isolated, as can be seen in the graphs of Fig 4.

Some parameters of the abnormal waves have been calculated in order to compare the characteristics of the different wave events, and the results are plotted in Fig 2. The parameters are: the wave period, wave height, estimated wavelength and front slope. These values have been calculated as follows. The wave height, *H*, has been calculated using the down-crossing

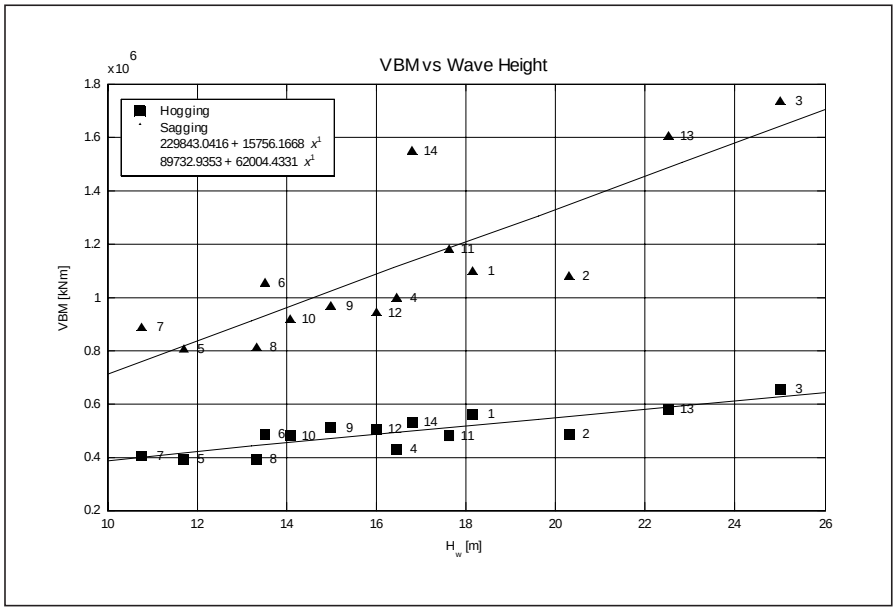

Fig 5. Correlation between the largest sagging and hogging peaks and the height of the abnormal waves.

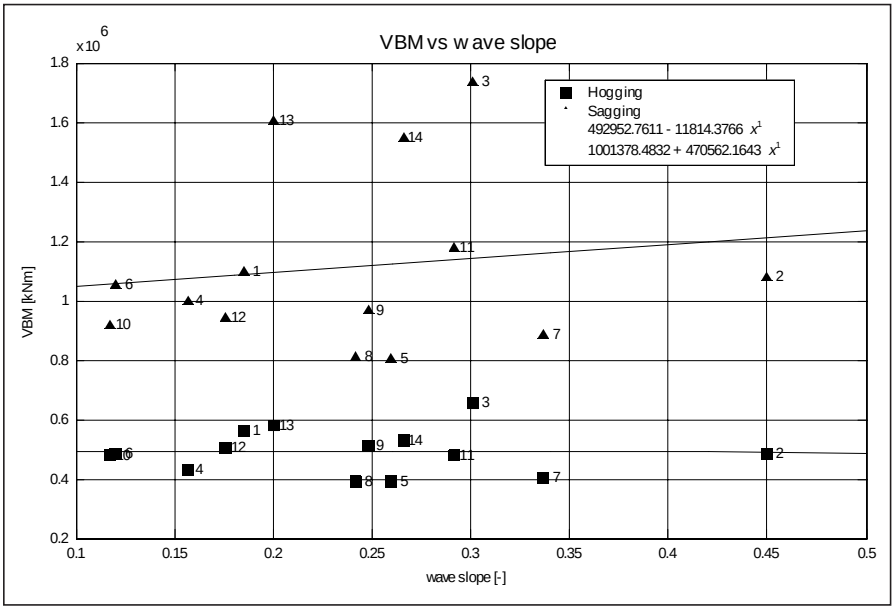

Fig 6. Correlation between the largest sagging and hogging peaks and the abnormal wave slope.

definition; it is the vertical difference between the value of the trough immediately before the maximum crest and the maximum crest. The wave period, *T*, was determined as twice the time it takes for the events used to estimate the height to occur. The wave length λ has been estimated using linear wave dispersion relation for deepwater waves as $\lambda=(2\pi)^{-1}gT^2$. The wave slope has been calculated as the ratio between wave height and half the estimated wave length.

