SWZ | MARITIME

Magazine for maritime professionals | Volume 143, July - August 2022 | www.swzmaritime.nl

7/8

Zero-emission solutions for shipping taking shape

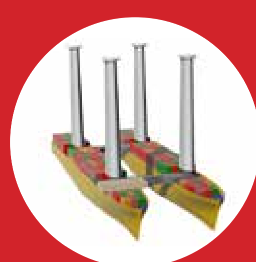
A TRANSITION THIS WAY COMES

SMM 2022 is here

Maritime industry gears up to discuss challenges ahead

Thruster issues

MARIN tests thruster behaviour in waves



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Cover: In June, Van Oord christened the Vox Ariane, the company's first trailing suction hopper dredger equipped with an LNG fuel system (photo Flying Focus).

SMM, sustainability and energy transition

Admittedly, it is an open door to say that many maritime professionals worldwide have probably been looking forward to finally meeting each other next month after four years at the SMM in Hamburg. Too bad for Europort, but the SMM is much bigger and more important for seeing what the international shipbuilding industry from all corners of the globe has to offer. Especially when it comes to finding answers to the question of how to make shipping less climate threatening and more sustainable. The SMM is ambitious in this respect with its motto: Driving the maritime transition. As editors of SWZ|Maritime, it would be a shame not to show in this July/August issue, just before the SMM, what knowledge institutes and businesses in the Netherlands have to offer when it comes to the maritime energy transition. On behalf of the editorial staff, our colleagues Willem de Jong (former Managing Director of Lloyd's Register London) and Johan de Jong (Manager International Relations at MARIN) have written and collected several articles that should provide our readers with some insight into what is possible in the field of making the shipping industry more sustainable and the energy transition to zero-emission shipping.

What the future of the shipping industry will look like is anyone's guess, but one thing is certain: the world is changing, and the second certainty is that it is changing ever faster. Changes that are not always welcome, such as the Russian invasion of Ukraine. These changes force us to think and, if necessary, to change our positions and views. This can lead to surprising insights, such as those of Willem de Jong, who is always considered a very thoughtful liberal, and who argues in favour of an illiberal European Jones Act. And also to the changing views of the author of this editorial, who is now considerably more positive about the European climate policy for the maritime industry than he was years ago.

It is also why the tens of thousands of maritime professionals go to Hamburg: with curiosity and an open mind to see what the latest technological possibilities are for the maritime industry to provide answers to the major issues of our time. And even though it will be the first time in four years that the trade fair can take place physically, a visitor record will probably not be reached. It is a great pity that many Russians will not be able to make it to Hamburg. This is all the more unfortunate, because it is precisely Russia, with its huge gas reserves, that could have played an important role in making shipping cleaner.

Antoon Oosting
Editor-in-Chief
swz.rotterdam@knvts.nl

SWZ|MARITIME'S EDITORS

Damen reports record order book of EUR 8.8 billion

Damen Shipyards' order book rose to a company record of EUR 8.8 billion at the end of 2021. Part of that rise was due to the acquisition of an order for no fewer than 99 vessels at the Workboats division and a record number of orders for Damen Yachting. After three loss-making years, the Netherlands' largest shipbuilder was back in the black in 2021. Despite the various Covid-19 measures worldwide, the negative operating result (EUR 43 million negative) in 2020 was transformed into an operating profit of EUR 25 million last year.

'2021 was a good year for us,' explains CEO Arnout Damen. 'We have delivered outstanding shipbuilding performance, for example with the complex diamond recovery vessel Benguela Gem, and we won the KNVTS Ship of the Year award 2021 for our electrically powered water buses for Copenhagen. Another great milestone in our efforts to become the world's leading "green" and "connected" shipbuilder was when we built the world's first full-electric harbour tug Sparky last year for the Port of Auckland and delivered eight ferries to three different clients in Canada, all fitted out with fully electric, hybrid or LNG propulsion systems.'

As for the outlook for 2022, the shipbuilder sees a number of uncertainties. Damen: 'The crisis in Ukraine is having a major impact on our company. Not least on the 214

KNVTS Ship of the Year 2021, the electric ferry designed for Copenhagen, Denmark.

colleagues we had working at our Kherson and Mykolayiv sites before the invasion, with the tragic loss of one of those colleagues. Not only do we sympathise intensely with them, we have also worked as one to ensure that hundreds of Ukrainian employees, and their families and relatives, were evacuated to safer havens at our shipyards in Galati and Gdansk, but also in Amsterdam and Vlissingen in recent months. Emergency supplies were taken to those who stayed behind. Many colleagues around the world contributed goods and funds, and provided refuge outside Ukraine.'

The conflict in Ukraine is also having a major impact in economic terms. 'Within a week after the invasion, we decided to suspend the delivery of vessels that had been ordered and the signing of new contracts with Russian and Belarussian clients. Later, the Dutch government's sanctions against Russia rendered those deliveries and contracts impossible. This year and the next, we have been, and will be, hard at work on finding solutions for the vessels already under construction and on the associated legal procedures.'

'Despite the consequences of this worrying conflict, we look to the future with optimism and confidence,' Damen continues. 'This is a view shared by our financial partners, who have recently confirmed their confidence with credit facilities for the years ahead.'

In total, Damen Shipyards Group completed 143 newbuild vessels in 2021, exactly the same number as in 2020. The volume of repair and conversion orders dropped off slightly to 1100 (2020: 1300). The production volume did rise, from EUR 2 billion to 2.4 billion. EBITDA increased from EUR 87.5 million negative in 2020 to EUR 81.5 million positive last year.

The increase in the order book from EUR 8 to 8.8 billion underlines the good starting position for the future. The portfolio includes, in addition to a range of tugs, yachts, inland vessels, fishing vessels, barges and workboats, four F126 frigates for the German navy, the Combat Support Ship Den Helder for the Dutch navy, and the training vessel Ab Initio, which was fitted out for propulsion with green hydrogen, for the STC Group from Rotterdam.

RWE and SolarDuck to accelerate development of offshore floating solar

RWE and the Dutch-Norwegian company SolarDuck have signed a collaboration agreement to develop the use of floating solar parks at sea. To accelerate the learnings on SolarDuck's floating solar technology, RWE will invest in a first offshore pilot in the North Sea.

SolarDuck's solar platforms float several metres above the water.

The project is a first step in the collaboration and lays the foundation for a larger demonstration project at the Dutch offshore wind farm Hollandse Kust West (HKW). RWE is tendering for this project, and has included SolarDuck into its bid with a combination of offshore floating solar with integrated storage solutions.

The integration of floating solar into an offshore wind farm is a more efficient use of ocean space for energy generation (using the space between the turbines) and allows for synergies with regards to construction and maintenance. The result is more balanced production due to the complementary nature of wind and solar.

Offshore solar farms have to withstand rough conditions, such as high waves, strong winds and a corrosive environment. SolarDuck's triangular-shaped platform is designed to float several metres above the water, following the waves like a carpet. Thus it keeps critical electrical components dry, clean and stable, as well as secures the integrity of the semi-submersible structure while enabling safe operations and minimal maintenance.

RWE will invest in SolarDuck's full-scale offshore pilot called "Merganser" with a capacity of 0.5 MWp in 2023. Merganser is expected to be installed off the coast of Ostend in the Belgian North Sea and will be SolarDuck's first offshore pilot following the successful deployment of an inland pilot in the Netherlands last year.

Van Oord and Subsea 7 win contract offshore Guyana

ExxonMobil affiliate Esso Exploration and Production Guyana Limited (EEPGL) has contracted a consortium of Van Oord and Subsea 7 for the Gas to Energy project, offshore Guyana. The scope covers project management, engineering, and installation of approximately 190 kilometres of natural gas pipeline.

The pipeline will be installed in water depths up to 1400 metres and includes crossing the seawall onshore. It runs from the Liza field in Guyana's offshore Stabroek Oil and Gas Block to an onshore natural gas fired powerplant west of the Demerara River, along the coast of Guyana. Subsea 7 says the contract is worth between USD 150 million and USD 300 million.

Van Oord's scope consists of the shore approach, utilising Horizontal Directional Drilling (HDD) methodology, and installation of 75 kilometres of pipeline nearshore. Van Oord will deploy its shallow water pipelay barge Stingray in water depths of up to 28 metres and start its operations in mid-2023. Power demand in Guyana is forecast to significantly increase in the next five years along with a fast-growing economy. The project will support Guyana's low carbon development strategy, which outlines a plan to replace heavy fuel oil with natural gas as the main energy source. The pipeline will transport 50 million standard cubic feet of gas per day.

Vuyk Engineering designs dredger for American market

Great Lakes Dredge & Dock Corporation, the largest dredging company in the United States, has contracted Vuyk Engineering Rotterdam BV to design a large cutter suction dredger (CSD). The CSD is to expand the current fleet of dredgers. The Dutch maritime design and engineering firm will provide a concept and basic design for the vessel, including a design package for the dredging equipment.

Having previously worked on projects such as DEME's Spartacus and Jan De Nul's IBN Battuta class, Vuyk Engineering has a considerable track record in designing dredging equipment. The services vary from complete design packages of vessels, to conversion scopes of cutter ladders, spud carriers and other specialised dredging equipment.

The new project combines the specific requirements applicable to the US market, with the latest technologies. The dredger will be equipped with sophisticated systems to reach best in class workability in harsh environments. Effort is made to ensure comfort for the crew. Besides that, the maintainability of the dredging equipment and machinery has top priority. Wear parts are easily accessible, and cranes can reach all large components, so parts can be exchanged quickly and safely.

Vuyk supplies a cutter suction dredger design to Great Lakes Dredge & Dock Corporation.

'For some time now, we have been looking into the possibility of establishing a foothold with our services in the United States,' says Floris Toetenel, Commercial Director at Vuyk Engineering Rotterdam. 'The first step was taken when we became an independent engineering company in 2021. This gave us the opportunity to seek out new business opportunities.'

Portugal and the Netherlands plan renewable liquid hydrogen supply chain

Shell New Energies NL, ENGIE, Vopak and Anthony Veder have signed an agreement to study the feasibility of producing, liquifying and transporting green hydrogen from Portugal to the Netherlands, where it would then be stored and distributed for sale. The consortium envisions hydrogen being produced by electrolysis from renewable power in the industrial zone of the Sines port. Then the hydrogen is liquified and shipped via a liquid hydrogen carrier to the port of Rotterdam for distribution and sale. The aim is to deliver a first shipment of liquid hydrogen from Sines to Rotterdam by 2027.

Key sector players in heavy duty, marine and aviation support this development as it fits with their intention to decarbonise operations. 'We consider liquid hydrogen as a key solution to import renewable energy into markets such as the Netherlands or Germany. We are developing the next generation of trucks, which can use liquid hydrogen directly,' says Dr Andreas Gorbach, Head of Truck Technology and Member of the Board of Management Daimler Truck AG.

Building more certainty for customers of liquid hydrogen is needed. Policy instruments that cover cost increases for end-users can be an effective means to achieve this. Such instruments are vital to increase the scale and reduce the cost of liquid hydrogen production and have the power to drive the infrastructure development along the full supply chain.

Within the consortium, Shell and ENGIE will collaborate across the full value chain and Anthony Veder and Vopak involvement will focus on shipping, storage, and distribution. They will initially assess the potential of producing, transporting, and storing around 100 tonnes per day, with potential to scale this up over time.

The governments of Portugal and the Netherlands have strengthened their joint ambition for the production and transport of hydrogen. This feasibility study follows the signing of an MoU in 2020. Furthermore, Portugal and the Netherlands confirmed their joint goals at the Rotterdam World Hydrogen Summit in May 2022.

Note that the project applied for IPCEI notification under H2Sines (Portuguese submission) and H2Sines.Rdam (Dutch submission).

RUSSIAN WAR DRIVES COST AND WILL NOT HELP SHIPPING TO DECARBONISE

One can easily state that most maritime professionals were looking forward to meeting all "the who is who" in shipbuilding and shipping at the Hamburg SMM, the leading international maritime trade fair, to see what innovations could help us to come to zero-emission shipping in 2050. Yet, the Russian-Ukraine war has turned the world upside down and threatens to change a lot of prospects for international shipbuilding and shipping.

Until the 24th of February this year, many people, including highly intelligent and powerful personalities in European politics, but also less highbrow types like the Editor-in-Chief of this magazine, couldn't have imagined how Putin would plunge Russia into a devastating war of conquest. Just before that tragic date, most of us were hoping to finally battle the Covid-19 pandemic and to overcome the negative economic consequences.

At the beginning of this year, the prospects for shipping and for investments in newer, cleaner ships with more sustainable propulsion looked favourable. A lot of shipowners and charterers earned well in most of the important shipping trades. Especially the container liners like Maersk, CMA CGM and MSC, but the Japanese also earned billions in profits that they invested in research programmes to decarbonise their fleets. The International Chamber of Shipping offered to create a USD 5 billion fund to stimulate R&D on zero-emission shipping. The pressure of especially the EU, and after the disastrous Trump-era now also of the Americans again, on cleaning up shipping's emissions did not miss its mark.

Decision-making process is too slow

The International Maritime Organization (IMO) in London, a specialised agency of the United Nations responsible for regulating shipping, is hampered by the fact that all decisions must be made in unanimity. This process takes a lot of time and persuasion before consensus is reached on badly needed progress on for example improving the sustainability of global shipping. For a broad spectrum of European politicians in particular, this takes far too much time while oil-producing countries for example would rather continue to benefit from their income from oil production and export.

At the end of June, the Maritime Executive reported that the European Parliament and the European Council both finalised their negotiating positions on landmark reforms to the EU's climate regulations, including for the first time, the inclusion of the maritime sector in Europe's Emissions Trading System (ETS). According to the Maritime Executive, the two bodies are in close agreement, except for two significant points: first, the use of the revenue from auctioning maritime emissions allowances; and second, who will have to pay the bill. The Council wants to ensure that 'national budgets of member states will benefit' from the revenue (not shipping research), and it puts the ship manager or shipowner on the hook for paying (not the charterer).

100 per cent of emissions

Both plans would extend the existing EU ETS to cover 100 per cent of emissions on intra-European routes and fifty per cent of emissions on overseas routes. The EU Council and Parliament agree that non-CO_2 GHG emissions should be tracked, though the Council's version would defer a final decision on whether to count methane in the ETS until a later date. The Council would like to place the burden of compliance on the vessel owner/operator, who could optionally negotiate with the charterer on a contractual mechanism for sharing cost. By contrast, the European Parliament's proposal makes a contractual cost pass-along mechanism mandatory.

In the Council proposals, all the revenues from auctioned allowances go to the administering member state (the flag state for an EU ship, or the state where the shipowner calls most often for a foreign-flag ship). This requires shipping researchers to apply to the EU's general-purpose Innovation Fund for green-transition financing, with "due consideration" assured for maritime-related projects. This means shipowners only see their money back when they start R&D projects themselves, like Maersk and MSC do now. Smaller shipowners lack the capacities for projects such as this.

Ocean Fund for green shipping

The EU Parliament opts for other solutions. It wants emissions from non-EU voyages covered 100 per cent after 2027, with some exceptions under certain conditions. Non-CO_2 greenhouse gases (methane) should be included in ETS calculations. 75 per cent of all revenues from maritime allowances should be assigned to a dedicated "Ocean Fund" to support the industry's green transition. And "polluter-pays" compliance cost allocation should be enforced using mandatory contractual pass-through of the costs to the commercial operator (charterer). Council and Parliament will now meet and negotiate the text of a large-scale legislative package, including emissions measures for other sectors like road transport and aviation.

With this comprehensive package of measures to simply financially force the shipping industry to reduce the use of fossil fuels and opt for less polluting propulsion systems, the EU increases the pressure on the IMO and other important shipping superpowers to make their ships and shipping more sustainable. And if big producing countries like the People's Republic of China oppose the EU measures or refuse to green their shipping, it will just make their products more expensive as it will cost more to get them to the European markets. Shippers and shipowners that are prepared to work with cleaner ships to and from the EU pay fewer levies and their goods come on the EU markets cheaper. So, China will have to go along in the developments towards greener shipping or lose part of the biggest market for their manufactured products.

Unpredictable Russia

The future role of Russia in the international shipping industry is not yet clear. So far, its biggest ship-owning company Sovcomflot (SCF) shrunk its fleet considerably as they had to sell a big part of their tanker fleet, hand back chartered ships and annul big newbuild orders in South Korea. A big chunk of its fleet was financed by Western banks and investors that had to withdraw due to imposed sanctions. SCF will fall back to a much smaller shipping company of just regional importance. And a lot of the ships owned by Western shipowners, especially tankers, offshore installation and supply ships and multi-purpose carriers that brought a lot of installations to further develop the Russian oil and gas industry, will simply not sail to Russia anymore due to the sanctions.

Besides the containers with luxury and strategic goods that stay in hub-ports such as Rotterdam, Hamburg, and Antwerp for transhipment to Russia and are now seized by customs authorities, the biggest part of Russian shipping was the transport (export) of Russian commodities, especially oil and gas. To develop the oil and gas fields in for example the Caspian Sea and especially the Arctic (Yamal in the Kara Sea) and in front of the Sakhalin peninsula, Russia was dependent on Western financing and knowledge from big oil companies like Esso, TotalEnergies and Shell. Specialised offshore contractors like Heerema, Boskalis, Van Oord, Belgian DEME and Jan De Nul, Allseas, and special heavy-lift shipping companies such as Spliethoff/BigLift, RollDock, RedBox and Jumbo Shipping did good business in Russia, but after 24 February, they all had to look for business elsewhere.

Slower developments

The sanctions will lead to a far slower development of the Russian Arctic coast. Now that the country no longer has access to Western financing, knowledge and technology, projects will take much more time to come to maturity. Of course, one can expect that the Chinese will step in to replace Western involvement, but it is doubtful they can offer in quality and capacity what Western companies are capable of. Also, the further development of the Northern Sea Route along Siberia with ports and emergency infrastructure will at least be at a far slower pace. Taking this route as an alternative to the Suez Canal will lose a lot of its attraction for most shipping companies.

The other consequence of Russia's attempt at conquest of Ukraine is that it makes all kinds of shipping more expensive. Russia is a hugely important producer of heavy fuel oil, which is still used in most seagoing ships. At the end of this year, the Western ban on the import of Russian oil by sea will come into effect. Russia can then only ship its Arctic and Ural oil around Europe through the Suez Canal to the Asian markets where it must compete with the oil from the Middle East. In the West itself, it will accelerate the exploration of new gasfields and the development of alternative energy sources as part of the energy transition to battle climate change.

> The sanctions will lead to a far slower development of the Russian Arctic coast

A nastier consequence of the ban on Russian coal per 10 August is that the European countries that still rely heavily on coal to produce their electricity will be forced to get this commodity from much further away: the US, South America (especially Colombia) and Australia. This should be an extra reason for all Western countries to step up their investment in offshore wind parks, in the installation of which, the Dutch offshore contractors and shipping companies are specialists.

Antoon Oosting
Freelance maritime journalist and SWZ|Maritime's Editor-in-Chief,
swz.rotterdam@knvts.nl

NEW ORDERS

The beamer Z-53 Van Eyck was ordered with Padmos Stellendam.

Four MultiCats 1908 on deck of the BBC Danube (photo R. Zegwaard).

Z-53 Van Eyck

Father Steve and sons Kenneth and Jason Savels, Zeebrugge, ordered the beamer Z-53 Van Eyck with Padmos Shipyard BV, Stellendam, on 17 July. The hull, which is subcontracted to Casco & Sectiebouw Rotterdam (CSR), Rotterdam, will be identical to that of the previously delivered Z-483 Jasmine (yard number 221), Z-39 Sophie (yard number 223) and Z-98 Windroos (yard number 224), only the superstructure and wheelhouse will be modified. The Z-53 Van Eyck will be capable of beam trawling as well as twin-rigging for langoustines on a seasonal basis. Delivery is scheduled for September 2023.

The details of the Van Eyck are: 385 GT, 114 NT – Loa (pp) x B x D (d) = 37.95 (33.85) x 8.50 x 5.40 (4.50) metres. Propulsion is provided by an ABC main engine, type 6DZC, with an output of 1300 hp at 1000 rpm on a fixed pitch propeller.

Four MultiCats 1908

On deck of the m.v. BBC Danube (2012 – 12,980 GT), four MultiCats 1908 arrived in the Waalhaven, Rotterdam, on 1 August. The workboats (yard numbers 571818-21, imo 9951240, 9951252, 9951264 and 9951276) have been built at Yichang for stock at Gorinchem. The details of the MultiCat 1908 are: 98 GT – Loa (pp) x B x D = 19.05 (18.90) x 8.06 x 2.75 metres, draught aft minimum 2.10 and maximum 2.40 metres. The propulsion is provided by two Caterpillar main engines, type C18 Acert TA/B (145 x 183), with a total output of 1215 hp or 894 kW at 1800 rpm via three Reintjes gearboxes, type WAF 264L (4.5 : 1), on two fixed Promarin propellers with a diameter of 1350 mm in Optima nozzles for a bollard pull of 13.5 tonnes and a speed of 9 knots. The bunker capacity is 46.6 m^3. The free deck area has a surface of 35 m^2. The MultiCat is equipped with a forward Heila deck crane, type HLRM 80-3S, with a lifting capacity of 5.3 tonnes at 12.04 metres. The Bureau Veritas classed MultiCat 1908 can be deployed for anchor handling, dredging services, supply, towing, hose handling and survey.

DMS Snipe

At Sharjah (UAE), Albwardy Damen Shipyards laid the keel for the DP2 MultiCat 3313 DMS Snipe (yard number 571840, imo 9966219) in June. The DMS Snipe is a shallow draught (< 2 metres!) MultiCat, which will be available on time charter basis from March/April 2023.

The details of the MultiCat 3313 SD are: 499 GT – Loa x B x D = 33.67 x 13.45 x 3.74 metres, maximum draught 2.60 metres. The propulsion system consists of three Caterpillar main engines, type C32 TTA Acert (145 x 162), with a total output of 3045 hp or 2238 kW at 1800 rpm via three Reintjes gearboxes, type WAF 562L (5,947:1), on three fixed Promarin propellers with a diameter of 1700 mm in Optima nozzles for a bollard pull of 25 tonnes and a speed of 10 knots. The two Veth CJ1000V bow thrusters

The MultiCat 3313 SD DMS Snipe.

have an output of 325 kW. The bunker capacity is 195 m^3. The work deck has a surface area of 200 m^2 with a maximum permissible load of 12 tonnes/m^2. The MultiCat is equipped with two hydraulic Heila deck cranes, type HLRM 230-4SL, a bow roller (7 metres, 1200 mm diameter, safe working load (SWL) 150 tonnes), stern roller (4 metres, 1200 mm diameter, SWL 100 tonnes). The DMS Snipe is equipped for anchor handling, dredging services, supply, towing, ploughing, hose handling and survey. Accommodation is provided for nine persons.

Two WIDs

Van Oord, Rotterdam, has ordered the construction of two additional water injection dredgers (WIDs, yard numbers 221 and 222) from Kooiman Marine Group. The new vessels will have the same specifications as the Maas and Mersey delivered in 2021, supplemented by innovative optimisations, including a slightly larger battery pack and accommodation. The versatile vessels offer not only water injection dredging, but also mass flow and power jetting systems. The latest technology has also been applied, including heave compensation and dynamic positioning, so that dredging can be largely automated and performed more efficiently. The water injection vessels will be equipped with a hybrid energy management system and will be able to store energy in batteries that can be used later for propulsion and other purposes. Diesel-electric engines will reduce carbon emissions. The new WIDs will comply with IMO Tier III legislation for reducing harmful NO_X emissions according to EU Stage V legislation.
The details of the Bureau Veritas classed WIDs are: 482 GT, 144 NT – Loa (pp) x B x D (d) = 43.07 (35.79) x 9.70 x 3.40 (2.10) metres. Propulsion is diesel-electric, consisting of two Caterpillar main engines, type C32 Acert (145 x 162), with an output of 1066 kW or 1448 hp, at 1800 rpm, which is coupled to a hybrid energy management system whereby electricity is generated by heat recovery and stored in batteries. The vessels will be equipped with two azimuth thrusters for a speed of 10 knots and a bow thruster in a tunnel. The minimum dredging depth is 1.80 metres, maximum up to 24 metres water depth. The bunker capacity is 102 m^3.

The WID Maas delivered in 2021 (photo Flying Focus).

