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Publisher Mark J Staunton-Lambert

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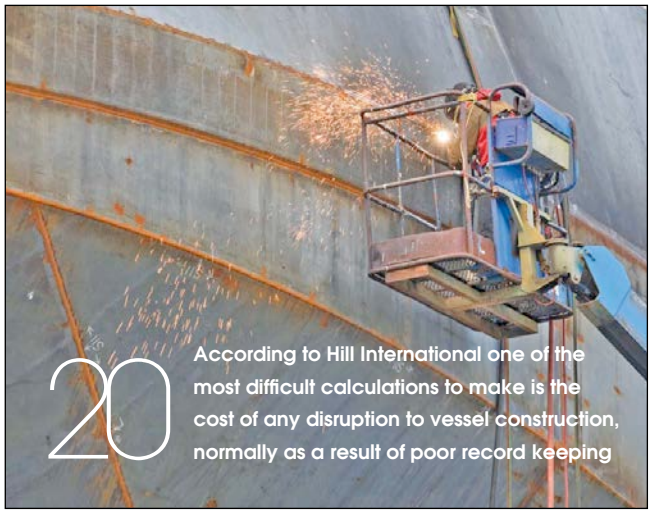

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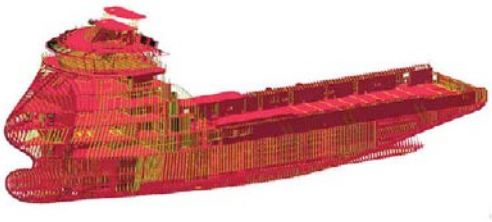

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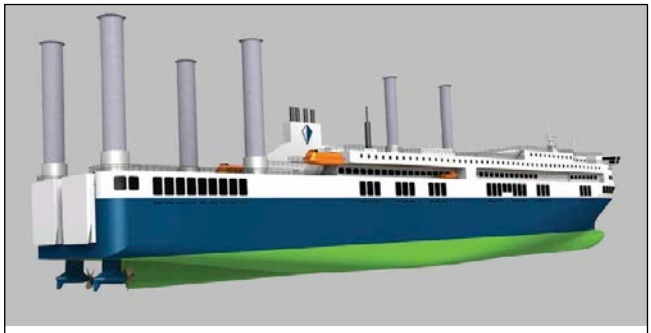
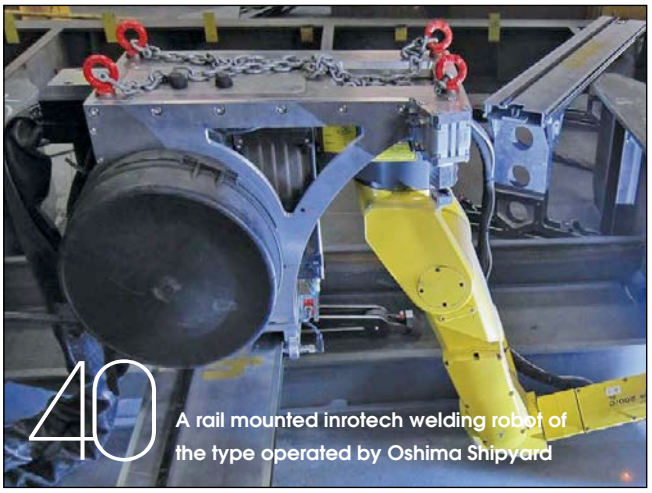
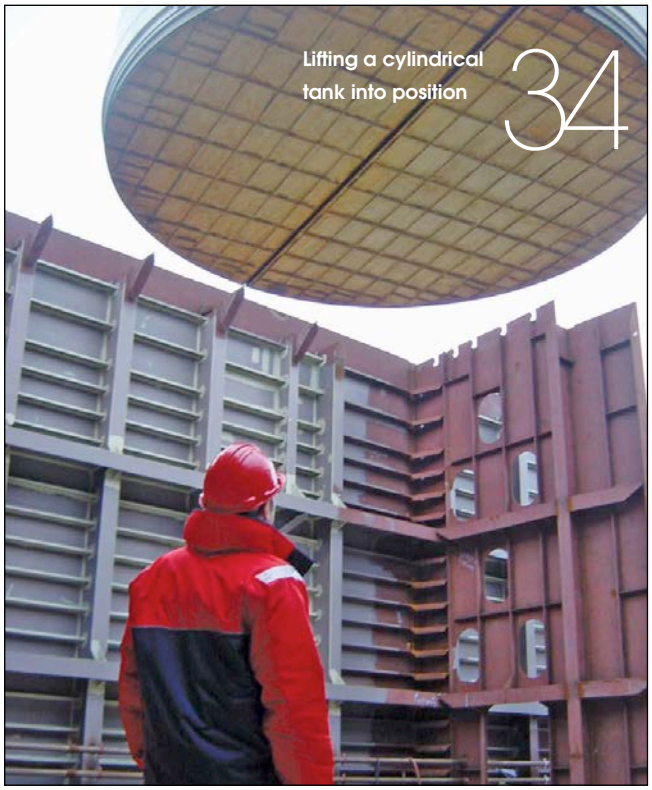


Development of the ferry DeltaChallenger could mark the beginning of a period when the shipping industry's CO_2 reduction outstrips the increase in shipping necessary to meet demand from a growing global population 26



40 A rail mounted inrotech welding robot of the type operated by Oshima Shipyard



Lifting a cylindrical tank into position 34

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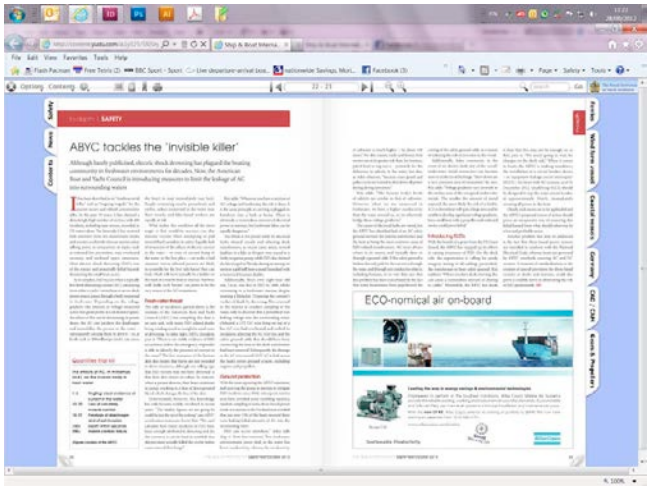

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Solving the carbon conundrum

Estraden **combines technologies to meet commercial and environmental demands**

Meeting the growing demand for maritime operations conflicts with the contrary demand to reduce greenhouse and other emissions from ships. In order to meet these conflicting demands, and to cut costs, vessel operators have adopted slow-steaming.

However, the demand for considerably greater emissions reductions and the insecurity surrounding fuel costs are driving ship owners to find new ways to meet these conflicting requirements.

One method is to combine more than one technology. Norsepower has introduced its new version of the Flettner rotor to the market. The rotors offer safe power reduction that leads to the savings on fuel costs that can only be beneficial to the industry and the technological revolution from Norsepower offers a cut in the use of the carbon based fuels in favour of the environmentally neutral wind power; the original ship power source.

Modern design materials and computing offer an upgraded version of the original Flettner rotor design giving up to 30% thrust to a vessel in the right conditions, allowing for significant savings even with fuel prices having fallen by more than 50% from highs of about US$600/tonne or more to around US$250/tonne today.

Even with the collapse in the oil price, however, there is little sign of ships speeding up, with slow-steaming introduced to both save fuel and help to reduce the chronic over-capacity in certain trades, particularly in the container sector.

The option to operate at lower speeds is not as easy for many ships types; as is well known, Bulk carriers, tankers and other cargo ships already operate at far lower speeds than the comparatively super-fast container ships. Conventional ferries, although faster (and some are known as fast ferries), must operate at a particular speed in order to meet their schedules, offering operators less scope to improve on fuel consumption through reducing the vessel's speed.

Many coastal vessels are typified by the fact that they operate at a lower speed, and if there is an opportunity to save fuel, even 10-15% of fuel, this could result in a significant bottom line saving for vessel operators while the cumulative effect of many vessels reducing their carbon footprint would be a significant step towards achieving the kind of emission reductions necessary to meet the challenge set by global warming.

The 200m long *DeltaChallenger*, a ro-pax vessel designed by Deltamarin in Finland utilises the Flettner rotor technology developed by Norsepower along with the latest LNG power technology to develop a ship that will reduce the power necessary to operate the vessel by around 10% on average. However, with the LNG powered Azipods driven by a dual-fuel electric system there will be further reductions in the emissions as compared to a similar vessel.

LNG is said to reduce SOx emissions by around 90% and NOx emissions completely while carbon dioxide pollution is reduced by 20%, pushing the total carbon savings up toward the 30% mark. While these savings remain below the required amount to actually reduce greenhouse gas emissions if the demand for shipping grows at the rate that most commentators expect over the next 15-20 years, it is a substantially bigger saving, and will give a smaller carbon footprint to coastal vessels utilising similar technology.

If there is a combination of technologies such as in *DeltaChallenger* the savings will increase, both for emissions and costs, however with the development of new technologies there may be the option for even greater savings.

As highlighted by Denis Morais in his blog regarding the International Conference on Computer Applications in Shipbuilding, held in Bremen in late September and organised by the Royal Institution of Naval Architects, speakers debated the fourth industrial revolution which is now seen by most industry observers as providing the biggest changes to the maritime industry in a century.

"The conference keynote did talk about Industry 4.0 and how it is and will affect the shipbuilding industry. Industry 4.0 is the fourth industrial revolution and it uses cyber-physical systems to monitor and control the physical world by using software. In essence this is the same as the *Smart Factory* or *Smart Yard* you may have already heard about.

"There were not very many presentations about this topic which was unfortunate. In my opinion this can significantly change the shipbuilding and shipping industry by allowing us to better capture and then analyse the data to make more informed decisions." *NA*

Propellers

Kappel Propellers make the difference

Norwegian chemical tanker operator Odfjell has reported a 20% improvement in the efficiency of one of its Poland class tankers following the fitting of a MAN Kappel propeller and shaft improvements.

Vice president of technology management at Odfjell, Knut Erik Fredriksen, told *The Naval Architect* that tank tests had shown that the propeller design could produce 20-50% efficiency improvements. However, even though the tank tests showed significant savings the actual efficiencies achieved were still "amazing for us", explained Fredriksen.

Trials on the optimised vessel of 37,000dwt showed that with the optimisation on the shaft generator, the new propeller and the optimisation of the turbocharger the vessel was making substantial savings in fuel.

"The return on investment is very good, even with the reduction in fuel prices the payback time is three-five years," says Fredriksen. The company is now looking to optimise a further 10 ships of 37,000dwt and another eight vessels of 40,000dwt. In total, 19 ships will be modified by 2017, said Odfjell.

Before and after tests of the vessels were done at the same speeds so that the test results were comparable. The optimised speed has been reduced slightly, according to Fredriksen, though he declined to be specific about the speed of the vessel, apparently for commercial reasons.

MAN Alpha Propellers reported that its MAN Alpha Kappel fixed pitch propeller, with its distinctive curved blades like the wing tip of an aeroplane, has been fitted to *Elsabeth C* a 58,500dwt Supramax bulk carrier owned by Frontmarine Co. Ltd. *Elsabeth C* is the first in a series of eight ships, all featuring single MAN B&W 5S60ME-C8.2 engines with an SMCR 8050 kW at 89 rpm.

MAN Diesel & Turbo's senior manager, head of propulsion, Thomas Leander, says the company is looking to develop new propeller designs and is currently looking for partners for a project which will probably include designs using composite materials. "It is important to have a customer as a partner and a university, but no project has been started yet," confirmed Leander.

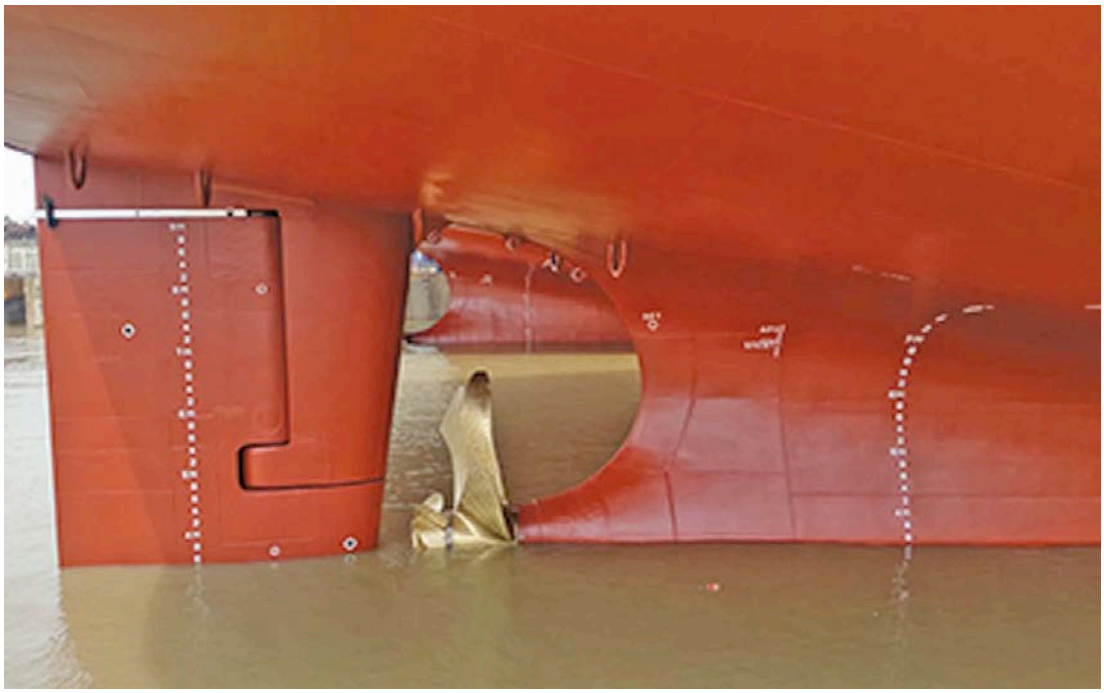
Regulation

Slide rule

Niels Bjorn Mortensen, Maersk Maritime Technology's director, head of regulatory affairs, says that the annual regulatory tennis between the IMO and United Nations Framework Convention on Climate Change (UNFCCC) is likely to end this year.

