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In this inland navigation special, we look at some of the vessels and concepts currently being developed or built. Topcis include the STC's Ab Initio, the Parsifal tankers, the PortLiner Anna, river cruiser A-Rosa Sena and Novimar.

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The Maritime Research Institute of the Netherlands (MARIN) has tested three innovative barriers to prevent collisions between ships and wind turbines. The immediate cause for this research was the incident with the Julietta D.

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The world's largest civilian hospital ship is entirely crewed by volunteers. Thousands of visitors toured the ship during its goodwill visit to Rotterdam. SWZ|Maritime reports from the ship.

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Cover: With the Blue Marjan, Concordia Damen delivered the first of forty Parsifal tankers for Shell. The ship is named after Marjan van Loon, managing director of Shell Netherlands (photo Maritime Filming Group).

Bio-LNG, H_2, CH_3OH or with batteries

First our apologies to our English-speaking readers for writing this April issue mainly in Dutch. Although the Central Commission for the navigation of the Rhine (CCR) publishes in French, English, German and Dutch, inland navigation has so many Dutch stakeholders that we address them in their native language. But don't forget the interesting articles in English.
En dan nu verder in het Nederlands. Onze aprileditie focust op de binnenvaart met het oog op de beurs Maritime Industry in mei, het belangrijkste binnenvaartgebeuren in Nederland. In Europa mag de binnenvaart misschien niet de belangrijkste transportmodaliteit zijn, maar wel in Nederland, België, Duitsland, Zwitserland en Frankrijk.
De binnenvaart stond altijd te boek als het milieuvriendelijke alternatief voor het wegvervoer, maar dankzij steeds schonere motoren voor trucks en kortere afschrijving gaat de energietransitie daar nu sneller dan in de binnenvaart. Die maakt op enkele uitzonderingen na, nog steeds bijna uitsluitend gebruik van diesel in verbrandingsmotoren. En als politiek en overheid de oorlog hebben verklaard aan fossiele brandstoffen die het klimaat bedreigen, dan heb je als schipper een probleem.
Want terwijl bij de grote containermaatschappijen de miljoenen maar blijven binnenstromen, blijft de binnenvaart met het concurrerende spoor- en wegvervoer vechten om marktaandeel.
Maar één ding staat vast: ook de binnenvaart moet vergroenen. De vraag is alleen nog welke brandstof het meest geschikt is – waterstof, bio-LNG, methanol al dan niet in combinatie met batterijen – en wie die energietransitie gaat betalen. Ondertussen wordt er volop geëxperimenteerd met klimaatvriendelijkere schepen. Op een door de CCR georganiseerde grote binnenvaartconferentie op 10 en 11 februari dit jaar gaf Bas Joorman, binnenvaart-productmanager van Lloyd's Register een actueel overzicht van alle projecten voor schepen op waterstof: de ombouw van het droge-ladingschip MSC Maas, het nieuwe 135 meter lange droge-ladingschip Antonie, de ombouw van de tanker Volendam, het nieuwe opleidingsschip voor STC, een nieuw schip voor de haven van Amsterdam, de bouw van een 86 meter lang beunschip, een 135 meter lang containerschip en de ombouw van nog een beunschip. Best een indrukwekkende lijst. Maar er gebeurt nog veel meer interessants in de binnenvaart en wie kan daar dan beter over berichten dan onze collega-redacteur en oud-Schuttevaer-bestuurder Martin van Dijk die borg stond als trekker van deze binnenvaartspecial.

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SWZ'S EDITORS

First Dutch hydrogen-powered newbuild inland navigation vessel launched

The Dutch Minister of Infrastructure and Water Management, Mark Harbers, officially launched the first newly constructed hydrogen-powered inland navigation vessel Antonie on 30 March. The project is a collaboration between Nedstack, Nobian, Lenten Scheepvaart, Concordia Damen, Energy TransStore and the inland shipping cooperative NPRC. The Antonie is scheduled to enter service in mid-2023 and will sail emission-free.

The Antonie will sail emission-free from mid-2023.

Shipping Technology starts on fourth test ship

Shipping Technology has started testing its autonomous product on its fourth official test ship between Antwerp and Delfzijl with the tanker Experience (dimensions: L x W = 135 x 11.45 metres, tonnage: 4558).
Thanks to the Smart Shipping (SMASH) programme and Rijkswaterstaat (the Directorate-General for Public Works and Water Management), they are able to test the first autonomous Shipping Technology product, which they will be launching shortly. This product will be introduced to the market after a very minute and intensive testing and development process at expert level that has been running since August 2020.
Smart Shipping is about far-reaching automated shipping at sea and on inland waterways. This does not only involve technology on board ships. It also includes the design of the environment in which ships operate. Ships can then respond automatically to their environment by means of smart technology. For example, with sensors that detect environmental information. With this information, a ship can take action itself by means of smart technology or propose action to the crew. One example is using a sensor to measure the bridge height from the ship.

Second river cruiser awarded Green Award Gold certificate

River cruiser Spirit of the Danube (dimensions: L x W = 135 x 11.45 metres - 190 pax) has become the second river cruiser, after the Spirit of the Rhine, to receive the Green Award Gold certificate. The certificate was presented in Rotterdam in March 2022.
Both ships are equipped with marinised Scania engines and are Stage V approved.
The Green Award Rotterdam Foundation now has 1000 certified ships in inland shipping, 116 of which are in the river cruise sector. The Foundation's objective is a certification and incentive programme for shipping that contributes globally to sustainable waterborne transport.

Viking expands European river cruise fleet with eight new ships

Viking has welcomed eight new river cruise ships to its fleet during a celebration in Paris. Of the eight new Viking Longships, four are built specifically to navigate the Seine River. The other four will sail the Rhine, Main and Danube.
The naming of the new river ships comes as Viking Cruises continues its 25th anniversary and a year of multiple milestones.
In January 2022, the company launched Viking Expeditions and its first Polar Class vessel, the Viking Octantis. By the end of the year, Viking will have welcomed a second identical expedition ship, as well as two new identical ocean ships, new purpose-built vessels for the Nile and Mekong rivers and new Mississippi river voyages.
The Viking Fjorgyn, Viking Kari, Viking Radgrid and Viking Skaga will sail on the Seine River. The other four ships are the Viking Egdir, Viking Gersemi, Viking Gymir and Viking Hervor. The latter four measure 135 metres and can accommodate 190 guests and fifty crew. The vessels sailing the Seine are 125 metres long and can accommodate 168 guests and 46 crew.
More attention has also been paid to more environmentally friendly cruising. Two of the ships, the Viking Gymir and Viking Egdir, can run on batteries for sixty minutes during mooring and/or departure within urban environments. This is a progressive innovation to improve the environment.

Viking Longship on the Rhine River.

Robotics are to make northern Dutch shipyards future-proof

The Province of Groningen is granting the Groninger Maritime Board (GMB) a 250,000-euro subsidy for the feasibility study "Shared facility for the northern Dutch shipbuilding industry". This project will investigate how robotisation can be applied in the northern shipbuilding industry to improve the productivity of the entire chain.

The future of the northern shipbuilding industry is under pressure and orders are being lost because of too high costs. Cooperation is essential to maintain the maritime sector and employment in the northern part of the Netherlands. The outcome of the project will decide whether a robotics facility will be built.

The "Shared facility" project consists of various applications: from automated assembly of steel plates and profiles, to welding micro panels together in a central robot line. Automated processes increase quality and shorten lead times, allowing more ships to be built per yard each year. This increases employment in shipbuilding and among suppliers.

Fender Innovations acquires PolyMarine Service

Fender Innovations from Wieringerwerf, the Netherlands, manufactures lightweight fender systems for fast-sailing vessels. The company has now completed the acquisition of PolyMarine Service, based in Vlaardingen, which produces cast fender systems for slightly heavier workboats.

Both companies will now form part of the Fender Innovations Group. PolyMarin will change its name to Poly Marine Fender Systems to better reflect the scope of the business, but it will continue to operate from its current location. Because many of the customers of Fender Innovations are located in the Port of Rotterdam, it is useful to also have a production location and a warehouse in this area.

For Fender Innovations, this is the first acquisition since the company was founded in May 2012. The company continues to grow and has reported a 25 per cent rise in production across the whole of 2021. Some 85 percent of the fenders manufactured by the company are intended for export to around forty different countries. Although the shares of PolyMarine Service were officially transferred on 24 March, the acquisition of the company is effective from 1 January 2022.

Value Maritime CEO wins Young Entrepreneur Award at Nor-Shipping

Maritime trade fair Nor-Shipping has presented its Young Entrepreneur Award to Christiaan Nijst, Founder & Director of Dutch company Value Maritime. The award is a joint initiative between Nor-Shipping and YoungShip International showcasing emerging maritime talent and solutions (all nominees must be under the age of forty). Nijst caught the judges' eyes for his ambition with the firm's Filtree System. This exhaust gas cleaning system filters sulphur as well as (ultra-fine) particulate matter out of the exhaust, while ensuring the wash water used is filtered and neutralised before discharge.

In addition to the Young Entrepreneur Award, Nor-Shipping also presented the Next Generation Ship Award and the inaugural Ocean Solutions Award. The first was awarded to Havila Voyages' battery and LNG powered coastal cruise ferry Havila Capella. The battery packs were, at the time of delivery, the world's largest on board a ship, with an output of 6.1 MW. The vessel was built at Tersan Shipyard in Turkey. The first Ocean Solutions Award is meant for breakthrough innovations at, or approaching, the commercialisation stage. It went to Daphne Technology for a solution that simultaneously reduces all toxic and climate pollutant emissions for ships powered by heavy/residual fuel, LNG, and future fuels.

Nor-Shipping took place from 4 to 7 April at Oslo, Norway.

Alewijnse and Seafar join forces to help make autonomous shipping a reality

Alewijnse and Seafar have joined forces to further the development of autonomous shipping. They will work on the integration of Alewijnse's onboard remote control systems and the optimisation of technical maintenance and support.

In the future, captains will work ashore instead of on board, Seafar believes. From a control centre, each captain will direct several ships at once on different canals and rivers. Only a few sailors will be on board for maintenance, docking and (un-)loading. Should an emergency arise, a helmsman on the bridge can take temporary control of the ship. Seafar has already made this semi-autonomous sailing a reality by controlling ten ships from a control room in Antwerp, and it is planning similar facilities in Namur and Dordrecht. The company aims to have thirty new and existing ships operational, in both inland and coastal shipping, by the end of the year.

With Alewijnse, the company wants to work on innovative systems that connect with electrical equipment on board to enable remote maintenance and other interventions directly from the control centres.

Seafar captains direct ships remotely from a control room and steer up to three ships at a time.

IN DEBAT ENERGIETRANSITIE BINNENVAART MAG REALISME NIET ONTBREKEN

De transitie naar een binnenvaart die geen klimaatbedreigende CO_2 meer uitstoot, vergt veel onderzoek naar nieuwe technische oplossingen, nieuwe brandstoffen en heel veel investeringen in nieuwe en/of ombouw van schepen en infrastructuur om de benodigde brandstoffen te kunnen produceren en beschikbaar te maken. Een uitspraak dat de binnenvaart binnen tien jaar emissieloos kan varen is wat dat betreft dan ook volstrekt onrealistisch, maar helaas politiek en mogelijk juridisch wel relevant. De noodzaak om de binnenvaart sneller te vergroenen wordt dan ook alleen maar dwingender.

Nu als gevolg van de oorlog in Oekraïne de AdBleu, nodig om diesel gestookte motoren te kunnen laten voldoen aan Europese uitstootnormen (euro 4, 5 en 6), peperduur is geworden, heeft niet alleen de binnenvaart, maar ook het concurrerende wegvervoer een immens probleem. Maar dat maakt de noodzaak de binnenvaart te vergroenen er niet minder om, omdat tot nog toe de ontwikkeling van schonere motoren voor het wegvervoer sneller verloopt dan voor de binnenvaart. Tegenover het wegvervoer is de binnenvaart een veel kleinere bedrijfstak. Het wegvervoer is dan ook veel interessanter voor de motorenbouwers en het ontwikkelen en/of aanpassen van motoren speciaal voor de binnenvaart is dus aanzienlijk duurder.
De binnenvaart hoeft echter niet te rekenen op realisme in de politiek en begrip voor deze speciale problematiek van de energietransitie van

motoren en brandstoffen voor de binnenvaart. Een voorbeeld daarvan is de uitspraak van mr. drs. Marjan Minnesma van milieubeweging Urgenda die eind maart in Weekblad Schuttevaer vaststelde dat de binnenvaart binnen tien jaar emissieloos moet kunnen varen. De NGO Urgenda is naar eigen zeggen een organisatie voor innovatie en duurzaamheid die Nederland sneller duurzaam wil maken.

Uitspraak Hoge Raad

De als bedrijfskundige, jurist en filosoof opgeleide Minnesma boekte naam en faam toen ze in 2019 met een uitspraak in cassatie van de door haar bij de Hoge Raad aangespannen zaak de regering dwong de uitstoot van het broeikasgas CO_2 sneller (-25 procent) terug te dringen dan was gepland. Deze uitspraak kost de Nederlandse staat honderden miljoenen euro's en door de opgelopen energieprijzen misschien wel anderhalf miljard extra (NRC, 4 april) vanwege de door het rijk opgelegde productiebeperkingen voor kolencentrales.
Nu heeft Minnesma haar pijlen gericht op andere sectoren, waaronder de binnenvaart. Volgens haar is binnen tien jaar emissieloos varen haalbaar door meer in te zetten op wind- en zonne-energie. Daarmee moet waterstof en ammoniak worden gemaakt waarop de binnenvaart emissieloos zou kunnen varen. Ze vindt dat pas emissieloos varen in 2050 te laat is. Binnenvaartondernemers moeten volgens haar nu al nadenken over hoe ze over tien jaar naar nul uitstoot kunnen gaan.

Routekaart van CCR

Met haar uitspraken in Schuttevaer reageerde Minnesma op de onlangs door de CCR (Centrale Commissie voor de Rijnvaart) gepubliceerde "Routekaart voor het terugdringen van de emissies in de binnenvaart". Dat de binnenvaart moet verduurzamen is duidelijk. In 2018 legden de transportministers van de Rijnoeverstaten dat al vast in de Verklaring van Mannheim en gaven zij de CCR opdracht voor het opstellen van een routekaart. Hierin gaat de CCR ervan uit dat de binnenvaart de uitstoot van klimaatbedreigende gassen (onder andere CO_2) in 2035 met 35 procent ten opzichte van 2015 moet hebben verminderd en in 2050 emissievrij moet kunnen zijn.
Een ander belangrijk punt van kritiek van Minnesma is dat de CCR in

haar routekaart voor de berekening van de uitstoot uitgaat van een *tank-to-wake*- (TTW-)benadering. Hierbij wordt alleen de uitstoot bij het verbruik meegenomen en niet gekeken naar de emissies die vrijkomen bij de fabricage van de brandstof. Dat geeft volgens haar een versluierd beeld van de emissies.

Waterstof uit elektrolyse

De TTW-benadering is volgens de opstellers van de Routekaart ook slechts een tussenoplossing totdat er een *well-to-wake*-benadering (WTW, ofwel van bron tot verbruik) beschikbaar is voor de desbetreffende energiedragers. De CCR erkent ook dat de TTW-benadering mogelijk te optimistisch uit zou kunnen vallen. Voor bijvoorbeeld de productie van waterstof geldt dat dit nu vrijwel uitsluitend kan via elektrolyse wat veel, met fossiele brandstoffen opgewekte, stroom kost. De plannen voor de productie van waterstof via windenergie in een fabriek op zee moeten bijvoorbeeld nog werkelijkheid worden.
In tegenstelling tot wat Minnesma suggereert, wil de vereenvoudigde TTW-benadering allesbehalve zeggen dat de CCR de energietransitie niet serieus neemt, integendeel. Energietransitie vormt volgens de CCR 'een cruciale uitdaging voor de Rijnvaart en Europese binnenvaart'. Alleen als de binnenvaart bereid is te werken aan de overgang naar klimaatneutrale voortstuwingen, zal politieke steun voor haar verdere ontwikkeling blijven bestaan op lange termijn, waarschuwt de CCR. Als de binnenvaart in het transitieproces achteropraakt, zou de transportvraag wel eens kunnen verschuiven naar andere vervoersmodaliteiten.