LAUNCHINGS

Canopée

The Canopée (yard number 572, imo 9924120) was launched at Partner Stocznia Sp.z.o.o., Sczcecin, on 28 June. The keel had been laid on 4 February 2021. The completed hull was prepared for launching and moved from the shore onto a large pontoon. The vessel was floated after entering a nearby drydock. This kind of launching is very secure and reduces the chance of damaging the hull. In due time, the Canopée will be towed to Hardinxveld, the Netherlands, for further outfitting and commissioning by Neptune Shipyards BV. The ro/ro cargo ship Canopée will transport the future Ariane 6 launcher from the European continent to French Guiana and was designed by Groot Ship Design BV in close cooperation with Neptune Marine Projects BV and Goltens Green Technologies BV in Leek.
The details of the Canopée are: 10.640 GT, 7500 DWT – Loa (pp) x B x D (d) = 121.00 (118.20) x 22.00 x 7.05 (4.30) metres. Mechanical propulsion is provided by two dual-fuel Wärtsilä main engines, type 6L32 F (bore 320 x 400) with a total output of 7820 kW at 750 rpm, twin-propeller for a speed of 16.5 knots. The Bureau Veritas classed open-top vessel will

The Canopée will transport Ariane 6 launchers.

be equipped with four 30-metre-high Oceanwings to lower fuel consumption and emissions. The Oceanwings sail panels will cover an area of 375 m² each (total 1500 m²) and should save around 35 per cent on fuel consumption.
After delivery in November 2022, the ship will load components of the Ariane 6 rockets in Bremen, Rotterdam, Le Havre, Bordeaux and Livorno with destination Pariacabo on the Kourou river in French Guiana. The futuristic vessel will be operated by Alizés (Alizés means tradewinds), a joint venture of French shipping companies Jifmar Offshore Services SAS and Zephyr et Borée, Aix-en-Provence, which has been set up especially for this project. The Ariane 6 is the sixth generation of European launchers, which have launched satellites for decades from the Kourou launch site in French Guiana. The Canopée is named after the canopy above the "belly of Paris", an underground urban space where once Les Halles de Paris stood.

R.B. Weeks

The R.B. Weeks (yard number H258, imo 9652210) hit the water in a spectacular side launch at Eastern Shipbuilding Group Inc., Allanton shipyard, Panama City, Florida, on 17 June. The trailing suction hopper dredger (TSHD) is named in honour of Richard B. Weeks, co-founder of Weeks Marine Inc., Cranford N.J.. He is married to Magdalen Weeks, the namesake of the identical Magdalen (yard number H256, imo 9652210), delivered by Eastern on 22 December 2017. Royal IHC was awarded the contract for the engineering and equipment delivery for the new 6540 m³ TSHD for Weeks Marine Inc. in May 2020.
Like the Magdalen, the R.B. Weeks will be equipped with IHC-designed and built equipment, including the complete and highly efficient dredging installation, dredging automation and instrumentation, propulsion and main electrical system. During the past year, those key components have been manufactured, assembled and shop tested in workshops all over the world. Royal IHC will also provide a number of technical services, including the assistance of its qualified engineers for inspection during installation of the delivered equipment at the shipyard, and support during start-up and commissioning of the dredger.

The R.B. Weeks was designed by Royal IHC.

Those activities are scheduled for 2022 and early 2023. The dredger will again be equipped with IHC's unique dynamic positioning and tracking (DP/DT) system and eco pump controllers, which will both further enhance its efficiency.
The details of the R.B. Weeks are: 7581 GT, 7989 DWT – Loa (pp) x B x D = 108.51 (109.00) x 24.23 x 8.31 metres. Power is provided by two General Electric (GE) diesel generators, type 16V250 MDC IMO III/EPA Tier 4, 2 x 5682 hp or 2 x 3400 kW for driving two controllable pitch Wärtsilä propellers in nozzles and a Wärtsilä fixed pitch bow thruster of 730 kW in a tunnel. The GE auxiliary generator, type 6L250 MDC IMO III/EPA Tier 4 has an output of 1423 kW and the Caterpillar emergency generator, type C18 IMO II/EPA Tier 3 of 425 kW. Two pumps (2 x 1600 kW), a dredge pump (1 x 1600 kW) and two pressure pumps (2 x 445 kW) are installed on board. Delivery and commissioning of the R.B. Weeks is to be expected in 2023. Accommodation is provided for 26 persons. The construction of the Lloyd's Register classed Magdalen and R.B. Weeks has to take place in the United States to comply with the Jones Act.

DELIVERIES

A-Rosa Sena

At Düsseldorf, Clara Eichler, daughter of Jörg Eichler, CEO of A-Rosa, christened the new flagship A-Rosa Sena (imo 9903748, EU nummer 02339241) of A-Rosa Flussschiff, Basel, on 17 June. The rivercruiser had been ordered on 2 April 2019 and the keel was laid at the Rumanian Santierul Naval Orsova SA, Orsova, on 12 August 2020. After launching, the hull was loaded on the semi-submersible heavy-lift vessel Yacht Express that departed from Constanta on 28 April 2021 to Rotterdam,where it arrived on 10 May. The hull was towed to Concordia Damen, Werkendam, for outfitting.
The A-Rosa Sena (134.87 x 17.70 metres) is hybrid powered comprising a Mitsubishi Stage V diesel-electric propulsion installation (3 x 1048 kW for a speed of maximal 24 km/h) and a lithium battery storage unit (total 1200 kWh). This enables the vessel to call at ports almost silently and without producing local emissions. A diesel engine will be used for cruising, but when entering or leaving port, the ship will switch to an electric engine powered by the battery for emission-free operations. Moreover, the four-deck vessel will also be fitted with a shore power connection.
The concept, basic and detail design and engineering of the the innovative E-Motion ship was prepared by C-Job Naval Architects in cooperation with JOI-Design, Hamburg, for the interior. The rivercruiser can accommodate 280 guests in 119 balcony cabins, seven balcony suites, two special cabins for disa-

The A-Rosa Sena is the new flagship of A-Rosa Flussschiff.

bled persons and twelve family cabins. The A-Rosa Sena, a name chosen as a tribute to the Arabic expression for beauty, departed from Cologne for the maiden voyage with the first guests on board on 18 June. Throughout the summer, the A-Rosa Sena offers seven-night voyages from Cologne via Amsterdam, Rotterdam, Dordrecht and Antwerp.

Ulvik

Royal Bodewes, Hoogezand, delivered the pneumatic cement carrier Ulvik (yard number 711, imo 9851751) on 20 July. The keel had been laid on 21 December 2020 and the launching followed on 6 May. The first trials were executed on 11 July from Delfzijl to Eemshaven and the second the next day. The Ulvik is the first in a second series of four ice class 1A cement carriers ordered with Bodewes by Eureka Shipping (SMT), Limassol. The Solvik (yard number 712, imo 9944089), yard number 713 (imo 9956331) and 714 (imo 9966453) will be delivered before mid 2024. Yard number 713 is under construction at the former De Hoop Foxhol site previously acquired together with Passer SIDC, Klaipeda. The details of the self-discharging cement carriers are: 2658 GT, 988 NT, 4288 DWT – Loa x B x D (d) = 89.98 (84.98) x 12.50 x 8.60 (6.00) metres. Propulsion is provided by an ABC main engine, type 6DZC (256 x 310), 1802 hp or 1326 kW at 1320 rpm, on a single propeller in a nozzle for a speed of 11.5 knots. The bunker capacity is 154.17 m^3. The four holds have a capacity of 4215 m^3 or 148,851 cft. The Ulvik departed from Eemshaven for the first voyage to Brevik on 27 July.

Arklow Cove

Simultaneously with the Ulvik, the Arklow Cove was towed from Westerbroek to Delfzijl on 11 July. The sea trials were also held at the same time on the Ems. At Eemshaven, Ferus Smit, Westerbroek, then delivered the Arklow Cove (yard number 432, imo 9757163) to Arklow Shipping. The ice class 1A Trader 5100 is the ninth in a series of ten. The Arklow Cove departed for its maiden voyage to Teesport on

The pneumatic cement carrier Ulvik is the first in a series of four (photo F.J. Olinga).

The Arklow Cove is the ninth in a series of ten Traders 5100 (photo F.J. Olinga).

17 July to load fertilizers with destination Gdansk.
The details of the Arklow C-ships are: 2999 GT, 1692 NT, 5094 DWT – Loa (pp) x B x D (d) = 87.40 (84.99) x 15.20 x 7.12 (6.26) metres. The propulsion is provided by a MaK main engine, type 6M25 of 1740 kW or 2364 hp at 720 rpm on a controllable pitch propeller for a speed of 12 knots. The bunker capacity is 101 m^3 heavy fuel oil (HFO) and 96 m^3 marine gas oil (MGO). The hold (48.86 x 12.60 x 8.50 metres) has a capacity of 218,800 cft or 6196 m^3. The maximum allowable load of the tank top is 15 tonnes/m^2 and of the hatches 1.75 tonnes/m^2.

Aquadelta

Bijlsma Wartena BV handed over the water injection dredger (WID) Aquadelta (yard number 388, imo 9941831) to Van Der Kamp Bagger Beheer BV, Zwolle, on 7 July. The keel had been laid on 12 April 2021 and the launching took place on 1 April 2022. The Bureau Veritas classed WID sailed via the Van Harinxmakanaal to Harlingen on 24 June. Trials and tests were held on the Wadden Sea from 27 June.
The details of the Aquadelta are: 440 GT, 149 NT – Loa (pp) x B x D (d) = 48.04 (39.36) x 12.00 x 3.65 (2.30) metres. The propulsion is diesel-electric by five DAF main engines, type MX-13 390 (130 x 162) with a total output of 1950 kW or 2250 hp at 1675 rpm on two azimuth thrusters and one bow thruster in a tunnel.

The ASD 2811 TSM Odet.

TSM Odet

Damen Song Cam Shipyard JSC, Haiphong, has delivered the ASD Tug 2811 TSM Odet (yard number 513214, imo 9886110) to Compagnie Maritime Thomas (Compagnie de Remorquage Maritime de Sète), Marseilles. The tug was launched on 24 March 2020 and ready for delivery ex-stock on 28 April 2021. The TSM Odet sailed from Haiphong to Sète in just over fifty days on its own keel and arrived there on 12 June 2022.
The details of the ASD Tug 2811 are: 299 GT, 89 NT – Loa (pp) x B x D (d) = 28.57 (25.76) x 11.43 x 4.60 (4.65) metres. The propulsion system consists of two Caterpillar main engines, type 3512C TA HD/D (170 x 215), total output 3806 kW or 5104 hp at 1800 rpm, on two RR azimuth thrusters, type US 205, with a diameter of 2500 mm for a bollard pull of 62.7 tonnes and a speed of 13.1 knots. The bunker capacity is 69.43 m^3. TSM (established in 1905) owns and operates 25 tugs, workboats and offshore vessels and is based at Rouen, with subsidiaries in Dieppe, Brest, Bordeaux and Sète.

TSM Batz

Neptune Shipyards BV, Aalst, completed the EuroCarrier 2409 TSM Batz (yard number 588, imo 9963530) on 17 June. The keel had been laid on 19 July 2021 and was launched as NP

Bijlsma Wartena has delivered the WID Aquadelta (photo Hette Kloosterman).

The EuroCarrier 2409 TSM Batz.

588 at the end of May 2022. Trials were held near Maasvlakte II and the TSM Batz departed from Rotterdam to Brest via Cherbourg on 8 June.

The details of the EuroCarrier 2409 are: 173 GT, 51 NT – Loa (pp) x B x D (d) = 24.45 (22.80) x 9.54 x 3.00 (2.06) metres. The propulsion installation consists of two Volvo Penta D16s (144 x 165) IMO Tier III, with a total output of 1250 kW or 1698 hp at 1900 rpm on two propellers with a diameter of 1350 mm in nozzles for a speed of 10 knots and a bollard pull of 20 tonnes. The knuckle telescopic Heila deck crane, type HLRM 170/4S, has a maximum lifting capacity of 28.1 tonnes at 5.77 metres. The multi purpose vessel is also equipped with a Heila deck crane, type HLRM 140-4S fore, a Heila HLRM 25-4S deck crane aft and an A-frame and spuds to operate in shallow areas. The bunker capacity is 56.1 m^3.

The EuroHopper 400 Sandborn (photo Flying Focus).

Sandborn

Neptune Shipyards BV, Aalst, delivered the EuroHopper 400 Sandborn (yard number 554, imo 9965667) to Sibelco Nordic A/S, Rønne, on 13 July. The keel had been laid on 23 December 2021, the launching took place on 2 April 2022. The hopper dredger underwent trials on 15, 16, 29 and 30 June 2022.

The details of the Sandborn are: 467 GT – Loa (pp) x B x D (d) = 43.2 (40.32) x 10.00 x 4.00 (3.38) metres. The diesel-electric installation by C-Systems BV consists of three diesel generators on two electrical Veth L-drives 400A and one Veth Tunnel 240 for a speed of 10 knots. The bunker capacity is 45.34 m^3. The hopper dredger is certified by Bureau Veritas for unrestricted navigation, dredging within 8 miles from shore and dredging over 8 miles from shore with a swell height less than 1.50 metres. The hopper capacity is 434.41 m^3. Accommodation is provided for four persons.

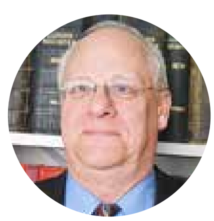
BL-734505 Pax Dei II

Padmos Shipyard BV, Stellendam, delivered the flyshooter/twinrigger BL-734505 Pax Dei II (yard number 227, imo 9929522) to Armement Boulonnais SAS (T. de Boer & Zonen, Urk and Unipêche), Boulogne-sur-Mer, on 3 June. The hull, which was built by Casco- & Sectiebouw Rotterdam, arrived in tow at Stellendam for completion on 15 October 2021. After trials, the Bureau Veritas classed Pax Dei II departed from Stellendam to Boulogne-sur-Mer on 28 July.

The details of the Pax Dei II are: 233 GT – Loa (pp) x B x D (d) = 24.99 (23.40) x 8.50 x 4.00 (3.60) metres. The propulsion system consists of a Mitsubishi main engine, type S12R-MP-TAW (170 x 180), of 588 kW or 799 hp at 1400 rpm for a speed of 10.5 knots. The bunker capacity is 29.74 m^3. The Pax Dei II is identical to the BL-936072 Madeleine (yard number 220, imo 9905631), completed by Padmos on 21 January 2021.

The flyshooter/twinrigger BL-734505 Pax Dei II.

Gerrit de Boer
Has been a maritime author for over fifty years and is one of SWZ|Maritime's editors, gerritjdeboer@kpnmail.nl

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IR WILLEM DE JONG, WILLEM.DEJONG3@GMAIL.COM

European shipbuilding: Quo vadis? European Jones Act? A personal observation

Usually, my Global news items are neutral and objective pieces covering maritime news, which I think is interesting for our readers. But this piece is different because it is not neutral, but gives my own thoughts and ideas on the subject of European shipbuilding. One of the triggers was a statement recently made by a senior representative of the Association of German Shipbuilders (VSM). According to VSM, European commercial shipbuilding will have completely disappeared from the market for almost all ship types within the next ten years. Unless drastic measures are taken now.

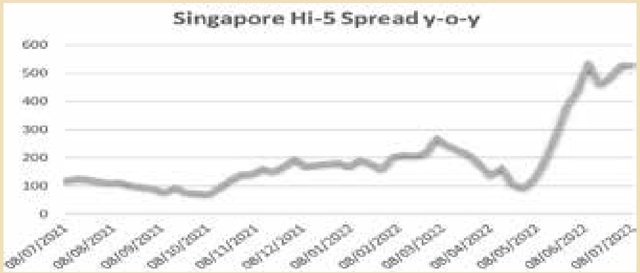
Every Monday, I happen to receive a list of all ships ordered worldwide in the preceding week. A complete list giving comprehensive details of ship type, size and capacity, building yards, engine make, flag, owners, etc. Very interesting information, but at the same time very worrisome for an interested European reader. It shows that over the last few years, all ships of any importance were ordered at Asian yards, with just a few exceptions. Only orders for small ships, yachts, and special craft were placed with European yards. No tankers of any type, no bulk carriers, no car carriers, no container ships, no ferries, no reefer ships, just vessels of what one generally calls of miscellaneous type and mostly small. In other words, no more large commercial ships from European yards. It certainly tends to confirm the VSM statement.

What to do about it while also taking into account the changing political situation in our world? The Ukrainian war makes us think about our dependencies and its potential dangerous consequences. Do we allow ourselves to be completely dependent on Asian yards, with China as the main player? Ending up without an adequate infrastructure to build such ships and running the risk of also losing our marine equipment industry and design offices? For all our larger commercial ships? Which carry eighty to ninety per cent of the world trade? I cannot believe that this is what the EU should allow to happen. How would it also affect our capability to build naval ships? Which drastic measures could turn the tide? European subsidies? That would be very expensive, I fear. Too expensive and most probably leading to a subsidy war with China and Korea that Europe is bound to loose. I think it is too late for subsidies. What else?

The American Jones Act was always a dirty word in most maritime circles. As a believer in free trade, I used to hate the idea. But Europe should consider something similar at the present time. Not as strict and general as the American one perhaps, but with sufficient teeth to force the market in such a way that we would be able to revive part of our large shipbuilding. A kind of Jones Act for certain ship types, such as ferries, short sea trade ships, certain types of tankers, container ships up to a chosen size, etc. Not a popular idea for most of us and one with many and important disadvantages, while it is also difficult to introduce and to maintain. I would love to see alternatives leading to the same goal to avoid that the VSM statement comes true. Do you know such alternatives? If so, we will happily report them in our magazine! Please send your thoughts and ideas to Willem de Jong, willem.dejong3@gmail.com.

Profitable scrubbers

With large differences between prices of high sulphur fuel oil (HSFO) and very low sulphur oil (VLSFO) seen in the recent past and expected in the near future, exhaust gas scrubbers are very profitable for shipowners. The difference could be as high as 400 to 500 dollars/tonne, which results in very attractive returns on investment for scrubber installations. See the Singapore HI-5 Spread y-o-y:



Graph from hellenicshippingnews.com, sourced by Intermodal's research.

According to Intermodal's research, it has been shown by recent studies that running on HSFO with a scrubber installation produces way lower emissions than running on low sulphur marine gas oil (LSMGO). It is understood that this is caused by the fact that the production of LSMGO results in more harmful emissions than the production of HSFO. While most vessels currently carry open-loop scrubbers, many vessels now opt for hybrid types that offer increased flexibility for operation in all areas, regardless of Emission Control Area (ECA) constraining rules or seawater alkalinity. The main criteria regarding the justification of a scrubber investment are return on investment (ROI), including capital expenditures (CAPEX) and operating expenses (OPEX), the space occupied, and the weight. It is understood that horizontal scrubbers weigh less and cover less space compared to vertical ones, minimising the impact on a vessel's cargo-carrying capacity.

ENERGIETRANSITIE IN DE SCHEEPVAART; WAAR STAAN WE?

De transitie naar een schone scheepvaart is een veelkoppig monster. Waren na jarenlang werken aan regelgeving de eerste koppen van zwavel, stikstofoxiden en roet gesneld, inmiddels groeien er nieuwe koppen aan het monster van de uitgestoten broeikasgassen (CO_2 en methaan).

Machinekamerconfiguraties: De traditionele verbrandingsmotor, de elektrische voortstuwing en de hybride machinekamer met verbranding en/of brandstofcel (H_2, methanol, ammoniak).

Het grote energieverbruik en de noodzaak tot eveneens grote onafhankelijkheid op met name de vaak lange zeevaarttrajecten vereist energiedichte, klimaatneutrale of liever nog emissieloze energiedragers. Naast grote technologische vernieuwingen rondom de omzettingen naar voortstuwing zijn dus ook oplossingen voor een veilige opslag en productie van deze klimaatneutrale energiedragers nodig.

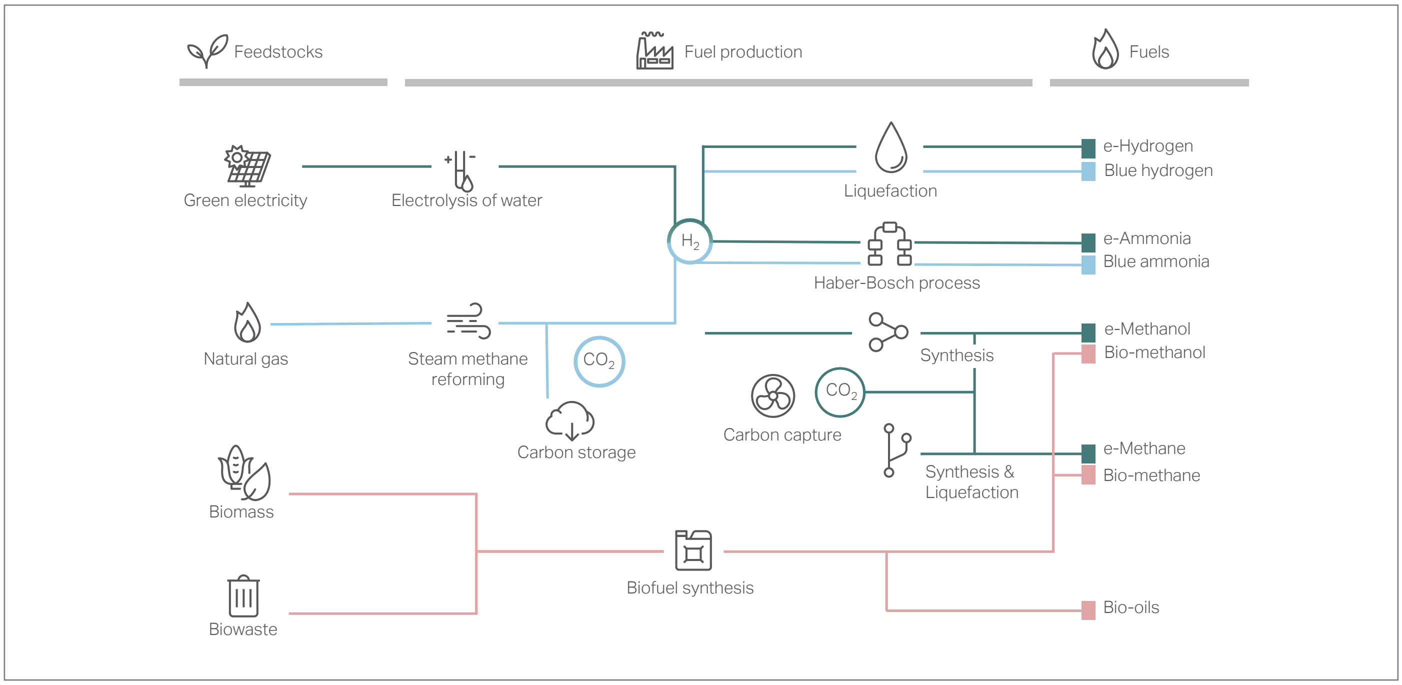
De scheepvaart is daarnaast een in hoge mate gediversifieerde (gebruik/scheepstypen) en gefragmenteerde (scheepsbouw)industrie en per definitie zeer internationaal en grensoverschrijdend. Praktisch betekent het laatste dat regelgeving bij voorkeur wereldwijd moet gelden en regelgeving op bijvoorbeeld Europese schaal complexe grenscontroles/prijscorrecties nodig maakt. De spreiding in scheepstypen/groottes en handelsroutes vereist veel onderzoek, want een unieke oplossing zal er niet zijn. De variatie in bouwlocaties zal eveneens tot meerdere oplossingen leiden, gedreven als deze zijn door lokale kennis, lokale energiebronnen, specifieke schepeninzet en regionale regelgeving.

De scheepsbouw is een unieke industrie waar vooralsnog standaardoplossingen ontbreken en consolidatie van werven nauwelijks bestaat. Dit in tegenstelling tot de auto-industrie waar auto's er onder de motorkap vaak hetzelfde uitzien en dezelfde componenten en ontwerpen gebruiken. Interessante vraag is of de energietransitie dat in de scheepsbouw gaat veranderen of dat opnieuw een nog grotere variatie van scheepsontwerpen en vermogensoplossingen gaat ontstaan.

In deze editie van SWZ|Maritime komen diverse oplossingsrichtingen (technologisch/operationeel) aan de orde aangevuld met de kernvraag: waar komen welke brandstoffen vandaan en wie gaat ze op zo kort mogelijke termijn veilig beschikbaar maken? Wat gaat de scheepvaart/scheepsbouw meemaken in de komende tijd? Welke rol moet/gaat (inter)nationale (doel?)regelgeving spelen en hoe komen we tot de juiste keuzes? Welke rol kan de industrie eigenlijk spelen?

Technologie & operaties

In dit nummer komen verschillende oplossingen langs voor de vermogensopwekking aan boord naast oplossingen die vooral het energiegebruik willen beperken. Sinds de invoering van Energy Efficiency Design Index (EEDI), nu tien jaar geleden, hebben we al ge-



De kosten en de schaalbaarheid van toekomstige koolstofarme brandstoffen zijn hoogst onzeker. Waterstof wordt niet relevant geacht voor de diepzeevaart en wordt in dit overzicht niet verder geanalyseerd (bron: Maersk Mc-Kinney Møller Center for Zero Carbon Shipping).

zien dat vooral de snelle, grote schepen al forse stappen terug hebben gedaan in de operationele vaarsnelheid. Dat betreft in het bijzonder de containerschepen en in mindere mate de passagiers- en ro-ro-schepen. Voor deze laatste categorieën zijn de logistieke aspecten van een vaarschema vrij dominant. Dit heeft al tot forse besparingen geleid. Effectief betekent dit helaas dat de totale uitstoot van CO_2 door de scheepvaart nog steeds met 9.6 procent (2012-2018) is gegroeid ten gevolge van de stijging van het zeetransportvolume. Per ton vervoerde lading is de uitstoot in de orde van grootte met 25 procent gedaald. Netto is daarmee het aandeel van de scheepvaart in de wereldwijde uitstoot gestegen van 2.76 procent (2012) naar 2.89 procent (2018). Kortom, verdere besparingen en verbeteringen zijn hard nodig.