Ship responses

This section presents the results from the time-domain simulation of ship responses to the group of selected wave traces. The calculations are for the ITTC S-175 container ship which has the following main particulars: length bp of 175.00m, beam of 25.40m, draught of 9.50m, displacement of 24,742tonnes, and a service speed of 22knots. The ship advances in long-crested head waves with a reduced speed of 13knots, which is a little less than 60% of the service speed. This is a realistic speed for a container ship in a seastate with significant wave heights of around 8m-9m.

In all cases, the ship is forced to pass through the location in the space where the wave record was measured, exactly at the time instant when the abnormal wave crest is generated (measured). The reference point in the ship is the centre of gravity.

The wave exciting forces are given by deterministic wave traces. In order to calculate the excitation forces, a summation of harmonic wave components represent the wave traces. The Fast Fourier Transform is used to transform the wave signal to the frequency domain and in all cases 1024 points were used.

Data	File #
Camille	{13, 14}
Draupner	3
Alwyn	{1, 2, ..., 12}\ 3

Table 1. Data to file number association.

The major part of the wave signals were collected at a sampling rate of 5Hz (Alwyn records), thus 1024 points correspond to three minutes of record and some seconds of zeroed wave elevation. The Camille wave records were collected at a 2Hz sampling rate and the Draupner at roughly 2.13Hz, thus 1024 point corresponds to a longer period of time. Between 80 and 90 harmonic components were used to reconstruct the original wave traces.

Fig 3 presents the type of simulation responses that were obtained running the time-domain code with the wave traces as input. This wave trace was measured during the Camille hurricane and was attributed the number 41. The first graph presents the simulated wave elevation represented in the reference system advancing with the ship speed.

This is the wave elevation at the longitudinal position of the centre of gravity (very close to midship). It can be observed that a very large wave occurs around the second 190. The crest has an amplitude of around 10.5m and the next through is similar with opposite sign, which results in a wave height of around 21m.

The second graph presents the relative motion at the bow (forward perpendicular), and the horizontal auxiliary lines represent the height of the deck and the bottom at the same position. The third graph shows the vertical downward force for each unit length, due to green water on deck at the forward perpendicular. The last graph presents the vertical bending moment at midship.

This set of results show that the forward deck is submerged, not when the bow encounters the large wave crest, but when the bow encounters the next crest, which is much smaller. This means that the ship is able to climb the large crest, but then the bow dives on the next one. Associated to this second event there is an estimated height of water on deck of around 10m.

This height of water on deck produces a vertical downward force, at the position of the forward perpendicular, with a maximum value of approximately 1800kN/m. The vertical bending moment at midship is also maximum when the ship dives the bow after the large crest. It is interesting to note that the green water on deck forces produce a hogging contribution for the vertical bending moment at midship, which limits the maximum value of the sagging moment.

Fig 4 presents graphs with simulations of the wave elevation (dashed lines) and the vertical bending moment at midship (continuous line) around the abnormal waves. The right vertical axes are used for the wave elevation and the left

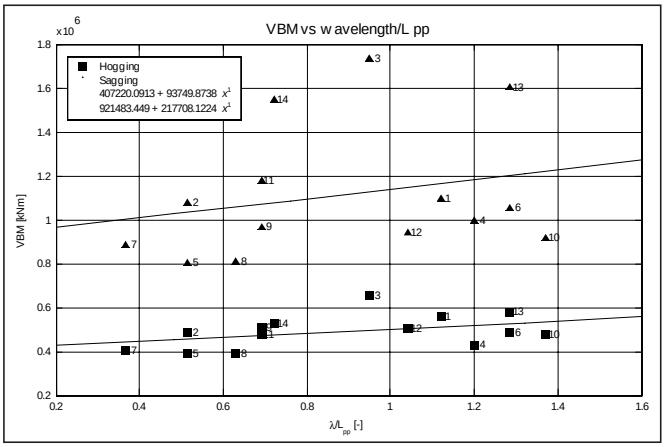

Fig 7. Correlation between the largest sagging and hogging peaks and the abnormal wavelength.