Relatief kleine markt

Ook signaleert de CCR dat de Europese markt voor binnenvaartschepen relatief klein is en dat specifieke technologische oplossingen hiervoor commercieel niet rendabel zijn. Het is daarom onwaarschijnlijk dat er een technologische oplossing specifiek voor de binnenvaartsector zal worden ontwikkeld. De CCR laat verder geen misverstand bestaan over de energietransitie in de binnenvaart. 'Het zal duidelijk zijn dat een verregaande reductie van zowel broeikasgassen als luchtverontreinigende stoffen door de binnenvaart tegen 2050 niet langer een optie is, maar een noodzaak als de binnenvaart haar positie als concurrerende, duurzame en milieuvriendelijke vervoerswijze wil behouden en versterken.'

Twee transitietrajecten

De routekaart schetst voor de vloot twee transitietrajecten. Eén meer conservatief traject gebaseerd op technologieën die zich al hebben bewezen en die op korte termijn kostenefficiënt zijn, maar die onzekerheden inhouden over de beschikbaarheid van bepaalde grondstoffen, en een meer innovatief traject. Bij het eerste is te denken aan biodiesel en vloeibaar biomethaan (of bio-LNG). Samen met een beperkte inzet van moderne technologieën zoals brandstofcellen en batterijen, zou dat al voldoende moeten zijn om de doelen van 2035 te halen.
In het innovatievere traject moet worden gekeken naar technologieën die nu nog in de kinderschoenen staan, maar op langere termijn veelbelovend zijn. Daarbij moet worden gedacht aan grootschalige elektrificering met batterijen en/of waterstof of methanol al dan niet in brandstofcellen omdat daarmee nul uitstoot is te bereiken. Voor de uitgebreidere WTW-benadering zou echter ook moeten worden onderzocht hoe duurzaam de productie van alternatieve energiedragers is. Bovendien hangen de emissies samen met andere aspecten van de levenscyclus van het schip en de voortstuwing, zoals de bouw, het onderhoud en de sloop van het schip.

Geen *one size fits all*

Al met al is dat zeer complex en dat kan de ontwikkeling van duurzame technologieën voor de korte termijn in de weg staan. Later kan alsnog op WTW worden overgeschakeld. Een belangrijke conclusie is dat er geen technologische *one size fits all*-oplossing is voor alle schepen en vaarprofielen. Om de energietransitie te realiseren moet daarom gezocht worden naar een technologie-neutrale benadering.
In de twee transitietrajecten schetst de CCR ook een toekomstbeeld van op welke brandstoffen verschillende scheepstypen naar verwachting zullen gaan varen. Voor schepen met hoge vermogens zoals duwboten verwacht de CCR in het conservatieve traject dat dit vooral biodiesel en bio-methaan of bio-LNG zullen zijn. Droge-ladingschepen varen dan vooral op biodiesel of bio-methaan (of bio-LNG) gecombineerd met methanol, waterstof en batterijen. Batterijen zullen vooral verschijnen in veerponten en dagtochtschepen. Het gebruik van waterstof op grotere schaal voorziet de CCR vooral in de grote rivier-cruiseschepen.

> Verregaande emissiereductie in de binnenvaart is niet langer een optie, maar een noodzaak

Grote vermogens

In het innovatievere traject, dat dus afhankelijk is van flinke overheidsinvesteringen in onderzoek en ontwikkeling, voorziet de CCR voor 2050 op veel ruimere schaal de toepassing van combinaties van het gebruik van waterstof en methanol, direct ingespoten in aangepaste verbrandingsmotoren dan wel vanuit brandstofcellen. Alleen voor de duwboten met de grootste vermogens (>2000 kW) blijven dan biodiesel en bio-methaan of bio-LNG de meest geschikte brandstoffen.
Ondertussen blijft de vraag wie de energietransitie gaat betalen. Voor het conservatieve transitietraject schat de CCR de kosten op € 2,43 tot 6,38 miljard. Het innovatieve transitietraject komt volgens de CCR uit op € 5,26 tot 10,19 miljard, al naar gelang de inflatie. Dat zijn bedragen die de binnenvaartsector alleen niet kan ophoesten.

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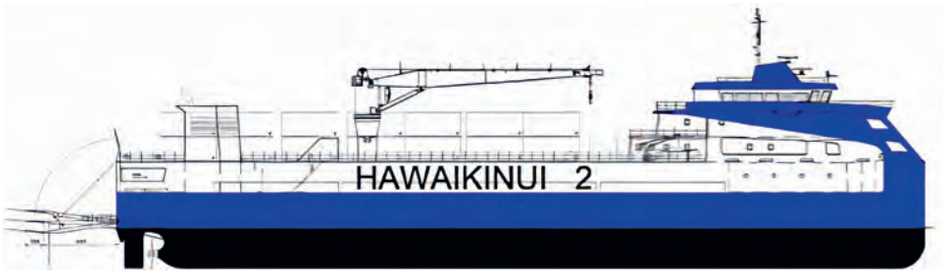

The ro/ro-vessel Hawaiki Nui 2 for Polynesia.

NEW ORDERS

Hawaiki Nui 2

Polynesian Navigation Company (SNP Société de Navigation Polynesiènne), Papeete, contracted Royal Bodewes Shipyards, Hoogezand, for building and delivery of the 1600 DWT ro/ro-vessel Hawaiki Nui 2 (yard number 810) on 4 March. The new vessel will replace the Hawaiki Nui (1980 – 895 GT) on the route between Tahiti, Huahine, Raiatea, Taha'a and Bora Bora for the transport of containers, trailers and general cargo. It will sail this route twice a week with a service speed of 12 knots. The Bureau Veritas classed Hawaiki Nui 2 (87 x 16 metres) is scheduled for commissioning early 2025.

Eloisa Eslea

Inverlussa Marine Services, Craignure, Isle of Mull, contracted Nauplius Workboats BV, Groningen, to build two hybrid aquaculture service vessels type UV 2713 on 25 February. The UV 2713 was designed by the in-house engineering company Argos Engineering. Construction of the first vessel, the Eloisa Eslea (yard number N022) has started and is scheduled for delivery at the end of this summer. Yard number N023 is to be delivered in December.

The details of the UV 2713 are: Loa (pp) x B x D (d) = 95 (23.99) x 13.50 x 3.50 (2.87) metres, air draught circa 17.00 metres. The diesel-electric installation includes three Mitsubishi main diesel generators, type S6R2-T2MPTK (170 x 180), 3 x 640 kW at 1500 rpm, for powering both propulsion (two Veth azimuth thrusters, type VL-400si (2 x 500 kW) and a Veth bow thruster, type VT 240 (250 kW)) and treatment equipment such as twin triple vacuum pumps and twin drum filters. The bunker capacity is 62 m^3. The three HS Marine deck cranes, type AK 48/18,5 E5, each have a lifting capacity of 1100 kgs at 18.55 metres.

The hybrid aquaculture service vessel Eloisa Eslea.

LAUNCHINGS

Arklow Coast

At Ferus Smit, Westerbroek, the Arklow Coast (yard number 431, imo 9757151) was launched on 26 March after Magdalena de Zwarte, wife of Erwin de Zwarte, senior chartering broker of Arklow Shipping, had performed the christening ceremony.

The Arklow Coast is the eighth in a series of ten (photo F.J. Olinga).

The details of the Trader 5150 are: 2910 GT, 1692 NT, 5085 DWT, Loa (II) x B x D (d) = 87.40 (84.99) x 15.20 x 7.12 (6.26) metres. Propulsion is provided by a MaK main engine, type 6M25 of 1740 kW, on a controllable pitch propeller in a nozzle for a speed of over 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. The Arklow Coast is the eighth ice class 1A Trader 5150 in a series of ten to be built for Arklow Shipping ULC, Arklow. The Arklow Coast is scheduled for delivery at the end of April.

Aquadelta

At Wartena, Bijlsma launched the Water Injection Dredger (WID) Aquadelta (yard number 388, imo 9941831) for Van der Kamp BV, Zwolle, on 1 April. The keel had been laid on 12 April 2021. The diesel-electric WID was designed by Conoship International BV, Groningen.

The details of the Aquadelta are: 497 GT, 149 NT – Loa (pp) x B x D (d) = 48.08 (39.36) x 12.00 x 3.65 (2.30) metres. The energy is generated by five dual-fuel Paccar-DAF main engines, type MX-13 390 (130 x 162), with a total output of 2560 hp or 1950 kW at 1675 rpm reduction geared to propeller shafts driving two propellers. The Bureau Veritas classed Aquadelta is intended to inject large volumes of water into the waterbed, fluidising the sediment so that it can flow naturally to other deeper areas.

The Water Injection Dredger Aquadelta (photo Dikken en Hulsinga).

DELIVERIES

VB Caiman, VB Cormoran and VB Orca

Damen Song Cam Shipyard JSC, Haiphong, has delivered two ASDs 2811 and one ATD 2412 to Tug Services Panama S.A. (Boluda Corporation) for towage services at Balboa. The new tugs sailed from Haiphong to Balboa on their own keel and arrived on 28 February and 11 March. The ASDs 2811, VB Caiman (yard number 513203, imo 9831127) and VB Cormoran (yard number 513213, imo 9886108) were launched on 1 October 2018 and 12 May 2021 respectively.

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, total output 3806 kW or 5104 hp at 1800 rpm, on two RR rudder propellers, 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 69.4 m^3.

The ATD 2412 VB Orca (yard number 545024, imo 9858266) was launched on 11 June 2019. The details of the ATD Tug 2412 are: 299 GT, 89 NT – Loa (pp) x B x D (d) = 24.74 (22.22) x 12.63 x 5.95 (6.45) metres. Propulsion is provided by two Caterpillar main engines, type 3516 TA HD, with an output of 4200 kW or 5632 hp at 1600 rpm on two RR rudder propellers, type US 255 with a diameter of 2800 mm, for a bollard pull of 70 tonnes and a speed of 12 knots. The bunker capacity is 71,8 m^3. All tugs have been built under class of Lloyd's Register.

Two ASD tugs 2312

Damen Song Cam Shipyard JSC, Haiphong, has delivered two ASDs 2312 to Canadian principals. The Saam James Point (yard number 513612, imo 9901946) was delivered to SAAM Towage Canada Inc., North Vancouver BC, on 25 February. The Ocean Yaletown (yard number 513610, imo 9901922, originally Ocean Gastown) was taken over by Location Ocean Inc., Quebec QC, on 6 February and arrived in North Vancouver BC on 17 March.

The technical details of the Bureau Veritas classed ASD 3212 are: 263 GT, 210 NT – Loa (pp) x B x D (d) = 22.81 (20.43) x 12.03 x 4.41 (3.50) metres. Propulsion is provided by two Caterpillar main engines, type 3512C TA HD/D (170 x 215), with a total output of 3805 kW or 5168 hp at 1800 rpm on two RR azimuth thrusters, type US 205S with a diameter of 2800 mm, for a speed of 12.5 knots and a bollard pull ahead of 70 tonnes or astern of 65 tonnes. The bunker capacity is 80.65 m^3.

The ASD 2811 VB Cormoran.

The ATD 2412 VB Orca.

The ASD 2312 Saam James Point.

Two RSDs 2513

Svitzer Australia Pty. Ltd. has signed a contract with Southern Ports Authority for a non-exclusive towage licence at Port of Bunbury in Western Australia for a term of five years. To service the port, Svitzer will deploy two state-of-the-art newbuilds equipped with fire fighting capability to provide safe, efficient and reliable towage services. Svitzer's entry to the port will include installing solar panels on the tug berth and the use of fuel efficiency tools to track and help reduce emissions. Svitzer Australia contracted Damen Song Cam Shipyard JSC, Haiphong, for two RSD Tugs 2513 for Bunbury. The first, the Svitzer Koombana (yard number 515015, imo 9905461), was delivered on 7 February. The keel had been laid on 20 April 2020 and the launching followed on 17 May 2021. The tug arrived at Bunbury on 17 March. The second, the Svitzer Marlton (yard number 515017, imo 9905473), was launched on 15 March 2022 and can be expected at Bunbury in May, replacing the Svitzer Nana (2012 – 486 GT).

The details of the RSD 2513 built under class of Bureau Veritas are: 353 GT, 282 NT – Loa (pp) x B x D (d) = 24.73 (22.51) x 12.50 x 4.95 (6.20) metres. The propulsion system consists of two 16-cilinder Caterpillar main engines, type 3516C TA HD/D (170 x 215), with a total output of 5050 kW or 6862 hp at 1800 rpm on two RR azimuth thrusters, type US 255, with a diameter of 2700 mm for a bollard pull of 85 tonnes ahead, 80 tonnes astern and a speed of 12.7 knots. The bunker capacity is 82.8 m^3.

The RSD 2513 Svitzer Koombana.

Accommodation is provided for four crew members.

El-Alamein 2

Damen Shipyards, Hardinxveld, delivered the second MultiCat 2712, the El-Alamein 2 (yard number 571825, imo 9928970), to the Suez Canal Auhority, Ismaila, on 18 March. The hull of the El-Alamein 2, built at Safe Sp. z.o.o., Gdansk, was delivered at Dordrecht by the mt Leopard on 12 August 2021. Trials and tests were made from Rotterdam on 9 and 10 March to the Maasvlakte after which the MultiCat set course to Ismaila with ETA 10 April.

The El-Alamein 1 (yard number 571824, imo 9928968) departed from Hardinxveld on 7 March and arrived at its destination on 3 April.

The technical details of the MultiCat 2712 are: 336 GT, 88 NT, Loa (pp) x B x D (d) = 27.27 (23.99) x 12.50 x 3.80 (3.05) metres. Propulsion is provided by two Caterpillar main engines, type C32 TTA Acert, with a total output of 2432 hp or 1790 kW at 1800 rpm via three gear reduction boxes, type WAF 572 (7.091 : 1), on two fixed pitch Promarin propellers in Optima nozzles with a diameter of 1900 mm for a bollard pull of 34.8 tonnes and a speed of 10.5 knots. The hydraulically driven bow propeller has an output of 200 hp. The bunker capacity is 110 m^3.

The MultiCat 2712 El-Alamein 2 (photo H. Trommel).

Jacobus

At IJmuiden, Tessa van Laar, the nine-year old daughter of owner Paul van Laar, christened the Jacobus (yard number 549, imo 9910284) of Jacobus Shipping Ltd., Lowestoft, on 25 March. The Jacobus was built at Pattje Waterhuizen BV under own management of Van Laar Maritime BV. The keel had been laid on 16 April 2020 and the vessel was launched three months later. After completion, the Jacobus departed from Waterhuizen to Delfzijl on 14 March 2022. Trials were executed on the Ems on 16 March and the next day, the Jacobus sailed to IJmuiden.

The details of the multi-purpose/stand-by vessel Jacobus are: 389 GT, 123 NT, 420 DWT – Loa (pp) x B x D (d) = 37.50 (33.25) x 8.70 x 4.25 (2.85) metres. The diesel-electric installation consists of two Cummins diesel generators, type KTA19-M (159 x 159), with a total output of 1216 hp or 894 kW at 1800 rpm for driving two azimuth thrusters (2 x 550 kW) and a Veth bow thruster (90kW). The service speed is 9.8 knots. The Jacobus is suitable for both diesel-direct and hybrid mode and the electrical installation is prepared in such a way that in future, it can also run completely emission-free with a hydrogen generator or battery pack. The foldable deck crane has a lifting capacity of 1.2 tonnes at 10.4 metres. The day after the naming ceremony, the Jacobus departed and sailed to Emden for its first contract: inspecting wind turbines on the North Sea. During daylight, two drone pilots inspect wind turbine blades for cracks or other irregularities. In July, a remotely operated vehicle (ROV) will be added on board for carrying out underwater checks of the wind turbine foundations simultaneously.

Lafjord

After the Rosfjord, the second of two fully electric double-ended shuttle ferries for Boreal Asset AS, Hammerfest, the Lafjord (yard number HS2019-0677, imo 9913262), was officially delivered by Holland Shipyards, Hardinxveld, on 17 March. The keel of the Lafjord had been laid on 1 September 2020 and the launching took place on 27 July 2021. Trials were held on 11 and 25 January. Three days

The multi-purpose/stand-by vessel Jacobus (photo Flying Focus).

later, the ferry was tranferred to Rotterdam-Waalhaven. In the night of 14-15 February, the Lafjord left in tow of the mt En Avant 9 and after a call at Eemshaven (16 till 28 February), the transport arrived at Flekkefjord on 2 March. The first crossing Abelnes – Andabeløy v.v. was made three days later. The 963-GT Rosfjord (yard number HS2019-0678, imo 9913274) with an accommodation for 35 cars and 149 passengers has been in service on the route Launes – Kvellandstrand v.v. since 23 December 2021.