Hydro-aero efficiency

De verbeteringen aan de romp en voortstuwingsinstallaties zullen doorgaan en een impuls krijgen om twee redenen. De nieuwe vermogenssystemen, de langzamere vaart en relatief grotere schepen vanwege de grotere brandstofvolumes kunnen tot nieuwe rompvormen leiden waarbij men mogelijk kiest voor langere, slankere schepen. De energiebesparende vindingen zullen zich blijven ontwikkelen. De eerlijkheid gebied wel om te zeggen dat deze besparingen beperkt van omvang zijn (vijf tot tien procent).
Grotere verbeteringen zijn te verwachten van het hydrodynamische ontwerp indien schepen afgerekend gaan worden op de uitstoot die ze werkelijk tijdens reizen veroorzaken. Zie ook hierna onder regelgeving. Het zou betekenen dat afgestapt gaat worden van de afname van schepen op basis van een proeftocht alleen. In de praktijk zal een schip geoptimaliseerd worden met behulp van reissimulaties uitgaande van verschillende beladingscondities, vaarsnelheden en omgevingscondities.
De relevantie van deze wijze van scheepsontwerpen neemt verder toe als windhulpvoortstuwing op grotere schaal haar intrede doet. Deze *wind-assisted propulsion* wint aan belangstelling en projecten daaromtrent beogen niet alleen de uitvoerbaarheid en energiebesparing aan te tonen, maar ook opname in de regelgeving te faciliteren.

Nieuwe vermogenssystemen

De invoering van nieuwe klimaatneutrale energiedragers genereert veel nieuwe vragen rondom de vaak meer complexe vermogenssystemen die de nieuwe energiedragers vereisen. De range aan oplossingen, die ook regelmatig in dit blad voorbijkomen, wijken af van wat we weten over het gedrag van de traditionele dieselvoortstuwingen. Naast belangrijke vragen over het ruimtebeslag van aandrijflijn en de opslag van de energiedrager, eisen de nieuwe systemen nieuwe kennis over de werking van de nieuwe brandstoffen in de huidige verbrandingsmotoren, de (dynamische) prestaties van

ENERGY TRANSITION IN SHIPPING

Shipbuilding is a unique industry where standard solutions are still lacking and consolidation of yards is almost non-existent. The interesting question is whether the energy transition will change this in shipbuilding or whether an even greater variety of ship designs and power solutions will emerge. Safety and availability of alternative fuels seem to be more challenging than technology while price will also play a role.

het totale vermogenssysteem, de interacties met andere vermogensgebruikers en de aansturing, die vaak vanwege het meer geïntegreerde karakter complexer is. Zeker als elektrische systemen de directe aandrijving leveren en moeten samenwerken met de aggregaten voor het hotelbedrijf en andere voorzieningen neemt de complexiteit toe. Batterijen maken dan standaard deel uit van de configuratie. Deze complexiteit maakt de invoering van Model-Based Systems Engineering meer en meer noodzakelijk.
Zoals het artikel over Future Proof Shippings waterstof/brandstofcel-oplossing laat zien, is het nauwkeurig kennen van de operationele profielen, de feitelijke totale energie- en maximale vermogensvraag, van groot belang voor een goede dimensionering van de in dit geval brandstofcel-, batterij-, en waterstofopslagcapaciteit. In de conceptontwerpfase zijn deze afwegingen al van belang en kost het doorlopen ervan ook meer tijd.
Technologisch lijken de meeste nu onderzochte energiedragers en -omzetters haalbaar voor een schoon en emissievrij bedrijf. Verder onderzoek op onderdelen is zeker nodig. De beschikbaarheid van alternatieve brandstoffen en de veiligheid hiervan lijken een grotere uitdaging.

De nieuwe brandstoffen

Voor de korte termijn lijken (groene) methanol, de overige dieselgelijkende bio-brandstoffen, elektrische voortstuwing met batterijen en LNG kansrijk. Met de aantekening dat het fossiele LNG weliswaar een schone brandstof is, maar nauwelijks een bijdrage zal gaan leveren aan de CO_2-emissiereductie. De toepassing ervan lijkt vooral een politiek/economische afweging, zie ook hierna.
Voor de langere termijn is een veel breder palet aan energiedragers in beeld waarvan vooral waterstof zowel als directe bijmenging in verbrandingsmotoren als als energiedrager voor brandstofcellen sterk in beeld is. Zelfs korte-termijntoepassing (*compressed hydrogen*) is mogelijk hoewel de opslaghoeveelheden nog beperkt zijn. Grootschalige toepassing vraagt meer onderzoek naar veilige opslag van zowel compressed als *liquid hydrogen* naast vaste-stofopslag van waterstof. Overigens is niet alleen veiligheid hier de drijver, maar ook de volumereductie.
Naast waterstof krijgt voor de langere termijn ook ammoniak veel aandacht, mede vanwege de verwachte, lagere prijs. De veiligheidsissues zijn serieus en daarom zal toepassing ook na grondig onderzoek voorlopig beperkt blijven tot grotere schepen met een kleine en specifiek deskundige bemanning. Ammoniak kent naast directe verbranding ook een toepassing als energiedrager voor brandstofcellen wat de mogelijkheid creëert voor toepassing van flexibele en efficiënte configuraties.
IJzer als brandstof en kernenergie staan ook in de belangstelling, maar kennen beide nog geen recente nieuwe toepassingen.
Een gemeenschappelijk vraagstuk rondom al deze brandstoffen is de *carbon footprint* om tot deze brandstoffen te komen. Een daadwerkelijke inzet als bijdrage aan een klimaatneutrale of emissieloze operatie vereist inzicht in deze footprint. Dat inventarisatieproces is nu in Europa gaande en maakt tevens duidelijk dat de mogelijkheden tot een *zero-carbon footprint*-productie van de meeste van deze brandstoffen nog niet (tekort aan hernieuwbare energie) of beperkt (tekort aan landbouwarsenaal) mogelijk is. Het EU Taxonomybeleid probeert sturing te brengen in de richting van welke investeringen moeten gaan bijdragen aan het verminderen van de industriële footprints. Dat legt dan ook direct beperkingen op aan een goedkope, snelle productie van deze brandstoffen.
Hoe de diverse technologische ontwikkelingen in de brandstofproductie hun beslag krijgen, wordt uiteindelijk ook bepaald door voor welke prijs ze beschikbaar komen en of ze veilig verkrijgbaar zijn op de goede locatie. Overheden zien zich hier voor een enorme uitdaging geplaatst. Dit overlaten aan de markt vraagt duidelijkheid over de regels en een gelijk speelveld binnen en buiten Europa naast grote investeringen in gedeelde infrastructuur. Overheden moeten daarvoor naast de veiligheidsissues inzicht hebben in de verwachte technologieontwikkeling, de verwachte prijsontwikkeling van de nieuwe brandstoffen (onder zero-carbonfootprint-eis) en ook een gelijk speelveld creëren. Wachten totdat de industrie dit allemaal zelf gaat regelen gaat (te) lang duren en daarvoor zijn er te veel onzekere factoren en wederzijdse afhankelijkheden.

Internationale regelgeving

Het hoeft geen betoog dat internationale afspraken de enige manier zijn om de scheepvaart mee te nemen in de IPCC-klimaatafspraken. De regelgeving binnen de International Maritime Organization (IMO) maakt hier wel belangrijke stappen, maar is tegelijk gebonden aan wat individuele (groepen van) landen faciliteren voor wat betreft technologie, brandstofproductie en infrastructuur.
In het verleden heeft de IMO al grote stappen gemaakt met de invoering van de EEDI en meer recentelijk de Energy Efficiency eXisting ship Index (EEXI). Dit zijn beide ontwerpgerelateerde regelgevingen die niet per se een-op-een vertellen wat het schip presteert op zee. Waar het aan ontbrak, hoewel de Energy Efficiency Operational Indicator (EEOI) een poging was, is een daadwerkelijke operationele beperking van de CO_2-uitstoot. De nu per 1 januari van kracht zijnde Carbon Intensity Index (CII) gaat potentieel veel veranderen. Feitelijk definieert deze index hoeveel CO_2 je mag uitstoten per vervoerde ton mijl lading en daarmee is het een budgetterende maatregel die gevoeld gaat worden. Weliswaar zijn de criteria nog ruim en is de sanctionering geduldig, het principe van budgettering van de CO_2-uitstoot is nieuw en een steun om daadwerkelijk als maritieme industrie concrete doelstellingen te halen.
Zoals hiervoor al aangegeven kan de impact van dit type budgetterende regelgeving nauwelijks overschat worden. Het kan potentieel schepen stilleggen en zal de nadruk op een zuinig operationeel bedrijf sterk doen toenemen.

Johan H. de Jong Msc
Manager International Relations bij MARIN en een van de redacteuren van SWZ|Maritime, j.h.de.Jong@marin.nl

TRANSITIES IN DE SCHEEPVAART

Van zeil naar stoom en motor, van kolen naar olie, van slepen naar duwen, van stukgoed naar containers en van fossiele olie naar… ja... naar wat eigenlijk?

Inmiddels weet iedereen, die enigszins bekend is met wat er in de maritieme wereld speelt, dat we moeten overgaan van operationeel en economisch buitengewoon prettige fossiele olie naar nog weinig bekende en hoogstwaarschijnlijk veel minder aantrekkelijke alternatieve brandstoffen en systemen voor de voortstuwing en het hulpbedrijf van schepen. We staan aan de vooravond van een geweldig ingrijpende transitie. Een transitie die voor de hele wereldvloot idealiter in 2050 moet zijn voltooid. Een kolossale opgave. Maar niet de eerste grote transitie waar de scheepvaart mee wordt geconfronteerd.
De Zee, een tijdschrift oorspronkelijk ‘gewijd aan de belangen der Nederlandsche stoom- en zeilvaart’ en een voorloper van SWZ|Maritime, bevatte in 1879 een artikel over de “Toestand en toekomst van de Zeilvloot”. Hier volgen een paar stukjes uit dat artikel in het oorspronkelijke Nederlands.

De toekomst der zeilvloot?

Wat zal op den duur van de Zeilvloot terecht komen?
‘Zonder nu bepaald te willen beweren dat voor Zeilschepen, althans voor de eerstkomenden tijd, in het geheel geene ruimte meer zijn zal, zo moet men nu toch bij kalm nadenken erkennen, dat de toekomst aan de dooders der Zeilvaart, d.i. aan de Stoomschepen, behoort. – Wel gaat met de Stoomvaart alle poëzie van het zeemansbedrijf verloren, gelijk ook de eigenlijke zeeman daardoor niet meer wordt aangekweekt, maar de geschiedenis der Stoomvaart leert ons duidelijk, dat hare vorderingen in de kennis van goedkoop transport van dien aard zijn, dat alleen daardoor reeds het Zeilschip geheel zal worden verdrongen.’
‘Het spreekt wel vanzelf, dat het allen beminnaars der zoo zegenrijke en werkelijk schoone Zeilvaart zeer ter harte moet gaan, dat de toekomst voor de Zeilschepen er bepaald donker uitziet. Vooral in ons goede Vaderland, waar de liefde en lust tot de zeilvaart al eeuwen oud is, wordt de kwijning dier vaart sterker gevoeld dan wellicht ergens anders. Het was van oudsher een nationaal bedrijf bij uitnemendheid, waaraan door alle rangen en standen in de maatschappij werd deelgenomen, waarvoor allen, hoog en laag geplaatst, hart hadden. Ook zijn de schoonste bladzijden uit de geschiedenis van ons volksbestaan, en van onze voormalige handels-heerschappij, innig met de zeilvaart verbonden.’

We staan aan de vooravond van een geweldig ingrijpende transitie

‘Eene conclusie zullen wij niet nemen, ook al omdat het niet nodig is te concludeeren. Laten we de feitelijke toestanden nemen zooals die zijn. Doen wij wat in ons vermogen is en met vereende krachten, om te steunen wat nog te behouden is. En in elk geval, laten we den hartgrondigen wensch uitspreken, dat het aloude Nederland den kamp niet opgeve, maar tot den laatste toe in het strijdperk blijve, tot het zorgvuldig bewaken van de belangen der zoo zegenrijke Zeilvaart.’
Amsterdam, mei 1879, A. Bruinier

Een behoorlijk emotioneel verhaal. De schrijver realiseert zich dat de transitie van zeil- naar stoomvaart op hem afkomt en onvermijde-

Foto: Transities zijn de scheepvaart niet vreemd, zoals de overstap van zeil naar stoom (foto Rob Oo, Flickr, https://www.flickr.com/photos/105105658@N03/50887020646).

lijk lijkt. Hij vindt dat duidelijk niet leuk. Zo gaat dat vaak bij transities. Het gaat niet alleen over economische en technische motieven, emoties spelen ook een rol.

Van transitie naar transitie

De maritieme industrie heeft in de loop van de eeuwen veel transities meegemaakt. Zoals, inderdaad, van zeil naar stoom. En van stoom op kolen naar stoom op olie. Dat laatste lijkt een kleine aanpassing, maar was in wezen ook een soort revolutie. En toen naar dieselmotoren, weer een grote stap. Dit soort transities kwam in de hele scheepvaart voor. Ook in de binnenvaart, van zeilen naar stoom voor de grotere schepen. En, wat later, voor de overige binnenvaart van zeil naar motoren, van slepen naar eigen voortstuwing en van eigen voortstuwing en slepen naar de duwvaart. Die transities waren niet altijd eenvoudig en gingen vaak met problemen gepaard. Ongelukken met stoommachines, ketels, dieselmotoren, etc., gemakkelijk ging het niet altijd. De transities vonden niet alleen plaats op basis van technische ontwikkelingen, maar waren vooral economisch gedreven. Vooral de ontwikkelingen naar steeds grotere schepen en meer gespecialiseerde schepen waren economisch gedreven; het resultaat van algemene ontwikkelingen en, soms, van een slim idee zoals bij de introductie van de container. Bij die transities waren er winnaars en verliezers. Als je te vroeg was, kon dat het einde van je bedrijf betekenen, was je te laat, kon dat ook gebeuren. Bij te vroeg voor de menigte uitlopen bleken de risico's, economisch en/of technisch soms te groot, als je te laat was ging de concurrent er met het werk van door en bleef je met legen handen achter. We weten wat er gebeurd is met de lijnrederijen die niet of te laat de containerrevolutie volgden. Alle bovengenoemde transities waren vrijwillige transities. Niemand "dwong" reders en bouwers de transities af. Je kon kiezen achter te blijven en door te gaan met je zeilschip, sleepschip of stoomschip. Of je kon de transitie maken op het moment dat jou het beste leek. Met of zonder succes. Sommige transities duurden lang, zoals de transitie van zeil naar de verschillende vormen van mechanische voortstuwing. De eerste stoomschepen voeren aan het begin van de negentiende eeuw terwijl er na 1900 nog zeilschepen zijn gebouwd waarvan er sommige tot na de Tweede Wereldoorlog commercieel hebben gevaren. Andere transities gingen snel. De container verdrong het stukgoed binnen 25 jaar. Met daarbij aanzienlijk kapitaalverlies aan nog goede, soms bijna nieuwe lijnschepen.

> Het bijzondere van de komende transitie naar fossielvrij varen is, dat er sprake zal zijn van dwang

WHERE IS THE SHIPPING INDUSTRY HEADED?

The shipping industry faces an enormous task in meeting the 2050 climate goals. Although it is not the first time that the industry is confronted with a transition, such as from sail to steam and from steam to diesel, it is the first that will be forced. In addition, it is still uncertain what the best solution is to meet the set requirements.

Gevarieerde scheepvaart, maar wel op diesel

Met technische en economische evoluties en revoluties zijn we uitgekomen waar we nu zijn. Een zeer gevarieerde scheepvaart, met grote en kleine schepen, vaak zeer gespecialiseerd, maar met één gemeenschappelijk element: de dieselmotor draaiend op fossiele olie. Er zijn van de huidige wereldvloot slechts zeer weinig schepen met een ander soort voortstuwing. En ook bij de nieuwbouw is, in aantallen schepen, de diesel met een fossiele, CO_2 producerende brandstof de meest gekozen oplossing. Van de ruim 100.000 koopvaardijschepen, de 4,6 miljoen vissersschepen, de omstreeks 10.000 superjachten en de honderd duizenden binnenvaartschepen en overige schepen en jachten, al varend of in aanbouw, maakt slechts een te verwaarlozen deel gebruik van een brandstof welke minder

Zo werd stukgoed vervoerd voor de transitie naar de container.

Wind(hulp)voortstuwing is klaar voor een comeback. Zo bouwt Neptune Shipyards de Canopée. Het 121 meter lange schip zal worden uitgerust met vier 30 meter hoge Oceanwings (foto Neptune Shipyards).

broeikasgassen uitstoot dan fossiele olie. Minder dan 2000 waarbij ook de schepen die geheel of gedeeltelijk op LNG kunnen varen worden meegerekend en dat is wellicht beter dan olie, maar beslist niet CO_2-vrij. Anderzijds zijn er veel schepen die relatief aanzienlijk minder schadelijke emissies produceren dan gebruikelijk was. Dankzij hybride systemen, hydrodynamische verbeteringen, efficientere motoren en gebruik van windvoortstuwing. De IMO-regels voor de Energy Efficiency Design Index (EEDI), Energy Efficiency eXisting ship Index (EEXI) en de Carbon Intensity Indicator (CII) en de hoge brandstofprijzen spelen daarbij een stimulerende rol.

Waar gaat het heen?

Het bijzondere van de komende transitie naar fossielvrij varen is, dat heel anders dan bij vorige transities, er sprake zal zijn van dwang en dat nog niet duidelijk is waar we naar onderweg zijn. Een lastige combinatie waar reders en werven moeilijk mee uit de voeten kunnen. Welke al bekende of nog niet bekende brandstoffen en/of systemen zullen het verschil gaan maken en ons de mogelijkheid geven om in 2050 aan de afspraken van Parijs te voldoen en laten de scheepvaart, in de breedte, een goede bijdrage leveren aan de noodzakelijke beperking van de emissie van broeikasgassen? We staan, zoals gezegd, aan de vooravond van een gigantische uitdaging. Wordt het methanol, ammonia, waterstof, biobrandstoffen of CO_2-opslag? Met brandstofcellen, batterijen of aangepaste dieselmotoren? Wat worden de eisen: van *well-to-wake* of van *tank-to-wake*? Hopelijk maken de artikelen in deze SWZ-editie u hierbij iets wijzer. Waarschijnlijk zal ook de rol van windvoortstuwing daarbij aan de orde komen. Weliswaar niet in de vorm waar de heer Bruinier zo lyrisch over heeft geschreven. Desalniettemin zou hij er waarschijnlijk toch blij van zijn geworden.

Ir. Willem de Jong
Voormalig Managing Director van Lloyd's Register Londen en één van de redacteuren van SWZ|Maritime,
willem.dejong3@gmail.com

THE AMMONIADRIVE RESEARCH PROJECT

Several news items and short movies have appeared online recently, announcing that the AmmoniaDrive Consortium was awarded a prestigious NWO Perspectief grant. But what is the AmmoniaDrive research project? How does it contribute to combatting shipping-induced climate change? Who are in the consortium and why? And finally, what research activities will take place?

AUTHORS: DR IR P. DE VOS, TU DELFT (CORRESPONDING AUTHOR, P.DEVOS@TUDELFT.NL); DR IR L.M.T. SOMERS, TU EINDHOVEN; PROF. DR IR T. TINGA, UNIVERSITY OF TWENTE; DR E.M. FOEKEMA, WAGENINGEN UNIVERSITY; PROF. DR B. VAN DER ZWAAN, UNIVERSITY OF AMSTERDAM; PROF. DR R.R. NEGENBORN, TU DELFT

At the NWO Teknowlogy festival on 31 May 2022, all seven new Perspectief research projects, amongst which AmmoniaDrive, were put in the spotlight as key research projects funded by NWO and the Ministry of Economic Affairs and Climate Policy. Nederland Maritiem Land published a news item about AmmoniaDrive winning a Perspectief grant, the Delft University of Technology (TU Delft) announced the winning of the grant on its website and the participating partners have shared the news through their intranet or social media. This article explains what the AmmoniaDrive research project actually entails.

The AmmoniaDrive Consortium

Before the "what", "why" and "how", let's first address the "who". The AmmoniaDrive Consortium consists of six Dutch universities, three Dutch applied research institutes and fifteen companies (see the table below). Building the AmmoniaDrive Consortium started in 2020 with the MIIP AmmoniaDrive and continued throughout the application and selection procedure of NWO Perspectief, in order to secure the grant and enable the AmmoniaDrive research actually taking place in the coming years.

NWO Perspectief – round 2020/2021

The aim of the funding instrument Perspectief is to make a contribution to the creation of economic opportunities within the societal challenges and key technologies of the Mission-driven Innovation Policy (see the NWO Perspectief website for more information,

Universities	TU Delft – 3ME: Maritime and Transport Technology department		
	University of Groningen: Energy Conversion division		
	Wageningen University & Research: Marine Animal Ecology subdivision		
	Eindhoven University of Technology: Power & Flow group		
	TU Delft – TPM: Safety and Security Science section		
	University of Amsterdam: Van 't Hoff Institute for Molecular Sciences		
	University of Twente: Department of Mechanics of Solids, Surfaces & Systems		
TO2 institutes	TNO: Powertrains Technology & Structural Dynamics expertise groups		
	Wageningen Marine Research		
	MARIN: Marine Power Systems		
Companies / other	Royal IHC	C-Job	Yara
	Bureau Veritas	Damen	Boskalis
	Progression-Industry	DNV	Wärtsilä
	DMO	Anthony Veder	SmartPort
	Circonica	Van Oord	Bijlboegfonds

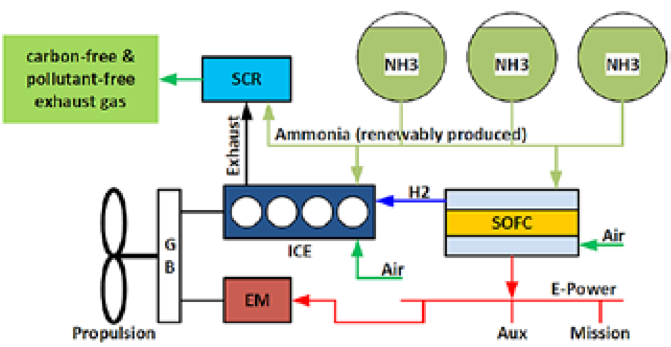
The AmmoniaDrive Consortium.

www.nwo.nl/onderzoeksprogrammas/perspectief). NWO Domain Applied and Engineering Sciences organises an open Perspectief call for new programme ideas annually. A Perspectief round consists of three phases, which for round 2020/2021 meant the following:

I. Eighty programme-initiatives for applied, multidisciplinary research of a technical nature were handed in to NWO in Phase I.
II. 48 programme-design documents were handed in to NWO in Phase II. Fourteen were selected to progress to Phase III.
III. Seven consortia were awarded a Perspectief grant after further international peer review of Phase III, the detailed research proposal and presentation and defence before the selection committee at NWO.

The AmmoniaDrive concept

To understand why the AmmoniaDrive research project received the grant, one needs to study the power plant concept that is depicted in the figure below. It is this power plant concept that is central to the AmmoniaDrive research project.
The innovative AmmoniaDrive power plant concept uniquely combines solid oxide fuel cell (SOFC) and internal combustion engine (ICE) technology using renewably produced, i.e. "green", ammonia as fuel. Despite its toxicity, ammonia is considered by many as an effective hydrogen carrier and future fuel for sea-going vessels, mainly because of its promise of being a cost-effective, carbon-free and relatively energy-dense fuel. However, choosing ammonia as a sustainable shipping fuel does not yet solve the question of how it is used as a fuel, or in other words, how the energy stored in ammonia can be converted into useful (mechanical or electric) power on board of ships.
Engine manufacturers are currently developing diesel-ammonia dual-fuel marine ICEs as a solution to this question. The fuel cell community is at the same time advocating ammonia-fuelled fuel cells (FCs). By combining these two technologies, the AmmoniaDrive power plant has the potential to optimally use the strengths of both energy converters, SOFC and ICE, while utilising ammonia effectively as both hydrogen and energy carrier.
At the same time, the AmmoniaDrive power plant is expected to have a relatively small and thus acceptable impact on ship design; at least when compared to the impact hydrogen-based or battery power plants would have. AmmoniaDrive, therefore, is a single-fuel, high-efficiency power plant that could actually fit on board of ships and that has no pollutant emissions anywhere in the carbon-free energy chain (well-to-wake).

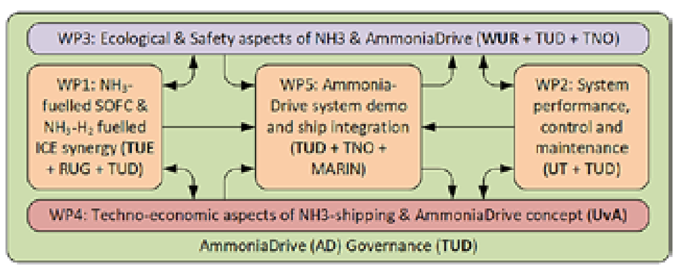


The AmmoniaDrive concept.