According to Mortensen, since the Kyoto Protocol was established in 1997 the question around regulations dealing with greenhouse gases (GHG) has been "kicked back" to the IMO every year at the Conference of the Parties (COP) meeting which takes place at the end of each year. This year at COP21 in Paris the "rumour is that this may not happen," he said.

A close up of a MAN Alpha Kappel propeller fitted to a vessel



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The suggestion is that the UNFCCC will take control of the regulations that should curb the emissions of carbon dioxide in particular. The debate within the shipping industry to date has centred around the type of market measure, either an Emissions Trading System, a carbon tax or a combination of the two.

Meanwhile, Mortensen also took a swipe at those in the industry that complain about the difficulties of implementing rules. He said that Maersk's C-Class ships had engines that could not stop on HFO and so "at every port call they would switch fuels to MDO, perhaps 20 times a voyage with no problems."

He went on to say that there had been a fear that following the introduction of Sulphur Emission Control Areas there would be a shortage of distillate fuel, this had proved an unfounded fear and that no-one had predicted that the price of MGO would decline by 50%, in fact the doom-masters had predicted a significant increase in the price of distillate fuel.

However, Mortensen also pointed out that SOx compliance "is through a piece of paper", that is owners produce a document that says the fuel bought from the bunker seller complies with sulpher regulations. As such this rule is "easier to circumvent" than other rules. He said there are other questions that also remain to be answered regarding the sulphur rules.

For example, will the global cap on sulphur emissions be implemented in 2020 or 2025 and will we know before 2018 which date it will be implemented. In addition we need to know that a global cap can be enforced. He said that an owner had attempted to fit a Continuous Emission Monitoring System (CEMS), but they could not do it; "One of the ships needed to go to drydock in order to fit a CEMS and are these gadgets tamper proof?" asked Mortensen.

LNG

TOTE awards complex LNG conversion

The conversion contract for a diesel-electric vessel has been awarded to Singapore's Keppel yard.

At around the same time that TOTE's ground-breaking, first LNG-fuelled containership newbuild is being commissioned, the company's diesel-electric trailership *Midnight Sun* will enter Keppel Shipyard to undergo repowering to dual-fuel LNG propulsion.

One of two 2003-built, Orca-class sisters that maintain the Tacoma (Washington)/Anchorage (Alaska) service, the complex project with *Midnight Sun* will constitute the world's first major conversion of a large ro-ro vessel for operation on LNG fuel.

Key elements of the job will be the removal of the four MAN 9L58/64 medium-speed main engines and replacement with four Wärtsilä 12V50DF dual-fuel medium-speed units, the provision of 2,200m^3 of LNG tank capacity, and the addition of 47km of new cabling. The work is expected to be completed within a 90-day timeframe.

TOTE said that the re-engineering of *Midnight Sun* would eliminate NOx emissions, cut SOx by 90%, particulate matter (PM) by 91%, and CO_2 by 35%. Sistership *North Star* is scheduled to undergo a similar conversion towards the end of next year.

LNG bunkering will initially be accomplished by way of a barge currently under construction; plans have been laid for an LNG liquefaction terminal at Tacoma to supply the TOTE vessels and the broader transportation industry in the Pacific Northwest region from the end of 2018 onwards.

Coatings

Real data, better prediction

International has launched a new data tool that uses information collected from vessels in service to improve the accuracy of performance predictions for vessel powering, fuel consumption and CO_2 emissions.

The new product, IntertracVision, responds to the industry's well-known war of words and guarantees, and aims to ease the decision-making process for ship owners and operators looking to invest in the right coating product. The company believes there is a lack of specificity and accuracy with current methods of modelling and data collection, such as Noon reports, and so has created the product to assure clients of their coatings' performance offerings with real vessel data presented in an easy to use calculation tool that can analyse key performance variables.

UCL Energy Institute lecturer, Tristan Smith, says: "As one of several academic contributors to IntertracVision, we aim to support this initiative by bringing the industry a step closer to a new era of robust, rigorous analysis…This should enable ship owners to explore the 'what ifs' and performance prediction uncertainties in such a way that they can then make more informed decisions based on the key variables."

Currently the tool can only analyse containerships, bulkers and tankers, but International plan to expand its capabilities to include LNG and cruise ships. The company makes clear that the product is in constant development and will continue to improve with the addition of further data sets – version 2.0 is already on the horizon, says Michael Hindmarsh, global marketing manager, deep sea dry docking, International. *NA*

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Emotions running high before COP21

A lively debate seems likely when the 21st session of the Conference of the Parties (COP) for the United Nations Framework Convention on Climate Change (UNFCCC) opens in Paris at the end of November, *writes Sandra Speares*.

The lead up to the conference has been emotionally charged with the most recent intervention by the Marshall Islands suggesting that outgoing IMO secretary-general Koji Sekimizu's recent comments constituted a "danger to the planet" - which seems to be going a step further than such interventions tend to do.

In a statement, the Marshall Islands suggested that the IMO secretary-general's latest words were a "danger to the planet" because of his call "for global leaders at COP21 not to intervene and not insist that the IMO now set a clear and ambitious sector target for shipping."

Foreign Minister Tony de Brum also remarked: "Of great alarm is the secretary-general's misuse, or at least misunderstanding, of the evidence-base on shipping and its greenhouse gas (GHG) pollution."

In his recent comments in the run-off to the COP21 discussions, Sekimizu stressed the progress made so far on the emissions issue, but that measures will have to consider the impact of the global economy if global trade continues to grow, and also energy prices.

"It is important to stress that IMO is, to date, the only international organisation to have adopted global legislation to significantly reduce CO_2 emissions from a particular industry. Nothing similar exists for any other industry or business sector."

He went on to say: "But who should decide on such measures and where should this be done? Clearly, this is an issue that needs to be addressed by governments – and by governments willing to act together, in a spirit of cooperation. Historically, debate among governments about shipping has taken place within IMO, where the nature of, and impact on, the shipping industry is best understood. And I believe IMO is the only place to take this debate forward."

According to the secretary-general: "In the process leading up to the Paris meeting, world leaders might be tempted to consider specific measures aimed at reducing shipping's overall contribution of CO_2 emissions, such as an overall cap. Such measures would artificially limit the ability of shipping to meet the demand created by the world economy, or would unbalance the level playing field that the shipping industry needs for efficient operation, and therefore must be avoided."

Sekimizu's comments that figures contained in IMO's most recent study of GHGs suggest that during the five years to 2012 the total contribution from international shipping to global emissions actually reduced from 2.8% to 2.2%, were one target for the Marshall Islands response.

According to the registry it is in the front line for climate change and "we face the very real existential threat if the world does not act now and act decisively. Climate change is not a future issue; it must be addressed, and addressed decisively, now.

"If RMI acts alone and directs only its registry to take a firm stance on shipping emissions, it will simply achieve the demise of our registry. It requires the industry as a whole to make a collective paradigm shift. This will only happen if the IMO sets a firm target now for the industry to reduce its overall emissions profile. Unfortunately, and after only the briefest of debates, the IMO determined not to grant the RMI request, citing the need to complete its work on agreeing a data collection, monitoring and evaluation process for shipping and to consider the outcomes from COP21 in Paris."

"At MEPC 68, the debate on our proposal for a target was short but supportive - 24 countries spoke out from across the spectrum of developed and developing economies. That the words of the third-largest shipping registry, with strong multilateral support in the IMO, were not enough to move the debate on targets forwards and that the secretary-general himself is publicly communicating a contradictory message raises serious questions about the organisation's ability to take a balanced view on this topic."

Other criticisms of the secretary-general's words came from Bill Hemmings of Transport & Environment who commented: "How extraordinary that after 18 years, the very essentials of Kyoto are being disputed, and by the outgoing IMO secretary-general, no less. The Marshall Islands are right that Paris must intervene, and UN secretary-general Ban Ki Moon must now see to that."

John Maggs, president of the Clean Shipping Coalition maintained that the secretary-general's statement illustrates "why the IMO has so far failed to grasp the nettle over GHG emissions and why its future role must be guided by an agreement in Paris. His insistence that shipping and its emissions will grow with world trade and that emission reductions are only possible at a ship level, echo the views of a complacent industry. It suggests that the IMO, left to its own devices, would be unable to show the sort of leadership that the industry needs if it is to prepare for the future and play a proper role in tackling climate change."

Claims on emission reductions during the recession looked like "bad faith" he suggested, maintaining these were largely the result of slow steaming. He also suggested that shipping was falling behind other industries like the oil industry in seeking a carbon cap.

It remains to be seen given some of the emotive responses aired so far, whether valuable progress can be made at the meeting in December. *NA*

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Power

BV classes first ethane-powered ships

Belgian classification society, Bureau Veritas (BV), will class eight multi-gas Dragon-class vessels that can for the first time be powered by ethane, as well as LNG and conventional diesel fuel.

BV's business development manager, Martial Claudepierre, says: "The ability to burn ethane as well as LNG to power these unique vessels is a major step forward in the use of clean fuels. It means the vessels can use cargo gas during transits to provide a clean and clear commercial and environmental advantage. We have worked with Evergas and the Danish Maritime Authority to verify and ensure that the use of ethane is at least as safe as required by the IGC and will not impair the engine compliance with MARPOL Annex VI."

The vessels were originally designed to be LNG/diesel powered, utilising two 1,000m^3 LNG tanks on deck to power two main Wärtsilä 6L20DF engines; however, in order to exploit the cargo gas the vessels would be transporting, the ability to burn ethane was added.

"Using ethane required extra engine room ventilation and additional gas detection, plus modifications to the main engines including a lower compression ratio, different turbocharger nozzles and de-rating of the engine to cope with the lower knocking resistance of ethane," says Claudepierre. "But the gains in not carrying an additional fuel and in environmental performance from being able to burn clean fuel throughout the voyage are significant."

BV will begin with the classing of *JS Ineos Insight*, the first of the new 27,500m^3 ships to be built by Sinopacific for Evergas – a Danish company that specialises in the transportation of petrochemical gas by sea.

www.bureauveritas.com

BWTS

Major orders for Optimarin BWTS

Optimarin has won ballast water treatment system (BWTS) contracts for two newbuilds as well as 10 systems to be retrofitted for an Asian shipowner.

Two 667m^3/h capacity systems have been ordered by Norwegian Car Carriers (NOCC) for its 6,500 car capacity Pure Car Truck Carrier (PCTC) sister ships. The vessels are currently under construction at Hyundai Samho Heavy Industries, South Korea, and are expected for delivery in late 2016 and early 2017.

Optimarin CEO, Tore Andersen, says: "NOCC was drawn to [our] expertise, as it was to the fact that our systems have a small footprint – with their modular nature making them simple to install – and a proven track record of operational success from vessels around the world. With the ratification of the IMO's Ballast Water Management Convention (BWMC) expected imminently, shipowners, and the yards that provide them with high quality service, need that peace of mind."

An unidentified Asian shipowner has also ordered 10 Optimarin BWTSs to be retrofitted in partnership with Goltens Green Technology, Optimarin's preferred retrofit partner. The systems will be fitted to a group of 6,700TEU units and feature 1,000m^3/h capacities. The vessels will undergo work at Chinese yards, according to an Optimarin source.

"Our technology is equally as suited to the needs of yards and newbuilds as it is to the challenges of retrofitting into existing vessels," adds Andersen. "This flexibility positions us well to meet the needs of an industry that now needs to confront the threat posed by untreated ballast head on."

www.optimarin.com

Engines

First Japanese ME-GI passes FAT

German-Norwegian classification society, DNV GL, has overseen the successful completion of factory acceptance testing (FAT) for Japan's first ME-GI engine at Mitsui Engineering & Shipbuilding Co.'s Tamano works.

The engine is the first of two MAN B&W 8S70ME-C8.2-GI units for Crowley Maritime Corporation, USA, to be installed on the 2,400TEU *El Coqui* and *Taíno* – two of the first LNG-powered ConRo ships.

Crowley selected the engines due to their high efficiency and power concentration, which will help to power the vessels at speeds of up to 22kn, according to MAN Diesel & Turbo.

"The ME-GI engine uses high pressure gas injection that allows it to maintain the numerous positive attributes of MAN B&W low-speed engines," says a spokesperson from MAN Diesel & Turbo.

They added: "The ME-GI is not affected by the multiple de-ratings, fuel quality adjustments or large methane-slip issues as have been seen with other dual-fuel solutions."

Environmentally responsible shipping is at the forefront of Crowley's newbuild designs; the company reports that the two new vessels should reduce the amount of CO_2 emissions from each container by approximately 38%. In addition, the ME-GI engines they have selected offer significant reductions in NOx and SOx, as well as CO_2, according to MAN Diesel & Turbo.

DNV GL will issue a CLEAN notation and a Green Passport to *El Coqui* and *Taíno* on their successful completion. The vessels are scheduled for delivery in the second and fourth quarters of 2017.

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Monitoring

CBM "unlike any other"

Class NK is beginning verification tests for its next-generation condition based monitoring (CBM) system, CMAXS e-GICSX, for Mitsui Engineering & Shipbuilding Co.'s MAN B&W engines.

The new CBM system uses existing technology from the 2004-launched e-GIGS system, but combines it with new, big-data handling capabilities to analyse any abnormalities or changes in performance.