The details of the Lafjord are: 469 GT, 141 NT – Loa x B x D (d) = 29.80 x 10.50 x 4.80 (3.00) metres. Wärtsilä supplied the e-motors for the two Schottel thrusters, type SRE 210 L, batteries, onboard and shore-based battery charging equipment and various electrical systems. In between trips, shore power will be used to rapidly recharge the ferries' batteries, allowing day-round operations on electric power. For emergency situations, a back-up Scania DI 16090M generator has been installed, which is capable of running on bio-diesel. The zero-emission ferry Lafjord has accommodation for ten cars and 99 passengers.

Landing Utility Vessels

The Scottish aquaculture sector (salmon and trout) is an important market for Damen Shipyards. In association with Coastal Workboats Scotland Ltd., Exeter, Damen design bureau OSD-IMT, Hoofddorp, engineered Landing Utility Vessels (LUVs) as stock vessels to service the Scottish aquaculture sector. This type is optimised for aquaculture jobs thanks to the deck lay-out with the bridge and accommodation situated at the side of the deck, leaving more open deck space and unobstructed length from bow to stern for large loads.

The first LUV 1608, the Lady Rebecca, was de-

The fully electric double-ended shuttle ferry Lafjord.

The LUV 1908 Bàta nam Bràthairean.

The LUV 1608 Lady Rebecca.

livered on 26 July 2019 to salmon farmer Loch Duart Ltd., Sutherland. At the same time, Damen revealed it planned to build three such workboats for stock for the Scottish fish farming market, even though they did not yet have any customers for the vessels. The LUV 1608 has a HS Marine AK67 E4 crane on one side to compensate the wheelhouse on the other. There is no need to ballast the boat when using the crane, although there is a ballast tank. The size of the deck crane offers a very high capability that is not usually seen on a vessel of 16 metres with lifting capacity close to 14 tonnes at 3.5 metres and 3 tonnes at 13 metres. The LUV can carry out a wide range of support tasks, including the transportation of people, equipment and feed to offshore fish-farming locations. The LUV 1608 hull is 16 metres long, but the design is also available in a 19-metre, 22-metre and 25-metre version to provide additional deck space. The original concept was for a Utility Vessel, but landing functionality was added to ensure a wider geographical reach for operations in areas where there was less port infrastructure available. As usual, Damen standardised the vessel designs and the LUVs can be customised to meet individual client requirements. The first LUV 1908, the Bàta nam Bràthairean (Gaelic for Boat of the Brothers), was delivered to salmon farmer Organic Sea Harvest Ltd. (OSH), Skye, on 8 April 2021. This new company operates on the Isle of Skye off the west coast of Scotland. Their LUV will ultimately support a total of four individual fish farms. The LUV 1908 (Loa x B = 19.10 x 7.50 metres) is a larger version of the 1608 and has a total unobstructed deck space of 100 m^2 with a maximum permissible load of 2.5 tonnes per m^2, allowing a maximum of 50 tonnes of cargo to be carried on each trip.

The draught is just 1.7 metres when transporting 40 tonnes of cargo. Propulsion is provided by two Volvo main diesel engines, type D13, with a total output of 588 kW at 1800 rpm via ZF W325 gearboxes on two fixed pitch propellers with a diameter of 1150 mm for a speed of 8 knots and a bollard pull of 5.7 tonnes. The engines are IMO Tier III-compliant and fitted with exhaust gas aftertreatment and SCR (selective catalytic reduction) systems to reduce CO_2 (by as much as ninety per cent) and SO_X, NO_X, and particulate matter emissions. Steering is done with the aid of two interconnected rudders. The vessel is fitted with an HS Marine AK 72/26 E4 fully foldable and telescopic boom type crane on the foredeck and a smaller HS Marine AK 16 beside the wheelhouse on the aft deck. The 65 DWT LUV 1908 has a bunker capacity of 4.9 m^3. Like previous LUVs, the 1908 features a hydraulically operated bow ramp (3200 x 3600 mm) giving it ro-ro (roll on-roll off) capability. Its tasks will include transportation of people, equipment, feed and other dry cargo to offshore fish-farming locations with loading and unloading taking place either by ro-ro direct to the shore or by using

The LUV 2208 Tiffany II.

The Koenigsborg is a converted platform supply vessel, type Ulstein PX-121 (photo Flying Focus).

its two deck cranes. The bottom plate and the bow ramp are constructed from extra strong steel plates to withstand beaching and landings, and the fendering is very tough. Thick rubber fenders are mounted to the hull sides, to decrease impacts from other boats, quays or floating farm equipment. This mounted fendering offers better protection than the usual car tyres hanging alongside the hull. On-site, the vessel can also be used to support activities of all kinds, including pen maintenance and net cleaning. The vessel has day accommodations for up to eight people.

Kames Fish Farming Ltd., Oban, has taken delivery of the first LUV 2208 Tiffany II on 4 April. This sustainable fish farm company, operating in the lochs and estuaries round the Western Isles near the Scottish coast, seeks to improve waterborne operations at their steelhead trout farm. In addition to the vessels already built and under construction, four more LUV 2208s are to be built for stock.

CONVERSION

Koenigsborg

After positive experiences with the walk-to-work (W2W) vessels Kasteelborg and Keizersborg, Wagenborg Offshore Operations BV, Delfzijl, has contracted Royal Niestern Sander, Delfzijl, for the conversion of a standard platform supply vessel into a W2W emergency response and rescue vessel (ERRV). Wagenborg acquired the platform supply ship Hermit Viking, identical to the Kasteelborg, type Ulstein PX-121, from Remoy Shipping AS, Fosnavaag. The Hermit Viking arrived at Delfzijl from Murmansk on 18 October 2021 and within 24 weeks, the converted vessel went on trials on the North Sea as Koenigsborg (imo 9722522) on 27 and 28 March. The Koenigsborg is equipped with an Ampelmann motion compensated gangway and a dedicated accommodation module on deck with offices, treatment room, storage space and cabins on deck of the vessel for accommodation of about forty of the charterer's personnel in accordance with SPS-60 class. As ERRV, the Koenigsborg can be deployed in emergency situations at platforms for rescue work, standby activities, emergency towing or patrol tasks. The vessel is equipped with extra facilities on board, such as an infirmary, reception rooms, a decontamination room, a recovery room and extra sanitary facilities. With the Kroonborg, Kasteelborg and Keizersborg, the Koenigsborg will operate in the southern North Sea for inspections and maintenance of unmanned platforms. For its first contract, the Koenigsborg left Eemshaven for Great Yarmouth on 29 March.

The details of the Koenigsborg are: 4191 GT, 1295 NT, 4065 DWT – Loa (pp) x B x D (d) = 83.40 (76.50) x 18.00 x 8.00 (6.69) metres. Energy is generated by two Caterpillar diesel generators, type 3516C (145 x 162), 2 x 2250 kW at 1800 rpm and two Caterpillars, type C 32 (170 x 190), 2 x 994 kW at 1800 rpm, for driving two electric propulsion azimuth thrusters, type AZP 100 CP with a diameter of 2800 mm, two bow thrusters, type TT 2200 DP CP, in tunnels and one retractable azimuth thruster, type UL-1201FP. The speed is 15.8 knots and the bunker capacity is 1470 m^3. The Koenigsborg is equipped with a motion compensated offshore deck crane with a lifting capacity of 20 tonnes at 10 metres or 1.5 tonnes at 32.5 metres and a knuckle boom shipboard crane with a safe working load (SWL) of 3 tonnes at 18 metres. Accommodation is provided for 21 crew.

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Green methanol for Maersk

It is one thing to order ships to run CO_2 free on methanol, it is quite another to get the green methanol for them. When Maersk ordered the ships, four of 4000 TEU and twelve of 16,000 TEU, they correspondingly started by participating in various projects around the world to produce enough green methanol. The company intends to source at least 730,000 tonnes of green fuel per year by the end of 2025. The green methanol projects are with Danish power company Örsted, Swiss integrated energy company Proman, Danish solar energy equipment supplier European Energy, China's Green Technology Bank (GTB), China's engineering service company CIMC Enric and US renewable fuel producer WasteFuel.

The deal with Örsted will see the development of a Power-to-X facility on the US Gulf Coast. This 675-MW facility will produce some 300,000 tonnes of e-methanol a year. It will be powered by about 1200 MW of renewable energy from new onshore wind and solar PV farms. The biogenic carbon needed to produce e-methanol will be extracted through carbon capture at one or more large point sources. Targeted to be ready in 2025, it is by far the most ambitious project globally producing e-methanol at this scale. The final investment decision is expected in late 2023. It is the second green fuels collaboration project between these partners after the potentially 1300 MW Green Fuels for Denmark project in Copenhagen, together with other large offtakers.

Proman aims at supplying Maersk with 100,000-150,000 tonnes of green methanol per year from a facility under development in North America. Producing bio-methanol from non-recyclable forestry residues and municipal waste. Proman is evaluating multiple bio-methanol and e-methanol projects in other places around the world, as part of a longer term green methanol supply strategy for Maersk and other owners.

European Energy will develop large scale e-methanol projects in North and South America with production start in 2025/26, with a combined capacity of up to 300,000 tonnes annually.

CIMC Enric will develop biomethanol plants for Maersk in China with the phase one project producing 50,000 tonnes/year as of 2024. GTB plans facilities in China for the same amount from 2024, later growing to 300,000 tonnes/year. Lastly, WasteFuel is developing a biomethanol project in South America producing over 30,000 tonnes per year starting in 2024.

In addition to these projects, in March, Maersk signed an agreement with the Egyptian authorities to jointly explore large scale green fuel production in that country.

Maersk currently uses 12 million tonnes of fossil fuels for its fleet, out of a total of some 300 million tonnes per year for the whole world fleet. So there is a long way to go and key challenges remain in securing sufficient quantities of competitively priced green fuels globally. Further legislative action is required to help level the playing field. Consistent and transparent emissions calculation and accounting standards will be critical to allowing like-for-like comparisons between future fuels, according to Maersk and its partners.

Shipping and Russia's agression

Shipping, one of the most globalised economic activities on our planet, is heavily affected by the current war in Ukraine. After months of being trapped at sea due to the pandemic, the curret war is holding hundreds of thousands of seafarers from the global fleet hostage. Many Ukrainian seafarers yearn to go home whilst sanctions are making it harder to sign on Russian seafarers. Together, Russia and Ukraine account for nearly fifteen per cent of the world's 1.89 million seafarers currently operating over 74,000 vessels in the global merchant fleet. Both countries are in the top five countries with the highest number of seafarers: Russia with 198,123 of which 71,652 are officers and Ukraine with 76,442 of which 47,058 are officers. To maintain trade levels, these seafarers must be able to join and disembark ships (crew change) freely across the world. However, flights have been cancelled to and from the region, making this extremely difficult. And they must be able to receive and send money to their families and this is now increasingly difficult due to sanctions and banking problems.

The International Chamber of Shipping (ICS) has warned that the existing labour shortage in global shipping will worsen due to the conflict. Recently, Wilfred Lemmens, Managing Director of the Royal Belgian Shipowner's Association was very forthcoming about the consequences: 'It will be a major challenge to find sufficient seafarers worldwide if the war continues. That could cause huge disruption to global maritime transport.' Around 5000 seafarers work on Belgian merchant ships with a fifth coming from either of the two countries. Research caried out by ICS reported that the average ship has a mix of at least three nationalities on board, and sometimes as many as thirty. Three languages are the minimum spoken on the average ship.

Shipping is currently responsible for the movement of nearly ninety per cent of global trade. Ukraine and Russia alone account for a quarter of all global wheat exports, while Russia controls 12.5 per cent of crude petroleum exports, according to the Observatory of Economic Complexity (OEC). Lloyd's List estimates that exports of crude and oil products from Russia have fallen by 1.5 million barrels per day (bpd), from prior estimated levels of some 7 million bpd before the invasion. An estimated 140 ships and 2000 crew were stranded at the end of March in the Sea of Azov and Black Sea with limited access to resources as a result of the invasion, according to NATO figures quoted by the ICS.

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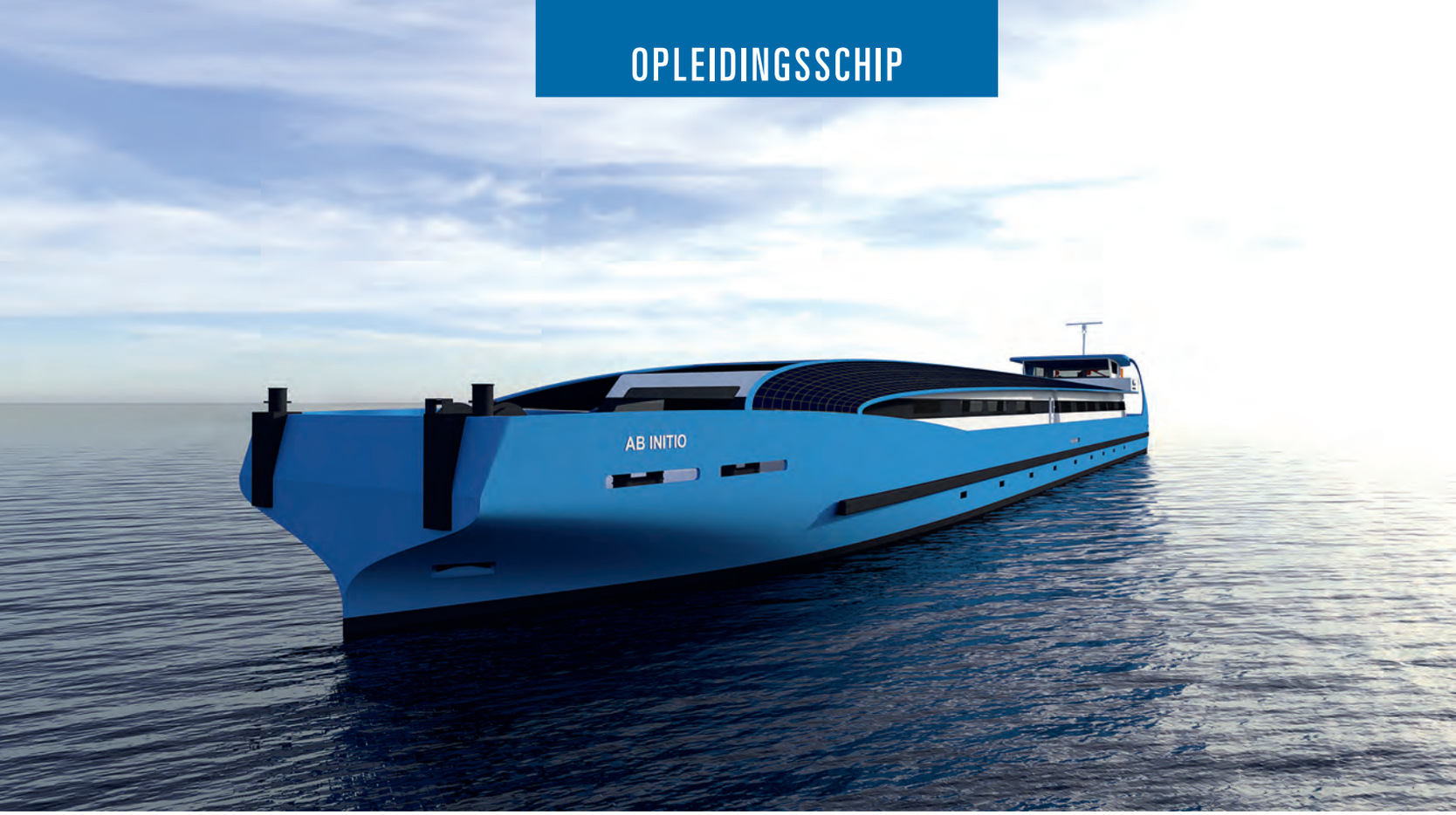


OPLEIDINGSSCHIP AB INITIO IS KLAAR VOOR DE TOEKOMST

Brandstofcellen, accubank en Stage-V-generatoren

Het futuristisch ogende opleidingsschip van de Rotterdamse STC Group, de Ab Initio (67 x 8,20 meter), vaart binnenkort urenlang emissieloos door de Rotterdamse haven. Het binnenvaartschip wordt daarvoor uitgerust met een lithium-ion batterijenpakket, een op waterstofgas draaiende brandstofcelmodule van 50 kW en tachtig zonnepanelen.