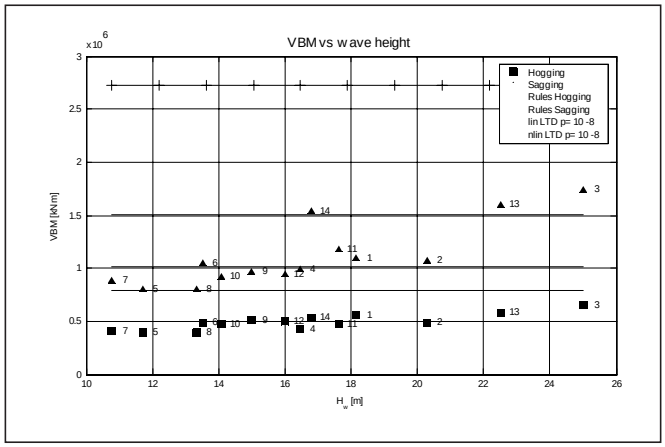

Fig 8. Comparison between the largest sagging and hogging peaks, and the rule values.

ones for the moment. The figure gives a general overview of how the vertical bending moment behaves with respect to this type of waves.

It is possible to conclude that the maximum hogging moment occurs always when the large wave crests passes through midship. However, the magnitudes of the maximum sagging moments are around two times larger than the hogging ones. In most cases the maximum sagging peaks occur, not when the ship bow encounters the large crest, but when the bow dives into the next wave crest.

The only case where this does not happen (file 8) is because the wave length after the large crest is very long, so the ship is able to follow the wave instead of diving its bow into the free surface. The simulations seem to indicate also that there is a strong correlation between the abnormal wave height and the maximum moments (which is not surprising). This is confirmed in the graphs of the next figures.

Figs 5 to 7 present the correlation between the maximum hogging peaks (squares) and sagging peaks (triangles) and, respectively, the abnormal wave height, front slope and wavelength. The lines are linear regressions. The graph of Fig 5 shows that both the sagging and the hogging maximum moments increase almost linearly with the abnormal wave height, although the sagging magnitudes are approximately double the hogging ones. The correlation between the hogging maxima and the linear trend is very good, while there is some more spreading in the case of the sagging peaks. This is probably because the hogging maxima are produced when the abnormal wave crest is at midship and the next wave does not affect this moment, while the maximum sagging peak is very dependent of the wave that follows the large crests, as already analysed in the previous paragraph.

Observing Fig 6, it can be concluded that, on average, the maximum vertical bending moment peaks are almost independent of the front slope of the abnormal waves. This is somewhat surprising, however it should be noted that the seakeeping model does not account for the impact loads that certainly occur when the ship bow encounters very steep fronts of water. The transient effects of the global ship vibrations that result from the bow impact may have an influence on the maximum hogging moment. On the other hand, the bottom slamming that occurs before the bow dives into the next wave, may also contribute to the maximum sagging moment.

Observing the three graphs, from Figs 5, 6 and 7, it is clear that there is a strong correlation between the maximum sagging and hogging moments and the height of the abnormal waves, and a weaker correlation with the front wave slope and wavelength (although these three variables are not independent).

The graph of Fig 8 is a reproduction of Fig 5, representing maximum sagging and hogging peaks versus the abnormal wave height, but where the minimum rules values required by classification societies were added. The continuous line represents rule value for hogging and the dashed line rule value for sagging. It can be observed that the calculated maximum hogging moments are always below the rule value, while some of the waves result in calculated sagging moments larger than those required by the rules.

Conclusions

This article presents a systematic study of the structural global loads induced by abnormal waves on a container ship. A non-linear time domain seakeeping code is used to calculate ship responses to deterministic wave traces that include abnormal waves.

A large set of wave traces are considered, which have been measured at different occasions and different places. In this way, it was possible to assess the influence of the abnormal wave height, wavelength, and shape on wave-induced structural loads.

From analysis of the results, it was concluded that the maximum hogging bending moments occurs always when the abnormal wave crest passes through midships. The hogging maximum peak increases almost linearly with the height of the abnormal wave. The maximum sagging moments are around double the hogging ones.