CMAXS e-GICSX uses a sophisticated algorithm to analyse correlations between voyage data including weather and sea conditions, and machinery data from engine sensors on electronically controlled diesel engines. By merging this data the system can detect machinery abnormalities and provide troubleshooting assistance that can be accessed without an internet connection, according to ClassNK. In this way, troubleshooting is localised within the onboard environment, the reliability of machinery is increased, and lifecycle costs can be reduced.

The new big-data CBM system has been co-developed by Class NK, Mitsui and MES Technoservice, and will be tested on a vessel managed by MOL with the cooperation of Mitsui O.S.K. Lines.

Three vessels from shipping companies including MOL have already been fitted with the CBM system and will wait on the verification of their abnormality detection and troubleshooting results. The test will be completed in the spring of 2016.

www.classnk.com

Ship safety

Upgrade for safety at port

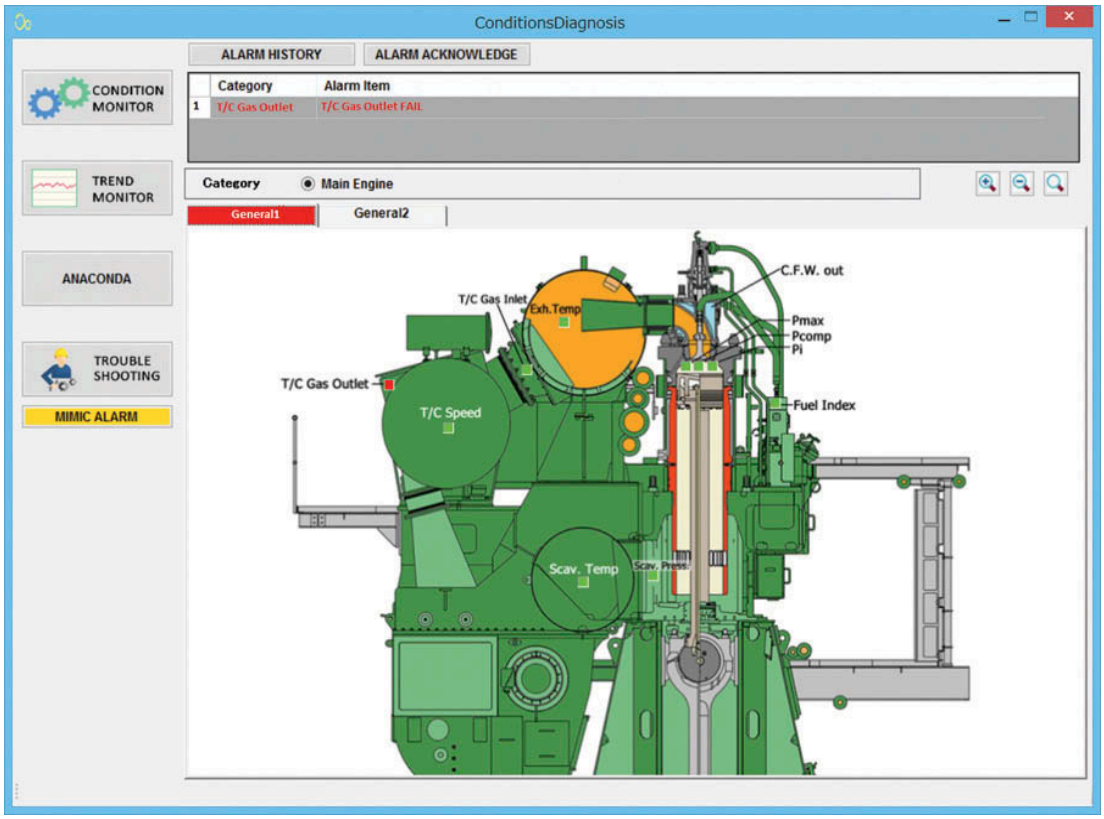
Aberdeen-based load management specialist, Scotload, is helping to improve port safety with a system that monitors mooring line stresses and provides data analysis for loading in adverse events.

The SmartLoad 2Ex system aims to reduce the risk of mooring incidents, such as when mooring lines break, utilising information about the exertion of load on mooring links to deliver accurate load monitoring results in real-time, according to the company.

Port Taranaki, a deep water port in New Zealand, has a long history of mooring difficulties, experiencing long period waves that excites the motion of moored vessels and increases the possibility of breaking the mooring lines. Because of these difficulties the port employed Scotload's system to help manage the hazardous areas.

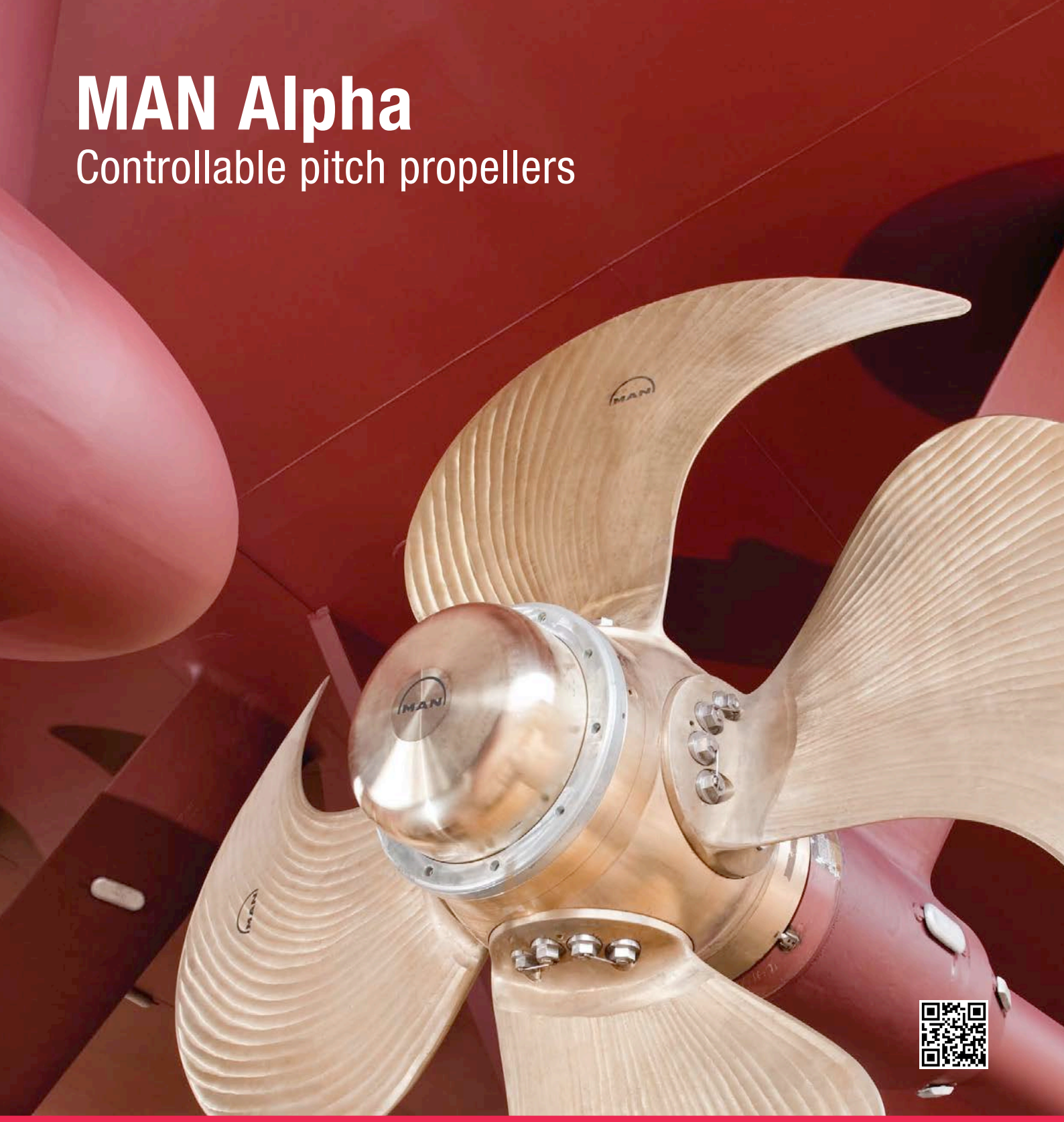
"Predictive models are used to forecast events but we wanted to increase efforts in better managing our response to these events," says Peter Atkinson, port planning manager, Taranaki port. "One of these parameters by which we are monitoring moored vessels is the mooring

A screenshot of CMAXS e-GICSX's functionality



MAN Alpha

Controllable pitch propellers



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line tension, which is why we approached Scotload, for their expertise in the field."

Scotload tailor-made the solution for the port, replicating the pins in the port's existing boss mooring links in order to combine their SmartLoad technology more effectively.

"This is a great example of how we can apply the innovative SmartLoad technology with any product, to be used with any combination of handset and software. The success of this installation has led to interest from other ports across New Zealand and I am very excited about the wider application into ports wanting to increase the safety of loading events worldwide," says Alex Cafferty, Scotload's agent for the region.

www.scotload.com

Propellers

Positive regulation change

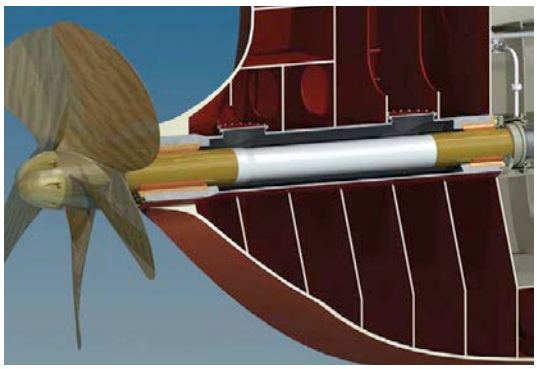
A change in classification societies' monitoring rules for seawater-lubricated propeller shafts could benefit ship operators and manufacturers alike, extending shaft inspection periods.

China Classification Society (CCS) has suggested that the withdrawal of shafts for inspection could be extended from every five years, to every fifteen years if the relevant condition monitoring criteria are met – these criteria have to be verified at each annual survey in order to benefit from the extension. CCS's statement follows in a line of amendments to similar rules by Lloyd's Register and Bureau Veritas – DNV GL is also expected to publish new rules in 2016.

According to Andy Edwards, commercial director, Thordon Bearings, technological advances in shaft lubrication have left regulation that states shafts should be withdrawn for inspection after five years behind the times.

"A major stumbling block to the wider take-up of the more environmentally efficient seawater lubricated system has been the requirement to withdraw the shaft for inspection every five years," says Edwards.

Thordon Bearings' seawater-lubricated propeller shaft system



"So the changes are very welcome as they are more representative of the advancements made in polymer bearing technologies and corrosion-resistant shaft coating systems."

If the extension is enforced shipowners will be free from the associated costs of a more regular shaft withdrawal period. As a result, Thordon Bearings expect more shipowners to convert from oil to seawater-lubricated systems, which are more environmentally friendly.

www.thordonbearings.com

Automation

Valmet DNA in LNG ferry

Tallink Grupp, a passenger and cargo transportation service provider, will use a Valmet automation system for its new LNG-powered ferry operating the Tallinn-Helsinki route shuttle between Estonia and Finland.

The automation system, Valmet DNA, will control and monitor the machinery systems and the electric power management system of the 212m ferry, and includes an emergency shutdown system (ESD) – the ESD is an independent system based on the same Valmet DNA system platform.

Tallink's new LNG-powered ferry will be controlled and monitored by an automation system from Finland-based Valmet

According to a Valmet spokesperson: "It is a powerful and fully redundant system designed to handle the control and monitoring needs of even the largest and most complex vessels."

Engineers from Valmet will manage the automation project from design, through programming and testing, to onboard commissioning and sea trials, and the automation system will be delivered in April 2016.

Tallink's new LNG-powered ferry will be built by the Meyer Turku shipyard, Turku, Finland, and features a passenger capacity of 2,800 and a service speed of 27kn. The vessel will comply with strict emission regulations so that it can operate in Emission Control Areas such as the Baltic Sea. It is expected for delivery at the beginning of 2017.

www.valmet.com

Evaluating delay, disruption and acceleration claims

In the third and final story of the series David Price of Hill International focuses on the evaluation of additional cost claims by builders when vessel construction is delayed. These contracts are often prepared by the buyer's lawyers and can be onerous in nature and as such different to an un-amended SAJ form of contract

Additional cost claims from builders occur more regularly when yards are constructing 'one-off' vessels such as superyachts, drilling rigs, offshore construction, floating production vessels and specialist dredging and pipe-laying vessels.

This article is based on English law which is still today the most commonly chosen law for large export newbuild projects.

Notice procedures

Shipbuilding contracts can be very procedural and the most common requirement that can cause difficulty for the shipyard is the necessity for notices in respect of claims for changes in the contract price.

The timing and the amount of detail required in notices varies from contract to contract and one should never assume that just because you are working on another SAJ, LOGIC or BIMCO NEWBUILDCON variant that the notice provisions will be the same – buyers often amend the notice provisions to make it harder for builders to secure the right to recover additional cost claims.

Failure to provide requisite notices may deprive the builder of his entitlement to additional costs under the contract.

Claims for damages in common law do not require prior notification. The main reason for money claims being made as alternative common law or civil law claims is the absence of the need to serve notices at common law or civil law (sometimes simply referred to in contracts as 'at law'). Builders often, as a consequence, turn to common law/civil law claims when they have failed to properly serve notices under the contract, but a word of caution is that these days we are seeing some contracts also making the service of a notice a condition precedent to a successful claim at law.

David Price of law firm Hill International says that additional costs are more likely to be incurred when yards are building one-off vessels

Basis of entitlement

Entitlement to recover additional cost exists in two forms, either as a result of the contractual rights in the express terms of the contract or by way of a claim on a common law or civil law basis.