Organisation

The AmmoniaDrive research programme consists of five Work Packages (WPs). The figure below provides an overview of the programme and the content of its WPs. Governance of the project lies with the Maritime & Transport Technology department of TU Delft, with Prof. Dr R.R. Negenborn as programme leader.
WP1 focuses on the experimental and numerical research into the main AmmoniaDrive system components: the SOFC and ICE. The function of the onboard SOFC-ICE power plant is to deliver useful power. WP1 aims to prove that the SOFC-ICE system can actually fulfill this function. WP1 leader is Dr Ir L.M.T. Somers of the Eindhoven University of Technology. Experimental and numerical research that will take place as part of WP1 addresses the performance of the ammonia-fuelled SOFC and ammonia-hydrogen fuelled ICE. Experiments to characterise combustion behaviour and engine performance will take place on different ICE facilities of research partners in the project.
WP2 focuses on the integrated system performance under various operating conditions using different automatic control and decision support strategies, while the anticipated sensor data is also applied for formulating dynamic maintenance strategies. WP2 leader is Prof. Dr Ir T. Tinga of the University of Twente, analytical and numerical research will be carried out under his and Prof. Dr Negenborn's supervision.
WP3 focuses on the very important ecological and safety aspects of AmmoniaDrive, including toxicity of NH_3. WP3 leader is Dr E. Foekema of Wageningen University & Research. Part of this WP is

AmmoniaDrive combines a solid oxide fuel cell with an internal combustion engine



AmmoniaDrive organisation.

the development of a safety framework based on experience in other sectors and fundamental safety sciences, while another part will experimentally study the ecological effects of an ammonia spill. WP4 focuses on techno-economic aspects of NH_3 shipping in general and AmmoniaDrive ships in particular. WP4 leader is Prof. Dr B. van der Zwaan of University of Amsterdam. The AmmoniaDrive power plant is based on relatively immature technology and ammonia as a renewable, synthetic e-fuel. Both features contain a lot of uncertainty with regards to their economic viability. The researchers in WP4 will therefore try to find out, using learning curve analysis, what is needed to make the AmmoniaDrive power plant economically viable within a certain time frame. Finally, WP5 integrates all information generated in the other WPs, aims to develop a (partly virtual) system demonstrator and researches a variety of ship integration aspects through post-doctoral research and (post-)MSc R&D activities at the companies of the consortium. WP5 leader is Dr Ir P. de Vos of TU Delft. Based on use case analyses, ship integration aspects will be researched for different ship types by developing concept and basic ship designs, thus quantifying the impact the AmmoniaDrive power plant will have on different ship types and developing novel design guidelines for naval architects.

Many technical and non-technical challenges need to be addressed before AmmoniaDrive is applied on ships

Researchers

From the short introduction to the AmmoniaDrive research project above, it is clear that many technical and non-technical challenges still need to be addressed before AmmoniaDrive power plants will actually be installed on board of ships. The central problem statement in the AmmoniaDrive research project, as mentioned in the research proposal, therefore is: it is unknown how the proposed AmmoniaDrive SOFC-ICE power plant performs on key performance indicators like emissions, system efficiency, safety, environmental impact, cost effectiveness, etc., either on board of ships or in other heavy-duty applications. This leads to the main objective of the project: the objective of the AmmoniaDrive research is to raise the Technology Readiness Level (TRL) and Societal Readiness Level (SRL) of the AmmoniaDrive power plant concept from 1-2 to 4-5. The AmmoniaDrive Consortium will aim to achieve this with nine PhD researchers and a Post-Doctoral researcher. The table below lists the researchers, their research topic and affiliations (i.e. supervising universities).
Next to the researchers mentioned in the table, the intention is to have a large number of graduation students researching for example ship integration aspects of the AmmoniaDrive concept in collaboration with the companies that are part of the consortium.

Timeline, vision and societal impact

The proposed start date of the AmmoniaDrive research programme is in the first quarter of 2023 with a duration of five years. During the research, the consortium aims to assess the feasibility of the AmmoniaDrive power plant for future ships and hence critically reflect on the vision and societal impact of the AmmoniaDrive research project. With AmmoniaDrive, we could be moving towards a future envisioned as follows:
It is 2050. The mainstream media announce that the 1000th AmmoniaDrive ship has begun its maiden voyage. This important milestone is celebrated by the AmmoniaDrive initiators. The ship was designed in the Netherlands, like most of the AmmoniaDrive ships before it, and built at a shipyard in Africa. Now it has arrived at the North Sea-based "Clean Energy" island, where green ammonia is produced from air and water. Renewable electric power from nearby offshore wind turbines and solar panels is used to obtain nitrogen and hydrogen from air and water. Here, the ship will bunker locally produced green ammonia, after which it will sail to the next port of call for

PhD	Research topic	Supervisor
1	NH_3-fuelled SOFC (NH_3 internal decomposition + AOG composition)	University of Groningen +TU Delft
2	NH_3-AOG combustion properties of different NH_3-AOG compositions	University of Groningen + Eindhoven University of Technology
3	NH_3+AOG-fuelled ICE #1 (ICE experiments & 0D/1D ICE models)	TU Delft-3ME (Mechanical, Maritime and Materials Engineering)
4	NH_3+AOG-fuelled ICE #2 (ICE CFD models)	Eindhoven University of Technology
5	AmmoniaDrive maintenance strategies (failure behaviour, availability)	University of Twente
6	AmmoniaDrive system performance and control (multilevel control)	TU Delft-3ME
7	NH_3-shipping & AmmoniaDrive safety aspects (in- & outboard safety)	TU Delft-TPM (Technology, Policy and Management)
8	NH_3-shipping ecological aspects (impact + mitigation of NH_3 spills)	Wageningen University & Research
9	AmmoniaDrive techno-economic analysis (cost and financial features)	University of Amsterdam
PD1	Transient load characterisation (power demand dynamics)	TU Delft + MARIN

AmmoniaDrive researchers.

loading its first cargo. While the ship is refuelling, a number of specialists from different Dutch firms, all with their own specialty with regards to AmmoniaDrive power plants, enter the ship to visually check the engine room. No irregularities are expected, as the data from the different sensors on board were already transmitted automatically to the AmmoniaDrive Systems and Control Centre in Amsterdam during the voyage to the Netherlands and no signs of issues or malfunctions were reported. Still, the visit provides additional certainty that everything is indeed as it should be and shipowners around the world have frequently expressed their appreciation of the care, quality and innovativeness of the Dutch maritime community exemplified by these visits.

ACKNOWLEDGEMENT

This research is supported by the Perspectief project "AmmoniaDrive" (project 14267/P20-18) of the Netherlands Organization for Scientific Research (NWO), domain Applied and Engineering Sciences (TTW).

This vision demonstrates how the AmmoniaDrive research can be the start of new economic activities for the Dutch maritime industry. The societal impact of AmmoniaDrive is therefore defined as: in a world where ammonia is embraced as a safe and affordable fuel for ships and other applications with no greenhouse gas or other harmful emissions, (engineering) professionals and society in general know the AmmoniaDrive power plant to be the best technical solution for powering ships, as well as other heavy-duty applications, such as island/emergency generators. Shortly, the consortium hypothesises that the combined SOFC-ICE AmmoniaDrive power plant is ammonia as a marine fuel "done right" and will undertake the necessary research to test this hypothesis.

Conclusion

This article has introduced the AmmoniaDrive research project, which will start shortly and run for the coming five years. The application and selection process to secure the funds for the project was challenging, but the AmmoniaDrive Consortium is proud to share the news that they succeeded in obtaining an NWO Perspectief grant. We look forward to sharing more exciting news and insights coming from the AmmoniaDrive research.

ENERGY TRANSITIONS AND GROOT SHIP DESIGN

Groot Ship Design (GSD) is a naval achitectural design bureau in the north of the Netherlands working on a global scale with different types of seagoing cargo vessels up to a size of approximately 20,000 TDW. All projects are aimed at better fuel performance and fewer harmful emissions. GSD also works on wind-assist propulsion using modern, industrialised sails, often in combination with alternative fuels to further reduce emissions. For wind-assist expertise, GSD counts on a close cooperation with Blue Wasp Marine BV.

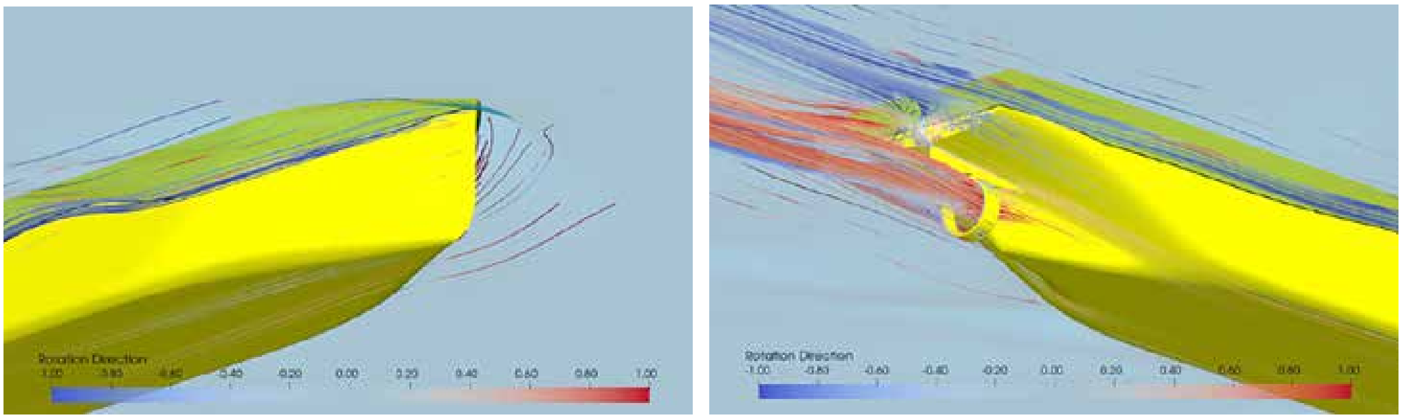
The design process and optimising the energy balance on board vessels starts with a good and realistic operational profile containing parameters such as: speed and draught for the expected load cases; time in port, transit, manoeuvring and at anchor/loitering; required autonomy (sailing range/bunkering intervals); port or waterway restrictions (draught, length, beam, air draught); and auxiliary power for cargo systems (reefer containers, cargo pumps, ventilation and cooling).
In 2009, GSD developed and implemented the Groot Cross-Bow, a hull shape with vertical bow and wave piercing abilities. The Cross-Bow results in improved performance in heavy sea conditions. Together with the hull shape, a large diameter propeller was utilised running in a nozzle. The propeller/nozzle combination provides additional thrust at lower speed (important in more severe conditions with less main engine power installed).

Design considerations for greener ships

Every year, GSD runs between twenty to forty design projects (from rough concept to tender package). Since 2018, there is an increase in projects being contracted and proceeding to yard numbers (actual new building). Some of the design portfolio highlights are:

- Shipowners/ship operators (clients) try to be "future proof", but their experience is related to the present market and their present fleet. They are therefore often not aware of the options and improvements available. GSD will assist in preparing a design fitted with the latest technology related to alternative fuels like LNG, bio diesel, electric power storage, wind-assisted propulsion, methanol, ammonia, hydrogen and combinations of these alternatives. It can be concluded there will be no general substitute to fossil fuel oil available on the market. Each future vessel will most likely be dedicated to a trade or operating profile, and as a result, the accompanying fuel/propulsion plant will be decided depending on the availability and expected costs of the alternative fuels.
- For every new design, it makes sense to optimise the hull shape to lower resistance, optimise propeller diameter/propulsion plant and as a result be able to install the lowest possible propulsion power. GSD uses in-house computational fluid dy-

Photo: First of the series, mv Vertom Patty, under construction at the shipyard in Kampen (courtesy of TB Shipyards).



Examples of a hull shape for the Groot 5200XL series, designed and arranged in-house and validated by MARIN.

namics (CFD) software to evaluate the new hull form. Alternative propulsion systems like WASP (wind-assisted propulsion) will also have influence on the selected hull form.

- Alternative fuels have a huge influence on the arrangement of fuel tanks as certain fuels require cryogenic tanks, like LNG, and other fuels like methanol are very hazardous and require double-walled tanks. Other fuels, like ammonia, are very hazardous as well and require special safety precautions. Each alternative fuel or form of energy storage, like batteries, has its own set of safety measures, which all influence the design of the ship. Each set of fuel will also influence piping and ventilation systems required as well as safety systems like fire suppression systems.
- A large battery package, permanently located in the vessel (energy storage), gives a different behaviour compared to liquid fuels. The battery package does not change weight during the transit operation. The battery weight is the same, fully charged or not. For a small bunker tanker design, the total weight of the battery package was estimated to be about ten per cent of the total light ship weight (LSW), resulting in an alternative vessel arrangement.
- Fuels like LNG and H_2 (hydrogen) stored in large tanks (fixed, integrated tanks or containerised, mobile tanks) require considerable space and will reduce the paying cargo capacity, compared to a similar vessel with conventional fuel and machinery. The type of vessel, for example a passenger vessel and certain types of offshore support vessels, is also important for the choice of alternative fuels and propulsion. These types of vessels often have large void spaces not normally utilised and can in this case be used for the more voluminous alternative fuels.

Every year, GSD runs between twenty to forty design projects

GSD design and newbuild highlights

- The Hanse ECO design for Arkon Shipping has resulted in five yard numbers under construction in China. The first vessel, the Wilson Flex I, has already been completed and is in operation. The vessel is designed with a hybrid propulsion system, including a main engine able to run on variable speed driving a fixed pitch (FP) propeller and a shaft generator (permanent magnet machine) mounted to the front of the engine. This configuration allows minimum use of the auxiliary generator sets.
- Electric bunker tanker design. For a Japanese client, GSD made the initial design for an electrically driven bunker tanker, able to sail and operate in the bay of Tokyo. The owner adapted the design and incorporated local equipment, building standards and started construction of two vessels. The first vessel, Asahi, was delivered at the end of March this year and after an intensive test period has been in operation since.
- The Vertom 7000 design has been created for the owner Vertom and is being executed by Thecla Bodewes Shipyards. In total, Vertom ordered six such vessels. The diesel-electric vessels have one to four generator sets and just a single propeller. Together with the Dutch companies Eekels and Vertom, GSD implemented an electric propulsion type based on standard com-

Wilson Flex I in Harlingen, the Netherlands.

Electric bunker tanker for a Japanese client.

The Williwaw design seeks to reduce CO_2 emissions by at least fifty per cent.

ponents with two electric motors mounted to a single gearbox, which drives the single propeller in a nozzle. The total system is energy efficient, fully redundant up to the gearbox and future proof. Future proof because in the future, one or more generator sets can be swapped for new powering technologies (that is, a generator set running on alternative fuel, an H_2 unit or battery pack). The electric system installed can "swallow" them all. The Vertom 7000 design is a front-runner project showing the possibilities of a single propeller MPV with an electric drive system.

- The Canopée is currently under construction at the building site of Neptune Marine Projects in Poland. It is designed as a RoRo vessel for transportation of Ariane space cargoes from Europe to South America. Due to the nature of the voyage, it was decided to add a large WASP system. The vessel will be fitted and operated with four large sails/wings provided by AYRO from France. In favourable conditions, the power reduction in the traditional propulsion (the vessel is provided with a twin propulsion system) can be significant. Canopée is considered to be one of the first modern dedicated cargo vessel designs with WASP on this scale. It is expected that it will act as a showcase for the use of WASP on a large scale.
- Williwaw project: In July 2022, GSD in close cooperation with Zéphyr & Borée and Blue Wasp Marine won the project for a next-generation container vessel (600 TEU capacity) utilising wind as dominant means of propulsion. The objective is to reduce the CO_2 emissions by at least fifty per cent compared to conventional market standard transport solutions. "Williwaw" means a sudden blast of wind descending from a mountainous coast to the sea. This project will make use of an optimised hull shape (designed to improve sailing behaviour), superstructure forward and will contain six large-area wing sails. Methanol will be the fuel for the propulsion system. The building yard has not yet been appointed and it is expected that at least ten vessels are required to fulfil the actual transport needs.
- In 2018, GSD introduced the first standard design for a basic, but very efficient multipurpose vessel/mini-bulker for traditional shortsea operations in Europe, the Groot XL series. This series now includes the sizes 5200/5900/6600/7300 DWT (tonnes deadweight, cargo weight). The hull of the series was developed in-house and fully optimised by CFD. A traditional propulsion plant with a single main engine/propeller powers the vessel. Although this does not sound very spectacular, the designs are very efficient, combining an enormous hold/volume (very suitable for light bulk cargoes), ice class (Finnish Swedish 1A or 1B) and a relatively low installed engine power. The design is adapted to accept one or two WASP units on the foreship to further reduce propulsion power when in operation (when the owner decides to do so). At the moment, approximately twenty such vessels (in various sizes) are under construction.

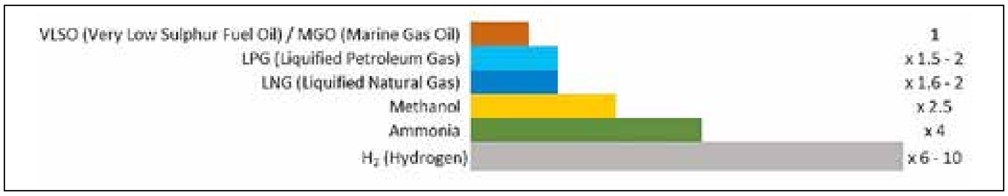
A large number of other vessels are currently under construction. GSD is not always allowed to share details of all projects.

Netherlands	8
Poland	1
India	14
Indonesia	6
China	42

Vessels designed by GSD under construction (initiated from different projects) per country.

Besides new designs and technical developments, GSD also develops tools to allow clients to make up their minds themselves about the proper arrangement and execution of their new vessels. GSD is working to launch a tool called the "vessel configurator", a virtual representation of the standard XL series, using augmented reality (AR) at SMM. Goal is to create a website on which clients can configure their own version of the Groot XL vessel they wish to add to their fleets. With this technology and presentation, ship design and shipbuilding are joining industries like the automotive industry in which these technologies are already common practice.

The "industry" also requires energy efficient and low-emission ships. Companies like IKEA, Hennessy and so on like to show themselves as environmentally friendly and like to claim that their transport chain is as well.



Alternative fuels also introduce new storage challenges. This graph shows the differences in fuel tank volume required for alternative fuels or bunkering intervals (according to DNV, April 2022).

Alternative propulsion systems

Diesel electric propulsion can give savings in fuel up to thirty per cent, but this depends very much on the operational profile. Ships that spend a lot of time manoeuvring, dynamic positioning, slow steaming and such are typical candidates for electric propulsion. Cruise ships are often prevented from anchoring at scenic locations due to the presence of coral reefs etc. and rely on dynamic positioning for station keeping. The advantage of electric propulsion is that the power plant can be in any available location on board and the propulsion thrusters can be arranged in the most favourable position reducing noise and aft ship vibrations to a minimum.

A little anecdote from a number of years ago in order to illustrate this: *A diesel electric supply vessel destined for the Gulf of Mexico (GoM) had just completed trials and was about to leave the fitting out quay in the port of Rotterdam. Engines were started, thrusters engaged and the ship silently glided out from the quay, turned around and headed out to the Nieuwe Waterweg, the North Sea and GoM. The American superintendent standing next to me asked: 'Do you hear anything?'. 'No,' I said, 'I do not hear anything peculiar'. 'Well,' said the American superintendent, 'if this was a typical, conventional (GoM) diesel direct supply vessel, we would be all wet from the propeller wash, standing here on the quay and there would be a tremendous noise from the diesels and the propellers as well as a lot of smoke from the diesels, while the ship was manoeuvring with the clutch and the traditional reversable gear box.'*

Example output of the GSD created vessel configurator.

WASP can be expected to give about fifty per cent fuel reduction in favourable conditions and some concepts are drawn as fully sailing ships. Interfacing with shoreside infrastructure and cargo handling is perhaps one of the most challenging remaining technical challenges, calling for movable systems that are more complex and more vulnerable, or otherwise restricting the dimensions and placement of WASP. Nevertheless, these are solvable problems through dedicated engineering and naval architecture.

> It is a challenge to implement new technologies and come up with an economically feasible design

Alternative fuels (replacing our traditional carbon fuels) are in the make, but not yet accessible on a large scale as we will need for efficient international shipping. Methanol, ammonia and hydrogen are expected to replace a good part of the traditional marine gas oil (MGO), marine diesel oil (MDO) and heavy fuel oil (HFO). For the actual ships under construction, the development, distribution network, and availability of prime movers/power converters is not yet sufficient. Therefore, it is expected that for the years to come, a mix of different power sources or fuels need to be implemented in the designs.

Co-creation in ship design

For shipowners, it is a huge challenge to make decisions for their current and future newbuilds. For naval architects, it is a true challenge to implement all the new technologies and come up with a realistic and economically feasible design. GSD proves every day that the company can work with shipowners and shipyards on these challenges, resulting in a good number of vessels under construction, which it calls 'co-creation in ship design'.

Björn von Ubisch MSc
Naval Architect and Marine Engineer, General Manager of Ubitec Holding BV, bvu@ubitec.nl

THE MAERSK 'METHANOL DUAL-FUEL' CONTAINER SHIPS

The many special and innovative features of a series of twelve Maersk methanol dual-fuel container ships, being built in Korea, were extensively described in a recent edition of the German maritime magazine Hansa. The article was written by ship consultant Niels Kaiser, based on available open information and his own analysis. This article in SWZ|Maritime, written with his and Hansa's permission, will reveal some of the highlights of these revolutionary ships. Not only revolutionary because of the owner's intention to offer climate-neutral transport using green methanol as fuel, but also because of many other energy efficiency measures included in the design.

Methanol (CH_3OH) can be produced in various ways. When used as fuel, it produces CO_2. Whether it can be seen as a climate-neutral fuel depends on how it has been made. When produced from biomass or from CO_2 taken from the atmosphere by the use of green electrical energy, it can be considered green methanol and be used as a climate-neutral fuel. Blue methanol made from fossil natural gas is not climate neutral and when used as a fuel produces 1.4 g CO_2/g methanol. By comparison, very low sulphur fuel oil (VLSFO) and marine gas oil (MGO) produce 3.15 and 3.20 g CO_2/ g oil respectively. The energy content (LCV) of methanol is in the order of 19.9 MJ/kg and for ultra low sulphur fuel oil (ULSFO) this is in the order of 42.7 MJ/kg. (For more information about methanol as a marine fuel, see SWZ|Maritime, March 2022, page 40, while the Global news section of the April 2022 edition provides information on how Maersk expects to acquire 730,000 tonnes of green methanol by the end of 2025 for their climate-neutral ships.)

Energy efficiency enhancing features

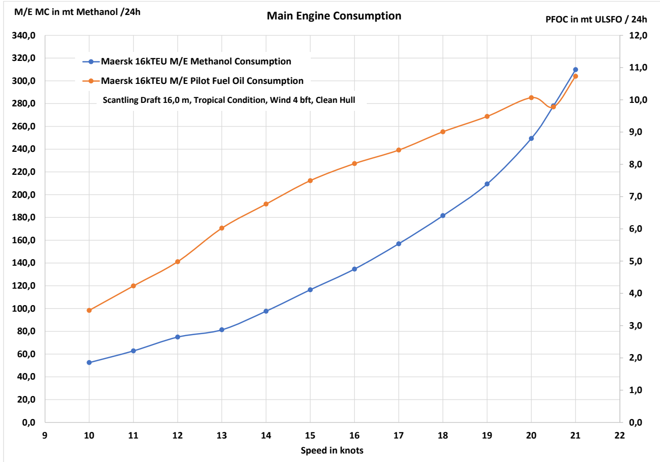
The new Maersk ships are not only designed with the use of a climate-neutral fuel in mind, the ambitions are much greater. According to the Hansa article, the following climate-friendly features are expected to be included in these ships:

- An air lubrication system (ALS) releasing pressurised air (at least two bar) under the foreship resulting in small air bubbles on the hull reducing the friction between hull and water. This is expected to lead to a six per cent reduction in hull resistance.
- A combination of a highly efficient rudder and propeller should result in an efficiency improvement of eight per cent compared with earlier designs of equally large ships.
- A hull cleaning robot will be permanently provided on each ship enabling hull cleaning when waiting outside ports. That will keep the hull clean and prevents increased fuel consumption caused by hull fouling. This is of particular importance when ports are seriously congested as seen recently.
- An exhaust gas energy recovering system with steam and

Photo: The new Maersk container ships have the accommodation located at the bow.

MAIN PARTICULARS

- Type: 16,000 TEU container ships
- Length: 353.5 metres
- Breadth: 53.5 metres
- Depth: 33 metres
- Draught: 16 metres
- DWT: 178,000 tonnes, lightweight ~ 45,000 tonnes
- Service speed: 18 knots
- Maximum speed: 21 knots
- Main engine: two-stroke MAN 8G95ME-LGIM; Dual-fuel (methanol and ULSFO); MCR 54,960 kW at 80 rpm; service MCR 46,000 kW at 72 rpm
- Shaft generator/motor (PTO/PTI): 3200 kWe
- Dual-fuel auxiliary generators: 4 of 2850 kWe each
- Bow and stern thrusters: 2000 kW each



Graphs of estimated main engine fuel consumption.

exhaust gas turbine delivers some six per cent of the main engine maximum continuous rating (MCR) back into the electrical power system. Also, the energy contained in the exhaust gas of the auxiliary engines and in the engine cooling water systems will be recovered.