The largest sagging peaks occur, in most cases, after the large wave crest passes through midship and the ship bow dives into the next wave crest. It was observed also that in some cases the downward forces due to green water on the bow deck tend to reduce the maximum sagging moment.

When analysing results for the whole group of abnormal waves, in average, the sagging maximum also seems to increase linearly with the wave height. However, compared with the hogging peaks, there is a larger dispersion relatively to the mean line. This is due to the fact that the sagging peak depends of the height and shape of the wave crest that the ship encounters after the abnormal wave. Finally, it is observed that maximum bending moments seem to be independent of the front slope of the abnormal wave.

Acknowledgements

This work has been carried outwithin the scope of the research project 'Rogue waves - forecast and ompact on marine structures (MAXWAVE)', partially funded by the European Commission, under the programme Energy, Environment and Sustainable Development (Contract No EVK3:2000-00544).

Work of the third author has been financed by a grant SFRH/BD/10527/2002 of Fundação para a Ciência e a Tecnologia.

The authors are grateful to BP for having provided the data relative to hurricane Camille, to Statoil for providing the Draupner data, and to Herriot-Watt University for having shared the North Alwyn data.

Successful commissioning of cavitation tunnel for Vietnam

THE end of last year proved to be a busy time for CTO (Centrum Techniki Okretowej) SA. Dr Leszek Wilczynski, from this Polish model tank, notes an increase in research projects, reflecting the positive upturn in the shipbuilding market. December, in particular, brought a challenging task. This consisted of commissioning a new cavitation tunnel for the Vietnamese Shipbuilding Science and Technology Institute, VINASHIN. The entire tunnel was manufactured and constructed in Poland. After its successful commissioning, the tunnel was shipped to Vietnam.

The dimensions, design parameters, functions, and auxiliary systems of this tunnel were described in the September 2004 issue of *The Naval Architect*, page 108. As a brief reminder, the main features of the tunnel are: stainless steel construction, length between vertical axes 16m, height between horizontal axes 8m, test section of dimensions 500mm x 500mm x 2500 mm, maximum flow speed in the test section v=12m/sec, minimum cavitation number =0.15, and maximum main pump engine power P=90kW.

Due to the dimensions of the tunnel, the use of stainless steel, and the general technology utilised, the considerable amount of welded joints, together with the required manufacturing tolerances, created a difficult task. The typical manufacturing tolerances regarding the most important sections of the cavitation tunnel, ie, contraction, test section, and the diffuser, are of the range of magnitude of 10^{-1}mm, thus construction of the tunnel needs to be totally accurate. Accuracy is also required for perpendicularity, parallelism, and roughness of the internal surfaces of the tunnel construction.

Due to the strict requirement of the extreme construction stiffness that has to be fulfilled during tunnel operation in reduced pressure conditions, the number of external stiffeners welded on the outer surface of the top sections is the greatest. Thus the most accurately manufactured sections have been subjected to the highest risk of thermal deflections, especially when made of stainless steel.

Additionally, the profile of the walls of the contraction section has been optimised numerically. Any excessive discrepancy between the manufactured and designed shape could result in unacceptable velocity distribution in the test section. Other requirements concerning the manufacture of the particular sections of the tunnel include absolute leak-tightness within the range of pressure at which the tunnel is intended to operate, high stability of operation as far as main pump revolutions and velocity in the test section are concerned, and the lack of accidental cavitation developing on the internal surfaces of the empty tunnel (empty means filled entirely with water, but without any bodies installed in the test section) within the whole range of the tunnel design operation parameters.

The tests of the tunnel were conducted in Elblagm Poland, at ABB Zamech Marine. They have proved the high manufacturing quality as well as the expected consistency between the designed and actual parameters of tunnel operation, especially regarding the maximum speed in the test section and the possibility of achieving the presumed range of cavitation number.

The tunnel is intended to serve research purposes with the dimensions of the test section allowing testing of propeller models up to 200mm in open water or simulated behind conditions. The research equipment allows conducting of standard propeller model cavitation tests according to the recommendations of ITTC.

Currently CTO SA is conducting a research project supported by the Polish Ministry of Scientific Research and Information Technology. The project involved elaboration of a series of cavitation tunnel designs differing in test section size and flow parameters. The study includes extensive CFD analyses of flow inside tunnels of designed geometries and structural analyses performed for mass optimisation purposes.