Typical causes of additional cost suffered by builders include:

- prolongation to contract programme
- late information from the buyer (and his design team) for instance in respect of outfitting items such as furniture
- modifications and variations to the specification by the buyer
- late approval of builder's design by the employer
- 'preferential engineering' by the buyer
- late 'free issue' materials supplied to builder by the buyer
- lost productivity occasioned by working in an additional 'winter season' of weather due to earlier delays caused by the buyer
- loss of labour productivity due to matters such as the cumulative or 'ripple impact' of multiple changes and rework; direct or constructive acceleration; crowding of labour; excessive overtime; defective engineering; learning curve; out of sequence working; untimely approvals and access restrictions
- accelerative measures leading to uneconomic working methods
- change of availability of dry dock facilities due to delays
- change to overall yard logistics due to delays
- suspension due to late payment.

Heads of claim – generally

In most cases the evaluation will fall into three sections, i.e. costs associated with prolongation, disruption and acceleration.

By far the easiest to consider is the cost of prolongation and below are some possible claim headings for the evaluation of prolongation or delay:

- remuneration of yard management/ supervisors that are not working on the actual construction work and are not a head office expense
- dry dock and workshop facilities
- electricity, water and telephone accounts for the delay period
- additional insurance premiums
- loss due to carrying out work at a time of the year involving inclement weather
- attendances on subcontractors over a longer period
- increased costs (inflation) of labour,

plant and material where not otherwise reimbursable
- profit and overheads on increased costs reimbursed during the extended period
- security, safety and welfare measures during the prolonged period
- head office overheads of the yard which may include a lost opportunity to earn revenue from another vessel construction due to the prolonged period of construction in the dry dock
- finance charges
- loss of profit.

Plant, scaffolding, cranes and tools

Records should be completed weekly as a matter of course, and if possible agreed with the buyer. If the plant is hired, including hire from a sister company then the reasonable actual hire costs of such plant will apply.

In the case of the Builder's own plant, it was held in ***Property and Land Contractors v Alfred McAlpine Homes North*** that hire rates should be applied only if the builder can prove that by reason of the delay he has been prevented from hiring his equipment out to others. In the absence of such proof the builder's recovery is limited to depreciation, interest on the money invested, and maintenance and operators' wages (if appropriate).

Head office overheads

Builders when putting together claims will often claim for head office overheads. The case usually put forward to support this item is that a percentage has been added at tender stage to the net estimated costs as a contribution to the cost of running the head office.

The main problem for the builder is in being able to show an entitlement in principle. The basis of claim is that because of delay caused by the buyer, the builder was deprived of the chance of earning contributions or recovering its overhead costs from the construction of other vessels in the yard.

A popular means of 'lost opportunity' calculation is to use the 'Emden formula' which has been approved in certain cases. The 'Emden formula' uses an overhead percentage which is taken as an average from the Builder's audited accounts. If a formula claim for overheads is made, duplication with other heads, such as financing costs, must be abated.

A better means of recovering problem-solving costs is by diary records. In ***Tate & Lyle v GLC*** a claim for damages included 2½% added to other heads of claim to cover management costs. It was held that the time spent was a proper head of damage, but in this case nothing was proved: "While I am satisfied that this head of damage can properly be claimed … I would ... accept that it must be extremely difficult to quantify. But modern office arrangements provide for the recording of the time spent by managerial staff on particular projects." The importance of keeping records cannot be over-stated.

Loss of profit

A builder is entitled to reimbursement of loss of profit (unless specifically excluded by the contract or at law) if he can prove that he was prevented from earning profit elsewhere.

Financing costs

There is no doubt under English law that the builder is entitled to relief, by way of additional cost, for the cost of financing the

delay and disruption cost not paid by the buyer at the time the delay and disruption occurred. In his judgment in ***F G Minter Ltd v Welsh Health Technical Services Organisation (1980)***, Stephenson L J. said:

"It is further agreed that in the building and construction industry the 'cash flow' is vital to the Contractor and delay in paying him for the work he does naturally results in the ordinary course of things in his being short of working capital, having to borrow capital to pay wages and hire charges and locking up in plant, labour and materials capital which he would have invested elsewhere. The loss of the interest which he has to pay on the capital he is forced to borrow and on the capital which he is not free to invest would be recoverable for the Employer's breach of contract within the first rule in ***Hadley v Baxendale (1854).***"

In the case of ***Rees and Kirby Limited v Swansea City Council (1985)***, the Court of Appeal confirmed that financing costs were a recoverable head of loss and expense and stated such costs shall be calculated at compound interest, with periodic rests taken into account.

Inflation

If a fixed price project is delayed, the builder may be able to establish the additional cost of inflation if there is for instance a steel price adjustment clause in contract. If identifiable costs increase, e.g. steel prices, the calculation is simple; it is the increased cost of that activity carried out after the increase in cost. Clearly allowance has to be made for the increase in costs which would have in any event been incurred by the builder.

Disruption (or lost productivity) costs

One of the most difficult items to evaluate with any accuracy is disruption. The problem is usually caused by a lack of accurate records.

Disruption is not delay in itself but may contribute and lead to a delay to completion of the vessel. Alternatively the disruptive event could lead to a delay to a non-critical programme activity. Disruption is the reduction in labour of plant efficiency which results in an increased cost for a given element of work. It is a loss of productivity, hindrance, disturbance or interference to the builder's normal planned working method.

One of the most popular methods of evaluating disruption is the 'measured mile' basis. The measured mile approach compares different periods of productivity within a project, for instance welding efficiency during a period of disruption caused by the buyer as opposed to the efficiency when there are no limiting factors on efficiency of the workforce. Hopefully, by comparing the two levels of efficiency it will demonstrate that the level dropped during disruption.

According to Hill International one of the most difficult calculations to make is the cost of any disruption to vessel construction, normally as a result of poor record keeping

Acceleration costs

Acceleration costs are usually comprised of overtime payments, target bonuses, additional labour and plant resources.

There are two main reasons why a builder may accelerate:

- the buyer wants his vessel on time notwithstanding permissible delays, and orders or agrees acceleration measures
- the builder is running late and decides unilaterally to accelerate.

Agreed acceleration

Many contracts make no provision for buyers to order acceleration. It is then for the parties to agree. The acceleration agreement in these circumstances is likely to be construed as a separate contract and not necessarily subject to the terms and conditions of the original contract.

Constructive acceleration

This occurs if the builder is entitled to an extension of time, but the buyer has failed to award extensions of time through not applying his mind properly to the matter at all, resulting in the buyer putting himself in breach of contract.

This situation places the builder in a dilemma – he will himself be in breach if he finishes late; in short, due to the buyer's failure, the builder is being forced to accelerate to avoid being in breach. The buyer's failure gives rise to a claim for 'constructive acceleration' damages, but there are two major obstacles for the builder to negotiate. The first is establishing a breach by the buyer (simply making an error is not a breach), and the second is satisfying the requirements for causation and remoteness applying to damages claims.

In ***Motherwell Bridge v Micafil (2002),*** Micafil failed to grant an appropriate Extension of Time and Motherwell Bridge was entitled to be paid the acceleration costs. The Court held that Motherwell were entitled to recover additional costs and it was entirely reasonable for them to take the actions they did to keep to the time schedule imposed – with no relief from the buyer.

The Motherwell Bridge case established English law precedent for 'constructive acceleration' claims where a buyer is not awarding the builder the appropriate Extension of Time and the builder accelerates his work even though he would be entitled under the contract to additional time and money. The accelerative measures taken by the builders will generally be less expensive to the buyer than the retained on-going site yard overhead costs and are in that sense viewed as constructive. *NA*

Best laid plans

A new, technologically empowered cable laying vessel from ABB will set new standards for reliability, fuel efficiency and accuracy, according to the company

The power and automation technology group, ABB, has ordered "the world's most advanced" cable laying vessel to boost the capacity of its subsea cable installation and service, and to offer better efficiency and precision during its operation.

ABB will facilitate this improvement with its own technological innovations. The vessel's power consumption will be reduced by the company's power distribution solution, Onboard DC Grid, which uses a single DC circuit for ship propulsion. This system saves space by removing main switchboards and drive transformers, and allows the vessel's engines to work at variable speeds, optimising fuel consumption.

An ABB Integrated Automation System (IAS) and three Azipod CZ980 thrusters producing 1,900kW will also feature, and will work with the Onboard DC Grid to reduce fuel consumption by up to 27%. The IAS allows all onboard systems and equipment to work together via a single user environment, making ship management easier and consequently safer.

ABB vice president, Joar Gjerde says: "Our [fuel reduction] figure is based upon real measurement from the first vessel delivered with Onboard DC Grid, *Dina Star*. From this measurement the fuel saving was between 14% and 27% in low load conditions. However the first vessel did not have an ESS [Energy Storage System], so we expect even increased savings on this vessel including the battery."

The automation and power systems will help to reduce maintenance and its associated costs compared with traditional AC systems, according to the company. An advanced monitoring process will be used to pre-emptively target maintenance. This uses sensors and other monitoring hardware and software to create performance information that can be sent from ship to shore via satellite for onshore technical support. Advisory software for motion monitoring, forecasting and decision support will also feature onboard the ship as part of ABB's integrated system.

ABB's new cable laying vessel

Cross section of the new cable laying vessel

In addition, the vessel will be equipped with roll-reduction tanks and a remotely operated vehicle (ROV) will be used to conduct subsea operations using cameras and sonar. ABB says that both features will increase the reliability and accuracy of operations, especially when coupled with the ship's DP3 technology, which will facilitate high precision positioning.

The DP3 technology, which is the highest in class, also improves the ship's safety because the vessel is required to be constructed so that fire and flooding can be contained. This means that positioning and other essential systems are saved from damage and can continue to function in the event of such hazards. Furthermore, the use of an ROV removes the need for divers and so also stands to make operations inherently safer.

"This next-generation vessel, incorporating state-of-the-art ABB technologies, will be a key differentiator for our high-voltage cable business, enhancing flexibility and execution ability," says Claudio Facchin, president of ABB's power systems division. "It will also improve operational efficiency and customer focus, supporting profitable growth in line with our Next Level Strategy."

The 140m long and 30m wide vessel will be constructed at Kleven shipyard, Norway, and is scheduled for delivery in 2017. *NA*

Spinning magic

The Flettner approach to harnessing wind power for ships is by no means a new concept, it has been around since the 1920s, although some commentators suggest that the current potential for development has been reined back because of low bunker prices. Sandra Speares investigates

Recent collaborations in air power include Cargill's partnership with SkySails and Wessels' with Enercon; however Finland based Norsepower CTO Jarkko Väinämö and CEO Tuomas Riski reckon their product is leading the pack and offers a cost effective solution that fits in with vessels' existing technology. Discussions with new potential customers are going on all the time, says Tuomas Riski.

The Norsepower Rotor Sail Solution is a modernised version of the Flettner rotor – a spinning cylinder that uses the Magnus effect to harness wind power to propel a ship.

So how did the company decide to develop this particular product? "We think that this is a good compromise of a strut production device," says Jarkko Väinämö, "because the Flettner rotor is the smallest possible device to produce the biggest possible lift, which in fact means draught."

He says that if you compare their product with traditional sails or wind sails, the system takes a lot less deck space and blocks the minimum amount of navigational lights and visibility generally. These are the reasons why the company came to the conclusion that the Flettner rotor was the best possible design for wider application compared to traditional sails.

If one compares the company's prototype design with a kite sail system, the system is a lot more robust, he says, and there is no problem in launching the technology. "This is the smallest device which can produce a big thrust to the vessel. It is very robust and safe to use in all circumstances."

According to Tuomas Riski the technology is very simple and has a good availability that makes it a lot less trouble than more complicated designs.

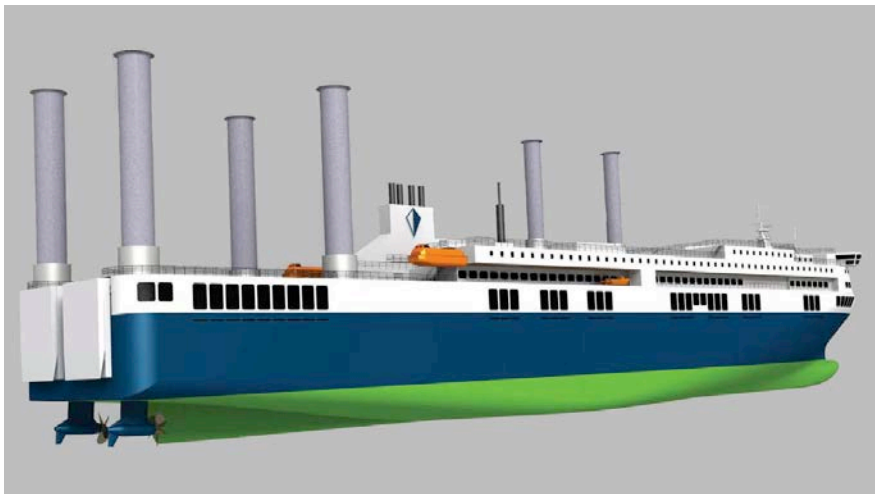
So how long does it take to fit the system? In the first case Norsepower was involved with a ship while it was in drydock and during that time the pre-manufactured foundations were welded. Later on the electrics and automation system were installed during a port visit as was the rotor, which took only seven hours to fit. As far as the two week dry docking was concerned this did not need to be extended because of the installation of the foundations, Riski said. "There were absolutely no offhire costs to the customer because of our technology."

It would potentially be possible to do the installation at sea provided the pre-manufactured foundations were already in place. However, this would only be viable for certain kinds of ship because welding would be necessary and this would be dangerous on a tanker, for example.

Jarkko Väinämö, Norsepower CTO, says the Rotor Sail technology is very simple and robust and can be fitted on ships in compliance with all rules and regulations

So is the system more attractive to some ships than others? According to Väinämö: "One point attractive to the customer is its operation in certain wind conditions but the 'time at sea' range of the vessel is also a very important parameter." For example, if the vessel is sailing for 50% of the time, when compared to a vessel which is sailing 75% of the time, the latter scenario represents a much more interesting business case for the customer. "The more you are sailing, the more you are winning." In terms of the design, the higher up the rotors, the better the wind. Vessels without considerable air draught limits are more adaptable to the technology.