- Electric motors of continuously operating pumps and ventilators will be fitted with frequency converters and speed control in order to use them efficiently. Piping systems will be carefully designed using flow resistance calculations to avoid unnecessary energy loss.

Operation of main engine and auxiliaries

The service speed of these ships under tropical conditions, Beaufort 4 wind, draught 16.0 metres and sea margin of fifteen per cent is taken as 18 knots. This requires an engine power of approximately fifty per cent of the specified maximum continuous rating (SMCR) of 46,000 kW. The engine runs under these conditions in the “Turbo Charger Cut Out” mode, with one of the three turbo chargers not working. In this mode, the main engine works efficiently over a wide power range, between 25 per cent and 65 per cent of SMCR, with an almost constant specific fuel consumption of about 300 g of methanol per kWh. The main engine SMCR of 46,000 kW is chosen well below the maximum MCR of 54,960 kW in order to achieve a low specific fuel consumption.

> It will surprise nobody that staying below the EEDI limit is not difficult for these designs

The main and auxiliary engines will be able to comply with the NO_X IMO Tier II requirements for open sea as well as the IMO Tier III requirements for emission control areas (ECAs). The main engine fuel consumption under the above conditions amounts to 182 tonnes of methanol per 24 hours and an additional 9 tonnes of pilot fuel per 24 hours, which could be ULSFO or a CO_2-neutral fuel.

Under normal conditions, the auxiliary engines are not required as the shaft generator (3200 kWe) plus the waste heat recovery system with an exhaust gas and steam turbine installation (2850 kWe) take care of the electrical load, including the refrigerated cargo of on average 340 FEU. The auxiliaries are used in port and during manoeuvring when power is required for the bow and stern thrusters.

The fuel tanks have a capacity of 16,000 m^3/12,500 tonnes methanol, resulting in an action radius of 28,500 miles at 18 knots. The ships are expected to make 4.5 round trips per year on the Europe-Far East route, which means a methanol consumption of some 52,000 tonnes plus 2500 tonnes of pilot fuel. The bunker tank capacity for VLSFO or ULSFO is 3000 m^3. In case green methanol is used, these twelve 16,000-TEU ships would avoid the emission of about one million tonnes of CO_2 per year.

EEDI and CII figures

Since 2013, the Energy Efficiency Design Index (EEDI) has to be calculated and for these ships should not exceed 8.43 g CO_2/nm x DWT. It will surprise nobody that this is not a difficult goal to achieve for these designs. Whilst operating on green methanol and a carbon-neutral pilot fuel, the EEDI is zero. With blue methanol and ULSFO pilot fuel, the EEDI is 6.11 and with VLSFO and ULSFO, the figure is 6.76.

More interesting to see is how the ships will be able to deal with the Carbon Intensity Indicator (CII) requirements applicable from 2023, but becoming more severe in the years to follow. This Indicator may be seen as a CO_2 budget, that is, the amount of CO_2 the ship may emit per year per nautical mile and per tonne deadweight. The required CII for the year 2023 is 5.10 g CO_2/DWT x nm, gradually lowering to 4.78 g CO_2/DWT x nm in 2026. These ships will have a CII of zero when operating on green methanol and carbon-neutral pilot fuel. With blue methanol and ULSFO as pilot fuel, the figure is expected to be in the order of 3.80 and with VLSFO and ULSFO about

Maersk's Fleet Decarbonization Optimizer.

4.57 g CO_2/DWT x nm. So for the time being, no problem for these ships, not even when operating on fossil fuel.

Second series of Maersk methanol ships

Besides these 16,000-TEU ships, Maersk has ordered a series of 2100-TEU ships, intended for shortsea trade. These ships are also built as methanol dual-fuel vessels with similar climate goals and corresponding features as the larger vessels.

> For the time being, the CII is attained even when operating on fossil fuel

The main particulars as far as known are: length 172 metres, breadth 32 metres, depth 16.8 metres and draught 9.5 metres. The service speed is 16 knots. The main engine is a MAN 6G50 ME-LGIM with an MCR of 10,320 kW. The expected fuel consumption is 54 tonnes of methanol per 24 hours and 1.7 tonnes pilot fuel per 24 hours. This series of ships has been described in the Hansa edition of May, also written by Niels Kaiser.

Maersk and its chartered ships

Like most container lines, Maersk uses many chartered ships, often about fifty per cent in number and TEU. Gradually, these chartered ships should also become more climate neutral. That will not be easy for the owners. In order to assist these in this process, Maersk Broker Advisory Services is available with its Fleet Decarbonization Optimizer programme.

> 'The science is clear: we must make an impact in this decade, and we are now accelerating our climate ambitions by ten years and committing to be net zero across our business and value chain by 2040 with 100 per cent green solutions for our customers.'
> *Soren Skou, CEO of A.P. Moller-Maersk, 2022*

Ir Willem de Jong
Former Managing Director of Lloyd's Register London and one of SWZ|Maritime's editors, willem.dejong3@gmail.com

THE CATAMARIN, A SAILING CARGO VESSEL

Quite a few studies have been done looking into fuel reduction for ships using sails as additional propulsion. In addition to this development, MARIN felt that fully wind propelled ships could also be a possible scenario. A study has been carried out to investigate the feasibility of this idea using a special catamaran concept. The results of this study show that it indeed has potential as a large amount of power can be produced by the sails and high ship speeds can be reached. This result encourages further development for example by starting a Joint Industry Project to address further aspects.

It is evident that ships must reduce emissions quickly; the International Maritime Organization (IMO) proclaims that greenhouse gas (GHG) emissions should be reduced by fifty per cent (with discussion ongoing to further increase this percentage) by 2050 (relative to the emission level in 2008). All sorts of resistance reduction measures will help, but these will be by far insufficient to reach the goal of the IMO. The same goes for means to provide additional thrust by aerodynamic forces; it helps, but it's not enough. Alternative fuels are either still fossil fuels (LNG, LPG) or require an enormous amount of electrical energy to be converted in another energy carrier such as hydrogen [1], which isn't available in the near future.

MARIN believes that some ships can use 100 per cent wind propulsion. Ships that only have sails need a large sail area and a high stability to keep the heel angle within limits. These requirements can be satisfied by a catamaran vessel. The vessel proposed in this article, the CataMarin, is a novel type of catamaran. The structural weight is greatly reduced by introducing flexible connections between the hulls.

The CataMarin

The CataMarin is intended as a vessel that is fully propelled by the aerodynamic forces on its four large suction sails. To avoid a large angle of heel, it uses the large stability of the twin hulls. A mono hull vessel reaches its heel limit much earlier than a catamaran for the same applied sail area and, consequently, the sails need reefing. The catamaran is known for its high transverse stability and can carry much more sail area, which makes this concept interesting. The transverse metacentric height, a measure for the transverse stability of a vessel, is 52 metres for the CataMarin. Typically, this is

Photo: The CataMarin concept: a twin hulled vessel connected by two beams with hinged connections to the hulls. Four large suction wings have been mounted on the beams.

an order of magnitude lower for a mono hull vessel with a similar displacement and hull shape.

There is an important difference between this concept and a traditional catamaran. The cross-structure of the traditional catamaran has been replaced by two beams that have hinged connections – ball joints – to the hulls. The advantage of this system is, that the two hulls can have individual surge, heave, roll and pitch motions and are only coupled in sway and yaw motions. This freedom in motions greatly reduces the loads on the cross structure and hence its weight. A consequence of having ball joints in the cross connection is, that each hull is not restrained in heel. Each hull needs sufficient positive stability to stay upright, thus it cannot be as slender as the hull of a conventional catamaran. Since the objective of the concept is to carry cargo in the hull rather than on deck (windage, safety), this is a relative disadvantage.

The catamaran is known for its high transverse stability and can carry much more sail area

To use the high transverse stability of the combined hulls, the sails need to be mounted on the beams instead of on the hull. The aerodynamic side force and heeling moment induce, through the beams, a side force on the hulls – resulting in drift – and a vertical force – resulting in sinkage. This vertical force compensates the heeling moment due to the sails.

The vessel is also equipped with twin propellers. These propellers can be used through an electric drive sourced by a battery pack. This system is used for quiescent periods and to enter and leave harbours. Alternatively, the propellers will also be used to regenerate energy and charge the batteries when wind conditions are favourable.

Hull form

The hull form is essentially the hull form of a slender monohull vessel. It has been adapted to generate side force at a drift angle in an efficient manner. This is important since drift is associated with additional drag; the additional drag is at least proportional to the square of the drift angle.

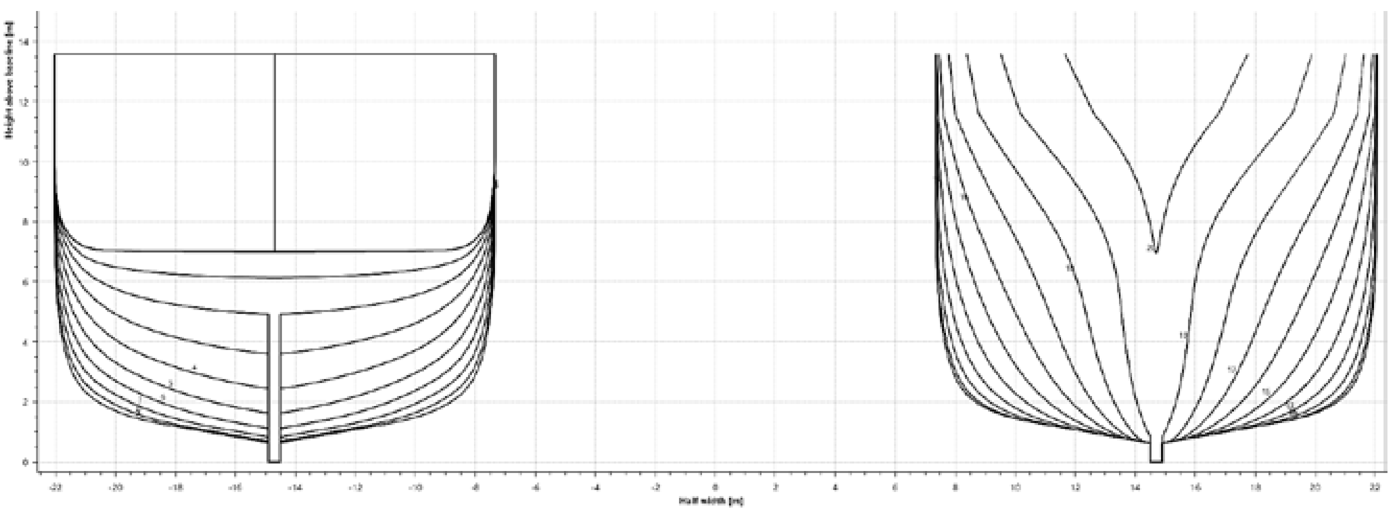
In general, side force is produced by a vertical surface at which there is a pressure difference between the two faces. The pressure difference can be created by having a strong vortex system on one side. The high velocities of the vortex induce low pressures (Bernouilli's law). It is not efficient to induce this low-pressure area on a surface that is not vertical since the goal is to generate a side force rather than a vertical force. Adding bilge keels to a hull is not a very efficient manner to generate a side force; instead, a long and shallow keel has been added similar to the clipper vessels at the end of the nineteenth century. A vortex is generated at the sharp tip of the keel and a low pressure is induced on the leeward face of the keel. The bottom of the hull has a deadrise angle of 10 degrees so that the keel of the vessel is also in an undisturbed flow at low angles of heel.

Dimensions

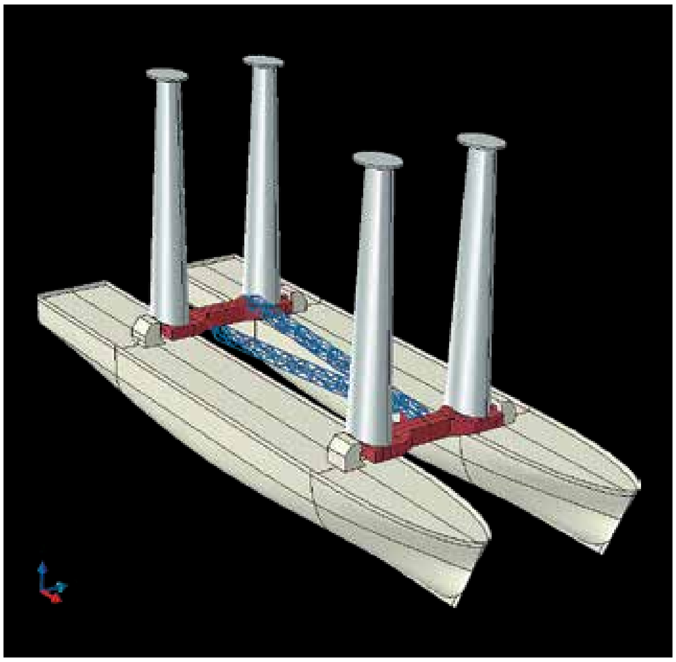
The CataMarin has been designed to have a similar load-carrying capability as the WASP-Ecoliner [2]. It has a length between perpendiculars of 120 metres, a total width of 44.1 metres, whereas each hull has a width of 14.1 metres. The container capacity is about 500 TEU, with a potential to place more containers on deck.

Sails

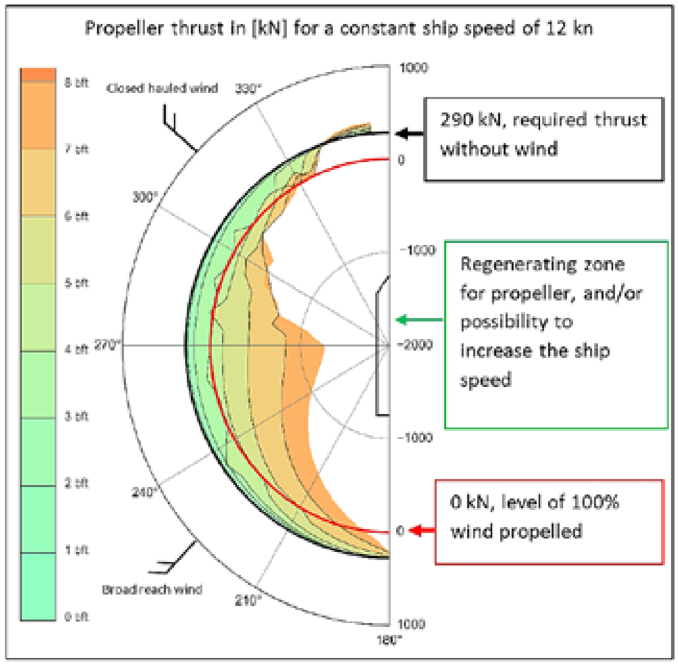
Four large high lift performance suction wings with a span of 44 metres and a chord of 6 metres with a total sail area of 1056 m^2 were selected to propel the vessel. This type of sail can generate a lift



Small-scale body plan of the CataMarin showing the centreline keel and the 10-degree deadrise angle of the bottom.



The cross structure of the CataMarin showing two transverse (red) and two longitudinal (blue) beams. The connections of the beams to the hulls and the links to the beams are all through ball joints.



Polar diagram of the required propeller thrust at a constant ship speed of 12 knots for a range of wind speeds. The sail area is 1056 m². The thrust is on the radial axis and the true wind angle on the tangential axis. A negative thrust presents a surplus of thrust.

force that is five to seven times larger than the lift produced by a soft sail for the same lateral area. The lift coefficient is comparable to that of a Flettner rotor. The benefit of such a sail is that the line of sight is less restricted and more forward thrust per lateral area can be realised.

The suction sail concept has been developed in the eighties of the last century by the Cousteau foundation [3] when the oil crisis gave a push to alternative propulsion concepts. The suction wing has a half circular and half elliptic sectional shape with a flap on the high-pressure side. On the low-pressure side, air is aspired from the boundary layer through a grid with small holes using wind fans inside the sail. This requires some electric power, but this is minor in relation to the effective power that the sail delivers to the vessel. By aspiring air from the boundary layer, large angles of attack are possible before stalling (resulting in a loss of lift) occurs and this makes high lift coefficients possible.

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Structure

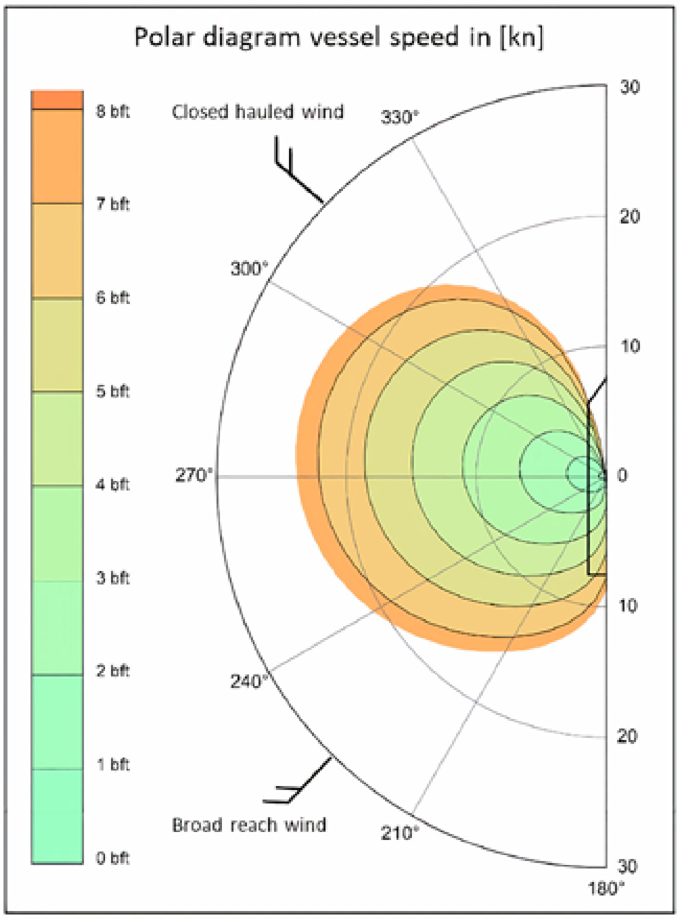
A design of the transverse beams has been made to check the feasibility of the concept and to have a reasonable estimation of the weight. A special point of consideration was the need for the system to absorb the driving force of the sails. This driving force results in a moment around the transverse (abeam) axis, which cannot be absorbed by the ball joints that link the beams to the hulls. A special system of longitudinal beams has been developed that connects the two transverse beams. One connection point of the longitudinal beam is at the level of the ball joint; the other connection point is at an elevated position. In this way, the system can absorb the moment due to the driving force of the sails while still allowing the freedom in motion of the hulls.

The weight of the transverse and longitudinal beams totals to 390 tonnes. This is approximately 8.5 per cent of the total steel weight of the vessel. It is expected that the reduced steel weight will result in lower building cost and a larger payload, hence improving the economy of the vessel. The linking systems also allow to pull the hulls closer together in port, facilitating loading and unloading.

Performance

The wave making resistance of the initial hull form has been reduced by a one-stage optimisation using the RAPID non-linear potential flow program [4]. The side-force production of the hull has been determined using MARIN's inhouse Computational Fluid Dynamics (CFD) software ReFRESCO. Two types of performance pre-

dictions were conducted. The first method considers the vessel in the Wind Assisted Propulsion (WASP) mode and solves the equilibrium condition for a constant design speed of 12 knots. The second method calculates the speed of the vessel assuming only the use of wind propulsion.
In the first method, a diesel engine was taken instead of an electric drive and the regenerating concept was modelled in a simplified way where the energy of a thrust surplus is included as a negative fuel consumption, thus lowering the overall CO_2 emissions. For a global route, and a constant speed of 12 knots, it was found that the CO_2 emissions were reduced by 39 per cent for a sail area of 1056 m^2 and were further reduced to 55 per cent when doubling the sail area to 2112 m^2. Although this is a rough approximation, it gives an indication of what can be achieved by a regenerating system. Weather routing simulations are needed to provide a more precise answer.
Assuming full wind propulsion in the second method, the speed has been calculated using a Velocity Prediction Program (VPP). This program calculates the speed for a range of wind speeds and headings relative to the wind. The result is presented in a polar diagram. For sailing in close-hauled and in following wind conditions, the vessel will sail a course giving the maximum speed in the required direction (maximising the speed-made-good), assuming there is sufficient sea room. Allowing for this, the CataMarin will exceed a speed of 12 knots, averaged over all wind directions, when the wind speed is more than 16.5 knots.
The heel angle is very low for all conditions; the maximum heel angle in the conditions calculated did not exceed 1 degree! The drift angle is also low, it does not exceed 4 degrees when sailing upwind in 30 knots wind speed.



VPP: Polar diagram of the speed for a range of wind speeds. The speed is on the radial axis and the true wind angle on the tangential axis. The sail area is 1056 m^2.

Additional research needed

The work carried out on the CataMarin has shown that this concept has quite some potential for full wind propulsion. The results have shown that relatively high ship speeds are possible using only sails. The heel angle remains very low and in fact, a larger sail area is possible for this design.

> The maximum heel angle in the conditions calculated did not exceed 1 degree

In the WASP mode at a constant speed of 12 knots, the CO_2 emissions were reduced by 55 per cent based on global wind statistics and assuming an increased sail area of 2112 m^2. Expanding the performance calculation model with weather routing, we believe that the CataMarin concept can efficiently operate as a zero-emission sailing vessel. Additional work is, however, needed to develop this concept into a real design. Topics to be studied are seakeeping in relation to the links and hinge performances, manoeuvring in harbours, voyage simulations on specified routes to determine arrival time statistics, internal lay-out, building cost and economic aspects to name a few. Some of these can be covered by MARIN, but industrial partners are needed to develop this concept into a real design. A possible follow-up can be a Joint Industry Project.

Geert Kapsenberg
Worked 35 years at MARIN, mainly in the R&D department before retiring. He is specialised in seakeeping and did a PhD on ship slamming, gk.kapsenberg@upcmail.nl

Anton Kisjes
Project manager in the cruise and ferry department of MARIN. His focus is on studying the manoeuvrability of ships and multi-disciplinary projects on wind-assisted ships, a.kisjes@marin.nl

REDUCED CO_2 EMISSIONS WHILST BURNING FOSSIL FUEL

Value Maritime's Filter and Carbon Capture System

There are many potential solutions to make shipping more climate friendly and emit less CO_2, such as developing engine fuels containing less or no carbon. See the various articles in this edition of our magazine, describing systems using hydrogen, methanol or ammonia. Yet, Value Maritime takes a different approach. With their Filtree and CO_2 Capture system, they achieve emission reductions whilst the ships are using conventional fossil fuels.

The installation may be used as an Exhaust Gas Cleaning System (EGCS) working as a scrubber, removing sulphur and ultra-fine particulate matter from exhausts from engines burning fuels like heavy fuel oil (HFO). The wash water is filtered and ph neutralised before discharge. The manufacturer claims that their Filtree system in combination with HFO is cleaner than when using marine gas oil (MGO), because the CO_2 footprint when producing HFO is lower than that of MGO. Depending on capacity, the installations have a weight of 14 to 30 tonnes and a footprint of 2.5 x 3 x 10 metres.

The system can also be extended to capture CO_2 on board. This system removes CO_2 and stores carbon from the vessel's exhaust gases and uses it to charge a CO_2 battery. Once the batteries are full, they can be taken to end-users of CO_2, such as greenhouses utilising it to enhance crop growth. Alternatively, the CO_2 can be used to enrich future fuels such as methanol. The CO_2 batteries are returned to the vessel to be recharged resulting in a circular solution. The CO_2 module is able to capture ninety per cent of the CO_2 of the ship's exhaust gases. By adding or removing CO_2 batteries, the CO_2 storage capacity of the vessel may be up or downscaled to ensure that the ship operates under the most optimal circumstances. All fossil fuels that have a carbon component are suitable for carbon capture.

> All fossil fuels that have a carbon component are suitable for carbon capture

Value Maritime's first CO_2

Photo: The Sven D from Visser Shipping was outfitted with Value Maritime's 9.0 MW scrubber, which can be extended with a CO_2 capture module.

Value Maritime's Filtree system.

capture module and CO_2 battery were installed in October 2021 on the vessel Nordica, operated by Visser Shipping. Further installations have meanwhile been ordered for ships from JR Shipping, Wijnne Barends, BG Freight, Boomsma Shipping and Noordwijk Ocean Services. Value Maritime also recently signed a contract for the first installation on a tanker of Eastern Pacific Shipping (EPS) and with X-Press Feeders.

The cost savings presented by the system depend on the bunker prices. With a large spread between sulphur-compliant fuels (MGO and very low sulphur oil, VLSFO) and high sulphur fuel oil (HSFO), these systems have relatively short payback times. Presently, the Filtree units are available for ships with engines in the range from 3 to 15 MW. If required, the units can be removed and reinstalled on other vessels.

Ir Willem de Jong
Former Managing Director of Lloyd's Register London and one of SWZ|Maritime's editors, willem.dejong3@gmail.com

WHAT'S BEHIND HYDROGEN-FUELLED SHIPS?