Fig 1. Final stage of the cavitation tunnel assembly.

Fig 2. The housing of the propeller dynamometer investigated in the test section of the tunnel.

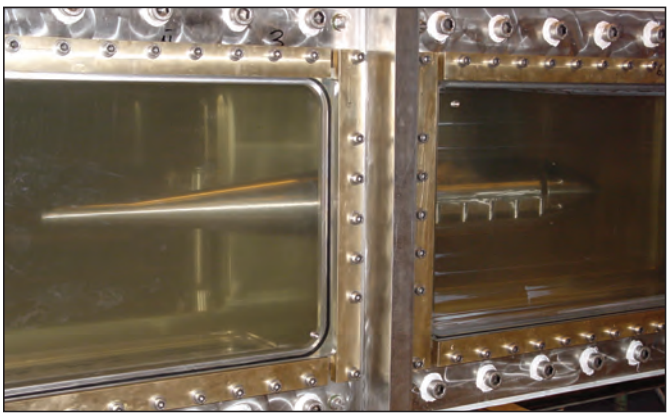

Fig 3. An overall view of the cavitation tunnel during the commissioning tests.

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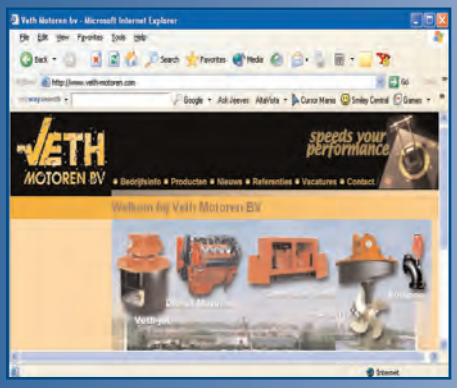

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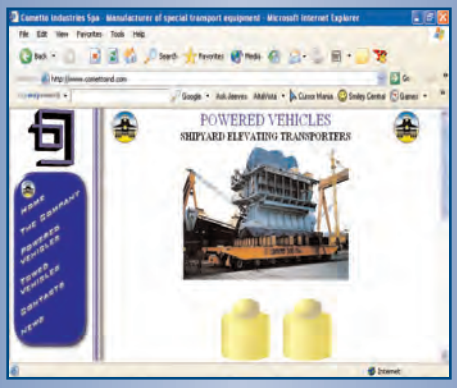

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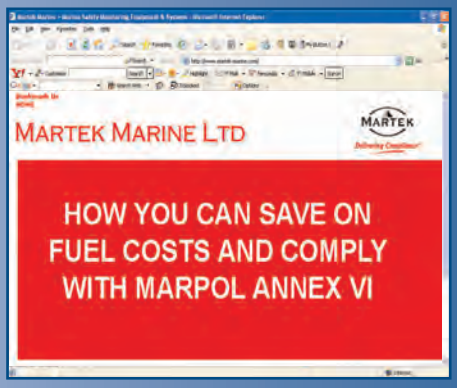

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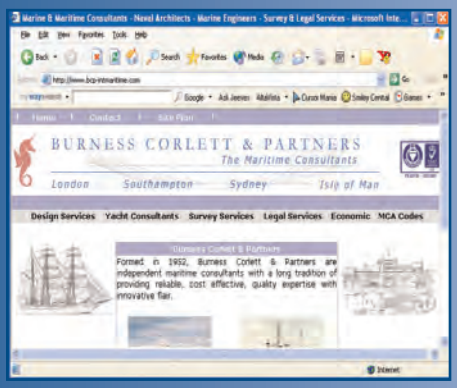

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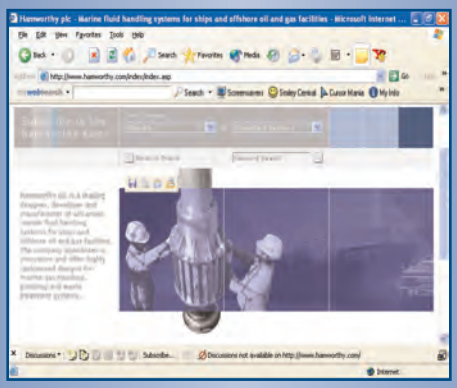