As far as the types of vessel on which the system can be installed are concerned, he points to passenger ferries that are keen to promote their green credentials. This system



Development of the ferry *DeltaChallenger* could mark the beginning of a period when the shipping industry's CO_2 reduction outstrips the increase in shipping necessary to meet demand from a growing global population

is one more thing that could make ferries more attractive to customers, Väinämö says. The product could be very attractive for those ferries operating in the Baltic, for example.

The product is designed to work with existing propulsion systems onboard ships. The automation system operates in such a way that when the vessel is typically leaving the port, the crew can enable the rotor, which monitors the wind. This means that whenever there are favourable wind conditions, the system will automatically start to operate.

The crew does not have to worry about the wind speed and direction. Once the rotors start it is possible to take all possible thrust out of the wind. The crew can see the extra thrust and if they don't touch the main throttle, they can see that the speed has increased, Väinämö explains. They can reduce the power of the main engine when there is favourable wind and still maintain the targeted speed.

So is there any change to work patterns? "Adjustment of the speed is one of the daily tasks anyhow. We don't change the way of working by any means and that is also important." If the crew don't adjust the throttle, the ship merely arrives at its destination sooner and saves fuel because of that. Although some crew training is necessary to use the system, this takes less than an hour, he says, and the bridge team have been able to pass the information onto other crew members.

If the wind speed drops or shifts to an unfavourable angle, the rotors will idle – "instead of trying to produce thrust they try to minimise the air drag."

In terms of the competition, Väinämö says there is no other auxiliary propulsion product on the market at the moment that can offer so much. There are companies who have planned similar wind propulsion solutions with different technologies, but as far as he is aware none of them have been piloted so far. The company is the first to have class approval with a trialled product with "proof of concept", he says. The company, he says, is "ahead of the pack".

Väinämö emphasises that the technology is very simple and robust and can be fitted on ships in compliance with all rules and regulations. With more complex systems, he says, it is necessary to apply for a derogation as far as some regulations are concerned. "We encourage naval architects when they do new designs to take into account this possibility because it is more efficient when it is built into a new vessel."

The required number of Norsepower Rotor Sails and the size of each sail are based on the size, speed and operating profile of each vessel, according to the company. Norsepower rotor sails are available in three sizes with different rotor sail heights of 18, 24 or 30 metres. The Fuel costs are reduced from 5% to 30% without lowering the operating speed of the vessel.

The position of each sail, the required number of sails and each sail's size are based on the following vessel-specific factors:

- total thrust to be achieved with the Rotor Sails
- aerodynamic properties of the vessel; i.e. location of superstructures, cranes, etc. and potential interference between the rotors
- existing support structures in the vessel for the rotor foundations
- influence of the Rotor Sails on the stability of the vessel
- influence of the Rotor Sails on control and manoeuvrability of the vessel
- vessel-specific requirements for cargo handling.

As far as working areas of cranes and gantries, loading and unloading of cargo are concerned, navigational requirements include visibility from the bridge and the potential effect of the sails on radar and navigational lights. Safety requirements include fire hazards from dangerous cargos, icing in winter, and a safe working area for crew on deck.

Deltamarin's new ro-pax vessel *DeltaChallenger* was showcased earlier this year. The vessel has six rotor sails by Norsepower, giving ca. 10% of the total propulsion power (1.3MW). Fuel economy and manoeuvrability is gained through the combination of dual-fuel electric machinery, four power plants (2 x 6MW and 2 x 3MW) and the new compact Azipod D pod propulsion system from ABB. The steering unit of the pod can be fitted in one deck so that it does not hamper the loading of cars.

The vessel will have GTT Mark III membrane LNG tanks of 1,200m^3 in total. The tanks give superior layout advantages making new efficient loading and unloading configurations possible without decreasing passenger and cargo capacity.

The vessel utilises heat recovery and demand controlled ventilation to ensure maximum comfort while at the same time minimising the energy consumed.

"Challenging the existing methods and utilising the latest technologies have always been part of Deltamarin's philosophy. With the new *DeltaChallenger* we aim to show what the future's combined passenger and

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cargo ship could be. By combining the top-level existing technology, you can create something unique but functional. The right product for the customer may not be the *DeltaChallenger* as such, but the idea is that together with the customer and our partners we can develop exactly the exceptional ship that best serves the customer's future needs," explains Päivi Haikkola, Deltamarin's manager, R&D.

Meanwhile, Norsepower Oy and Bore recently announced successful sea trials of Norsepower's system. The sea trials, verified by NAPA and supported by VTT Technical Research Centre of Finland, confirmed fuel savings of 2.6% using a single small Rotor Sail on a route in the North Sea. With these fuel savings, the technology has a payback period of four years. Based on the trials of the Bore-owned, 9,700dwt ro-ro, *Estraden,* Norsepower and Bore believe that a full system on *Estraden,* with two rotors has the potential to deliver 5% efficiency savings on an ongoing basis.

The trials were measured and analysed with continuous monitoring systems from maritime data analysis, software and services provider, NAPA and VTT Technical Research Centre of Finland, which collected data over a six-month period during which both the Rotor Sail technology and automation system was operational for 99% of the time.

The results confirmed that Norsepower's rotor is able to produce large amounts of thrust force, which enables considerable fuel savings. Reinforcing VTT's findings, NAPA conducted a randomised trial that found clear and significant savings, despite largely calm weather conditions throughout the study. After establishing a baseline profile of the vessel in normal operation, the Rotor Sail was activated and de-activated at random intervals to verify that any measured effect was solely due to the sail, and that any benefit was measurable across the vessel's operating profile.

The average verified fuel savings during the trial in NAPA's analysis was 2.6%. The trial was conducted using ClassNK-NAPA GREEN. "As impartial data analysis and verification is vital for charterers and shipowners looking to retrofit efficiency technology onto vessels, we used both randomised trialling and advanced statistical modelling to ensure objective results. The Rotor Sail offered clear savings against this criteria and adds to a growing list of innovative eco-efficiency technologies that have proved themselves through robust data collection and advanced analytics," says Esa Henttinen, executive vice president, NAPA.

Commenting on the company's contract with Bore, Riski says the performance is being measured on a continuous basis with Napa. Then they will have a look to see if they can double the savings potential with two rotors. The company is hoping to establish an overall saving of more than 5%.

So is it easy to install? The company is currently using a standard product from Napa. "It is a simple add-on interface to the basic monitoring and research system by NAPA implemented in cooperation with Norsepower." It is easy to fit and monitoring systems can be installed to verify the performance of the technology. In addition, it should also be possible to sell the technology as a service in the long term, he says.

There is interest in the technology on the market as well as selling it as a service, Riski says, where the customer would be invoiced on the basis of the actual verified savings. So how much does it cost? In the case of the Bore delivery the cost for two rotors is approximately €700,000 (US$781,000) with turnkey delivery and an energy saving of approximately 5%. These are fairly small rotors in a big ship and Riski says that the company is fairly confident that slower steaming vessels with bigger rotors could make savings of up to 20%.

"When you are using wind propulsion, you have to have as good wind conditions as possible. I'm not saying this would be the solution for all the consumption problems of the entire global fleet, but in areas with enough wind, you can make a very good business case," Riski explains.

The product is therefore appropriate for certain markets more than others. "The most important factor is that you have a high enough average wind speed." The second point is for the wind to be from a favourable direction compared to your typical route. The favourable direction is "through wind from the beam", he says. Three interesting market areas include the North Sea and Baltic Sea, as well as the North Atlantic and North Pacific.

The prototype has been run with a through wind speed of 25m/s at full speed, without any trouble, he continues. You can operate the rotor in any kind of weather, but in a huge storm the interest is not really in saving fuel and in entirely calm conditions the technology is not going to work properly. "When you have no wind you are saving nothing. To understand the potential you have to combine the weather statistics with your route area." *NA*

GLOBAL LEADER IN SMART & GREEN TECHNOLOGY

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PANASIA has a mission of 'reinforcing the competitiveness of on shore, off shore plant/marine equipment industry' by securing original technology. In order to transform the nature of products into eco - friendly products, PANASIA has constantly invested and as result, nearby 200 patents were acquired at present.

Ballast Water Treatment System

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Gas code cleared for entry into force

June saw the formal adoption of the IGF by the IMO and the entry into force of the code is set for January 2017, write David Tinsley and Nick Savvides

Since the service introduction 15 years ago of the Norwegian ferry *Glutra*, the world's first LNG-fuelled vessel, the uptake of LNG in marine power and propulsion installations as a method of reducing polluting emissions has steadily gained momentum, albeit on a localised or regional basis.

The latest developments for LNG fuelled vessels could come out of Korea with Hyundai Heavy Industries (HHI) having signed a deal that will see the yard collaborate with GE to develop the US company's gas turbine system known as COGES (Combined Gas turbine Electric and Steam).

According to HHI's head of project planning (gas carriers), Moojong Kang, the COGES system consists of a gas turbine that generates steam that drives generators producing electricity. This latest system is "very light with a low maintenance cost," says Kang.

Kang told *The Naval Architect* that the fuel consumption is reasonably low, higher than the ME-GI engines, but less than the four stroke and dual fuel units currently available. The development of COGES could offer a significant step up in efficiency for LNG powered vessels and with the adoption of the gas code could see a significant jump in the number of ships operating with gas powered engines.

However, the wider usage in international traffic is also, in prospect, abetted by the development of the regulatory framework governing gas-fuelled ships, in conjunction with the economic and operational benefits offered by LNG.

Back in 2000, the approval of *Glutra* was based on Norwegian national draft regulations and details from the rules governing gas carriers.

A milestone in the legislative process was denoted by the IMO Maritime Safety Committee's adoption in June 2015 of the International Code of Safety for Ships using Gases or other Low-flashpoint fuels. Dubbed the IGF Code, the mandatory provisions will enter force on 1 January 2017, through associated amendments to the SOLAS Convention, and will apply to newbuild cargo carrying vessels of at least 500gt and passenger ships using natural gas fuel.

It will thereby become possible for compliant gas-fuelled ships to sail in an unrestricted manner on any voyage, given the requisite bunkering sources.

The IGF Code aims to minimise the risk to the ship, its crew and the environment with regard to the nature of the fuels involved. The edict embraces the arrangement, installation, control and monitoring of machinery, equipment and systems using low-flashpoint fuels, focussing initially on LNG.

Gas carriers certified to the International Gas Code (IGC) and which use their cargoes as fuel will be exempt from the IGF regulations, provided that the fuel storage and distribution design and arrangements comply with the IGC stipulations.

IGC takes a goal-based approach in addressing all areas that need special consideration for the use of low-flashpoint fuels, with goals and functional requirements specified for each section forming the basis for the design, construction and operation of vessels. ***NA***

DSIC LNG carrier with COGES on deck

Source: Lloyd's Register

Independent tanks for a chemical tanker

Every now and then articles appear about independent tanks on chemical tankers, such as the March 2011 issue of *The Naval Architect* where Ernst Vosnack's so-called bottle tanker design was discussed. The problem with such designs is the total tank weight, which means the cost price for the tanker remains high. Martijn van Poppelen from Koole Engineering reports

Designers often ask what makes independent tanks so interesting. For the answer it is best to look at the current designs. These are the well-known standard chemical parcel tankers with duplex tanks and corrugated bulkheads, and, typical for this design, the tanks are adjacent to each other and to the ballast tanks.

This positioning has some major disadvantages, such as major heat loss when a tank is heated – if you heat your cargo you are also heating the adjacent cargoes and the ship itself. As a consequence a lot of heating coils and a high temperature are needed to maintain the desired temperature of the cargo. The high temperature of the heating coils can be very disadvantageous for the cargo quality.

Another aspect is that these tanks are difficult to clean, especially when products like fats have to be transported. If the ballast tanks are filled at the same time, the fats will solidify and the cleaning becomes a very laborious and time consuming job. In these cases it is quite normal for the cleaning of tanks to take several days. Other problems with these tankers can include fatigue cracking in the tank bulkheads with the risk of cargo contamination. Furthermore stowage is a complex puzzle because of the temperature differences of different cargoes, as well as incompatible cargos that cannot be stored next to each other due to possible hazardous reactions.

Martijn van Poppelen believes that there will be more chemical tankers with independent tanks in the future

Independent tanks on the other hand can be insulated, bringing some important advantages. First of all the heat loss will be minimal; the temperature of the heating coils can therefore be lowered, which is beneficial for the cargo quality for certain products; contamination of cargoes is not possible anymore; cleaning is improved considerably because the tank temperature can rise during the cleaning process; and stowage becomes very simple because every product can be stored in any tank, as you no longer have to account for different cargo temperatures or hazardous reactions between cargoes.

But if independent tanks are so beneficial why don't we use them in chemical tankers today? Independent tankers are widely used in both gas carriers as well as bitumen tankers. This is mainly because of their extremely high or low cargo temperatures which makes insulating the cargo tanks a major design objective. They have independent tanks which are relatively expensive as well as complex and heavy. There is a tendency in shipbuilding to make rectangular tanks which fit nicely into the holds. In order to make the side walls of these rectangular tanks strong enough a considerable number of heavy stiffeners are needed. The duplex weight of such independent tanks will increase making these tanks too expensive.

Looking at shore based storage tanks we always see vertical cylindrical tanks. The reason is obvious: due to the liquid inside we only get tensile membrane stresses in the wall. This means we do not need stiffeners on the outside of the tank, and because we only have tensile stresses, the material needed is minimal.

So can we make use of vertical cylindrical tanks on a ship; how do we fix

Star Curacao entered service in 2009 and is considered to be the beneficiary from the development of *Star Bonaire*

these tanks onboard a ship; don't we lose a lot of cargo space; and won't these tanks become too heavy?