Future Proof Shipping (FPS) is a shipowner that develops realistic and practical sustainable shipping solutions. The company has taken on the challenge to prove that zero-emission shipping is not only possible, but that it is achievable at a reasonable cost, which is priceless for our planet.

TEXT & PHOTOGRAPHY: FUTURE PROOF SHIPPING, UNDER THE EDITORSHIP OF SWZ|MARITIME

The shipping company already has a fleet of three inland container vessels, all set to be retrofitted to run 100 per cent on green hydrogen. They aim to have ten zero-emission ship projects kickstarted within the next five years and they are just about to bring their first vessel, FPS Maas, into the yard to be retrofitted in August.

The research

To understand the vast amount of research, planning, testing and verification that goes into the process of retrofitting a vessel to zero emissions, the FPS team have put together white papers describing their methods and findings. This information can be built upon and is to help accelerate the transition to zero-emission shipping for all. The two short white papers are available through links (see text box). The first white paper covers the operational profile measurements of an inland container vessel and the sizing of fuel cells and hydrogen storage. A short summary of this white paper is presented in the text box below.

FPS chose to retrofit their existing inland vessel FPS Maas to full zero-emission technology by replacing the existing internal combustion engines with hydrogen fuel cell technology. Proper sizing of the fuel cells is crucial for this project. They measured the power profile of the vessel for several months to ensure that they had a deep understanding of the operations. The power profile includes the power demand of the main propulsors together with hotel load and auxiliary power demand. The white paper shows the results of these measurements and presents the basis for the selection and sizing of the fuel cells and hydrogen storage. These results can also be used as reference values for other similar inland container vessels.

The challenge

Converting an existing vessel to zero-emission technology is exciting and novel, but also complex, with numerous technical and economic challenges intersecting. The sizing of main components for zero-emission technology needs to be conducted carefully so that unnecessary costs are avoided, and the vessel can continue to operate safely. Thus, the retrofit of the Maas started with operational measurements to determine the power requirements for the future power configuration based on zero-emission technology. Next, the measurements were used to size the fuel cells, battery packs and hydrogen fuel tanks. The first white paper gives an overview of the vessel specifications, measurement setup and sailing route. It also presents the results of measurements, followed by FPS' choices re-

> Converting an existing vessel to zero-emission technology is exciting and novel, but also complex

Photo: The FPS Maas will be retrofitted to sail on renewable hydrogen and fuel cells.

Fabrication of the fuel cell for the FPS Maas.

garding the installed power for fuel cells and the amount of hydrogen required on the route.

Preference for hydrogen

Thanks to the measurements of the power profile, the team was able to size the future fuel cell system optimally. The fuel cells will be typically loaded at between seventy and 75 per cent to reach their maximum efficiency and the assumed specific hydrogen consumption of 60 g/kWh gives a representative (average) value of consumption at the beginning and end of lifetime of the fuel cells, as hydrogen consumption increases as the fuel cells age.

Due to the long route, the Maas will operate on high energy demand, therefore, it is clear that hydrogen remains FPS' preferred choice. An all-battery alternative would require approximately two to four times more space because of its lower energy density. Another point of concern is the (current) unavailability of electric charging facilities in the ports the vessel will call at. For this vessel, a 1 MW charging installation would be required, and it would take ten hours to charge the batteries.

It goes without saying that the hydrogen use gives new challenges around day-to-day operations like bunkering, planning of refuelling schedules and routes, maintenance and risk detection, all of which require re-training and educating crew and shore personnel. Ultimately, the introduction of hydrogen will enhance not only the sustainability, but also the safety of the industry.

With the diesel configuration having a rated power of 1200 kW and the power demand being around 650 kW, it is clear that the existing ship is highly overrated for the investigated route. However, different routes towards Germany might require higher power as the river current is stronger. FPS will soon measure performance on the routes to Germany and further east from the Netherlands, to design zero-emission ships that can successfully sail on those routes as well, such as the FPS Rijn and the FPS Waal.

CO_2 footprint findings

The second white paper details the CO_2 footprint and life cycle analysis of inland vessels powered by renewable technologies. While there is a consensus that renewable technologies such as hydrogen and battery-based solutions provide significant improvement of the CO_2 footprint for inland vessels, there are still some questions related to the overall life cycle impact of these new technologies. For example, what are the dominant factors in the overall CO_2 footprint, and more specifically, what is the contribution of the production phase in comparison to the operational phase of inland vessels?

Together with the Eindhoven University of Technology, FPS performed a comprehensive desktop study based on available life cycle data and literature, using the FPS Maas as the test case. They concluded that the most dominant phase in the lifecycle of an inland vessel – with the highest CO_2 footprint – is the operational phase.

A combination of renewable hydrogen and PEM fuel cells provided the lowest CO_2 footprint

They also found that the CO_2 emissions impact of the production phase of the fuel cells, batteries and hydrogen storage tanks is much smaller than the operational CO_2 footprint of the existing vessels. Thus, a combination of renewable hydrogen and PEM (Proton Exchange Membrane) fuel cells provided the lowest CO_2 footprint for the investigated case.

Due to the long operational life and the high number of annual working hours, the operational phase is the dominant contributor to CO_2 emissions for a typical inland vessel. The production of hydrogen based on renewable technologies remains a must-have, and in combination with PEM fuel cells, it provides a solution with the least negative environmental impact out of the pathways considered.

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Location of the fuel cells, batteries and hydrogen system on board the FPS Maas.

WHITE PAPER SUMMARY

Knowing the power requirements (both total energy kWh and average/peak power kW) is relevant to conceptually optimise the installed hydrogen storage (Kg -> KWh), fuel cell (kW), battery (kWh) and motor (kW) capacities. To this end, choosing representative sailing routes, payload conditions and the more general operational modes is key. The container vessel Maas was used to establish these requirements per category by measuring the actually used power over time for the main propeller (propulsion), the bow thruster (manoeuvring), the hotel load (permanent use for living) and auxiliary consumers (navigation, pumping, other payload related consumption).

Power (kW)

For the 200-km run between Geel, Belgium, and the Eemhaven, Rotterdam, the presented power was used (see below). These values are confirmed on other Dutch and Belgium routes.

- Average power main propeller: 485 kW
- Maximum power main propeller: 1222.5 kW
- Total duration of power peaks >750 kW: 163 sec (0.2 per cent of total voyage)
- Average hotel and auxiliary power: 8.5 kW
- Maximum hotel and auxiliary power: 28.6 kW

Based on these measurements, FPS proposed to size the main electric motor at 650 kW and the fuel cell system at 825 kW (3 x 275 kWe). Two battery systems are installed to cope with peak demands and facilitate pure battery operation.

The sizing of the two battery systems is determined on the basis of the following considerations:

- Regulatory requirements to ensure the vessel can travel to shore only on battery power in case of shut down of fuel cell systems.
- Energy required to supply hotel and auxiliary systems during the disconnection and re-connection of hydrogen storage systems.
- Additional capacity for power peaks and operational uncertainties.

Energy (kWh)

The summation of the total required power over the time travelled determines the amount of hydrogen needed. After taking into account the various efficiencies on motor (.98), frequency and DC-DC drive (.95) and the grid (.99) and the specific hydrogen consumption of the fuel cell efficiency (60g/kWh delivered), the total amount of kg hydrogen becomes clear (674 kg for a one way trip).

The volume taken by the storage of hydrogen and the electrical installation affects the cargo capacity of the vessel. In future designs, a smaller engine room and more dedicated arrangements will likely result in a further optimised design. The current volume requirement to store the 640 kg of hydrogen are two 40’ containers, approximately the space of one 40’ container for the FC installations (including the balance of plants) and another for the two batteries.

SMM: ALWAYS ONE BRILLIANT IDEA AHEAD

Whether it is about digital or green innovations, SMM is the perfect stage. From 6 to 9 September, it will be the meeting place for representatives of shipping companies, suppliers, shipyards and scientists to share views and ideas, expand their networks and do business. The 30th SMM focuses on the maritime energy transition, the digital transformation and climate change.

TEXT & PHOTOGRAPHY: HAMBURG MESSE UND CONGRESS, COMPILED BY SWZ|MARITIME'S EDITOR-IN-CHIEF ANTOON OOSTING, SWZ.ROTTERDAM@KNVTS.NL

Again and again, the leading international maritime trade fair has reinvented itself, often inspired by its visionary exhibitors. Around 2000 exhibitors and more than 40,000 visitors from over 100 countries are expected to attend. In eleven exhibition halls, SMM covers the entire value chain of the maritime industry. As a platform for innovation, it brings together leaders from around the world. The 2021 SMM was held as an online event due to the Covid pandemic. This year, the maritime community will once again gather live at the exhibition campus and in conferences featuring top-ranking panellists.

'This year we will be offering even more opportunities for networking, and a wider selection of free content. For the first time, SMM participants will be able to present their knowledge or product novelties on so-called Transition Stages,' says Claus Ulrich Selbach, Business Unit Director Maritime and Technology Fairs & Exhibitions at Hamburg Messe und Congress. The themes on the stages reflect the SMM motto "Driving The Maritime Transition". One stage will be dedicated to alternative propulsion systems, environmental technologies and sustainability, another one will focus on automation, digitalisation and data management. The third stage will address interior design, outfitting and technologies for passenger ships as well as challenges and opportunities facing the cruise industry.

'Following the speeches and presentations, our new networking format "It's wine o'clock" will provide a relaxed environment for exhibitors and visitors to share thoughts and views,' Selbach adds. This is exactly what makes SMM special, believes Knut Ørbeck-Nilssen, CEO Maritime at DNV: 'It is a place to inspire and be inspired, coming face-to-face with the individuals, technologies and services that will write the next chapters in the story of how we conduct responsible commercial activity within the ocean environment.'

Towards climate-neutral shipping: The green revolution

The all-important question in the maritime industry is: How can shipping achieve climate-neutrality rapidly? The international maritime trade fair combines the know-how of experts from science, shipping, shipbuilding and the supply industry.

The world fleet, an estimated 60,000 vessels carrying ninety per cent of the global trade volume, generate more than two per cent of global CO_2 emissions. The International Maritime Organization (IMO) aims to achieve climate-neutral operations by the year 2100. The sector itself is more ambitious: The shipping industry wants to be carbon-neutral by 2050. SMM seeks to help to achieve this goal. Participants from around the world will be able to learn more about new trends and innovations, especially in the fields of climate protection and alternative propulsion technologies. At gmec, the global maritime environmental congress, industry leaders on five discussion panels will share insights.

Photo: SMM will allow visitors to experience new technologies first hand.

The current debate revolves around the potential of alternative fuels, according to Selbach: 'What innovations are available in this segment, and what is the current state of research? Industry stakeholders will be able to get up-to-date information on these questions at the gmec conference, at the exhibition stands and, for the first time, at the "Transition Stages".'

One goal, many solutions: LNG, methanol, hydrogen

Batteries alone cannot resolve the energy problem, Uwe Lauber, CEO of MAN Energy Solutions SE, points out: 'To power a large container ship electrically, you would need a battery the size of the vessel itself. The owner would be unable to carry any containers. And the ship would be too heavy to float, and sink.' There is no way to avoid combustion engines, he added. But the good news is, the industry can build engines capable of burning emission-free fuels today, says Lauber. IMO supports these efforts of the supply sector. 'Without a doubt,' states IMO Secretary General Kitack Lim, 'achieving decarbonisation ambitions in the shipping sector will rely on a smooth transition to alternative low and zero-carbon marine fuels.' The IMO is working on creating a global legal framework to accelerate this process, he stresses. Lim will speak at gmec.

As the global orderbooks reveal, only one in nine ships currently on order will be equipped with a propulsion system capable of running on alternative fuel. Classification society DNV does not expect the fuel environment to change fundamentally until the pivotal year 2050. Methanol, ammonia and hydrogen are favoured solutions. But nobody knows which fuel will ultimately dominate. A challenging situation, especially for early movers. 'The fuel question is the most difficult and most important decision our customers will have to make this decade,' says Torgeir Sterri, DNV Senior Vice President.

Meanwhile, there is much the shipping sector can learn from other modes of transport, according to Elisabeth Munck af Rosenschöld, Global Sustainability Manager at IKEA. The Swedish furniture giant began chartering vessels last year. At gmec, Rosenschöld will explain the background of this maritime investment.

It is about the money

Answering the fuel question not only takes courage, but also money – lots of it. Klaus Schmidberger from KfW Bank will look at the topic from the perspective of an economist. He stresses that the required investments are enormous and that what the affected stakeholders need more than anything is a sound basis for planning – 'sooner rather than later'. A typical cargo ship has a lifespan of twenty to 25 years, he says. Owners who want to be climate-neutral by 2050 need to invest today.

The costs are just one side of the coin, he points out; the other is the responsibility to stop climate change. 'Is the industry doing enough to decarbonise?' A question which will be at issue when experts such as Sönke Diesener from the environmental organisation Nabu meet up with industry leaders like BIMCO CEO Lars Robert Pedersen. And there are many other issues that merit discussion. For example, can AIDA Cruises Communications Chief Hansjörg Kunze imagine installing hydrogen fuel cells on board cruise ships? And how would Thomas Wiese, Director Strategy & Innovation at Siemens Energy Marine, implement such a concept? These are just two of the many questions to be addressed at gmec. This panel discussion will be open to the general public. Tickets are available at 25 euros. The specialist conference will take place on 7 September.

Naval forces: Innovations for enhanced security

Numerous exhibitors will showcase technology innovations geared towards the needs of naval forces. In parallel with the exhibition, experts and high-ranking officials of international navies, the industry and international organisations will meet at the International Conference on Maritime Security and Defence (MS&D) on 8 and 9 September to discuss defence challenges, technology developments and cyber security under the leitmotif "Protecting The Seven Seas".

There is war in Europe; a sad reality for several months now. Military conflicts not only take place on land and in the air, but increasingly on the water as well – with far-reaching consequences: 'This war is another heavy blow to the global economy, and that includes international shipping, logistics chains and ports. Many ships are stuck in the Black Sea, their crews unable to tell when they might be able to continue their voyages. Parts of the sea region are full of mines. The port city of Mariupol is destroyed, and Odessa has again been the target of massive Russian attacks,' says Bernd Aufderheide, President and CEO of Hamburg Messe und Congress, at the SMM advance press conference. At MS&D, the discussion will focus on questions of defence policy and equipment for naval forces.

> The all-important question: How can shipping achieve climate-neutrality rapidly?

As the current international situation shows, global free trade is increasingly exposed to risks. The protection of sea routes for international commercial shipping is the subject of the keynote presented by Dr. Martin Kröger, Managing Director of the German Shipowners Association (VDR), at the beginning of MS&D. General (retd.) Egon Ramms, former Commander of the Allied Joint Force Command and one of the highest-ranking German officers in NATO, will outline the political and military lessons to be learned from the Ukraine war to date.

But Ukraine and its ports on the Black Sea are by no means the only political hotspots in the world. Around the world many nations are responding to the new security situation by increasing their defence expenditures substantially.

Maritime security in the Far East

One of the panels of this year's MS&D will address maritime security in the Indo Pacific region where maintaining low-friction relations between nations is considered a major challenge. The Chinese government is continuously increasing its military spending at rates exceeding the country's economic growth. Military expenditures in

2021 were at roughly USD 293 billion. China aspires to replace the US as the strongest military power by 2049. On the water, the People's Republic is already in the lead: 'Between 2014 and 2018, China added naval ships equivalent to the total tonnage of the UK's Royal Navy or the entire Japanese naval fleet to its already considerable navy,' says Dr. Sarah Kirchberger, Head of the Department for Strategic Development in Asia-Pacific at the Institute for Security Policy at Kiel University. 'This naval armament policy is practically unequalled in history.' In her speech, Kirchberger will explore the objectives and potential of the Chinese navy.

Apart from scientists and industry experts, a number of high-ranking naval officers will provide insights during the conference. Vice Admiral Ahmed Khaled Hassan Said, Commander-In-Chief of the Egyptian navy, will speak about the security situation in the eastern Mediterranean. Rear Admiral Henning Faltin from NATO COE CSW will discuss the importance of protecting military installations in coastal regions. The role of the German Maritime Forces Staff in securing the Baltic Sea will be the subject of a speech by Rear Admiral Stephan Haisch from the German navy – a topic very much in focus today because of Russia's aggressive behaviour.

> As the current international situation shows, global free trade is increasingly exposed to risks

Advanced technologies

As adviser to the Institute for Security Policy at Kiel University, Patrick O'Keeffe will focus his presentation on cyber security during naval operations. High-tech applications are in the spotlight at thyssenkrupp Marine Systems (tkMS) as well. Specialised in naval shipbuilding, the company is currently dealing with an "explosive inheritance" from World War II. There are still vast amounts of discarded ammunition lying on the bottom of the sea. In German territorial waters alone, there are approximately 1.6 million tonnes left. 'We only have a few years to act before a large portion of the ammunition will be rusted through,' says tkMS General Manager Knut Baumann. In his speech, he will present a partially autonomous recovery system used to defuse these ticking timebombs.

Unmanned systems are on the agenda of the second panel too: Ares Shipyard, for example, has developed an armed unmanned surface vehicle (USV). At SMM, the Turkish shipyard will present the numerous potential uses of the "ULAQ", which can travel at speeds of up to 70 kilometres per hour.

Green fuels that may be suitable for naval vessels are the topic of the presentation by Andreas Junginger from MAN Energy Solutions, connecting the military with the civilian maritime world and the key topic of SMM: The maritime transition to emission-free shipping.

Offshore Dialogue: More watts with fewer emissions

Electricity generation on the water, which could also propel the maritime energy transition, is seen as an important means to battle climate change. At the Offshore Dialogue (OD) on 8 September, experts will explore options for sustainable use of the oceans.

Renewable energy sources top the agenda: By 2045, the Federal Government wants to increase the German offshore wind capacity nearly tenfold. The country's wind farms are expected to have a combined capacity of 70 gigawatts (GW) by that time. The European Commission is planning to increase the EU-wide capacity to as much as 340 GW by 2050. Building all these wind turbines is a huge technical, logistical and financial challenge – and it is a very urgent project, not only to achieve independence from Russian natural gas but also to cut emissions radically.

Shipping will likewise be highly dependent on wind turbines as it strives to become carbon-neutral: 'Ambitious expansion of wind power on land and at sea is a prerequisite for the production of alternative ship fuels,' Selbach points out. 'Whether methanol or ammonia, synthetic fuels won't be truly sustainable unless they are based on "green" hydrogen produced with renewable energy.'

All this entails an enormous challenge: Offshore wind farms are to be built at distances of 30 to 40 kilometres from the shore, anchored in the seafloor at depths of up to 40 metres. Can this be realised without damaging vulnerable marine ecosystems? This is one of the questions to be discussed at the OD.

The power of data

The oceans are a threatened biosphere. The "Ocean Decade" initiative is the United Nations' response aiming to implement international solutions for the protection and sustainable use of oceans by the year 2030. 'Oceans are of enormous importance to us here on earth because they regulate the climate and limit global heating caused by human greenhouse gas emissions. The effects of climate change on oceans and coastal regions are massive, and we must take action urgently to improve the situation in the oceans,' says Dr Steffen Knodt, Member of the Board of the German Ocean Decade Committee (ODK). At the OD, Dr Knodt will provide an overview of the committee's national and international activities.

Safe and fast

Findings from regions that have been hit by climate change especially hard, are of particular importance to climate research. For example, the Arctic is heating three times faster than the world average. To obtain concrete data on this, scientists must use specialised ships that can navigate through thick sea ice. Lasse Rabenstein and his start-up Drift+Noise help expedition teams do so. At the OD, the company's co-founder will present the ice information app "IcySea". This app has supported the crew of the AWI research vessel Polarstern. Thanks to satellite images, open water channels were identified and the trip was shortened. This translated to substantial financial savings, considering the vessel's daily operating costs of 70,000 euros. At the OD, Rabenstein will speak about the increasing number of ice-free days in Arctic waters, which will allow more ships to sail through the Northwest passage.

Energy from the sea

From fishing vessels to scientific research, merchant and cruise ships, there is plenty of traffic in coastal waters. Offshore wind farms increasingly crowd these areas. One of the world's biggest operators with offshore wind farms totalling 2.4 GW in installed power is German RWE. 'We would like to invest much more rapidly,' notes RWE CEO Markus Krebber. But, he adds, requests for government support are taking too much time to process. Contrary to the Netherlands, Germany has no clear goal for its hydrogen industry, he says. Dr Bernadette Zipfel, Team Lead Engineering Management Future Technologies, will explain how the company envisions the future of energy generation.

Having done extensive research on the subject, Prof Dr Martin Kaltschmitt from the Hamburg University of Technology (TUHH) gives his assessment: 'Offshore wind power is steadily gaining in importance. The same will apply to offshore hydrogen production in the medium term, which will help transport the electrical energy generated far offshore as efficiently as possible so it can be made available on land.' At the OD, he will discuss what he believes to be the most promising approaches.

One major topic is how all this energy produced offshore could be stored. In his presentation, Dr Walter Kuehnlein, Consultant and

SMM 2022 will once again see a lot of conferences where experts will discuss their views with the audience.

Founder of the start-up terra.blue, will highlight several options. Together with the Chairman of the Board of the Society for Maritime Technology (Gesellschaft für Maritime Technik, GMT), Prof. Dr Sören Ehlers, Kuehnlein will be moderating this year's Offshore Dialogue.


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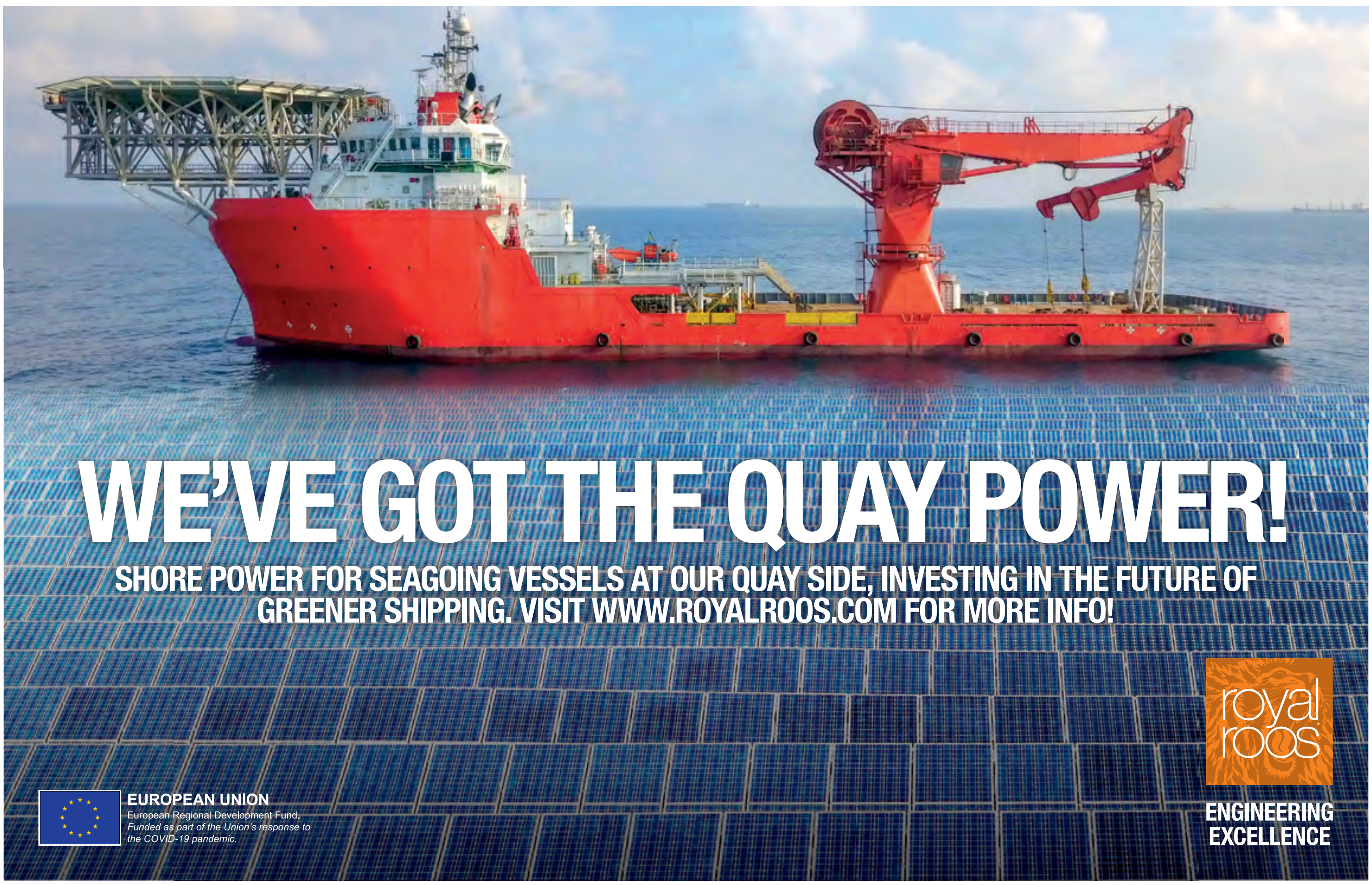
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DECISION SUPPORT – MORE THAN JUST TECHNOLOGY

Plough operation module on board a water-injected dredger vessel

Decision support systems are a growing development in the maritime industry. Current technology allows the processing of various data sources with complex algorithms resulting in support for the crew on board. Often complex technical solutions are found with the objective to improve safety or increase efficiency of operations. This sounds promising, but why is the introduction of such high-tech solutions not always as successful as expected beforehand?