Met volle batterijen (400 kWh) en waterstoftanks (33 kilo) kan de Ab Initio zeker acht uur emissieloos varen. Dan moeten de batterijen en tanks opnieuw worden gevuld of moet een van de op GTL (*gas to liquid*) draaiende Stage V gecertificeerde generatoren worden gestart.
Tot de aanschaf van een door Zepp.solutions uit Delft gebouwde brandstofcelmodule werd pas tijdens de bouw besloten. Het systeem stond niet in het oorspronkelijke ontwerp en er was destijds ook geen geld voor.
'Maar we zagen het als een belangrijk systeem voor de toekomstige binnenvaart,' zegt projectbegeleidster Nicole van Spronsen van het STC, die het stokje eind maart overgaf aan Marjolein Mahu. 'Via subsidieaanvragen en sponsoracties lukte het om het oorspronkelijke bouwbudget van 3 miljoen euro ruimschoots te verdubbelen. Diverse maritieme toeleveranciers wilden ons sponsoren en kregen zo ook een streepje voor bij de keuze van componenten.'

Kennismaken met diverse systemen

De sponsoractie leverde, ook educatief gezien, interessante keuzes op. 'Er waren bijvoorbeeld twee bedrijven die een milieuvriendelijk ultrasoon antifouling-systeem aanboden,' aldus Van Spronsen. 'Eén systeem beschermt nu de beunkoelers en het andere het vlak. Voor

Foto: de futuristisch ogende Ab Initio heeft een goed herkenbaar profiel (tekening C-Job).

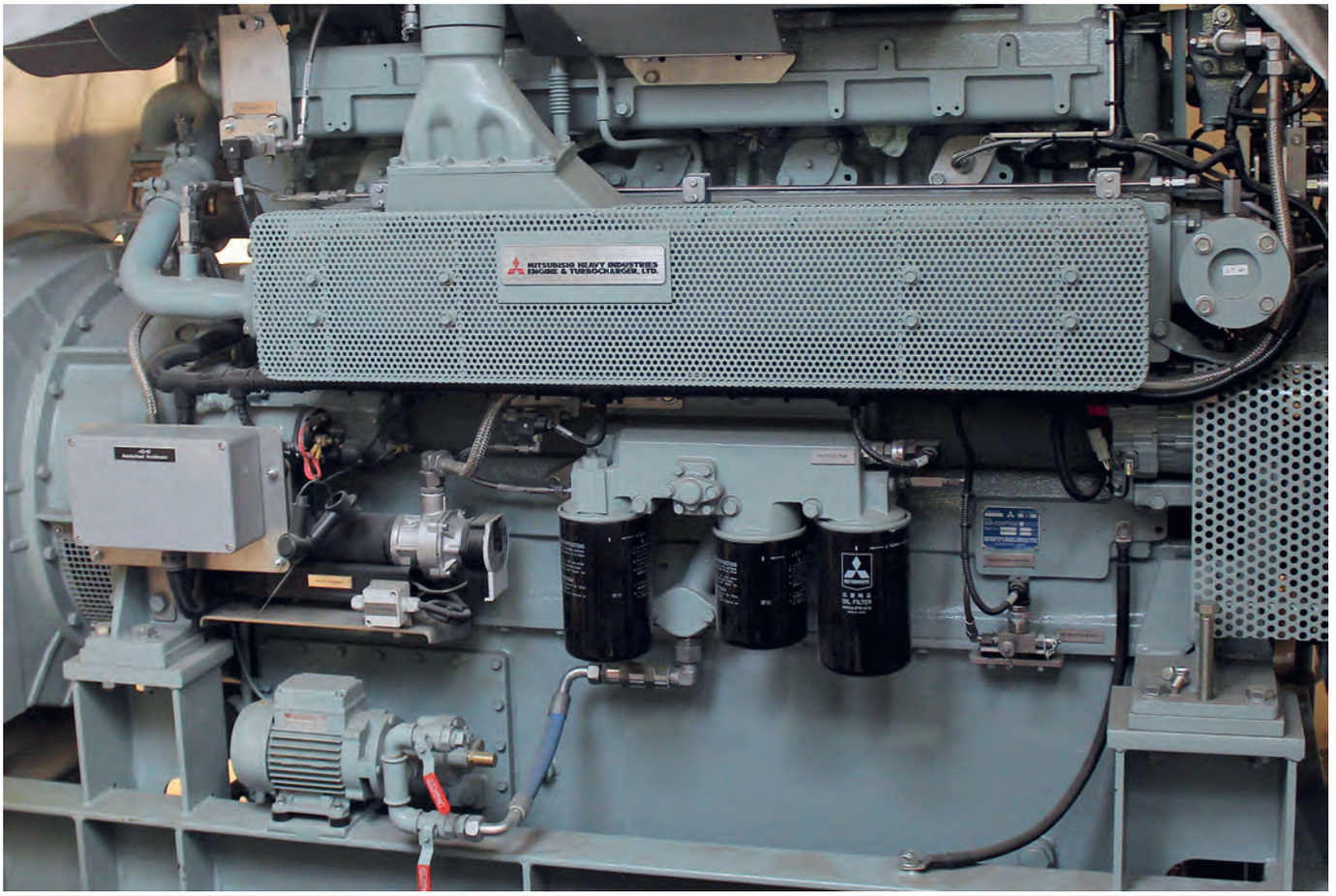
toeleveranciers is plaatsing van hun producten interessant omdat de toekomstige schippers er tijdens hun opleiding al kennis mee maken.'
Er staan ook twee generatoren van twee verschillende leveranciers aan boord. In het achterschip staat een 280-kW-generator van Volvo-Penta en in het voorschip een KEES Generator van 600 kW van Koedood. Alphatron levert de navigatieapparatuur, timmerbedrijf Hoogendoorn de lessenaar en EST-Floattech de batterijen. Veth Propulsion leverde een 200-kW-boegschroef met 360 graden draaibaar stuurrooster. Machinefabriek De Waal uit Werkendam tekende voor de oliegesmeerde schroefasinstallatie en plaatste twee weerstandsarme Easy Flow-roeren. 'Men heeft overwogen thrusters te plaatsen, maar 95 procent van de binnenvaart heeft gewone schroeven met roeren,' zegt eigenaar Marco de Waal van Machinefabriek de Waal. 'Dan is het beter dat ook op een opleidingsschip te gebruiken.' De Waal voorziet de moer achter de propeller van een stromingskap. 'Dat verbetert de afstroming en voorkomt dat de moer roest,' aldus De Waal. 'De stuurmachine leveren we met een extra bedieningspaneel. De student zit straks gewoon in het midden van de lessenaar. Rechts daarvan bouwt timmerbedrijf Hoogendoorn een extra eilandje voor de instructeur waarop alle bedieningshendels voor de voortstuwing, besturing en boegschroef nogmaals zitten. De instructeur kan dus direct ingrijpen wanneer dat nodig is.'
Een direct omkeerbare permanent-magneet-elektromotor van 600 kW van Oswald drijft de propeller van het elektrische schip aan.

> Met volle batterijen en waterstoftanks kan de Ab Initio zeker acht uur emissieloos varen

Aanpassing voor brandstofcel

Hoofdaannemer Concordia Damen uit Werkendam faciliteerde de voor de brandstofcelunit benodigde aanpassingen tijdens de bouw. 'Zij deden dat zelfs graag,' zegt Van Spronsen. 'En Lloyd's Register bood aan om de certificering van schip en waterstofsysteem te verzorgen.'
'De complete brandstofcelunit wordt, inclusief druktanks, op de voorzijde van het bovendek geplaatst,' vertelt projectmanager Nico de Bie van Concordia Damen. 'Omdat het besluit tot aanschaf pas in een laat stadium viel, paste het niet meer in een van de machine-

Een van de koppellieren op de van een duwkop voorziene Ab Initio.



Eind maart werd in Werkendam druk gewerkt aan de afbouw van het opleidingsschip. Hier de hoofdgenerator in de machinekamer voor (foto Hans Heynen).

kamers. Een van de aanpassingen die we voor het waterstofsysteem moeten doen, is het aanbrengen van een extra A 60 brandwerende isolatielaag tussen de leerlingenruimtes en het brandstofcelsysteem.'

TU Delft spin-off

Zepp.solutions levert de complete brandstofcelmodule, met warmtewisselaar, omvormer, pompjes, opslagtanks en regel- en controlesysteem. 'Het is een compleet platform dat na plaatsing direct op de DC-bus (gelijkstroomsysteem) van het schip kan worden aangesloten. Wanneer de koppeling is gemaakt, weet de brandstofcelmodule precies wat er aan vermogen wordt gevraagd en gaat dat dan leveren,' legt medeoprichter en mede-eigenaar Jonas Brendelberger van het in 2017 uit het Forze Hydrogen Racing Team van de TU Delft voortgekomen bedrijf uit. 'De module regelt ook de opslag van geproduceerde stroom in de accu's wanneer dat nodig is. Bij deze systemen zijn brandstofcellen en accu's op dezelfde DC-bus aangesloten. Wanneer de vermogensvraag zo laag is dat de motoren het volledige vermogen van de brandstofcel niet gebruiken, laadt het overgebleven vermogen de batterij op.'

De hybride Ab Initio zou oorspronkelijk alleen vier uur emissieloos op de batterijen kunnen varen. 'Via de brandstofcel komt daar tijdens de vaart nogmaals zo'n hoeveelheid energie bij,' zegt Brendelberger. 'De brandstofcel is dus een *range extender* die daar vier uur aan toevoegt. De elektromotor vraagt tijdens het varen altijd meer vermogen dan de brandstofcel maximaal levert. Er zal dus steeds aanvullend vermogen uit de accu's worden gehaald.'

Op afstand uitleesbare sensoren maken smart maintenance mogelijk

Onder een druk van 350 bar wordt straks 33 kilo waterstof in de hogedruktanks meegenomen. De brandstofcel zet dat met een efficiëntie van vijftig procent om in elektriciteit. 'Dat is voldoende voor 500 kWh aan emissieloos vermogen,' stelt Brendelberger. 'Met meer waterstoftanks zou de cel natuurlijk langer vermogen kunnen leveren, maar dan moet de batterijcapaciteit ook groter worden om langere tijd voldoende voortstuwingsvermogen te kunnen leveren. Het maximale vermogen van de brandstofcel blijft immers 50 kW.'

Waterstof wordt straks gebunkerd bij een waterstofstation in de

Rotterdamse haven. ‘Het waterstof bunkeren en het werken met de brandstofcel maken deel uit van het leerproces van de studenten,’ aldus Van Spronsen. ‘Zij leren zo tijdens de opleiding al dit systeem van de toekomst kennen.’ De gekozen PEM-brandstofcel is in staat 20.000 tot 30.000 draaiuren het opgegeven vermogen te leveren. ‘Door veroudering neemt de spanning, en daarmee de efficiëntie, van een brandstofcel echter heel langzaam af,’ legt Brendelberger uit.

Na 20.000 tot 30.000 uur (afhankelijk van de gemiddelde belasting) kan de cel dan niet meer het gevraagde maximale vermogen leveren. De cel blijft wel functioneren, maar haalt niet meer de efficiëntie.

Bij de bouw van het schip is rekening gehouden met de mogelijkheid om in de toekomst grotere brandstofcellen of andere emissieloze energiesystemen te plaatsen ter vervanging van een van de generatoren. ‘De aandrijftrein is modulair opgebouwd en boven de generatoren zitten luiken, zodat ze in de toekomst kunnen worden vervangen door milieuvriendelijkere alternatieven,’ vertelt Van Spronsen.

Windturbine vervalt

De in het oorspronkelijke ontwerp van C-Job Naval Architects en Concordia Damen getekende windturbine is vanwege de brandstofcel gesneuveld. Van Spronsen: ‘Op die plek komt nu het brandstofcelsysteem.’ De brandstofcel vervangt dus geen dieselgenerator. ‘Die zijn gebleven en bedoeld om te worden gebruikt op de langere reizen door Duitsland en België.’

De Ab Initio moet bij het begin van het nieuwe schooljaar, in september 2022, operationeel zijn. ‘We hebben de proefvaart in juni gepland, net voor de zomervakantie van het STC,’ zegt De Bie. ‘In de vakantieperiode kan de vaste bemanning dan aan het schip wennen.’

De Ab Initio biedt ruimte aan dertig studenten. Die kunnen op langere tochten aan boord eten en overnachten. Het schip vaart straks tachtig procent van de tijd in de regio Rotterdam en maakt twintig procent van de tijd lange tochten door Duitsland en België.

Moderne lesmethodes

Aan boord komt een professionele keuken, waarvan het afvalwater, net als het toiletwater en andere afvalwater, wordt gereinigd alvorens te worden geloosd.

Bijzonder is de lesruimte grenzend aan de machinekamer in het achterschip. ‘Daar zit een geluiddicht venster in dat zicht biedt op de machinekamer,’ zegt Van Spronsen. ‘Zo kan de leerkracht uitleg geven over wat daar gebeurt, zonder storende machinekamergeluiden.’

Voor het technisch onderwijs wordt ook lesmateriaal ontwikkeld met *virtual reality*-brillen. ‘Dan ziet de student in de machinekamer op het scherm van zijn HoloLens-bril additionele informatie over de machines waar hij naar kijkt,’ legt Van Spronsen uit. ‘De machinekamers zijn zo ingericht dat leerlingen overal goed bij kunnen.’

Bedoeling is dat straks op het hele schip zo’n virtual reality-training mogelijk is. Op simulatoren van het STC is het schip al nagebouwd, zodat men op de simulator nu al kan oefenen met het varen.

Het schip wordt uitgerust met op afstand uitleesbare sensoren op de slijtende delen en ook andere relevante informatie is op afstand uitleesbaar op het STC. Dat maakt onder andere *smart maintenance* mogelijk. Ook brandstofgebruik, koers, snelheid, stand van de accu’s en gegevens en verbruik van de brandstofcel zijn straks op school af te lezen.

Duwkop

De Ab Initio heeft een duwsteven met twee koppellieren, zodat in de praktijk kan worden geoefend met het aan- en afkoppelen van duwbakken. ‘Dat maakt het bijvoorbeeld mogelijk een tankbak aan te koppelen,’ zegt De Bie. ‘Studenten kunnen dan leren hoe je met *manifolds* moet werken en wat er allemaal bij laden en lossen van gevaarlijke stoffen in de tankvaart komt kijken.’

> Een lesruimte met geluiddicht venster biedt zicht op de machinekamer

Een eigen duwbak heeft het STC niet, bedoeling is dat die kunnen worden geleend of gehuurd.

Omdat er op het opleidingsschip vaak met ankers moet worden geoefend, krijgt het schip RVS slijtplaten bij de kluisgaten.

De Ab Initio vervangt de twee vijftig jaar oude opleidingsschepen van het STC, de Prinses Beatrix en Prinses Irene. Van Spronsen: ‘De slaapplaatsen worden in ieder geval een stuk comfortabeler op het nieuwe schip. Op de oude schepen zijn de bedden 1,80 meter lang. Nu slapen langere leerlingen vaak op de grond. Op het nieuwe schip is dat niet nodig, daar zijn de bedden ruim 2 meter lang.’

Fieldlab

De Ab Initio is, naast een opleidingsschip, een innovatief fieldlab. In samenwerking met hbo-studenten kunnen bedrijven innovatieve maritieme producten en diensten daar in de praktijk testen.

Hans Heynen
Maritiem journalist,
hans.heynen@casema.nl

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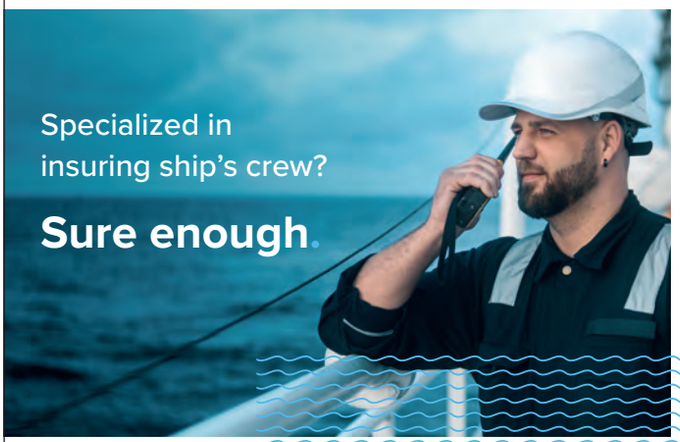

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IT'S THE INSIDE THAT COUNTS.

PARSIFAL INLAND TANKER DELIVERIES ARE ON SCHEDULE

Concordia Damen is actively working on the deliveries of the major new construction project Parsifal. This large investment of forty inland tankers will transport liquid products on behalf of Shell on the European inland waterways and rivers.