Koole Tanktransport has built two sea going tankers with cylindrical tanks, so it is possible. How did we do this? The story starts with our inland ships where we successfully used cylindrical tanks on more than one occasion. However, these ships do not have to cope with the accelerations of seagoing ships. When we started with *Star Bonaire* in 1995 we first designed a skirt like construction to fix the tanks to the ship. These skirts were able to accommodate thermal expansion caused by cargo temperatures up to 80°C. This design was sent to class and was approved and the building of the ship and tanks was started.

At that moment one of the owners asked me: what would happen if the ship was bending or twisting? We had not taken these deformations of the ship into account in our calculations and so we had to start again. We had to work around certain restrictions because the ship and tanks were already being built, but after four months of working day and night we designed a flexible mounting for the tank. Now, after more than 18 years in service, *Star Bonaire* and the cargo tanks have proven themselves and are still performing very well.

When we launched *Star Bonaire* in 1996 we had the feeling that these cylindrical tanks were very good, but the way we fixed them in the ship was sub-optimal due to the restrictions of both the ship and tanks already being half-built. As a result, we decided to start a new development from zero and asked ourselves some questions: what would be the best way to support a cylindrical tank in a ship and what would the ship look like?

The most favourable way to support a tank which is subject to horizontal accelerations is not only on the lower side, but also on the upper side of the tank. This way the supporting loads are spread, lowering the buckling stresses in the tank wall, and wall thickness can therefore be minimised.

From *Star Bonaire* we learned that we have to deal with the deformations of the ship in waves. But how can we predict these deformations? Class rules did not give us any help in this situation so we developed our own method. We made a model of the ship and placed it in a wave field. We then calculated the pressures on the hull and placed these pressures onto a FEM model of the ship and tanks. Combined with the accelerations we were able to calculate the deformations of the ship. After this we had to change the position of the ship in the wave field and calculate the deformations again. In total we made more than 15,000 calculations in order to understand in what situations maximum deformations could occur. From this exercise we derived a simplified method to calculate the deformations.

Lifting a cylindrical tank into position

So now we knew that we had to fix the lower and upper parts of the tanks and we could calculate the deformations a ship would undergo in waves. The next step was to make a design for the tank which could withstand the accelerations and the deformations of the ship in waves.

We developed various concept designs for the tanks and we made a more detailed FEM model of these tank designs. With these models we made extensive calculations accounting for still water and wave loads, deflection of ship and tanks, thermal expansion, strength, fatigue and buckling. From these analyses we could choose a design which fulfilled all requirements and could be built by a tank builder. The concept of this tank design is quite innovative and we applied for and were granted a patent. The patented design enables the use of extremely thin tank walls, which are relatively even thinner than that of a beer can, while keeping far away from any danger of buckling. Part of the trick is to use the shear strength of the tank, which is quite different from other independent tank concepts. This is just one of the many innovations connected to this design.

In 2005 we started with the development of *Star Curacao* and the decision was made to use this new tank design. We could now focus the tank development with this ship project in mind. The vessel was intended to carry 3,500 tonnes of cargo so we first had to determine the cargo volume and thereby the diameter and height of the tanks. The cargo tank plan comprised seven large centre tanks and so the diameter would be limited by the breadth of the ship. From this the height of the tank could be derived. In order to meet the cargo volume requirement we had to increase the depth of the ship by about 25% compared with ordinary tankers.

A nice feature of this concept is that the hull can be built as a single hulled vessel because the tanks are independent. This

meant that even building in the Netherlands was possible. However, stability and damage stability issues required close attention and so to meet damage stability requirements we had to divide the hold space into five compartments.

During the whole development we had regular meetings with Class. We kept them informed about the details of the development and had extensive discussions about the calculations. This meant that when we had to approve the design of the ship and tanks for *Star Curacao* we only received minor remarks on our drawings.

Star Curacao came into service in January 2009. She has an IMO 2 chemical tanker notation, 7 duplex cylindrical tanks, 4 deck tanks and a cargo capacity of 4,400m^3. The focus for *Star Curacao* is on edible oils and fats in the Northwest European short sea market. She makes around 100 trips a year, and is operated by a crew of 8.

One of the things that makes *Star Curacao* so efficient is the ease of cleaning the cargo tanks. If the tanks have to be swept, this can be achieved within 15 minutes by two people. Washing takes only 20 minutes, even for the difficult fats. The cleaning is going so well because of the insulation around the cargo tanks which ensures that the temperature of the tank wall can rise above 70°C during washing. We have calculated that we save about 60% on energy costs during washing compared with a conventional tanker.

After cleaning, the tank is ventilated for 20 minutes making the tank completely dry. And even when ballast is set the tank stays dry because the cargo tanks are insulated and segregated from the ballast tanks. The cleaning and ventilating is fully automated. Thanks to this efficient cleaning *Star Curacao* can make 100 trips a year, about 40% more than the competitors.

I have heard numerous stories of tankers who have been cleaning for two days or more on solidifying fats. Or tankers that are refused for loading because of water in the cargo tanks – if you put cold ballast water adjacent to a cargo tank it is likely that the water vapour in the air condenses on these walls. All these problems can be avoided with suitable independent tanks.

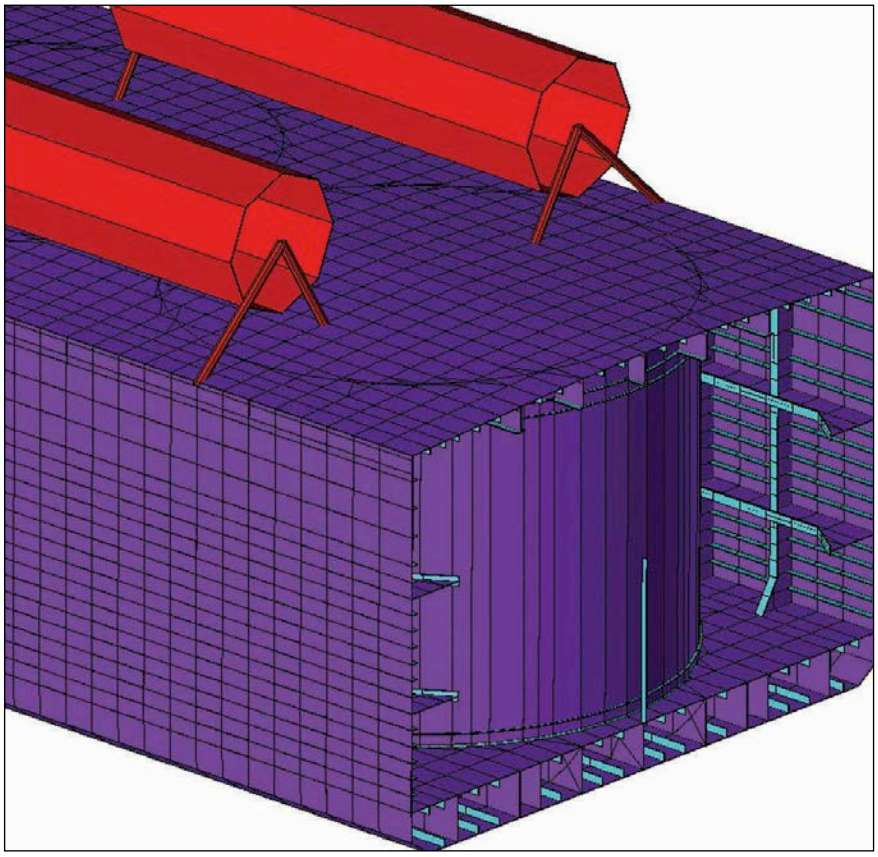
Another aspect that makes *Star Curacao* an interesting ship is the saving on energy for cargo heating. We calculated that due to the insulation we save about 85% on energy compared to a conventional tanker. Moreover we use the HT cooling of the main engine for heating the cargo to 60°C. So when sailing and the cargo temperature is below 60°C we don't use any fuel for heating at all.

Some time ago I told this story to a ship-owner of chemical tankers. He said that it was all very impressive, but he could not believe that we would not lose cargo capacity. We decided to make a comparison between one of their existing ships and the same ship with independent cylindrical tanks. Together with Conoship we made a cargo tank plan, designed and calculated the construction of the midship, and calculated the duplex usage for the independent tanks. We kept all the dimensions, the tank volume and the number of cargo tanks the same except for the depth of the ship. The result was that we had to increase the depth by about 25%, but surprisingly the total lightship weight remained the same. The deadweight therefore also remained the same. We did however save 35% on the usage of duplex!

We also made this comparison for a ship about 8 times the size of *Star Curacao* and we found the same results: we did not lose any cargo capacity and we saved around 35% on duplex.

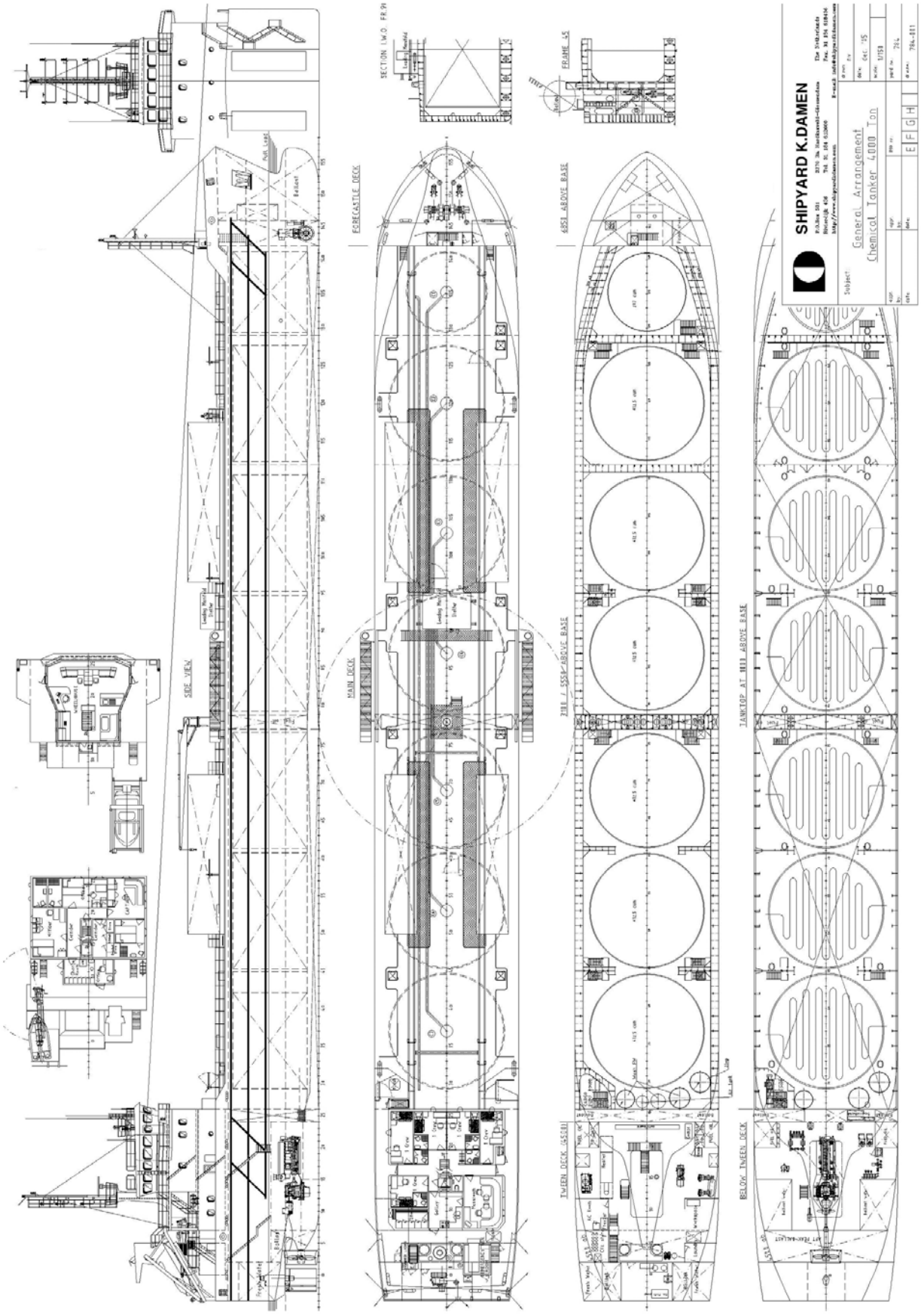
Koole Tankstorage, as it is called today, is very satisfied about *Star Bonaire* and *Star Curacao* as the ships are performing much better than their competitors. At the moment we are designing the next ship for Koole Tankstorage.

Some years ago the ship development department was separated from the Koole Tankstorage company and is now continuing on as an independent company under the name of Koole Engineering. Today we are working together with several ship owners in designing chemical tankers with independent tanks. Within a few years we might see more chemical tankers with independent tanks sailing around the seas. *NA*



A cutaway showing the cylindrical tank in place on a chemical tanker

GA of Star Curacao



RINA - Lloyd's Register
Maritime Safety Award

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The Maritime Safety Award is presented annually to an individual, company or organisation that in the opinion of the Institution and Lloyd's Register, is judged to have made an outstanding contribution to the improvement of maritime safety or the protection of the maritime environment. Such contribution may have been made by a specific activity or over a period of time. Individuals may not nominate themselves. Nominations are now invited for the 2015 Maritime Safety Award.

Nominations of up to **750 words** should describe the nominee's contribution to:

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Lloyd's Register

The closing date for nominations is 31 December 2015. The Award will be announced at the Institution's 2016 Annual Dinner.

Nominations may be made by any member of the global maritime community and should be forwarded online at www.rina.org.uk/MaritimeSafetyAward or by email to MaritimeSafetyAward@rina.org.uk

Queries about the Award should be forwarded to the Chief Executive at **hq@rina.org.uk**

Japanese yards gain newbuilding momentum

A newbuilding push in Japan and a decline in South Korea has seen Japanese yards, at least temporarily, regain second spot in the newbuilding league in terms of the number of vessels built. *The Naval Architect* looks at Japan's apparent resurgence

It is an unlikely event, but given the economic irregularities that persist globally it should perhaps not be a surprise that by some parameters Japan has regained second spot in the newbuilding league from South Korea.