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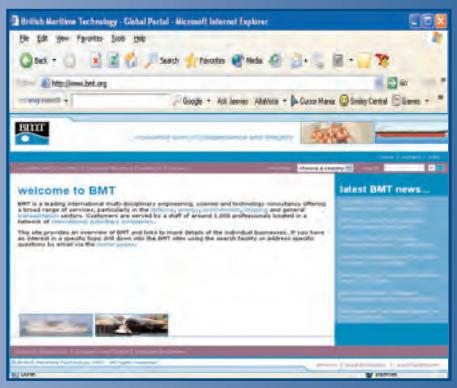

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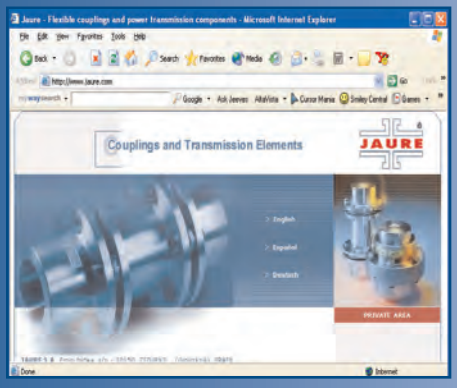

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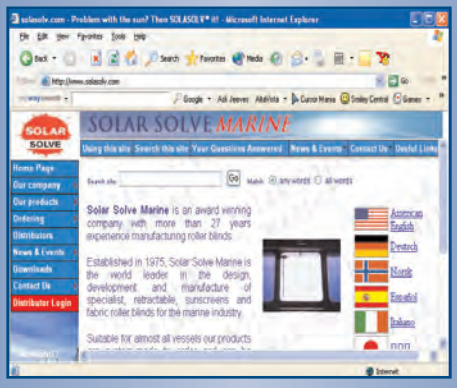

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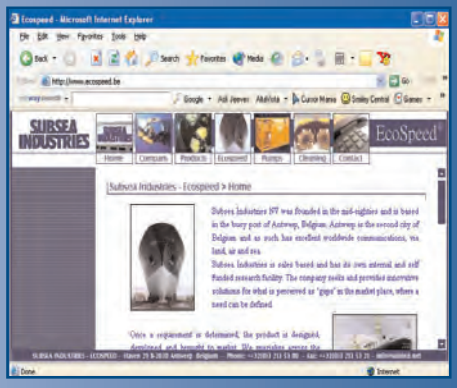

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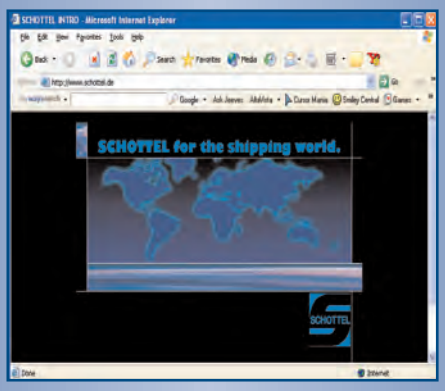

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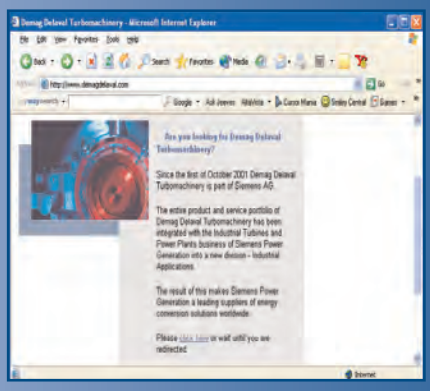

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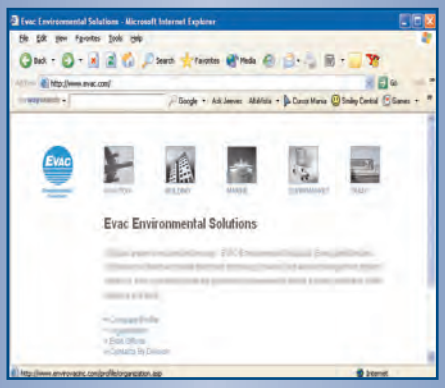