The first hull moored in the port of Werkendam in June 2021 and final outfitting started immediately. The first tanker, the Blue Marjan, was delivered on the 24th of December. Since then, a total of four hulls have been delivered. Currently, there are four to five hulls at the quay, waiting to be finished.

Because a lot of the work has already been done during construction, the final fitting out could be shortened by three weeks compared with a standard order of the same vessel dimensions. Subsequently, every month, a casco comes ashore. During this finishing period, five hulls are in the port of Werkendam at the same time. The final tanker will be delivered at the end of 2024.

The dimensions of the double-hulled tanker, Type C / 1R / Gasfuel are: L x W x D = 110 x 11.50 x 3.25 metres. The tonnage is 2816 tonnes. Its statutory is: ES-TRIN 2019-1, sailing area zone 3, 4 and zone 2 in the Netherlands (see SWZ|Maritime's April 2021 inland navigation special for a general arrangement of the Parsifal tankers).

Engine power

In the front engine room, there are two MAN-Rollo LNG engines, type E3262 LE201 of 495 ekW. The LNG tank of 60-cubic-metre capacity is located in a separate room (tank space) at 6 metres distance from the bow and directly in front of the cofferdam of the cargo area.

In the aft engine room, there are two Oswald electric motors, type TF46.100-24WWR (PM Synchron), of 500 kW each, supplied by Hybrid Ship Propulsion and coupled to the two propeller shafts. This torque motor is a permanent magnet motor, with annular geometry with hollow shaft and rare-earth magnets. The coolant standard is

Engine room aft with Oswald electric motors.

Photo: Hulls at Concordia Damen for outfitting.

water in a closed circuit, antifreeze. A MAN-Rollo diesel generator set, type D2676LE328, of 277 ekW is also located in the aft engine room.

Trial procedures

The trials before final delivery are executed according to the Standards in the field of Inland Navigation (CESNI) drawn up by the European Committee. The basic idea behind the trials is to measure the relation between energy consumption and mechanical power at a speed of 16 km/h. A series of trials are performed on LNG, where the relation between energy and mechanical power is established.

Concordia Damen is building forty inland tankers for Shell

The relation between mechanical power and vessel speed is also measured. Manoeuvring trials, sound/vibration levels and several functional tests are tested and reported in the same document. These tests are all carried out in LNG mode. If deemed necessary, a selection of the manoeuvring tests can be carried out in diesel mode as well.

The trial speed is measured in km/h. Speed trials are conducted in calm water conditions (wind speed ≤ 2 Bft and sea state ≤ SS2) in sufficiently deep water with a minimum bottom clearance of 5 metres. Speed runs are held during the trials at 2.90-metre draught or by a minimum of seventy per cent of the design draught as close as attainable, and fully horizontal by ballasting the vessel with water, using tanks and compartments intended for this purpose. Such speed runs and endurance tests are held with a brake power as close as possible in the prevailing circumstances to the installed brake power.

The test area is the "Vuile Gat" at a place called Tiengemeten, the Netherlands. This is an official testing area for inland waterway vessels. In case there is any current, the speed test will be done in both directions. In case the actual situation at the test area is not according to the circumstances mentioned (depth, wind, etc.), the speed will be adjusted and recalculated as to these necessary circumstances.

Power of the machinery

The power developed by the propulsion machinery during the river trials is to be as close as possible to the power for which classification has been requested. In general, this power is not to exceed the maximum continuous power at which the weakest component of the propulsion system might fail.

The following navigation tests are carried out to check the manoeuvrability of the vessel:

- Crash stop ahead.
- Full speed ahead: full astern.
- Half speed ahead: full astern.
- Turning circle test.
- Zig-zag manoeuvring test (20/45, 20/45).

Steering times from board to board

Power	Time	70 / 70 degrees
400 Volt pump	14 sec	8.23 deg/sec
24 Volt	19 sec	7.37 deg/sec

Power	Speed
Two engines	18.5 km/hr
One engine	14.8 km/hr
Aft generator	8.8 km/hr

Power	Crash stop	By full speed
Two engines	430 metres	18.5 km/hr
Two engines	230 metres	13.1 km/hr

Parsifal trials – manoeuvrability, while 94 per cent loaded.

Stopping capacity

The stopping capacity is to be proven by means of stopping manoeuvres carried out within a length of 350 metres. A stopping commando shall be given at a speed of 13 km/h. Where the stopping manoeuvre required is carried out in standing water, it shall be followed by a navigation test while going astern. The measured stopping length is 230 metres.

Run number 1

(18 km/h) (17.9) (19.4)	Upstream	Downstream	Unit
Heading			deg
Engine power gen. LNG 1	467	455	ekW
Engine power gen. LNG 2	462	460	ekW
Engine power gen. diesel	0	0	ekW
Total power consumption	929	915	ekW
Prop power SB	422	422	ekW
Prop power PS	422	422	ekW
Total prop power	844	844	ekW
Hotel power grid aft	15	17	ekW
Hotel power grid front	33	24	ekW
Total hotel load	48	41	ekW

Speed trial 100 per cent MCR (LNG 1 + LNG2).

Propeller ekW

LNG 1 ekW	LNG 2 eKW	Av	PS	rpm	SB	rpm	Av	Speed km/hr
177	175	176.0	150	214	151	212	150.5	13.9
237	234	235.5	203	239	203	235	203.0	15.4
330	330	330.0	299	272	300	300	299.5	16.1
433	431	432.0	396	298	399	295	397.5	18.3
462	465	463.5	422	304	432	302	427.0	18.7

Parsifal power and speed trials at 94 per cent load (LNG sets only).

Capacity for going astern

Where the stopping manoeuvre required is carried out in standing water, it shall be followed by a navigation test while going astern. Vessels have to achieve a speed in relation to the water of at least 6.5 km/h. The measured speed astern was 7.4 km/h (only by bow thruster).

Gas consumption measurement

Gas consumption is measured in gaseous state between the tank and engine by means of built in flow sensors on the fuel supply. Fuel temperature is measured as well. Both flow and fuel temperature are continuously logged.

The gas quality and caloric value is measured in gaseous state in the pipe between the LNG tank and the engine room by taking gas samples. Corrections to the net fuel consumption are applied according to ISO 3046/1.

Run number 1

(16 km/h)	Upstream	Downstream	Unit
Heading			deg
Engine power gen. LNG 1	303	287	ekW
Engine power gen. LNG 2	306	287	ekW
Engine power gen. diesel	0	0	ekW
Total power consumption	609	574	ekW
Prop power SB	268	260	ekW
Prop power PS	274	250	ekW
Total prop power	542	510	ekW
Hotel power grid aft	15	17	ekW
Hotel power grid front	33	33	ekW
Total hotel load	48	50	ekW

Fuel consumption in gas mode at 16 km/h.

Noise level measurements

The noise level measurements are executed with the main engine running at 95 per cent rpm during free sailing condition. These measurements are performed to document the noise levels of the vessel's propulsion train at delivery of the vessel. These tests are all carried out in gas mode. The diesel generator aft is not running.

Location	Noise limits
Sailing condition	
Engine room	109 dB(A)
Wheelhouse	49 dB(A)
Living room	69 dB(A)
Cabins	57 dB(A)
@25 [m] of vessel	75 dB(A)
In harbour	
@25 [m] of vessel	65 dB(A)

Noise limits according to ES-TRIN, Edition 2021/1.

Location	Noise limits
Sailing condition	
Engine room aft	80 dB(A)
Engine room front (ESD)	109 dB(A)
Wheelhouse	69 dB(A)
Living room SB	69 dB(A)
Living room PS	69 dB(A)
Crew cabin 2 (PS front)	54 dB(A)
Crew cabin 3 (PS middle)	57 dB(A)
Crew cabin 4 (PS aft)	59 dB(A)
Crew cabin 8 (SB aft)	59 dB(A)
Crew cabin 9 (SB front)	57 dB(A)
Entrance area	
@25 [m] of vessel	75 dB(A)
In harbour	
@25 [m] of vessel	65 dB(A)

Noise measurements of the Parsifal tanker.

All tests comply with the pre-calculation assumptions of this major project.

The aft deckhouse without gangways is highly insulated. This results in low decibel measurements.

ACKNOWLEDGEMENT

This article is based on information provided by Concordia Damen Shipbuilding BV.

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PORTLINER'S STORY CONTINUES

PortLiner Anna will be launched in 2022

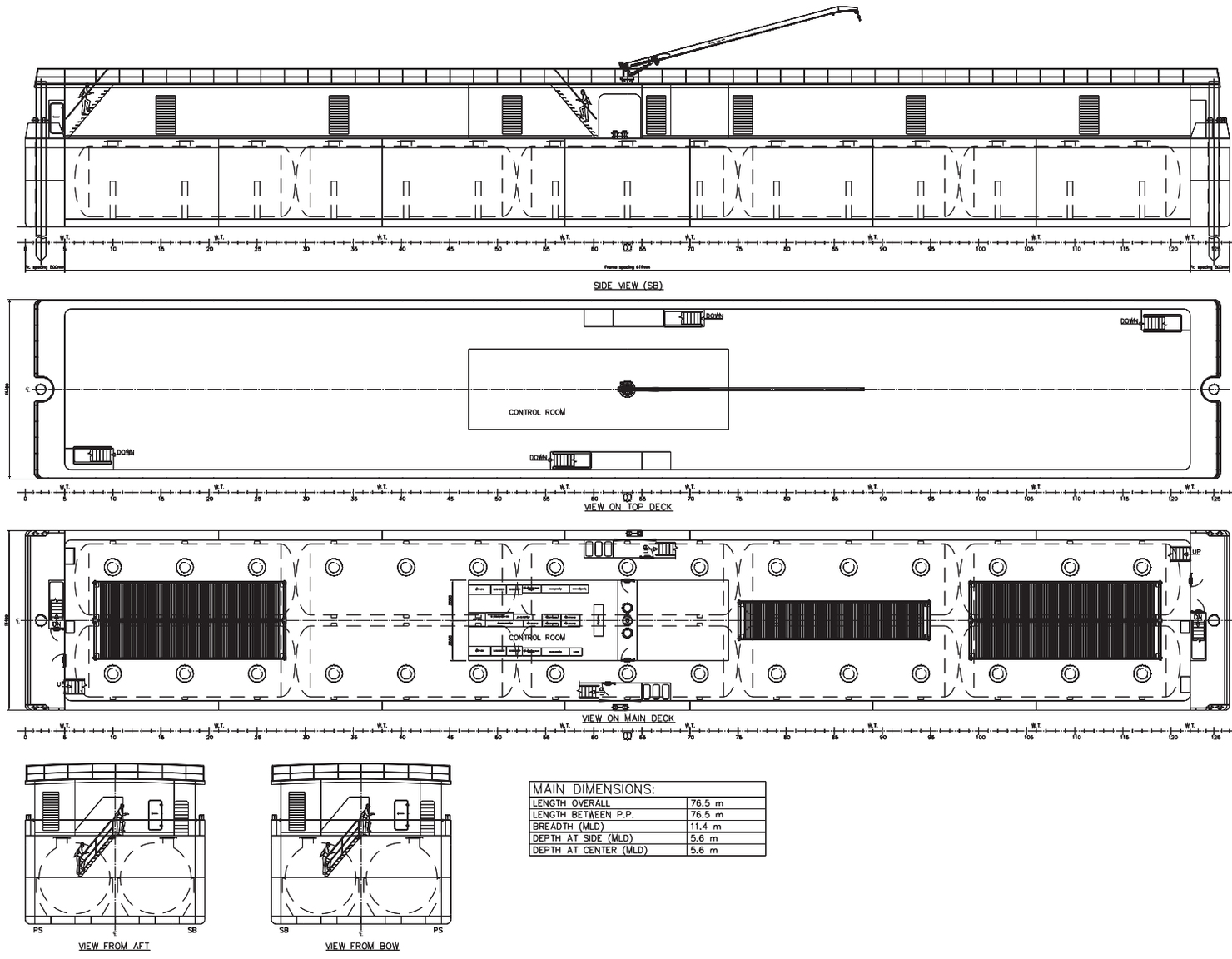
PortLiner's aim is zero-emission inland shipping, deploying all-electric vessels equipped with flow batteries. The company has the hull of the PortLiner Anna ready for further completion into an extremely environmentally friendly inland shipping vessel for container transportation.

'Our aim is "zero-emission" shipping, in a safe and reliable way, at competitive rates,' says PortLiner CEO Ton van Meegen. 'Vanadium redox flow battery technology is well-developed and perfectly viable for shipping allowing autonomy of multiple days. Furthermore, flow battery technology is not limited to new vessels – existing vessels with conventional diesel engines can be retrofitted and converted into zero-emission all-electric ships.'

Flow battery solution with recharging pontoon

In this further development strategy, a strategic cooperation agreement was signed at the end of 2021 with Enerox GmbH, Austria, brand owner of CellCube, and installation company Werkina BV in Werkendam. Together, they plan to build a sustainable zero-emission solution for the maritime market for electrified vessels and the related bunker and recharging infrastructure. CellCube is a global tech leader for vanadium redox flow batteries, while PortLiner is a waterborne transport innovator. Under a Head of Terms contract, they will build a maritime flow battery solution for the all-electric propulsion of an inland vessel and a waterborne storage and recharging unit (pontoon) together with Werkina. With this project, the parties want to demonstrate the feasibility of flow battery technology for decarbonising inland water transport as well as how flow batteries contribute to the energy transition of ports in building large-scale battery recharging infrastructure both onshore and waterborne. The concept based VRFB (vanadium redox flow battery) technology will ensure integration of wind and solar power into the waterborne energy mix, providing all-electric propulsion and putting an end to the use of conventional fossil fuels.
Flow battery technology is well developed and offers a competitive

Photo: PortLiner Anna next to the recharging pontoon.

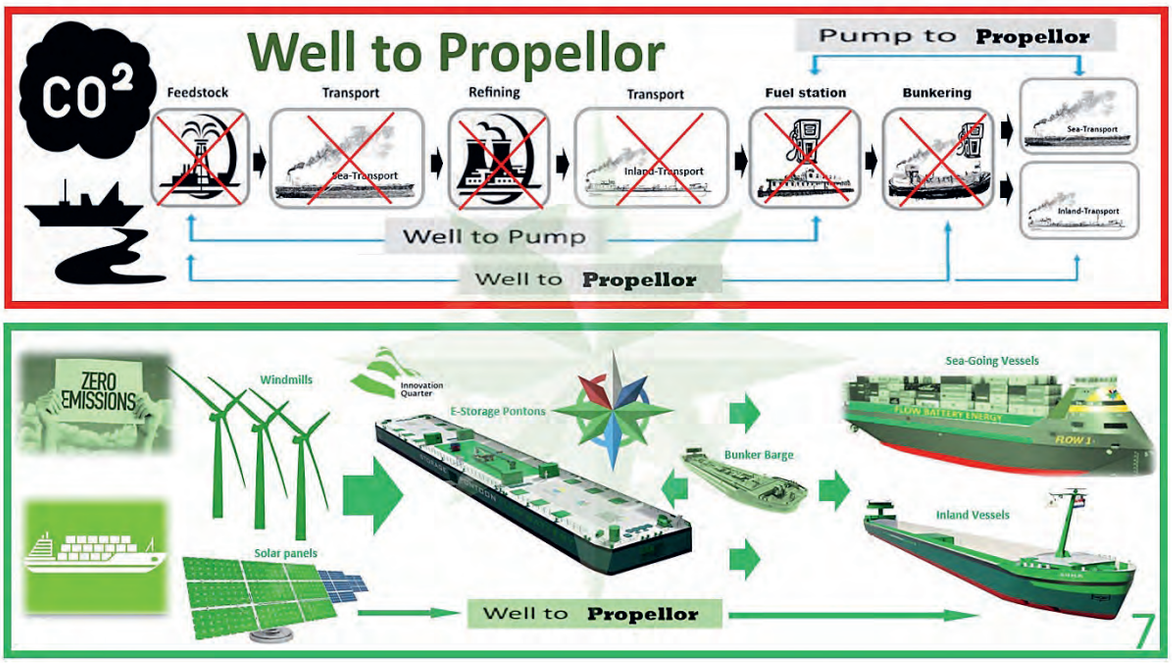


General arrangement of the recharging pontoon.

and viable way forward towards decarbonisation of maritime operations. In vanadium redox flow batteries, electric energy is stored in a liquid electrolyte that is non-flammable and non-explosive and that can be stored under ambient conditions. When the electricity is consumed, the electrolyte can be recharged. Alternatively, the depleted electrolyte can be swapped with recharged electrolyte.
The vessel's rated AC power is designed at a level of up to 1.5 MW, with energy capacity at 6.25 MWh (this can be more or less, depending on the sailing distance). The first recharging pontoon is planned to be operated with up to 2 MW power and a capacity of up to 25.6 MWh. This approach will allow for an all-electric radius of at least 350 kilometres. The waterborne recharging pontoons will be used for refuelling vessels with recharged vanadium electrolyte. In addition, these pontoons can act like a floating energy storage system and provide power and energy services for onshore applications, such as backup power for critical infrastructure, port electrification or provision of grid services.
The vessel and pontoon are to be delivered later this year.