The approach in development is often taken from a technical perspective. The most state of the art, complex techniques are available for use on board and engineers are eager to develop them. But sometimes the basic principle is lost: technology should support the operator and the human's role is not to satisfy the technology. In this article, we want to show the risk of underexposed human factors and the options available to incorporate them properly.

Seeking balance

Various operations are becoming more complex or are intended to be performed by a smaller crew, which increases the task complexity for individual operators. Technology progresses rapidly and data processing power allows the provision of a lot of information for the crew. The essence is to provide the crew with sufficient information, not overloading them with details, in time and unambiguous. In reality, this proves to be a challenge. If successful, it supports the crew and allows cooperation, even when the crew members have various backgrounds and experience levels.

Complex technology

Development is often approached from a technological perspective. Explainable, because in many cases complex technology is required. Furthermore, the decision support must be of a high level, otherwise trust in automation is too low.

An engineering perspective on a tool is different than the user perspective. The user has a preference for a clear spot-on tool providing the essential information for the task at hand. It should be clear at one glance which action is needed.

For the operator, the decision support system will likely be one of many systems operated to perform his overall task. The engineer on the other hand might be tempted to keep all options open and provide background information, which is not directly essential to the operator's task. While engineering a single decision support system, the focus is often on the one system and not on the operator's full task. This difference in perspective leads to different requirements and therefore different design choices.

Finding the right balance between simple and sufficient is a challenge. The art of leaving things out is difficult, but important. Of course, it is tricky to omit things that might be relevant. Therefore, it is very important to understand the operation and the information used by the operator to make a decision. On the other hand, the way of working and the information used at this moment should not limit developments.

Understand the context

A good understanding of the daily operation on board is essential as a starting point for the development of decision support tooling. Understanding the task distribution between crew members, the type of decisions to be taken, time pressure under which decisions need to be taken, other tasks that need te be performed in parallel with the task at hand, etc. All these factors will impact the decision support tool requirements and its use.

> One main design guideline to be applied is "less is more"

The user interface should match the task and responsibility of the user, for example: do not mix advice for captain, DP operator and surveyor in one tool.

Be very aware who the end user will be and what his/her tasks and responsibilities are.

To get to the best result, it is important to involve the future user in the design and development. This is very obvious for many tool developers, but not always common in the maritime sector. The distance between "office" and "on board" is often larger than desirable. This is not surprising, because the future users are often at sea and the distance, therefore, literally is large.

Define requirements together

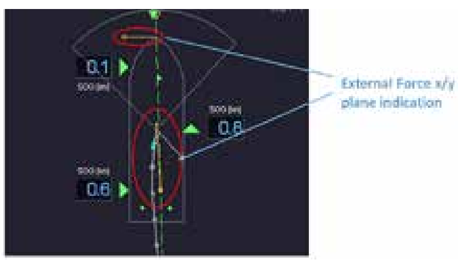
Once a good understanding of the operation is available, the system functionality can be defined. This includes not only the functionality in the sense of data sources, algorithms and alerting boundaries, but it also includes a user interface that provides the required information to the operator. One main design guideline to be applied is "less is more".
Decision support systems often include various data sources with data collected over a certain time span. Data required to provide the crew with good support, but not necessarily data to be presented to the operator. Including users in defining the user interface is key to determine the right level of detail of information to be presented.

Iterative design process

Once the requirements for the system and its user interface are defined, many design decisions still need to be taken. During this design process, it is essential to include operators to evaluate prototype versions of the system, allowing them to reflect on the design from an operational point of view. With a structured cognitive walkthrough, design decisions may be added or altered. Allowing multiple iteration steps in the design will allow for a first-time right installation.

Rules of the game

How brilliantly the decision support system might provide support to the crew, the crew still needs to know how to act on it. If a support system provides advice, is the crew required to adhere to it? Is the crew required to call the office? If the advice is not followed, who is accountable for the consequences in terms of reduced efficiency, workability, safety?
The issue can be illustrated by the situation in which a decision support system uses traffic light colours. What does orange mean? Abort operation? Continue operation applying additional safety procedures? The frontline operator will perform his/her task under time pressure and will not be capable of evaluating the situation to determine how to interpret the "orange" advice. It requires clearly defined rules established between frontline operators, being the crew on board and the company management ashore.



Main screen, forces/momentum indication, the arrow indicates the direction and the length is chosen such that the impact of the forces is visualised.

Automatic intervention of the system, the operator is "on" the loop and informed on the situation, no further action is required as the system automatically acts upon the situation. If the speed reduction is too fast/slow, the operator can intervene, the orange blinking colour is used to catch the operator's attention.

PLOUGH OPERATION MODULE BY RH MARINE

An example of a decision support system is the successful implementation by RH Marine of a plough operation module on board a water injection dredger. The vessel is intended for dredging at a pre-defined location. For these locations, a dedicated survey system is used. Various tasks require good cooperation and communication. Integrating this cooperation within the systems, will reduce the crew's workload.

Smart integration of systems

The first step is that the operator who monitors the results of the main operation (surveyor) can directly implement small changes in track and speed to optimise the result of the ploughing operation. With this, the vessel operator is relieved of continuously changing the track/speed setpoints. One step further is the smart integration of the plough forces and the dynamic positioning and tracking system (DPT). With this integration, the DPT system indirectly monitors the status of the plough operation.

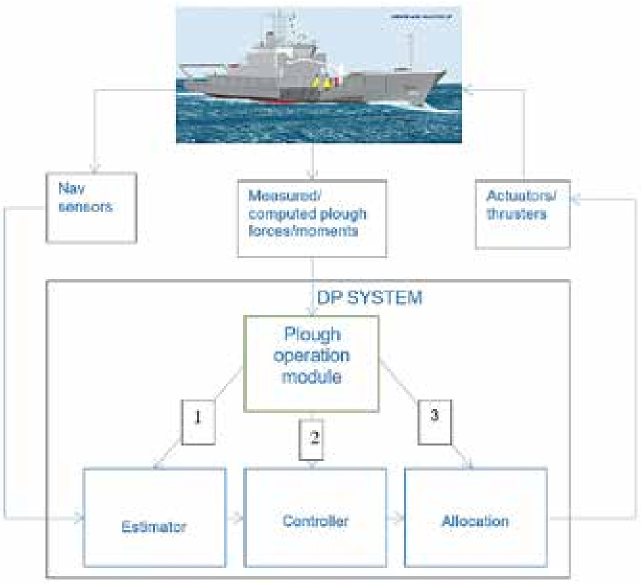
Philosophy of implementation

Implementation of the plough operational module is based upon a two-step philosophy:

1. Smart algorithm performing complex analysis in order to produce operational advice.
2. An intuitive way of presenting this advice or automated actions, such that they can be easily interpreted on an operational level.

Automation of tasks

In some cases, for example if the forces exerted on the plough are too large, or the plough is stuck and has to be retrieved, it is required to slow down. It would then be desired to keep station with the vessel. By feeding the DPT system with this information, it will automatically slow down or keep station to support the main operation. With this integration, an extra task is automated, enabling the vessel operator to focus on overseeing the complete operation including navigation.



The system will detect the plough status based on forces and frequencies of forces on the plough.

Technical implementation

From a technical perspective, the algorithm is complex. The forces and moments are read in the plough system and are fed through in the DP control system. Within the DP control system, these forces are used in several functional blocks.
The starting point of implementation was defining the different operational situations together with the end customer, where the operator normally should act and where in this case the system will act in order to relieve the operator from extra monitoring and interpreting and even taking action. Moreover, human operator error due to multi-tasking, higher workload and overload of data or information is also addressed.

Implementation of the system on the bridge of the water injection dredger.

Based upon the identified operational situation, the system will act differently. The schematic figure of the system elements explains that the system will detect the plough status based on forces and frequencies of forces on the plough. Depending on the outcome, various actions can be initiated automatically or advised. For example, changing the DP gain setting, adapting the speed over ground (SOG), transfer from sailing to station keeping, etc.

Human Machine Interface implementation

The technical detail level of the plough module is filtered to an operational level in the Human Machine Interface (HMI), in such a way that the operator can easily recognise the operational situation and can act upon it. In the HMI, only minimal elements can be found: an arrow indicating the forces, a digital speed setpoint indicator with multiple states and an indication on action to be taken by the operator or informing the operator about the automated action taken by the system. Though the algorithms are complex and represent high-end technological solutions, the user is informed by relatively minimal HMI elements to support the operator in the task at hand without distracting. The rules of the game are basically included in the HMI by means of the alarm line, which indicates the action taken by the system or action expected from the operator.
The result is an increased level of automation or support to the operator allowing the operator to focus on other tasks and reducing human error.

Water injection dredger.

Both crew and management will have their own expectations of the investment made by installing the decision support system on board. The rules of the game materialise the expected benefits in the day-to-day operation.
Generally spoken, various levels of support can be defined:

- I inform you about a situation.
- I suggest you take one of the following actions to avoid a situation.
- I demand to take the following action to avoid a situation.
- I took corrective action for you; all is well now.

Helpdesk after implementation

In many cases, decision support systems require various data sources, system settings and pre-defined parameters for a specific type of operation. Feeding the system with the right data sources is essential. Who will perform this task? The crew as well? It is worthwhile zooming in on this question and a more logical approach might be to have "the office" taking care of this task as an operational helpdesk. It requires different skills than the nautical ones the crew is trained in.
Apart from operational support, technical support might also be required. Complex systems, with various data sources and having many settings, might stall and present an error message. A technical helpdesk functionality might be required, depending on the role of the decision support system. Whether it is a support system required to be up and running 24/7 or it concerns a nice to have add on defines different requirements on the technical support. Defining this beforehand is essential for a successful implementation and crew acceptance of it.

Pitfalls

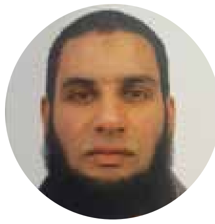
Development of high-tech decision support systems has the risk of running into technical problems and delays. A pitfall often seen in these kinds of projects is that the focus remains on the technological development of the system. Any delay in the process is absorbed by later phases of the implementation path. Cutting corners in creating a user interface without operator involvement saves time, but results in a less optimal user interface. Not defining the rules of the game having both the onboard crew and office crew involved saves time, but creates risk in low crew acceptance, ill use or neglect of the system and not meeting the expectations of the investment. Skipping training saves time as well, but meeting the objectives of the decision support system with a non-trained crew is hard.

Technology should support the operator

The message we aim to stress is best summarised by the following statement: Technology should support the operator, the human is not there to satisfy the technology.
For a successful implementation, various methods and tools are required, which seem expensive at a first glance, but will prove to be money savers in the long run. MARIN is currently supporting this process of introducing new technology for a number of customers.

Hans Huisman
Team leader Human Factors at MARIN, h.huisman@marin.nl

Willemijn Pauw
Senior project Manager at MARIN, w.pauw@marin.nl



Ehab el Amam
Consultant at RH Marine, ehab.elamam@rhmarine.com

AZIMUTHING THRUSTER ISSUES AND MARIN'S TEST LAB

Azimuthing thrusters provide for highly reliable and manoeuvrable vessels. Yet, this type of technology also has its issues, most notably thruster ventilation. The Maritime Research Institute Netherlands (MARIN) has set up a "complete" test lab as part of its Zero Emissions Lab to test the behaviour of thrusters in wave conditions.

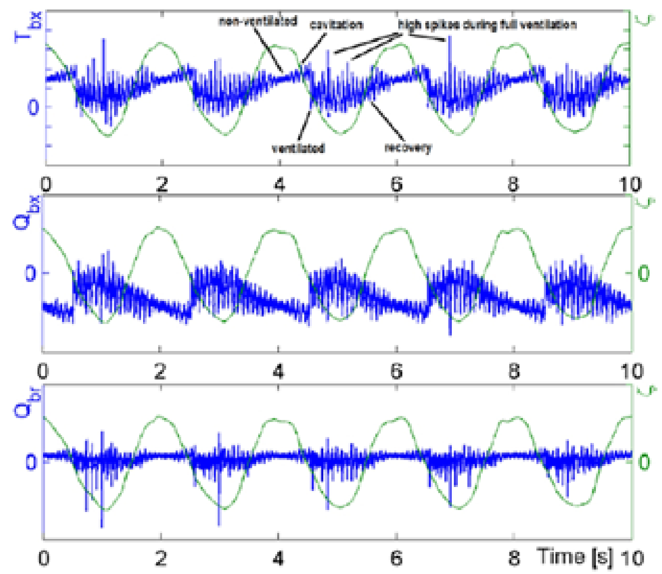
In the 1980s, the activities in the oil and gas related offshore industry increased drastically. The demand for dynamically positioned (DP) offshore support vessels also increased. The way to go forward was diesel electric propulsion and azimuthing thrusters at the stern, giving highly reliable and manoeuvrable vessels. The azimuthing thrusters, both pulling and pushing, open or with a nozzle, with the electric motor inboard or directly on the propeller shaft (podded propeller), were used for positioning and for propulsion and grew in size as the requirements of the thrusters grew. This growth of thrusters triggered a number of investigations into thruster efficiency and the external and internal forces acting on a thruster (see references at the end).

MARIN has set up a "complete" test lab where the thruster is mounted on a table suspended just above the water of the test tank (the former cavitation tunnel). The table can move in six degrees of freedom, like a flight simulator. The thruster is driven by an electric motor and a variable frequency drive (VFD), or by an internal combustion engine (ICE), which are part of an engine room installation with various energy producers and consumers. This will give a realistic picture of the thruster's behaviour in wave conditions.

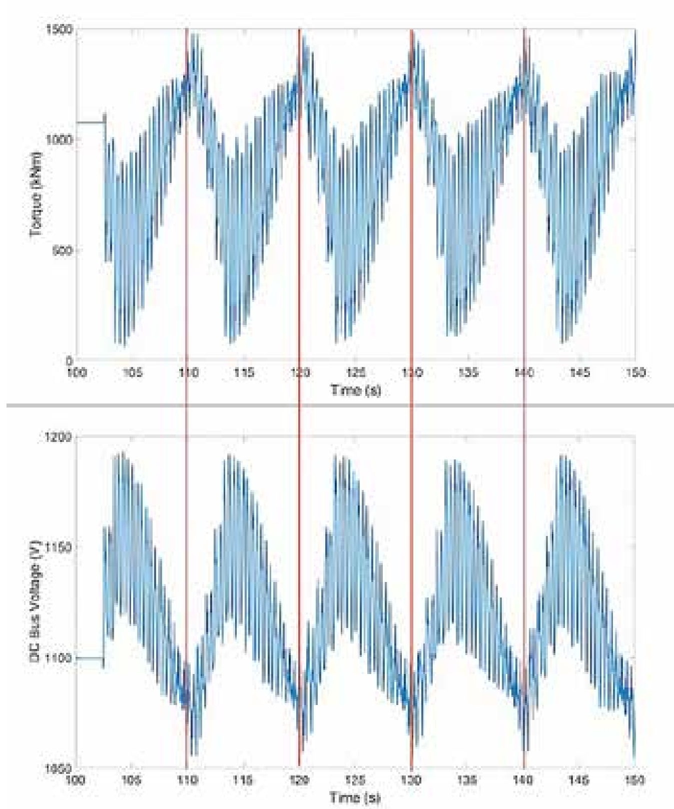
Thruster ventilation

Thruster ventilation occurs when the propeller approaches the surface. This can be due to wave action, vessel motion and a combination of both. When the propeller blade tip is close to the surface, the thruster ventilation can be significant with an efficiency loss of up to fifty per cent. This also depends on propeller speed; the higher the speed, the more efficiency loss. When this happens, the thruster will lose the load and with an electric drive the speed (r.p.m.) may increase. A diesel driven thruster will not speed up so fast due to the governor on the diesel engine. Certain thruster suppliers require a "speed-ramp" in the frequency converter to mitigate overspeed and overload. Not all thruster suppliers require this speed ramp, according to an electrical integration company supplying VFDs for thrusters. According to the electric integrator, this is not a problem as long as they know about the restrictions.

Photo: Offshore support vessel with two azimuthing thrusters aft and two tunnel thrusters forward (courtesy Otto Candies L.L.C.).



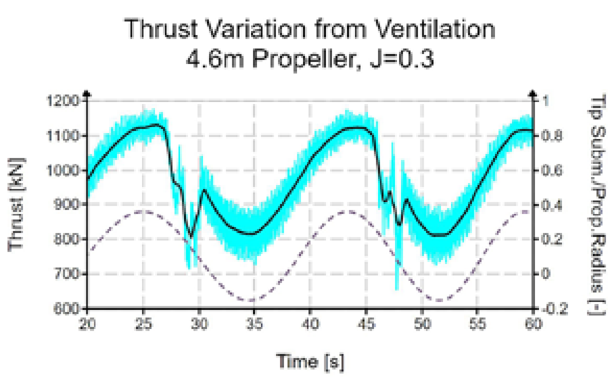
Blade dynamic loads in five wave periods, pulling thruster with open propeller $P_{0.7R}$/ D=0.8, thruster steering angle 0°, advance ratio 0, shaft immersion 1.5R, cavitation numbers ${}_n$=2.0, wave amplitude 1R, wave period 2 seconds (green line). Blade thrust T_{bx}, Blade shaft torque Q_{bx}, blade spindle torque Q_{br} (courtesy Jie Dang, MARIN).



Torque variations and DC bus voltage (courtesy MARIN).

Thruster failure

Failure of internal gears has been reported within a year of operation. One cause of failure has been identified as extreme manoeuvring with azimuth thrusters including thruster-thruster interaction. Another cause is thruster ventilation, which may happen in transit and when on DP.
'Typical damages found in a thruster are one broken tooth of the bevel gear and worn or burnt bearings of the pinion shaft, although many safety factors have already been applied in the design stage, which often include appropriate safety factors for surface pitting damage, sub-surface fatigue, tooth root damage, loss of lubrication film thickness and tooth interior fatigue fracture (TIFF). It is understood nowadays that TIFF is one of the major damage modes that causes the fatal failure of some mechanical azimuthing thrusters. TIFF starts as a small crack below the surface of the active flank, most often within the transition zone between case and core material. During operation, the crack grows gradually without notice inside the tooth towards the root area of the non-active flank. A single high transient load, impurities in the material or inconsistent material treatment (usually carburised case hardening) may be the origin of the initial crack' (Jie Dang et al).



Thrust variation of thirty per cent in 0.5 seconds (blue graph). Tip submergence from 0.4R to -1.4R (dotted black line). Ventilation begins at submergence of 0.2. J = advance coefficient = V/nD (courtesy R.P. Dallinga, MARIN).

Type of thruster	% damage
Main propulsion thruster	23%
DP thruster	7%
Auxiliary thruster	7%

Percentage of mechanical thrusters that experienced damage (averaged classification database).

Components	% damage
Propellers	24%
Gears	12%
Bearings	11%
Ducts	3%
Steering gears	0%

Types of thruster damage (averaged).

The various references do not give any indication of the frequency of these thruster damages, they only refer to the types of damage. Seals may be a problem, which account for a large part of the preventive maintenance of thrusters. Seal leaks may cause water ingress and deterioration of the quality of the lubricating oil. Seal

Thruster ventilation can start a chain of resonance frequencies that lead to damage

leaks can also be the cause of marine pollution by oil leaking out into the environment.
In 2005, Schottel decided to launch a project with regard to the improvement of bevel gears. This was done together with the Dutch company Bierens BV. One reason for this cooperation was the scarcity of bevel gears and Schottel wished to be able to control the process. It could also be the fact that the existing gears at the time were not up to the task with the increasing power of the thrusters.
Other reasons for damage to the thruster and internal gears may be the fact that the resonance frequency for the various components of the thruster may be very close together. For 2.5 to 3 MW azimuth thrusters, the blade frequency at eighty per cent load is very close to the thruster housing resonance frequency, which can be close to the aft ship resonance frequency. Thruster ventilation can start a chain of resonance frequencies that eventually will lead to damage. The thruster gear can easily have thirty per cent peak torque overload without any problems of TIFF.

MARIN Zero Emissions Laboratory

In the past, MARIN has received requests about model testing in order to obtain external forces acting on azimuthing thrusters and efficiency due to wave action and ship's motion. The thruster is ei-

Azimuthing thruster with nozzle, pushing type (top) with below the bevel gear in detail (courtesy Schottel).

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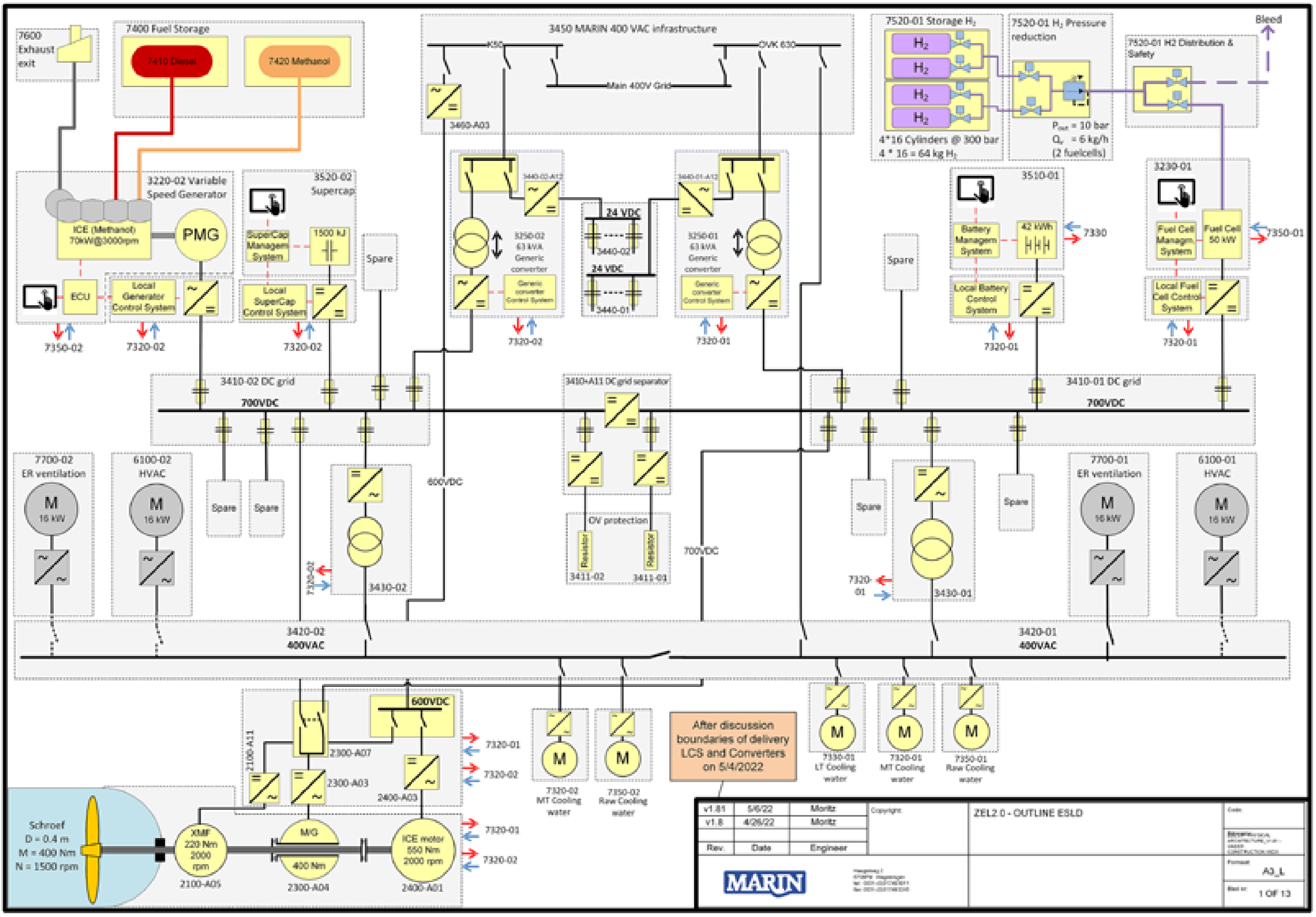


MARIN attached an "engine room" to the electrical motor in order to make the testing of thrusters as realistic as possible.

ther driven by an electrical motor via a gearbox or the electrical motor is in the thruster itself, a "podded" thruster. It is also possible to use an ICE as a motor for the thruster. The electrical motor is controlled by a frequency converter and it could be that the forces acting on the propeller in adverse conditions may cause a situation that can cause a blackout (see the voltage dip graph). MARIN decided to attach an "engine room" to the electrical motor as part of its Zero Emissions Laboratory in order to make the test as realistic as possible, see the diagram above.

The main power is from the power grid at MARIN. This is feeding a split direct current (DC) bus. There is also a split alternating current (AC) bus feeding consumers like:

- cooling water pumps;
- engine room ventilation fans; and
- HVACs (air-conditioning units).

The DC bus can also be fed from a:

- diesel generator using methanol as fuel;
- a super capacitor for high current, low-capacity tests;
- a battery bank for low current, high-capacity tests;
- a fuel cell with hydrogen as fuel; and
- another alternative power source (spare).