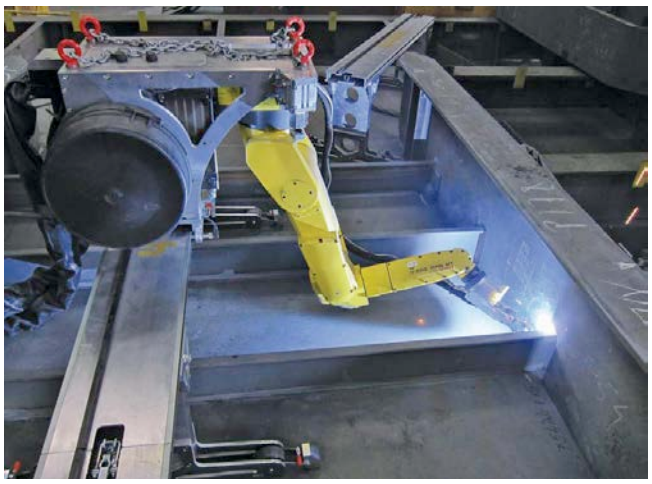
Intense competition, over capacity in the shipbuilding market and a supportive domestic market have combined to see Japanese yards regain some market share that they lost long ago to what was then the upstart newcomer on the Korean peninsula.

Japanese yards won more shipbuilding orders than their South Korean neighbours in the third quarter of 2015. According to shipbroker Clarkson Research Services, Chinese shipbuilders won new orders of 3.48 million compensated gross tonnes (CGTs) in September 2015 while the Japanese yards accrued 2.36 million CGTs and the Korean yards a total of 2.11 million CGTs.

In the first half of this year Clarkson's had already reported that Japanese yards had accrued more vessel orders than Korea, 22% of the vessel orders as compared to 21% for Korea, with China way out in front with 45% of the orderbook. Though the Koreans remained in second place in terms of deadweight, with orders totalling 29% of the total deadweight compared to 20% for Japan and 43% in China.

However, when the first nine months of the year are taken into account South Korea remains the front runner with new orders totalling 8.77 million CGTs, with China accruing 6.33 million CGTs in orders and Japan with 5.99 million CGTs.

As the newbuilding market has entered into extraordinary territory shipyards have adjusted their designs, entered new markets and streamlined their production processes so that they can maintain cash flow and stay ahead of their competitors. One such yard, Oshima, situated near Nagasaki in Japan, has improved its productivity through the use of welding robots and due to the success of these robots Oshima is now entering into negotiations with the Danish manufacturer, Inrotech, to acquire more of the machines.



A rail mounted inrotech welding robot of the type operated by Oshima Shipyard

According to Morten Arndal Nielsen, the chief commercial officer at inrotech, robots can replace the work performed by four welders and reduce the welding time for a job that normally takes 440 hours to just 120 hours, as witnessed in a Dutch yard.

Essentially the robots are built with Adaptive Logic Programming Technology (ALPT) which allows the machine to scan the job, detect the gaps and the extent of the welding job before performing the weld operation.

Initially Oshima bought eight welding robots which operate on a rail mounting, but the latest welding machines will be able to handle butt welds as well as filler welds. Essentially the laser sensor could not adequately scan the job for a butt weld, with two plates next to each other. However, the latest robots have now been fitted with a 3D scanning system developed by inrotech that has "transformed the scanning process," says Nielsen. "The robot will create a welding sequence from the first string to the last string, up to 70 passes or more if necessary, and then perform the weld," he says.

Technology such as the inrotech robots have helped Japanese yards maintain a competitive edge against tough competition from both China and South Korea, while the yards have also benefitted from an expected increase in orders for LNG tankers.

According to some analysts LNG business is set to break through the US$120 billion mark this year and the expectation is that it will continue to grow and that will require more vessels to transport the LNG traded.

Typically, Japanese yards have built LNG tankers with the spherical Moss tanks, which are generally more expensive than the membrane tanks favoured by the South Koreans. Analysts report that there will be between 50 and 60 LNG tankers delivered during 2017 and 2018 and that up to 25% of the total deliveries of these ships will be from Japanese yards.

If these orders materialise the Japanese may continue to challenge the South Koreans for the second spot in the newbuilding league and it could ultimately see the yards surge into second place for some time if the Korean yards' economic travails persist. *NA*

Steady cruise ship production for Italian builder

Fincantieri has delivered its largest ever cruise ship and is developing a new flagship for Silversea Cruises, maintaining a steady stream of innovative newbuilds for the luxury cruise sector

The cruise ship industry may not be suffering the same extent of overcapacity as other sectors of the marine industry, but it has still faced difficult times with fewer cruise ships under construction following the effects of the 2008 economic crash. Clarkson Research plots close to a 50% drop in cruise vessel deliveries between 2010 and 2015. However, despite these challenging conditions, shipyards such as Fincantieri are receiving regular cruise ship contracts. Part of their success stems from repeat orders, which represent a bond between owners and builders that is more important than ever for the resurgence of shipyards and the wider marine industry.

Britannia

Italian shipbuilding group, Fincantieri, has extended its relationship with P&O Cruises after delivering *Britannia* to the cruise company, which is owned by Carnival Group, in February this year. The 330m long and 38m wide vessel is the largest cruise ship to have been built by Fincantieri, and possesses a "future-proof design" in terms of layout, state-of-the-art performance and long-term regulation compliance, according to the company.

Britannia's diesel-electric propulsion package achieves a contract speed of 22kn and a maximum speed of 23kn. It includes two main 18,000kW propulsion units, and six Wärtsilä thrusters: three forward 2,500kW units and three aft 2,500kW units. Wärtsilä has also provided four auxiliary engines for propulsion as well as for powering the hotel load: two 14,400kW-Wartsila 12v46F engines and two 16,800kW-Wartsila 14v46F engines, which are fully compliant with the IMO Tier II exhaust emissions regulations set out in Annex VI of the MARPOL 73/78 convention.

The cruise ship's long-term design strategy can be seen in a number of environmentally-friendly solutions, such as its ballast water treatment system from Hyde Marine, which provides crucial regulatory compliance for the vessel as it transitions between European and Caribbean waters. *Britannia* also features a Thordon Bearings seawater-lubricated COMPAC propeller shaft system, which aims to protect the marine environment through the prevention of operational oil spills.

Speaking about *Britannia* and the development of its class, a spokesperson for Fincantieri says: "An innovative ship for a new ground breaking class…These ships will represent a new technological benchmark, in Europe and worldwide, for extremely high performance and for the high quality of the technical solutions. They are the best proof that innovation and customer care… are essential levers for tackling a crisis like the present one." The company states that 47 cruise ships have been built since 2002 and a further 14 ships are currently being designed or built in Fincantieri yards.

Britannia was built at Fincantieri's Montfalcone yard, Gorizia, and was constructed from 74 sections. It can accommodate 4,372 passengers, with a total capacity of 5,722 including crew. The cruise ship will be based in Europe before transferring to the Caribbean during the winter.

Silver Muse

One of the 14 cruise ships currently in development by Fincantieri is a new flagship for Silversea Cruises, *Silver Muse*; the family-owned cruise company is replacing the 2009-delivered 196m *Silver Spirit*, which was also built by Fincantieri.

The 212m long *Silver Muse* will be built at Fincantieri's shipyard in Sestri Ponente, Genoa, and will develop Silversea's position in the ultra-luxury cruise segment.

CEO of Fincantieri, Giuseppe Bono, says: "This project offers us the opportunity to develop creative solutions and set new standards for ship-building in the ultra-luxury segment, in which Fincantieri has won every new order on the market in the recent past." *NA*

Britannia while under construction

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Container shipping: a revolution in a box

The 1960s were a time of rapid and substantial change, not least in shipping. The advent of the cellular container ship affected not just ship design but also ports and cargo handling on land

A class of ship which quickly felt an icy wind was the fast break-bulk cargo liner which had evolved over many decades. Three RINA papers spaced over several years considered, from almost the same viewpoint by the same author, two generations of cargo liners, Glenlyon class in 1964 and Priam class in 1969, and then the Encounter Bay class of first generation OCL container ships from essentially the same design team. The author of all of these was Marshall Meek, the naval architect for Ocean Fleets which included the long established Alfred Holt & Co and its Blue Funnel line and the associate Glen Line. His co-author for the *Priam* paper was R. Adams, also of Ocean Fleets.

Priam class cargo liners had been developed from the Glenlyon class which in turn had replaced the Blue Funnel P class of 1950. These vessels provided a service between Europe and the Far East. The Priam class carried cargo in six holds with upper and lower tweendecks to provide 'shelf space' for small parcels for cargo. Cargo handling had been updated to a combination of deck cranes and derricks. Another change was the incorporation of a large tankage in which parcels of several different liquid cargos could be carried.

The ships were quite efficient in the context of the service they provided. However, the deficiency of the whole system was becoming more and more apparent as the loading and discharge of cargo was extremely labour intensive and stevedoring costs were rising much faster than other expenses. The graph (see…) shows the situation in the period to 1962. The crux of the matter was captured by the author: "in considering these operational matters it is natural to look at the efficiency of the ship as a vehicle of transport as expressed in the terms of the ratio of time at sea to time in port. In 1950 the P class spent 220 days at sea; in 1962 they spent only 180 days at sea. This decrease can only be because of slower port working and is regrettable." R.V. Turner in the discussion of the Glenlyon paper reinforced Meek's emphasis on the need for further work in cargo handling. He said: "the loading of a ship is a vast assembly operation carried out at infrequent intervals with an almost completely random variety of components. The ship must be a compromise to suit this random variety and optimisation of ship design in the logical scientific sense cannot begin until there is some form of regimentation in the cargo which is offered to the ship by the shippers."

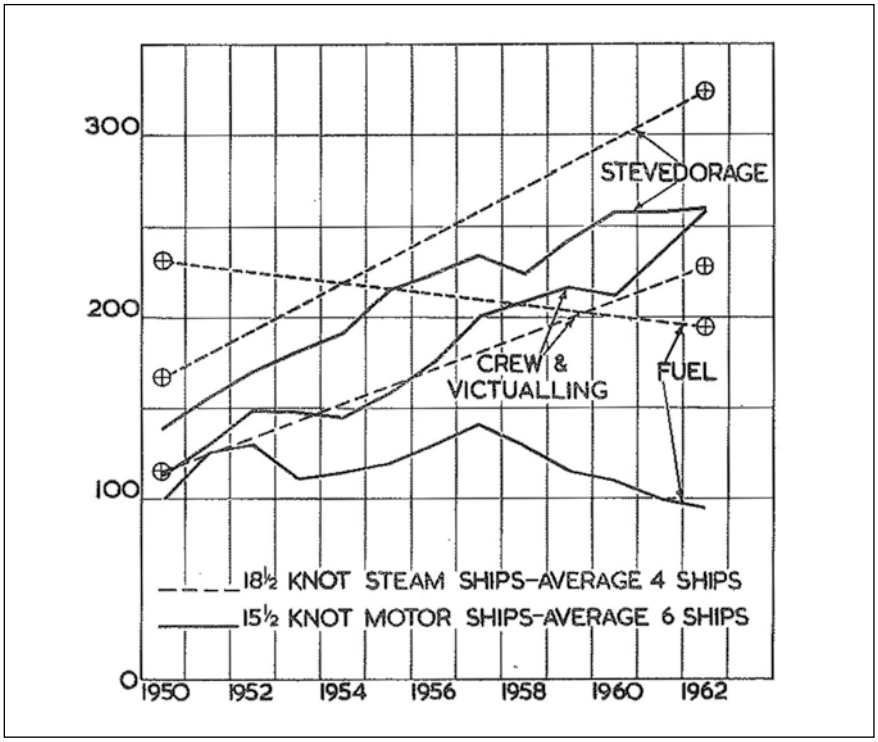


Fig 1: Comparison of fuel and other costs, 1950-1962

Meek returned to cargo working in his response to questions raised in discussion. "It is an incredible and disturbing situation that a ship when at sea in the surroundings that gratuitously provide elements of water and air is driven day and night to the limit of its endurance and if necessary of the crew's endurance; but from the moment it enters the fantastically expensive complex of ports whether in dry dock or on the loading berth beneath cranes or alongside sheds the ship becomes in too many ports economically dead for more than half of every day and subject to the whim of every port authority and labour regulation. In what other sphere of industrial activity does such an expensive capital outlay as a ship in its port facilities experience so poor a utilisation factor."

It was becoming clear that containerisation was the cure for at least some of these ills. In a way this was nothing new, people had attempted to transport different products in uniform containers for millennia. But it was the standardisation of the steel container into an ISO range of sizes and the wide acceptance of this that opened the way for the worldwide container revolution.

Taken together these three papers show why container shipping rapidly took over from cargo liners on many services. The efficiency of container stuffing on land was of little concern to the shipowner as long as the containers were available at the terminal to be loaded onboard. This cut the time and stevedoring costs dramatically compared with the laborious piecemeal loading of a break bulk cargo liner.