Storage pontoon

The recharging pontoon has the following dimensions: L x W x D = 76.00 x 11.45 x 4.00 metres (standard dimensions of a push barge). Classification is provided by Lloyd's Register.
In the lower hold, ten tanks of 200 m^3 each are built. On the upper deck are the pumps and the electrical unit for the operational handling. The pump system consists of two pumps each with a capacity of 200 m^3/hour.
The electrolyte in the pontoon can also be charged separately with a 1 MW shore connection. This takes place within six hours when the incoming power capacity is 6.4 MWh. In this operational



From well to propeller steps for a vessel that uses flow batteries and the recharging pontoon.

mode, it is not strictly necessary to swap the electrolyte.
'The CellCube system can provide a clean, reliable and sustainable option for long-term energy storage,' says Van Meegen. In an endurance test over numerous years, the key components of the system undergo over 10,000 cycles without interruption. It has already been in continuous operation for ten years at some of the company's customers and is still achieving the same performance indicators as on day one. With a lifecycle of over twenty years, even under the most adverse environmental conditions, the CellCube system is the undisputed choice for industrial multi-hour storage systems.

After ten years, the CellCube system can still achieve the same performance as on day one

Vanadium redox flow batteries

Vanadium redox flow batteries are ideal electricity storage systems and designed for continuous operation. They are capable of reacting within a few seconds and yet can still supply energy over the course of many hours and days. This makes it possible to not only cover peak loads during the day but, in combination with sun and wind, also to work through the night.
Vanadium-based storage systems cannot burn and do not lose capacity even after decades of use. But even beyond that, vanadium is stable for a nearly indefinite period of time, making it more durable than any other battery technology and highly cost efficient for a multi-hour storage system.
From the conventional operation of an inland vessel, there are many transition points to finally get to the required fuel. These steps are also called "well to propeller" (see picture above).
For more environmentally friendly innovative operation, the energy required for electrolysis is generated by wind turbines and solar cells. Once the E-storage pontoon has enough energy on board, the transfer can begin, either directly alongside or via a small floating bunker ship.

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A-ROSA FIRST TO SAIL WITH A FOUR-DECK RIVER CRUISER

The German tour operator A-Rosa from Rostock has commissioned a particularly large four-deck river cruiser, the A-Rosa Sena. Concordia Damen was selected to build the ship, because for many years now, the yard has focused on innovative shipbuilding with a strong emphasis on green shipping.

The design of the A-Rosa Sena's hull is optimised for minimal resistance on the water. It is the first four-deck inland passenger ship in the world and is built in such a way that it can pass the bridges at Rhine height of 9.00 metres after ballasting. The railing fences on the upper deck can be folded remotely. There are passenger ships in Europe with the same dimensions, but their passenger capacity is lower.

The dimensions are: L 134.87 x W 17.50 x D 1.72 metres with 140 cabins and a total passenger capacity of 280 pax. Cabins are located on the lower deck for a total crew of about 55. The ship will be deployed on the corridor Rotterdam-Amsterdam-Antwerp to Cologne v.v.

Special attention has been paid to passengers of all ages. There are 119 two-person cabins (21 m^2) with balcony, seven suite cabins (26 m^2) with balcony, twelve family cabins (28 m^2) and two cabins (21 m^2) suitable for physically challenged passengers. For children, there is a play lounge and a safe swimming pool on the upper deck. A larger swimming pool for adults is also available. On the lower deck, there is a luxury wellness area with a whirlpool, massage facilities, a sauna, an ice cave and a fitness room.

E-Motion ship

The new ship had to have a special appearance as an E-Motion ship. The necessary improved environmental aspects had to be clearly measurable and visible on board. The brief was to build a half conventional and half hybrid passenger ship. Management and technicians of Concordia Damen worked intensively on this challenge.

Due to the dimensions of this large four-deck ship, there are completely different weight ratios on board. After many calculations, the

Photo: The A-Rosa Sena is the first four-deck inland passenger ship in the world and specifically built to be able to pass under the Rhine's bridges.

finishing yard finally came to the conclusion to make the ship fully hybrid for mooring and unmooring at inner-city berths. While manoeuvring there, the ship can run on its battery capacity, completely hybrid.

The ship is fully hybrid for mooring and unmooring at inner-city berths

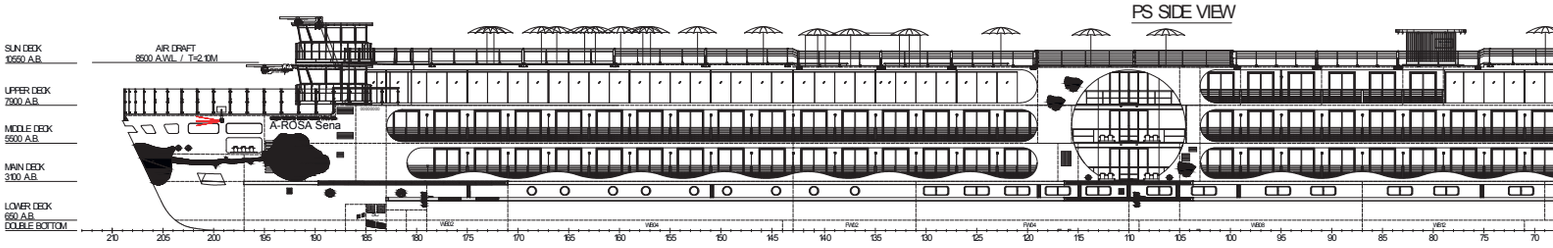
On canals and rivers, the A-Rosa Sena sails on Stage V Mitsubishi diesel engines (3 x 1048 kW - 4275 HP), whereby the battery pack can be used for peak shaving. The capacity of the batteries is then used to run the diesel engines at high efficiency. For example, if it sails on two generators and briefly runs short of power, the batteries can be used to make up the shortfall. This avoids the need to start the third engine and then have three engines running at relatively low power.
The lithium batteries have a total capacity of 1.2 MWh.

Heat and energy recovery

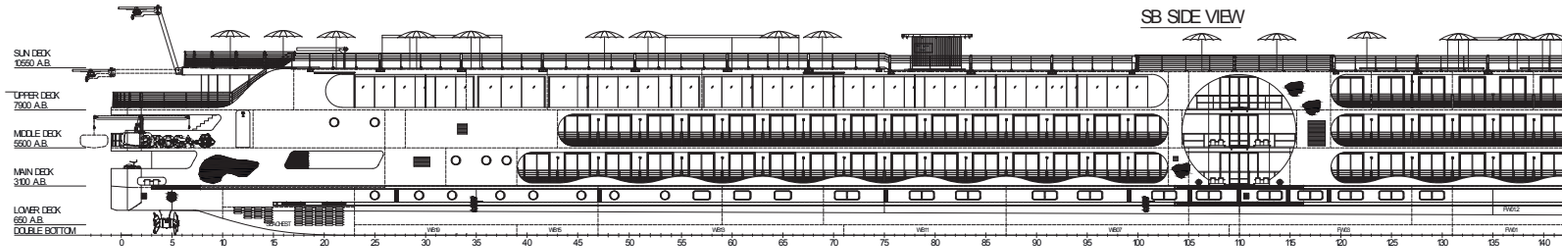
When sailing, as much heat and excess energy as possible is recovered. A ship's engine develops heat that is not used. From that heat of the cooling water and the exhaust gases, electricity (80 kWh) can be generated via the Orcan system. Part of the heat that would normally be lost can therefore be used again to generate electricity.
The first journey starts on the 15th of May 2022 in Cologne with destination Amsterdam.

When sailing, as much heat and excess energy as possible is recovered.

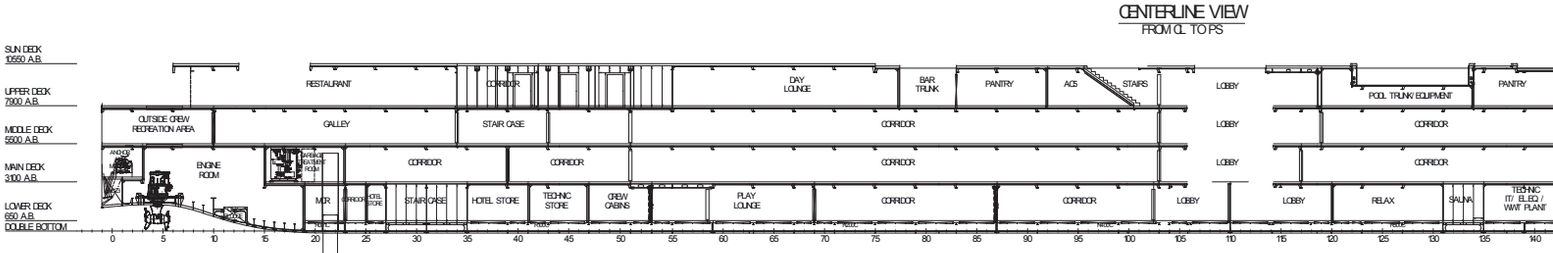
PS SIDE VIEW



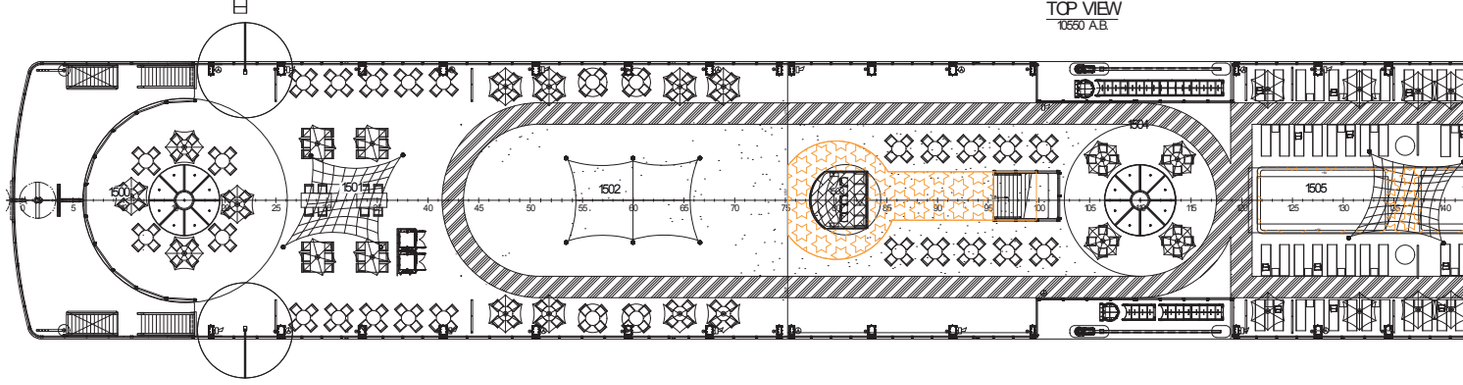
SB SIDE VIEW



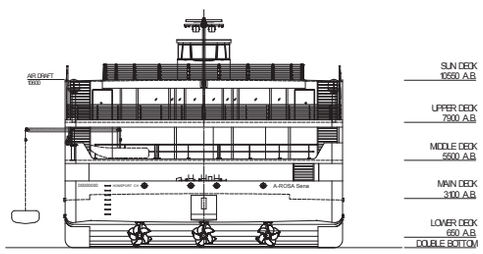
CENTERLINE VIEW
FROM CL TO PS



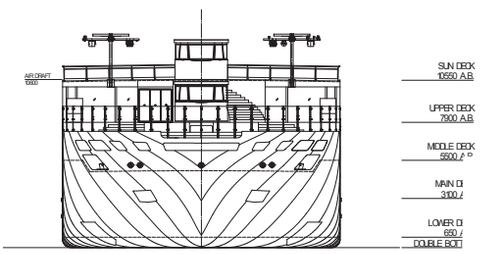
TOP VIEW
10550 A.B.

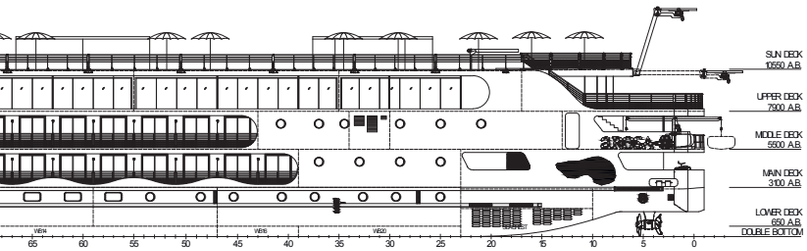


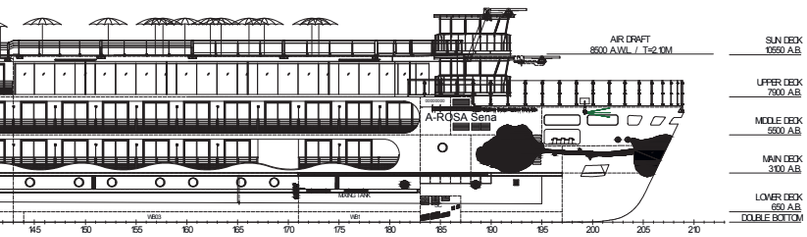
AFT VIEW

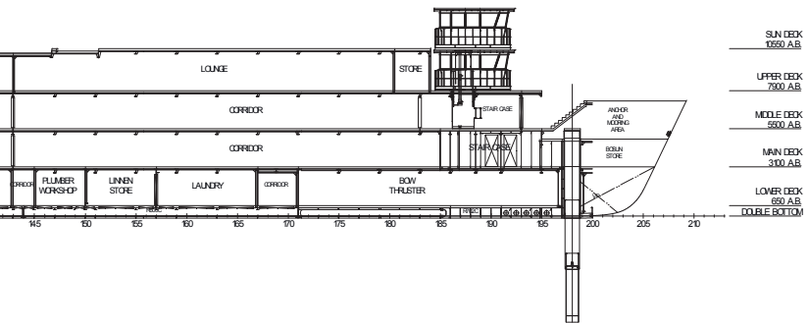


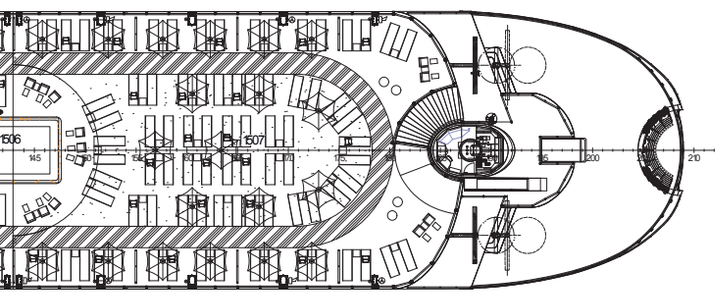
FRONT VIEW

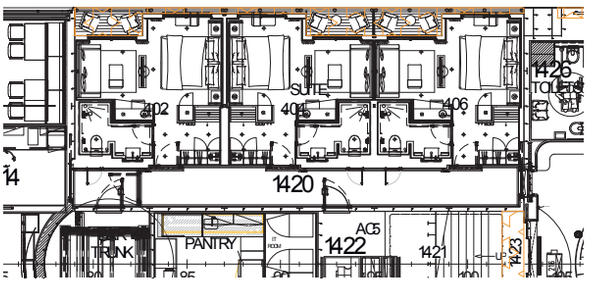












River cruise suites.