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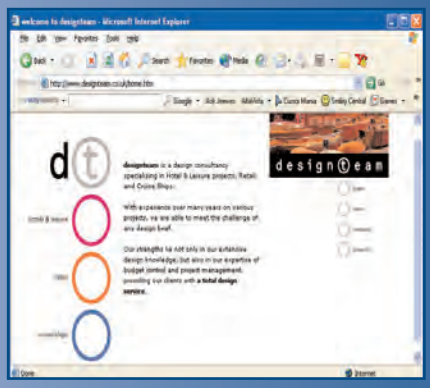

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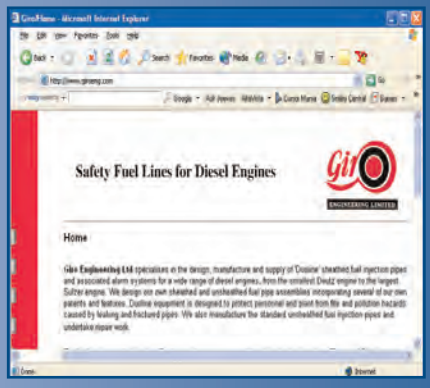

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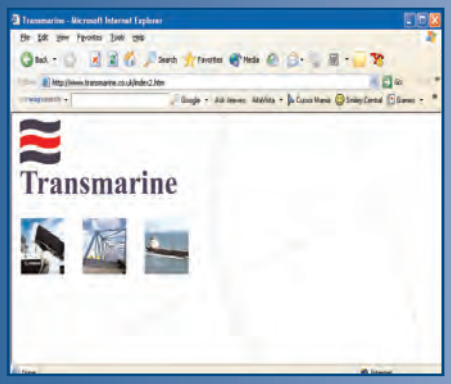

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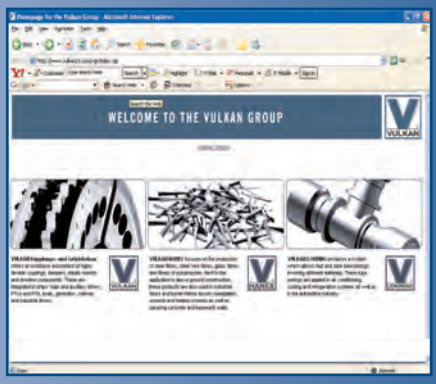

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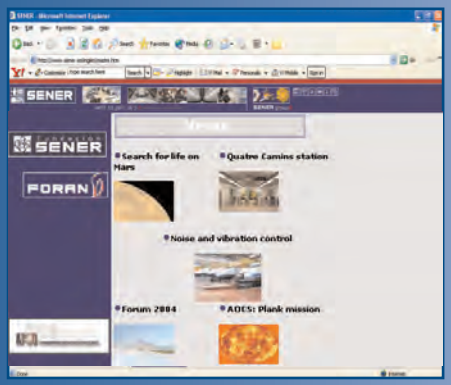

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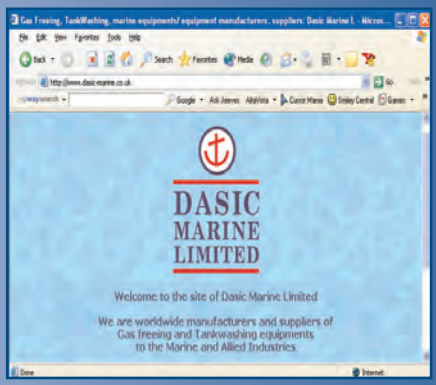

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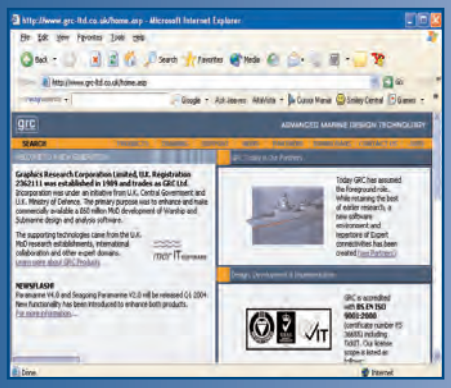