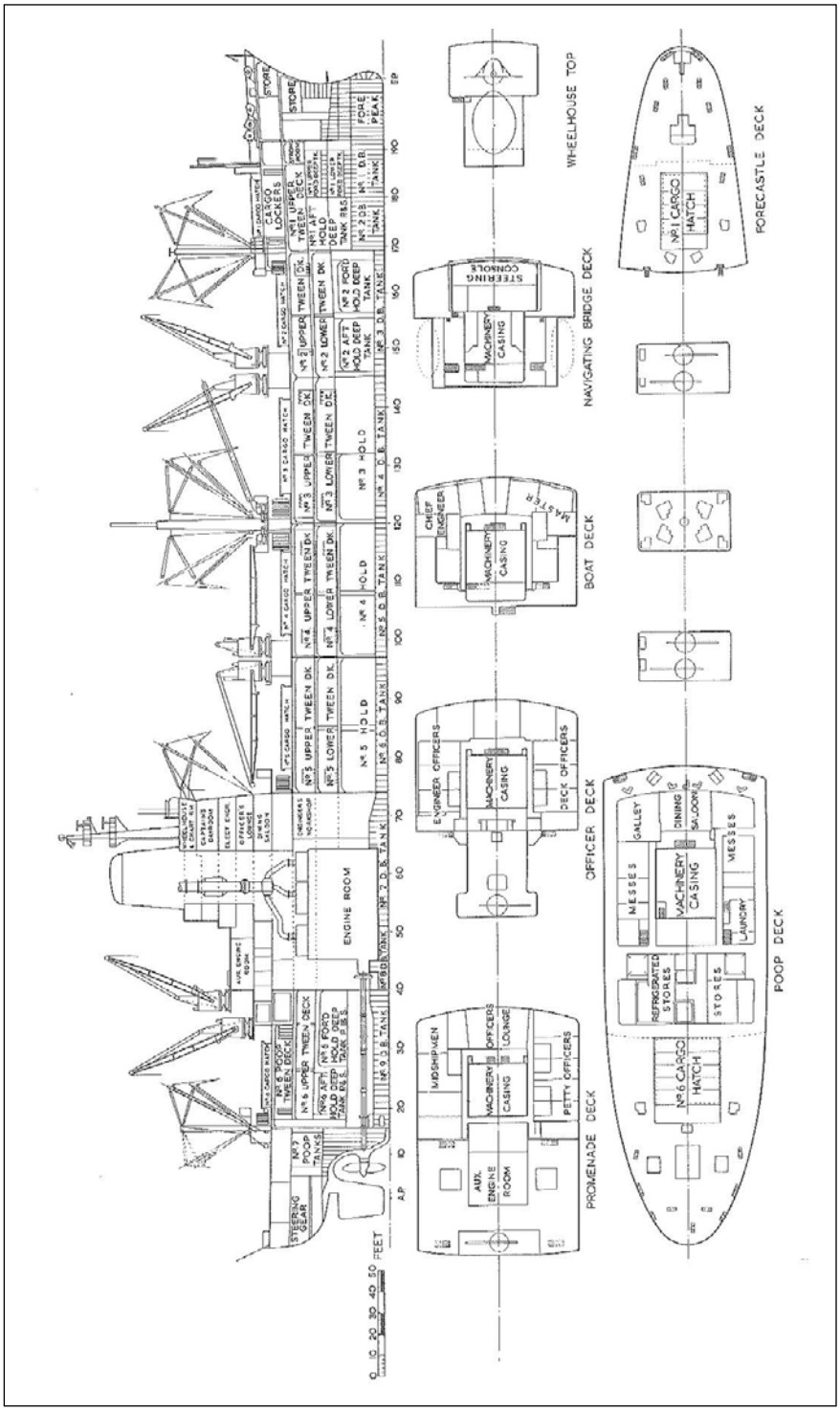
Ocean Fleets' naval architects had the job of designing the pioneering *Encounter Bay* class of container ships for OCL and the UK – Australia trade. OCL was a consortium formed by Ocean Steamship, P&O, British & Commonwealth Shipping and Furness Withy. Design work began early in 1966. They were not the first container ships as there had been some pioneering work in the USA but the paper makes clear how many uncertainties there were over what was needed from a container ship.

First to be settled was whether a cellular container ship was the right solution, or would some ro-ro solution work. Then the number of TEU needed for the proposed trade which would be UK - Australia; basically Tilbury, possibly Rotterdam, to Fremantle, Melbourne and Sydney.

Among the questions relating to containers was what would be the stowage factor. This was reckoned as 60cu.ft/ton at its most compact on this route. The likely weight of containers would vary with the seasons, for example homeward bound in the Australian autumn canned fruit would be a heavy cargo taking a container up to its rated load. At other seasons the same container, though full, might only carry 12tonnes of wool. A big unknown at that time was the actual strength of containers. The number that could be loaded one on top of the other was known, but an uncertainty for stacks on deck was the racking strength of containers and how they should best be lashed to prevent them going overboard or collapsing under side forces within the tiers. Extensive tests were carried out at full size to settle these points.

Another decision was service speed. Shippers could hardly be offered a service where the ships were slower than existing vessels, so service speed was set to 20/21 knots. Loading and unloading would take only hours, so effective utilisation meant large, fast and relatively few ships for a given trade. This speed would give an acceptable round time for a voyage of about two months and a frequency of service of 10 to 14 days.

The result of these deliberations was a series of ships carrying 1,300TEU of containers, 470TEU non-refrigerated and 304TEU refrigerated in cell guides below deck, and 526TEU on deck, stacked three high, the vessels being 227m long, 30.5m beam, 16.46m deep and drawing 10.6m. Deadweight was 21,750dwt at this draught and the block coefficient 0.60.



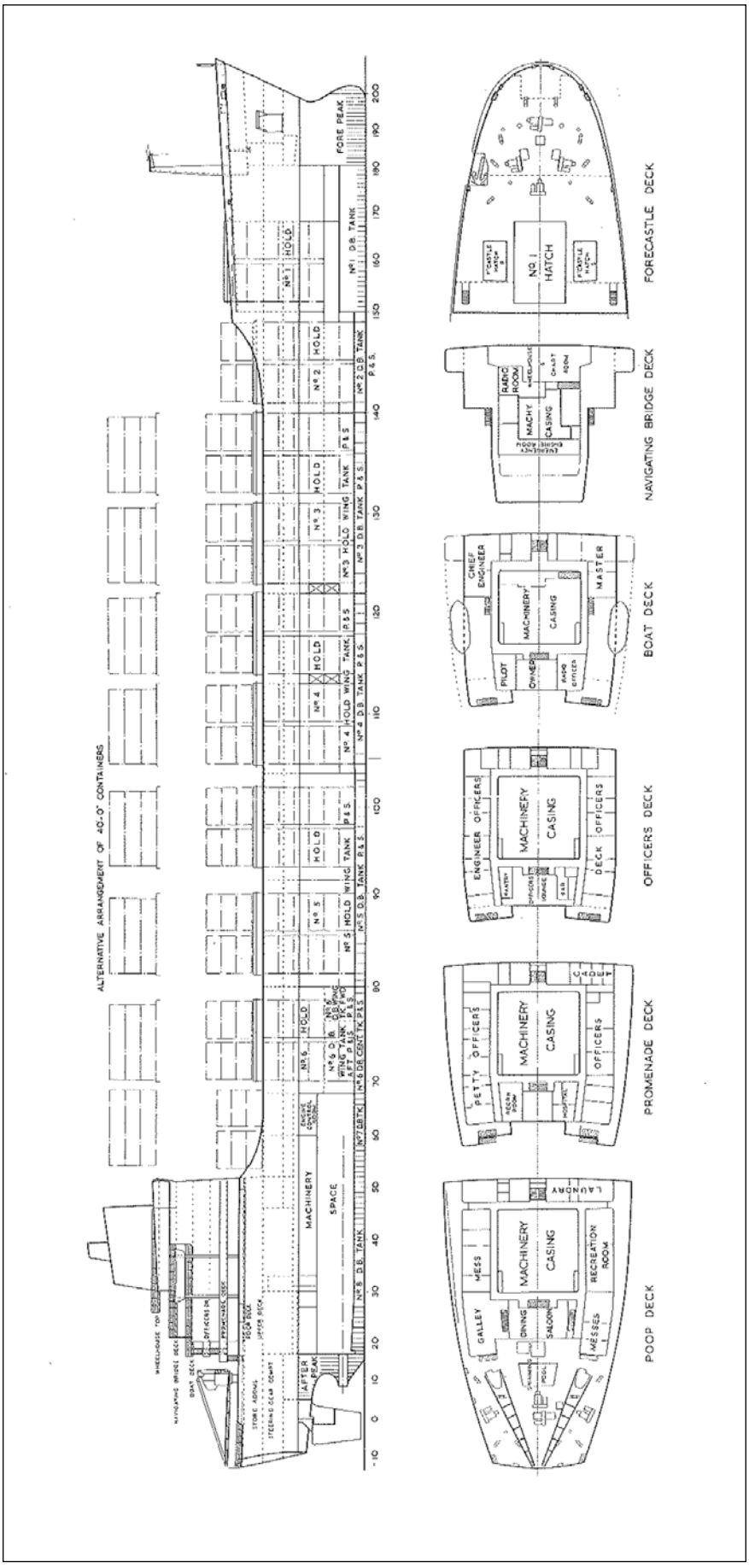
Priam class ship

The first OCL container ships

Powering calculations initially showed about 25,000shp was needed, which could be provided either by steam or diesel. Clearly fuel cost was not the most important consideration. According to Meek, steam was favoured "because it was thought to require a smaller crew, to be more likely to be free from machinery induced vibration and to give an engine room right aft in the ship. Also because there were unavoidable wing tank spaces throughout the ship and no pressing deadweight problems, the additional fuel to the steam ship was not an insuperable disadvantage. Overall there seemed to be little economic loss in the adoption of steam propulsion. Having fixed on steam the argument then ran that the horse power could be raised to 32,000shp with only a modest increase in engine room size and machinery cost and the additional speed capability would be a built-in asset."

Meek observed that the design of the main hull structure was probably the biggest challenge because there seemed to be no exact or even close precedent, and little published data. "A hatch width of 80% of the beam, although high, was not in itself a major problem in respect of longitudinal strength since the judicious use of higher tensile steels made it possible to keep the scantlings within reasonable limits and achieve acceptable stresses. It was the estimation of the weight and the load distribution along the ship's length that was the first major problem, the second was the design of a structure with only minimal deck that would resist the torsional forces likely to be imposed on the hull." Torsion boxes between hatches and wing bulkheads were the solution adopted. The RINA paper contains a wealth of detail about the lines and structure and the design of the container guides and methods of lashing containers for these pioneering vessels.

Six vessels in this class were built with the lead ship *Encounter Bay* delivered in February 1969. But already when the Bay class were under construction the designers' focus had moved to larger vessels with higher stacks both within the hull and on deck. Such early container ships showed the way and since then the growth has been enormous, expanding quickly in recent years to 14,000, 18,000 and now over 20,000TEU. *NA*



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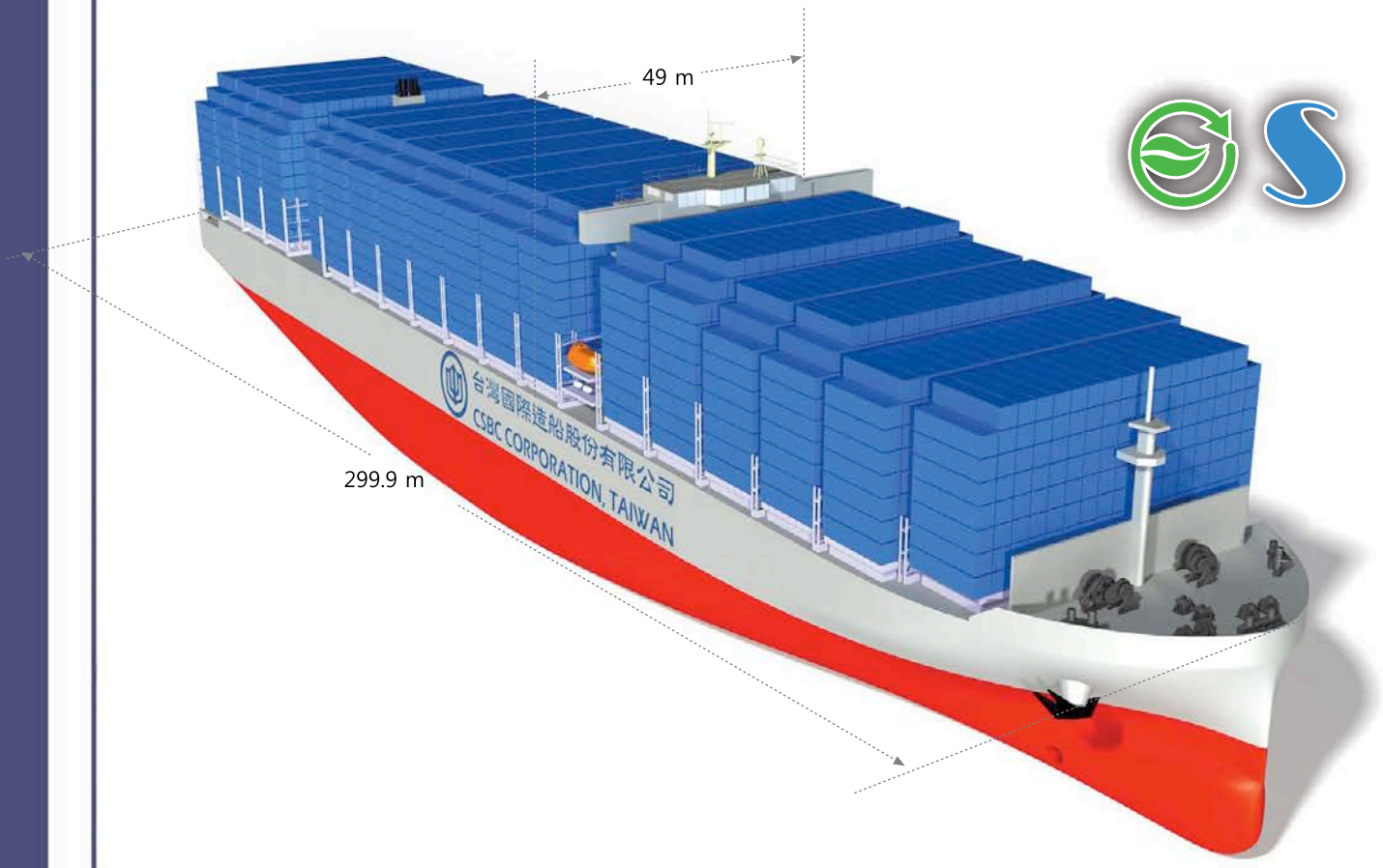

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