CAPACITIES				
TYPE		CABINS	BERTHS	TOTAL BERTHS
PAX	SUITE	6	4	24
	BALCONY	119	3	357
	BALCONY 31 m^2	1	4	4
	PRM	2	4	8
	FAMILY	12	5	60
TOTAL		140		453
CREW	DOUBLE	38	2	76
	MASTER CLASS	3	2	6
TOTAL		41		82

REFERENCE DOCUMENTS		
RULES AND REGULATIONS		
•• LR	A1 I.W.W. PASSENGER SHIP ZONE 3, FLAG: SWISS	
MAIN PARTICULARS		
L, overall max	134.87	m
Lwl, T=2.10	132.38	m
B, moulded	17.50	m
Depth	3.10	m
Draught, Operational	1.72	m
Draught, Scantling	2.10	m
Airdraft (ballast)	8.50	m
Speed (Deep water)	22.50	km/h
Speed (Shallow water)	17.00	km/h
Propulsion concept	Diesel - Electrical	
Propulsion power	3x800	kW
Persons on board	535	-

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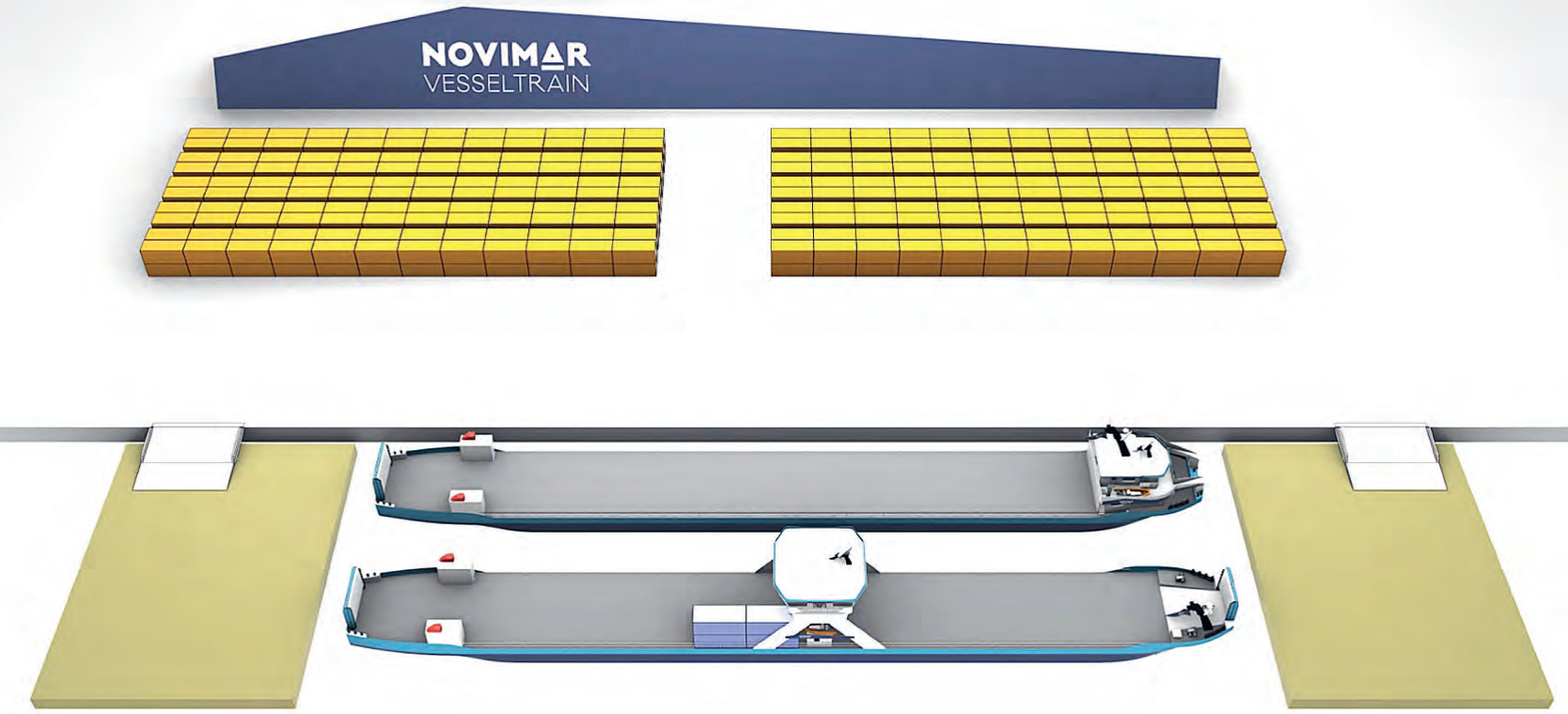


NOVEL INLAND WATERWAY TRANSPORT CONCEPTS

Moving freight effectively by vessel train

The European Commission has recently made more policies for logistical improvement in international inland navigation. Under the umbrella of NOVIMAR (NOVel Iwt and MARitime transport concepts) project partners aim to improve economic feasibility of waterborne transportation by introducing the concept of the vessel train.

Project NOVIMAR has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 723009. The project started with 22 partners from nine countries that together want to further develop the concept of vessel platooning. The project ran from the 1st June 2017 to the 1st June 2021.
The stakeholders together possess the necessary expertise to achieve innovation and the expected breakthrough in inland waterborne transport (IWT) performance.

Unlocking congestion

IWT is a major key-holder for unlocking congestion in seaports, at terminals, on road networks and access to urban areas, besides being a main factor in reducing CO_2 emissions in transport. These advantages, however, are not fully exploited due to inefficiencies in the seaport-inland logistics chain. Think of containers and vessels that are not loaded to their full capacities resulting in a sub-optimal use of IWT capacity. Intercontinental and intra-continental cargo (containers) designated for IWT are not yet delivered in large packages, which results in inland ships having to call at many (six to eight) terminals to collect a few containers with waiting time at and sailing time between terminals adding-up to sixty per cent of the total time spent in port.
And of course there are varying water levels limiting ship payloads due to insufficient air draught under bridges, possibly forbidden navigation during extreme high water periods and raised transport costs during low water periods. Another example can be found with volatile water levels and ever-changing river bed conditions impeding optimal river navigation and which causes time losses. And let's not forget waiting time at bridges/locks causing additional inefficiencies in IWT operations.
Therefore, the core NOVIMAR challenge was: where, how and with

Photo: Two designs ready for cargo handling. For a comparison of the two designs, see www.novimar.eu for several animations.

whom to intervene in the logistics system to obtain the largest possible impact at the lowest possible cost?
There were three main problems:

- A density problem: The entire logistics system needs to be compressed, meaning higher load factors, less time in port, shorter waiting times at bridges and locks, optimal navigation on rivers.
- A data fusion problem: Data collection, access to data sources, data perception and data analysis must be significantly improved to support a denser logistics system.
- A plan and control problem: Effective management of cargo flows, vessels, port terminals and waterway infrastructure for a compressed logistics system depends on data and information qualities that are not sufficiently available yet.

Six main ideas

The project partners in NOVIMAR came up with six main ideas to solve the three problems mentioned above:

- Improved load factor of containers by means of cargo reconstruction.
- Improved port logistics by reducing waiting times at terminals and sailing time between terminals.
- Improved river navigation by satellite, sensor and data fusion.
- Reduced waiting time at bridges and locks by a dynamic scheduling system.
- Innovative vessel solutions to cope with variable water levels.
- New business models in current stakeholders' networks.

	Container RoRo vessel	Conventional container vessel
Type of cargo	Containers + rolling cargo	Containers
Cargo capacity	Lower	Higher
Cargo handling speed	Higher	Lower
Cargo handling cost	Lower	Higher
Waiting time at terminals	Shorter	Longer
Round trips per year	More	Fewer
Vessel cost	Higher	Lower

Comparison between a container RoRo vessel and a conventional container vessel.

Concept simulations

Delft University of Technology is moving from paper to practice by taking NOVIMAR vessel concepts that add buoyancy to inland vessels to the next level. Several concepts are currently being researched with the aim to develop solutions for the inland waterway transportation sector to deal with reoccurring low water levels. Performing these simulated runs in the laboratory, the computer simulation software, developed at MARIN within this very same H2020 innovation project, can be adequately validated.
The vessel train concept and design objectives and approach are:

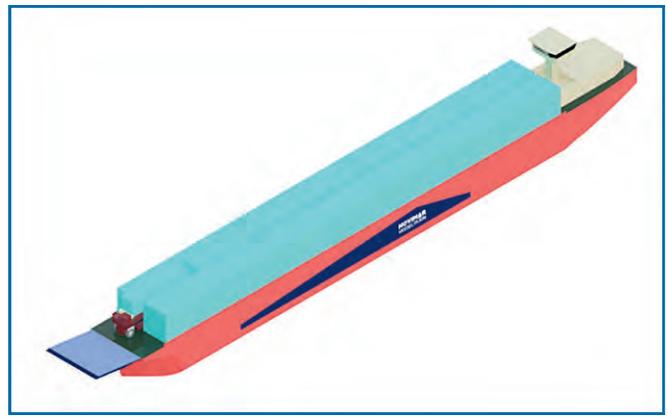
1. To reduce cost, time and risk related to the cargo unit shift between different modes.
2. To fully utilise the NOVIMAR RoRo cargo handling concept.
3. To design vessels able to operate as both lead vessels and follower vessels.
4. To design vessels efficiently as stand-alone cargo ships when no vessel train is formed.

The vessel train may be used in inland navigation (CEMT class Va and III), sea-river and short-sea shipping and can also use the RoRo technology in container handling.

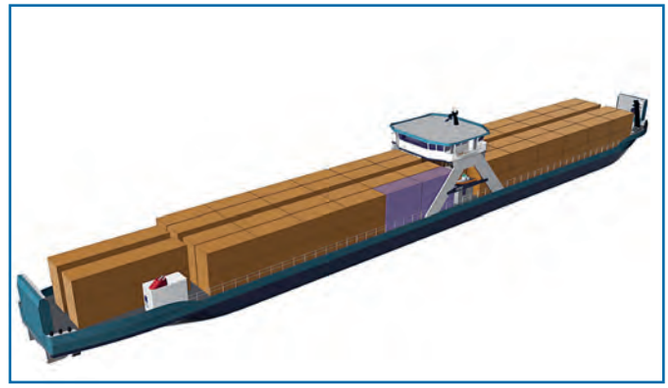
Design results

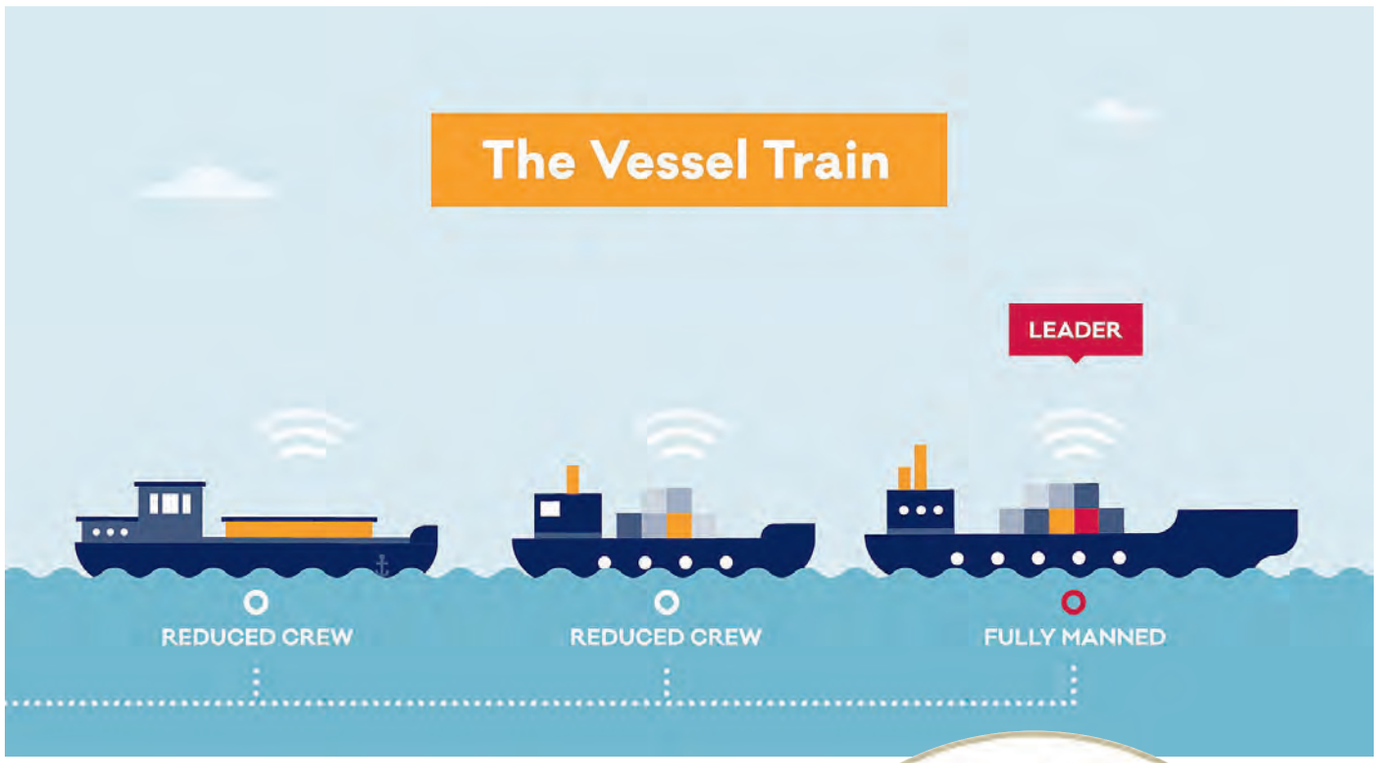
The research has resulted in the following ship design: a NOVIMAR Class Va inland container RoRo vessel with a regular draught. This vessel could look as portrayed below.

L:	110 metres
B:	11.45 metres
d:	3.9 metres
D:	7.05 metres
m_{DWT}:	3287 tonnes
TEU:	184, main deck 120 TEU + lower cargo hold 64 TEU
Bow ramp + port side fixed ramp for the lower cargo hold	

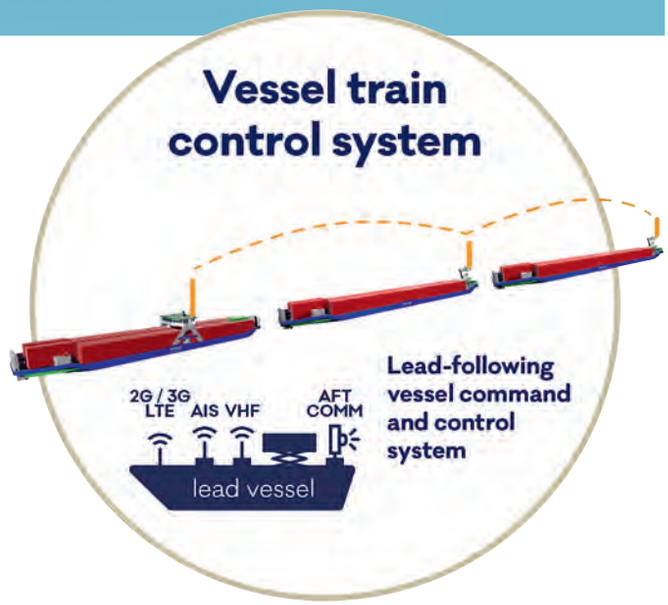


L:	104 metres
B:	11.45 metres
d:	2 metres
D:	3 metres
m_{DWT}:	1298 tonnes
TEU:	100 2 tiers or 146 3 tiers
Intact and damage stability standards fulfilled with average m_{TEU} = 11.8 tonnes (2 tiers)	
Drive-through cargo flow	





In a vessel train, only the leader is fully manned.



Vessel train

One of the research routes within NOVIMAR is the “Vessel train”. In this concept, inland navigation is further developed using the technology of autonomous sailing. The first ship is the "leader" of the convoy. This ship is fully manned and transmits the necessary nautical digital signals to the following ships in the convoy. The following ships have a strongly reduced crew on board.

NOVIMAR's key results are:

- A new waterborne transport system.
- A simulation model for transport systems.
- Transport system performance indicators for full social cost-benefit analysis.
- Input to regulatory developments for joint operations of conventional and unmanned vessels.
- Recommendations for optimised working conditions and human reliability, and training needs.
- Command and control technology for vessel trains.
- Navigation aid for IWT vessels and vessel trains advising speed and track on the river.
- New and revised concepts for RoRo cargo systems and vessels.
- A vessel train handbook.

ACKNOWLEDGEMENT

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CRASH BARRIERS AT SEA TO PROTECT WIND FARMS

The Maritime Research Institute of the Netherlands (MARIN) has tested three innovative barriers to prevent collisions between ships and wind turbines. The immediate cause for this research was the incident with the Julietta D on 31 January 2022.