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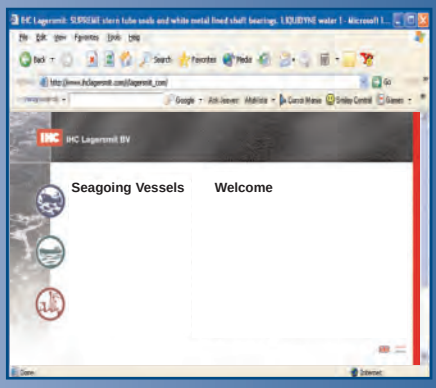

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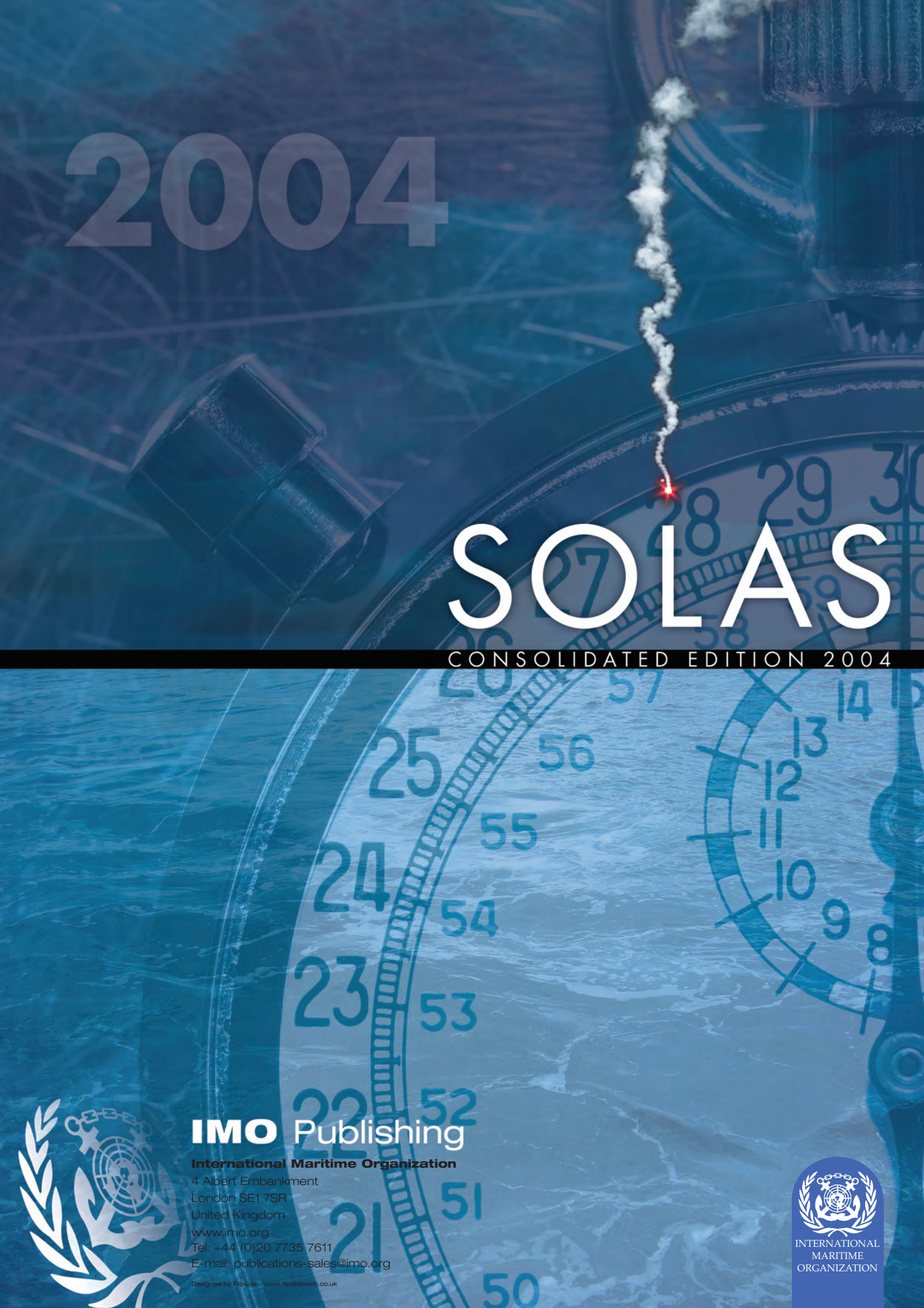

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