The propeller is driven by an AC motor via a VFD. There is also an XMF motor for generating high dynamic torque disturbances, which are validated from model tests and full-scale measurements.

Björn von Ubisch MSc
Naval Architect and Marine Engineer, General Manager of Ubitec Holding BV, bvu@ubitec.nl

MONITOR THE RADAR IN POOR VISIBILITY

Mariners' Alerting and Reporting Scheme

Lookout Offline: Mars 202222

As edited from MAIB (UK) report 14/2021

A small general cargo ship left port in the mid-afternoon in foggy conditions. After the pilot disembarked, the master set the autopilot to steer 129°, increased the ship's speed to 8 knots and released the helmsman to other duties on deck.

Soon, the officer of the watch (OOW) arrived on the bridge and the master handed him the con. The OOW called a crew member to the bridge for lookout duties as visibility was now reduced in fog. He then checked the radar and automatic identification system (AIS) and saw no traffic of concern, so he went to the bridge computer/chart table and undertook administrative duties.

Meanwhile, a fishing vessel was inbound for the same port as the general cargo vessel was leaving. The captain had set a course on the vessel's autopilot of 229 degrees, and its speed was about 5 knots. He was using his radar, switching between various range scales for detection of other vessels, but did not see any. As the vessel approached port, the captain left the wheelhouse and went to the aft deck to check on the deckhand.

At about this time, the OOW on the general cargo vessel now observed a target on the radar at less than 1 nm, about 30 degrees on the port bow. He reduced the radar range scale to 3 nm and checked the AIS for any signal from the target, but none was seen. He instructed the lookout to look for a contact and then joined him on the port side by the closed bridge wing door. They both searched visually, the OOW using a pair of binoculars.

Suddenly, they both saw the fishing boat emerge from the fog, 30 degrees on the port bow. The OOW sounded one long blast on the ship's whistle and then switched the helm to manual control and put the rudder hard-to-starboard. This action was nonetheless too late as the fishing vessel struck the cargo vessel's port side. The fishing vessel's captain and deckhand were thrown to the deck by the force of the collision. Although the crew of the fishing vessel were later rescued, the fishing vessel eventually sank due to an ingress of water.

Investigation findings

The report found, among others, that neither vessel was making sound signals, which could have alerted them to the other's presence. Of course, with the captain of the fishing vessel not even in the wheelhouse, an effective lookout was impossible on that vessel. The report also found that, due to administrative duties that distracted from his navigation, the OOW of the cargo vessel became aware of the fishing vessel's radar return when it was less than 1 nm away. At that range, and with a closing speed of about 11 knots, it gave him only about five minutes to assess the risk of collision and take avoiding action.

The tracks of the general cargo vessel and fishing vessel before they collided.

Lessons learned

- Navigating in fog is not a time to undertake administrative duties in lieu of navigation.
- Some fishing vessels, especially those made of wood as in this report, can give poor radar returns. Constant attention to the radar is needed in poor visibility to detect small targets such as these as soon as possible.
- AIS is a useful tool for detection, but not all vessels, especially fishing vessels, are so equipped.
- This lesson learned is a reoccurring one for Mars Reports: when in doubt, slow down.

Lack of physical barriers invites a tight squeeze: Mars 202224

As edited from the MSIU (Malta) report 02/2022

A small hopper dredger equipped with a deck grab crane was occupied with the refurbishment of a port breakwater. The work involved lifting boulders from the cargo hold with the deck grab crane and positioning them at the breakwater. The chief engineer, who maintained direct contact with the crane operator via a portable radio, was on the bridge overseeing the operation.

The master, who was new to the ship and had joined only two weeks earlier, was occupied with administrative tasks. At one point, he decided to go on deck and check on some recent maintenance work at the bow. He took the access way on starboard side of the cargo hold to reach the forecastle (the port side access way had been cordoned off). During this time, the crane operator, who was placing one boulder in position at the breakwater, noticed the master in proximity of the paint locker. After checking on the maintenance, the master decided to check the status of the boulders in the cargo hold. He climbed the starboard stairs to the cargo hold and looked inside the cargo hold. At this time, the crane operator had the crane's boom in line with the cargo hold and was picking up a boulder from the hold. Within a matter of seconds, the crane turned clockwise towards the breakwater, entrapping the master between the body of the crane and the cargo hold coaming.

The crane operator heard a scream and turned the crane back towards the cargo hold. He immediately noticed the master lying on deck. He raised the alert and the chief engineer, who was on the bridge, called for shore medical assistance.

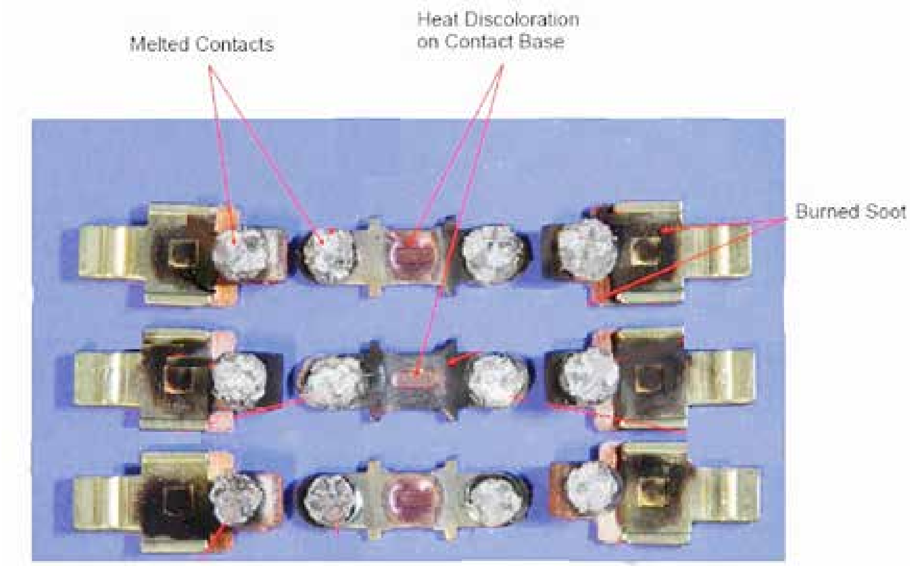
The master was admitted to the local hospital; he had suffered a massive hematoma, muscle laceration of the right abdominal wall, and a fractured vertebrae. The victim was discharged from hospital the next day and received further medical treatment once home.

Investigation findings

The investigation found, among others, that although access to the forecastle from the port side of the cargo hold had been cordoned off by a physical barrier system (a chain), access to the forecastle from the starboard side was unobstructed. Black and yellow ''hazardous area'' markings were painted in a semi-circle on the deck around the crane, extending from port to starboard. But paint markings are a symbolic barrier system and therefore require one's interpretation to be effective (as opposed to a physical barrier system).

Lessons learned

- While symbolic barriers are better than nothing, their effectiveness is debatable. Physical barriers are much better. And an excellent complement to physical barriers are administrative barriers documented in a vessel's safety management system (SMS).
- Mars Report 201851 documents a very similar accident, but one with more serious consequences as the victim, new to the ship, died of his injuries. In that case, not only was there an absence of physical barriers, but no danger warnings were present.



Disassembled contactor during forensic analysis (courtesy of Chevron North America).

Rescue boat davit winch unable to stop hoisting: Mars 202225

As edited from USCG Safety Alert 03-22

A rescue boat was being recovered after normal deployment and maintenance. At one point, the davit operator tried to stop the raising operation, but the hoist button, emergency stop and limit switch circuits all failed to stop the winch. Luckily, personnel were able to disconnect the electrical power via the 480V main breaker before the boat contacted the davit, avoiding serious damages and injury to personnel.

Investigation findings

Metallurgical analysis carried out after the event found that the failure occurred when the winch control contactors fused together due to the duty rating being exceeded. Additionally, it appears that the contactors were not rated for intermittent cycling (repeated start/stop sequences) of the winch. After inspection on other installations, several contactors showed evidence of overheating and indications of welded and scorched contacts were found.

Intermittent cycling is a common practice during recovery of a lifeboat or rescue boat into the stowed position. For example, a winch may be cycled after the boat has cleared the water to verify release gear condition. Or again, it may be cycled as the boat approaches the davit guides/stops to reduce momentum. While intermittent cycling is commonly employed for a safe recovery process, it may in fact cause power to exceed design and duty ratings of the electrical components.

Lessons learned

- Verify the condition of winch motor contactors and replace any contactors that show signs of excessive wear, overheating, or welding.
- Check the duty cycle ratings of lifeboat and rescue boat davit electrical components and compare those ratings to recommended and commonly-practised boat recovery procedures/processes.
- Confirm the design of the davit safety devices (that is, E-stop and limit switches) to see if they will secure electrical power to the motor in the event of welded contacts.
- Implement training for all personnel that operate the davits to ensure awareness related to electrical duty cycles and the actions needed to isolate power in the event of a welded winch motor contactor.

All Mars Reports are also published online, www.swzmaritime.nl.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NUYINA, SPARTACUS AND VIVA COMPETE FOR KNVTS SHIP OF THE YEAR AWARD

The jury of the Maritime Award: KNVTS Ship of the Year 2022 has nominated three ships for the Netherlands' most prestigious maritime award. This year, the battle is between icebreaker Nuyina, dredger Spartacus and superyacht Viva. The award will be presented for the 24th time during the Maritime Awards Gala 2022.

The nominees in random order are:

Antarctic research vessel Nuyina

An icebreaker and a research vessel in one; according to the ship's builder Damen Naval, the Antarctic Supply and Research Vessel (ASRV) Nuyina is the most complex ship ever built by the shipyard. With a length of 160 metres and a cargo capacity of 24,000 tonnes, the Nuyina is said to be the most advanced arctic research vessel in the world. The ship has a range of 16,000 miles at a speed of 12 knots, and can break 1.65 metres of ice at a speed of 3 knots.
ASRV Nuyina is one of the key components of Australia's Antarctic strategy and twenty-year action plan. As an icebreaker, its tasks include supplying Antarctic stations, scientific research, transport, disaster relief, evacuations and carrying out patrols.
The design and construction of the vessel was a multinational effort involving the Australian Antarctic Division, the vessel operator Serco, Danish designers Knud E. Hansen, Damen's engineering and detail design teams and the construction team at Damen Shipyards Galati in Romania. Around 120 Dutch companies from the entire supply chain of Dutch shipbuilding were involved in the project.

The Spartacus is the world's most powerful cutter suction dredger to date (photo Royal IHC).

Cutter suction dredger Spartacus

The Spartacus is the world's most powerful cutter suction dredger to date. It was built by the Dutch shipyard Royal IHC for DEME Group. The 44,18-kW Spartacus is also the first to be powered by liquefied natural gas (LNG). The four main engines can run on LNG, marine diesel oil (MDO) and heavy fuel oil (HFO). The two auxiliary engines also incorporate dual-fuel technology.
The Spartacus features several additional innovations, such as a waste heat recovery system, a one-man operated dredge control and a heavy-duty cutter ladder that can reach a dredging depth of 45 metres.
Its first dredging and land reclamation project was the development of the Abu Qir port in the vicinity of Alexandria in Egypt.

Superyacht Viva

Feadship has built motor yacht Viva for a western foreign account with the brief to design a comfortable ship with free views from the accommodation, environmentally friendly and Tier III compliant.
The Viva is an eco-friendly 94-metre pure custom Feadship with an advanced hybrid propulsion system. This allows Viva to travel a comfortable 12 knots on diesel-electric power. The yacht's consistency in all aspects landed it the 2022 Motoryacht of the Year award at the 2022 BOAT International World Superyacht Awards.
The giant glass construction is a prominent feature in the exterior design by Feadship Studio De Voogt and Azure. Painted in a special pearl-white livery, the hull has been designed, engineered and built to be as efficient as possible and reduce the engine power.

The Nuyina is said to be the most advanced arctic research vessel in the world (photo Damen Naval).

KNVTS Ship of the Year

Ships that qualify for the Maritime Award: KNVTS Ship of the Year 2022 must – especially with regard to innovative aspects – have been developed in the Netherlands, have preferably been built (for at least a

large part) in the Netherlands and must have been delivered between 1 May 2021 and 30 April 2022. The jury assesses the submitted ships against the criteria Design, Economy, Sustainability and Environment, Safety and Construction Process.
The winner will be announced at the Maritime Awards Gala, which takes place on 7 November at De Doelen in Rotterdam, the Netherlands. In total, five awards will be presented. The other four are the Maritime Innovation Award, the Maritime KVNR Shipping Award, the Maritime Designer Award and the Maritime Royal Netherlands Navy (RNLN) Van Hengel-Spengler Award.

Viva has a hybrid propulsion system and is IMO Tier III compliant.

EXCURSION SEPTEMBER

Afdeling Amsterdam
Saturday, 10 September 2022
Summer event: Beach clean-up
Unusual starting time: 10:00
Location: The Spot, Zandvoort
Come and join us to keep our beach clean on Saturday, the 10th of September 2022.

After a heatwave and hot summer, we can only imagine what our beach will look like this year. KNVTS invites you to spend half a day with Daan from Target Earth Foundation and clean Zandvoort's beach. We will provide grabbers, bags, drinks and lunch, all we need is you! Places are limited, so submit your free registration fast. Meeting point at 10:00: The Spot, Zandvoort, a twelve-minute walk north of the train station. More details to come later! Registration through www.knvts.nl ("agenda").

125-JARIG LUSTRUM KNVTS

De KNVTS, oorspronkelijk onder de naam "Vereeniging van Werktuigkundigen ter Koopvaardij" opgericht op 14 mei 1898 in het "Zuid-Hollandsche Koffiehuis" in de Korte Hoogstraat te Rotterdam, bestaat volgend jaar 125 jaar. Aan dit heugelijke feit kunnen we niet zomaar voorbijgaan. Daarom organiseert de KNVTS op 11 mei 2023 in Rotterdam een symposium (maximaal 200 deelnemers) voor haar leden en de maritieme sector met als titel: "De KNVTS peilt".

Aan de hand van praktijkvoorbeelden, demonstraties en lopend onderzoek zal vastgesteld worden waar de sector staat ten aanzien van de hoognodige innovaties. Innovaties met name op het gebied van duurzaamheid en digitalisering. In vervolg op eerdere toekomstvisies en ambities zullen vragen aan de orde komen als:

- Wat hebben we al gerealiseerd?
- Is het noodzakelijk de bakens te verzetten?
- Moeten we alle zeilen bijzetten?

Vernieuwers uit de maritieme sector zullen hierop ingaan en komen vertellen wat er al bereikt is en/of wat zij bereikt hebben. Samen met u zullen we op deze dag de balans opmaken en vooruitkijken. Gedurende de dag kunt u natuurlijk tussendoor en bij de borrel netwerken en bijpraten over ontwikkelingen op uw vakgebied. Zet dus deze dag alvast in uw agenda! Meer informatie volgt na de zomer.

IN MEMORIAM

De heer J.J.H. Post is 12 december 2022 op 82-jarige leeftijd overleden. Hij was het laatst woonachtig in Halfweg en is als senior surveyor werkzaam geweest bij Bureau Veritas in Amsterdam. Hij was ruim 53 jaar lid van de KNVTS.

De heer J. Sizoo is op 84-jarige leeftijd overleden. Hij was het laatst woonachtig in Boekelo en is als directeur werkzaam geweest bij Sizoo-Empes BV in Enschede. Hij was ruim 47 jaar lid van de KNVTS.

STATUTENWIJZIGING AANGENOMEN

Op de Bijzondere Ledenvergadering van de KNVTS van 29 juni jongstleden hebben de leden van de KNVTS unaniem ingestemd met de statutenwijziging van de KNVTS. Hiermee voldoet de vereniging aan de eisen van de WBTR (Wet Bestuur en Toezicht Rechtspersonen). Ook heeft een herstructurering plaatsgevonden van de categorieën leden die lid kunnen worden van de vereniging en heeft een vernieuwing plaatsgevonden ten opzichte van de oude statuten. Vergaderen via bijvoorbeeld het beeldscherm is nu ook in de statuten verankerd. Het Hoofdbestuur is van mening dat de statutenwijziging een goede basis legt voor de toekomst van de vereniging.

VAN DE AFDELING ROTTERDAM

We zijn blij dat de heren Jurjen Berends en Frits van Dongen de vrij gevallen plaatsen in het bestuur van de afdeling Rotterdam, na het stoppen van Wim Veldhuyzen en Martijn Versluis, hebben opgevuld. De samenstelling van het bestuur is nu als volgt:

- Voorzitter: vacant
- Secretaris: Jurjen Berends
- Penningmeester: Roel van Eijle
- Communicatie: Fleur Bakkum
- Lid: Mees van Wijngaarden
- Algemeen Adjunct: Frits van Dongen
- Adviseurs: Wim Veldhuyzen en Martijn Versluis

Het bestuur is ook nog op zoek naar een KNVTS-vertegenwoordiger die binnen de afdeling Rotterdam de contacten met de bedrijven en sponsoren aanhaalt.

Huishoudelijke zaken

Aanmelden voor de lezing: aanmelden voor een lezing hoeft niet. De secretaris zal bij lezingen een presentielijst maken en deze zal tijdens lezingen rondgaan om de naam en het e-mailadres van de aanwezigen te noteren.

Keuze huisvesting afdeling Rotterdam: binnen het ledenbestand van de afdeling Rotterdam wordt elke keer de opmerking gemaakt over de huisvesting waar vergaderd wordt of waar lezingen gehouden worden. Onze vorige huisvesting was in het Deltahotel in Vlaardingen. Dit werd door een aantal leden zeer op prijs gesteld. Enkele jaren geleden hebben we toch voor De Machinist gekozen. Dit vanwege bereikbaarheid met het openbaar vervoer en de kosten. Na discussie heeft het afdelingsbestuur besloten in de nabije toekomst bij De Machinist te blijven. Lezingen zullen dan ook voorlopig daar gegeven worden.

Studenten

De KNVTS heeft qua leeftijdsopbouw behoefte aan meer instroom van jonge mensen. Zij zijn de toekomst voor de vereniging. Daarnaast is het van belang ouderen en jongeren te laten leren van elkaar. Vanuit de afdeling Rotterdam zal Frits van Dongen samen met Martijn Versluis het "studentenvraagstuk" oppakken.

Lezingenprogramma

Juli en augustus is voor velen van ons vakantietijd. Daarna zullen we de reguliere lezingen weer oppakken. Onze reguliere lezingen zullen plaatsvinden op de vierde donderdag van de maand. Hiervan kan in april in verband met Koningsdag, mei in verband met Hemelvaartsdag, juni in verband met Pinksteren en december in verband met kerst worden afgeweken. De lezingen starten steeds om 19.45 uur bij De Machinist, Willem Buytewechstraat 45, Rotterdam.

- Op 22 september verzorgt Edward Heerema (President Allseas) een lezing op de TU in Delft. Hiervoor zijn de leden van KNVTS uitgenodigd. Verdere berichtgeving hierover volgt, zie ook de website van KNVTS en KIVI/Martec.
- Op 27 oktober komen de drie genomineerde werven voor de KNVTS Schip van het Jaar-prijs 2022 ons vertellen waarom zij in aanmerking komen voor de meest prestigieuze maritieme prijs van Nederland welke uitgereikt gaat worden op het Maritime Awards Gala op 7 november in de Doelen in Rotterdam.
- Op 24 november zijn Erik Klok en Sander Wolthuis uitgenodigd om een lezing te verzorgen met als onderwerp "Asset and maintenance".
- Op 26 januari 2023 verzorgt de afdeling Rotterdam de gebruikelijke nieuwjaarsreceptie met aansluitend een lezing.
- Op 27 april 2023 zal de KNVTS/CEDA combi-lezing worden georganiseerd.
- Daarnaast zijn er lezingen gepland op 22 december, 23 februari 2023, 23 maart 2023 en 25 mei 2023. De invulling van deze lezingen wordt op een later moment bekendgemaakt.

Te beantwoorden vragen voor onze afdeling

Vragen die wij onszelf stellen en die nog nadere uitwerking behoeven zijn onder andere: Hoe denken wij over Engelstalige lezingen in de toekomst? Wij zullen in Rotterdam bij uitzondering ook Engelstalige lezingen gaan houden om ook Engelstalige medewerkers van ondernemingen, KNVTS-leden of wellicht aankomende KNVTS-leden te bereiken. Wanneer er personen zijn die Engelstalige lezingen willen geven en zich hiervoor geroepen voelen, kunnen zich aanmelden bij het afdelingsbestuur.

Daarbij kunnen we ook de contacten met zusterverenigingen verstevigen. Hierbij kan gedacht worden aan KIVI Martec, CEDA, M.I.D., Brabo en Gallois. Vooraf is het echter van belang dat we binnen ons afdelingsbestuur duidelijkheid hebben over het functioneren en de organisatie van de afdeling.

Oproep

Wanneer er ideeën en/of zaken zijn die tot bloei van onze afdeling kunnen leiden zijn deze van harte welkom.

GREEN EVENTS AND NEW BOARD MEMBERS AT KNVTS AMSTERDAM

Just before the summer holidays started, the KNVTS Amsterdam board came together to discuss its next live events, starting right after the holidays. The details of these will be revealed in due time. For now, know that we will keep our focus on sustainability and green initiatives. In September (see the excursion mentioned separately), we will take action and contribute to a beach clean-up, where we will have the possibility to be directly involved and learn more about how we can keep the sea safe and clean.

This is just the beginning of the new KNVTS Amsterdam series of events. Be prepared, for example, for our participation at METSTRADE, with interesting lectures and networking occasions.

A new season full of events is not the only news at KNVTS Amsterdam: two members of our board, Kevin Roos and Mariana Candella, have decided to leave and we would like to thank them for their work and dedication over the past years, as well as wish them the best of luck for their future. Their contribution has been essential in making KNVTS Amsterdam what it is today and we are really looking forward to meeting them again at our events.

Luckily, we are happy to announce that two new members are ready to join our board: Alican Kilinc and Carolina Ulloa Parra, whose new ideas, experience and enthusiasm will be fundamental for our future initiatives. We are glad to share with you their introduction in their own words:

Alican Kilinc: 'I am a passionate sailor.'

Alican Kilinc

I'm 38 years old, living in Brielle with my girlfriend and two cats. I studied naval architecture and marine engineering at TU Istanbul and graduated in 2007. In the past, I have worked for various companies in different positions, such as as a naval architect, senior shipbuilding engineer, sales manager, and project manager engineering. I moved to the Netherlands in 2013, which has been a great decision so far.

Three years ago, I started my own company (consultancy and marine equipment sales) to bridge my network in Turkey and the Netherlands. Currently, I am working on a project at Feadship (Royal van Lent shipyard) as project manager engineering. I have worked on many offshore, workboat, highspeed and commercial vessel projects and am now enjoying the superyacht world as well.

I like making music and playing guitar, reading and I am a passionate sailor. I also love refitting sailboats as a hobby and as small side projects. I am quite a social person and already very excited about being onboard of KNVTS, which is a great heritage.

Carolina Ulloa Parra

I was born and raised in Chile where I studied Civil Industrial Engineering at the University of Concepcion. I am passionate about sustainability, networking, and events.

In 2007, after a couple of years of working in the telecommunication sector (Movistar), I moved to New Zealand, where I confirmed my passion for events. The same year I moved to Spain to acquire a deeper knowledge of corporate events with a post grade in Event Management in Barcelona.

In 2015, after eight years of working between Barcelona and Madrid, I decided to move to Amsterdam where I have worked in different sectors within the event industry like in the pharmaceutical sector (UBM) and the publishing industry (Elsevier). I currently work as Event Partnership Manager at The Next Web (a media and event company focused on technology and startups).

For the last four years, I have lived in Amsterdam West. I love this city, especially the freedom that the bike gives you. In my free time, I enjoy being outdoors and participating in/organising environmental events. It's my honour to join the KNVTS Amsterdam board to help with the organisation of its events.

Carolina Ulloa Parra: 'I am passionate about sustainability, networking, and events.'

SWZ|Maritime is onder meer het periodiek van de Koninklijke Nederlandse Vereniging van Technici op Scheepvaartgebied, opgericht in 1898. SWZ|Maritime verschijnt elfmaal per jaar. Het lidmaatschap van de KNVTS bedraagt € 88,00 per jaar, voor juniorleden € 39,00 per jaar, beide inclusief dit periodiek. Een digitaal lidmaatschap (alleen voor studenten) kost € 15,00 per jaar. Het geeft u de vooraankondigingen van de maandelijkse lezingen, te houden op vier verschillende plaatsen in Nederland en korting op verschillende activiteiten. U kunt zich opgeven als lid bij de algemeen secretaris van de KNVTS, Zeemansstraat 13, 3016 CN Rotterdam, e-mail: secretariaat@knvts.nl of via het aanmeldingsformulier op de website: www.knvts.nl.


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Hoofdredacteur: A.A. Oosting
Eindredactie: mevr. M.R. Buitendijk-Pijl, MA
Redactie: G.J. de Boer, Ir. H. Boonstra, Ir. A. de Bruijn, M. van Dijk, mevr. Ing. A. Gerritsen, Ir. J. Huisman, Ir. J.H. de Jong, Ir. W. de Jong, H.S. Klos, Capt. H. Roorda, B. von Ubisch, MSc, E. Verbeek, B. Lenferink (SG William Froude)
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Redactieadres
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