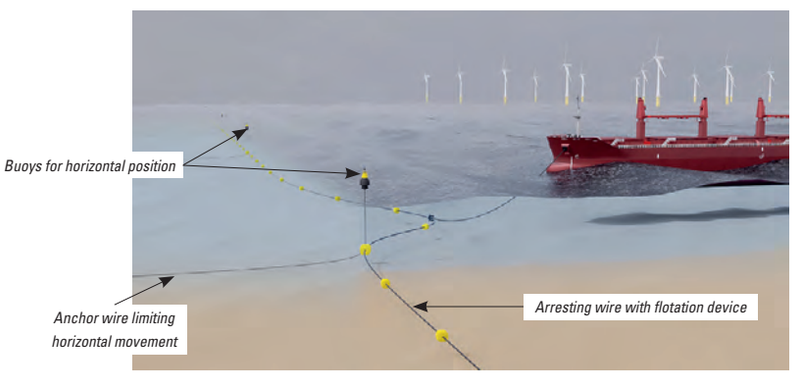
On the 31st of January 2022, the Julietta D, a bulk carrier with own gear, but in ballast, broke loose from its anchor and started drifting in a severe storm just west of IJmuiden. The Julietta D first hit a tanker loaded with petroleum, the Pechora Star, then hit a foundation of a wind turbine being installed. After that, it barely missed a gas production platform. The Julietta D developed a huge hole on port side aft, flooding the engine room, during one of the collisions. The crew was quickly evacuated with helicopters. Boskalis managed to get a tug coupled to the drifting vessel with no crew on board and the ship was towed to Rotterdam for repairs.

Workshop maritime crash barriers

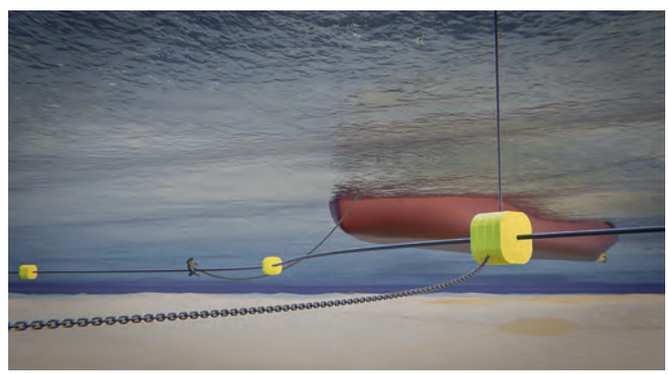
The Dutch authorities have decided that in 2030, there will be at least 2500 wind turbines in the Dutch sector of the North Sea. This will result in very little space for shipping and fishing. In case of an emergency at sea, it leaves no room for manoeuvring a large ship. The wind turbines are spaced about 1500 metres apart.
MARIN has looked into the number of incidents with drifting vessels or vessels out of control. The Dutch authorities have received reports that an average of eighty ships per year became adrift between 2009 and 2019. Probabilistic calculations have estimated that a ship may collide with a wind turbine 1.5 to 2.5 times a year in the Dutch sector of the North Sea.
MARIN organised a workshop on 23 February with experts in the industry from Bluewater Energy Services, Mooreast, Vuyk Engineering, Heerema Marine Contractors, Boskalis, GustoMSC (NOV), KRVE (Rotterdam Boatmen), Pinkster Marine Hydrodynamics, Huisman Equipment, Orca Offshore and SBM Offshore. This workshop came up with three proposals for a maritime crash barrier protecting wind turbine installations from drifting ships.

Crash barrier proposals

It is assumed that a collision between a ship and a wind turbine installation can either be a high-speed collision with the ship at transit speed and not able to manoeuvre or suffering from a navigational error. This type of collision will be bow on.
The second type of collision is at low speed, with a drifting ship hitting the wind turbine installation beam on. In this case, wind, waves and current are propelling the ship.
The first crash barrier solution involves a system with a safety wire above the seabed. This consists of a wire anchored as a protective barrier. The wire is suspended above the seabed and is held in place with buoys at the surface for the vertical position and by anchor lines for the horizontal position. The safety wire is also fitted out with flotation devices to keep it at a certain height above the seafloor. The safety wire is intended to catch an anchor lowered by the drifting vessel. Anchor weights on the seabed, attached to the safety wire, will arrest the drift. Fixed point moorings embedded in the seabed will ensure the ultimate stop. This will work like the ar-



Safety wire above the seabed.


The safety wire is intended to catch an anchor lowered by the drifting vessel.

The third option is a pre-tensioned safety net.

A ship may collide with a wind turbine 1.5 to 2.5 times a year in the Dutch sector of the North Sea

resting wires used on certain aircraft carriers with an angled flight deck in order to shorten the length required for a landing aircraft to stop. Often four to five wires are used in parallel.

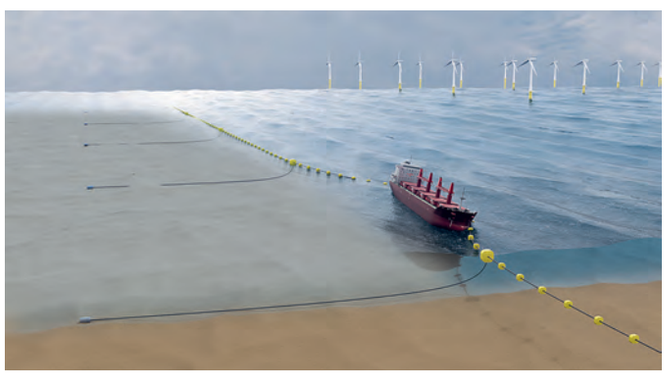
This is the most elegant solution as it permits access of smaller craft to the wind turbine area and there are less obstructions on the surface. It does, however, require manual action of the crew and the anchor equipment needs to be in good condition, which may not always be the case. The arresting gear on aircraft carriers does not always work to the satisfaction of the individuals involved.

The second proposal is a barrier on the surface. This system consists of a floating barrier consisting of a wire supported by relatively large buoys. The drifting ship is caught by the barrier and brought to a halt. This system is passive and requires no manual intervention. Smaller ships may have a tendency to ride over the barrier in extreme weather, but for large ships this chance is much smaller. On the other hand, a small vessel has a lot less energy in a collision with a wind turbine installation.

A third option is to install a pre-tensioned safety net protecting the wind farm installations. This is also a passive system and requires no human intervention. In this case, model tests have indicated that the net has a tendency to collapse and the drifting ship will eventually ride over the net.

Risk evaluation

The safety barrier will only be installed at critical parts of the periphery of a wind farm area. It is not realistic to think that a complete area will be surrounded by a safety barrier. Risk evaluation based on traffic frequency, prevailing weather and current and such will be part of this evaluation.



A safety barrier on the surface.

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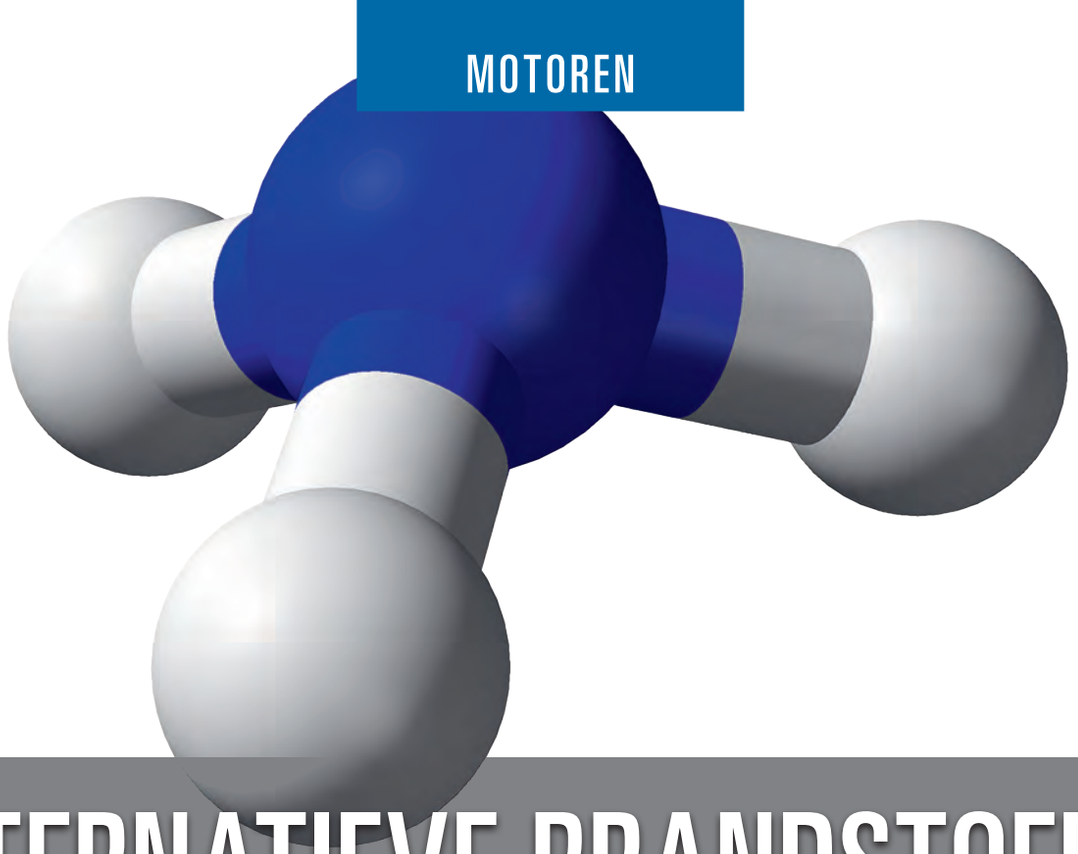


ALTERNATIEVE BRANDSTOFFEN VOOR DIESELMOTOREN

Deel 2 – Ammoniak

De meest veelbelovende oplossingen voor toekomstige scheepsbrandstoffen zijn op dit moment LNG, LPG, methanol, biobrandstof, waterstof en wellicht ammoniak. Afhankelijk van de manier waarop deze brandstoffen worden geproduceerd, kunnen zij een grotere of minder grote rol spelen bij het reduceren van de GHG-voetprint van de scheepvaart. Het eerste deel van dit artikel, gepubliceerd in onze maartuitgave, ging in op de mogelijkheden van methanol. Dit keer wordt ammoniak besproken.

Ammoniak (NH_3) is een verbinding van stikstof en waterstof, dus een brandstof zonder koolstof. Het wordt gebruikt als schoonmaakmiddel. Ammoniak lost vetten heel goed op en wordt dan ook vaak gebruikt om onderdelen schoon te maken voor bijvoorbeeld het aanbrengen van een verflaag. Daarnaast is het een halffabricaat voor kunstmest als stikstofbron en wordt het gebruikt als koelmiddel in grote koelinstallaties. Het heeft zeer goede thermodynamische eigenschappen. Ammoniak wordt tegenwoordig hoofdzakelijk gemaakt uit aardgas, waarbij een grote hoeveelheid broeikasgas, CO_2, vrijkomt bij het productieproces. Ook met een alternatief productieproces met behulp van elektriciteit geproduceerd door de zon en de wind kan het economisch niet concurreren met de standaard brandstof bestaande uit koolwaterstofverbindingen. In de toekomst zou de productie van ammoniak op gang kunnen komen via biomassa en op die manier een koolstofvrij *well-to-wheel*-systeem te realiseren.

Momenteel zijn er nog geen motoren die werken op ammoniak of ammoniak met het principe *dual-fuel*. Er zijn wel proefnemingen, maar deze motoren zijn nog niet gecertificeerd voor gebruik. Het lijkt erop dat stikstof gedragen brandstoffen zoals ammoniak geen alternatief zijn voor een lage *greenhouse gas*- (GHG-)emissie. Toch worden momenteel proefnemingen met ammoniak als brandstof uitgevoerd en zijn er rederijen die schepen hebben besteld met ammoniak als brandstof die in 2024 worden opgeleverd.

Eigenschappen van NH_3

- Kleurloos gas met kenmerkende zeer sterke geur.
- Aggregatietoestand gas.
- Dichtheid: 717 kg/nm^3.
- Smeltpunt: -78°C.
- Kookpunt: -33°C.
- Vlampunt: 132°C.

Foto: Ammoniak (NH_3) is een verbinding van stikstof en waterstof, dus een brandstof zonder koolstof.

- Dampdruk: 860 x 10^3 Pa bij 20°C.
- Goed oplosbaar in water.
- Zeer giftig.
- Bij verbranding: 4 NH_3 + 3 O_2 → 2 N_2 + 6 H_2O

Bij verbranding ontstaat dus stikstof en waterdamp en geen broeikasgas kooldioxide. Ammoniak is moeilijk te ontsteken (*slow ignition*).

Ammoniak als brandstof voor voertuigen

Tijdens de Tweede Wereldoorlog was er een tekort aan de bekende brandstoffen zoals dieselolie. In België werd voor bussen koolgas gebruikt, maar dit was weinig zinvol door de zeer lage energiedichtheid van het gas waarvoor een zeer grote opslagtank moest worden gebruikt. Als gevolg hiervan werd koolgas gemengd met ammoniak als brandstof voor bussen. Op het moment dat de bekende koolwaterstoffen weer beschikbaar kwamen, werden alle proeven met ammoniak weer stilgezet.

Het Amerikaanse leger deed onderzoek waarbij ammoniak werd geproduceerd met elektriciteit opgewekt met kleine mobiele kernreactoren, zodat ze minder afhankelijk werden van de aanvoer van de standaard brandstoffen. In de jaren tachtig van de vorige eeuw werden de onderzoeken opgeheven.

Brandstoffen met stikstof

Er werd veel onderzoek gedaan naar dit soort brandstoffen zoals:

1. Ammoniak, NH_3 voor S1-motoren (*spark ignition*).
2. Ammoniak voor dual-fuel- (DF-)motoren, NH_3 + andere brandstoffen voor S1 en C1 (*compression ignition*).
3. Hydrazine/N_2H_4: voor brandstofcellen en raketaandrijving.
4. Vloeibare stikstof/H_2: voor expansiemachines.

Ammoniak heeft een zeer hoge zelfontbrandingstemperatuur, namelijk 651°C en daarnaast een lage vlamsnelheid, een hoge verdampingswarmte en kleine explosiegrenzen (zestien tot 25 procent).

Ammoniak voor DF-motoren

Ammoniak kan worden gebruikt als motorenbrandstof met andere substanties om de negatieve eigenschappen als brandstof te compenseren.

- Voor S1-motoren: waterstof, H_2.
- Gasolie, MGO.
- Voor C1-motoren: dimethyl ether (DME) en (bio)diesel.

Gasvormige brandstoffen hebben de voorkeur omdat ze in S1-motoren gemengd kunnen worden met ammoniak terwijl brandstoffen met een hoger cetaannummer geschikter zijn voor C1-motoren, hoofdzakelijk door de betere ontsteekeigenschappen.

De vloeistof hydrazine, N_3, wordt voor allerlei doeleinden gebruikt, onder andere als raketbrandstof. Bekend is ook dat de F-16, een militair vliegtuig, deze brandstof gebruikt als noodstartbrandstof.

De optimale menging tussen ammoniak en diesel is veertig procent diesel en zestig procent ammoniak. Dit is niet wat wij bedoelen met een DF-motor, deze heeft maximaal één tot vijf procent *pilot fuel*, standaard MDO (*marine diesel oil*) of HFO (*heavy fuel oil*). Proeven met minder pilot fuel zijn momenteel gaande zoals bij motorenfabrikanten MAN ES en Wärtsilä.

Productie

Standaard wordt ongeveer zeventig procent van de wereldproductie van ammoniak geproduceerd met behulp van aardgas. De andere dertig procent wordt geproduceerd met behulp van kolen. Om één ton ammoniak te produceren, is 30 GJ aardgas benodigd. Er wordt dan 1,87 ton CO_2 geproduceerd. Dit is erg veel en daarom is het standaardproces, het Haber-Boschproces, niet geschikt om ammoniak als brandstof voor motoren te produceren.

Voor de productie van één ton NH_3 is tussen de 7000 en 8000 kWh aan elektriciteit nodig

Er zijn ook minder milieubelastende methoden voor de productie van ammoniak als brandstof, bijvoorbeeld door elektriciteit te gebruiken die door alternatieve bronnen zoals zonne- of windenergie wordt opgewekt. Dit geeft nagenoeg geen uitstoot van broeikasgassen. Het proces, elektrolyse, maakt alleen gebruik van water, H_2O. De elektriciteit moet wel "schoon" worden opgewekt, want het proces kost enorm veel energie. Voor de productie van één ton NH_3 is tussen de 7000 en 8000 kWh nodig. Het Haber-Boschproces met elektrolyse kost dan 12.000 kWh per ton NH_3.

Uit onderzoek blijkt dat bij het gebruik van ammoniak ten aanzien van aardgas de uitstoot van CO_2 behoorlijk hoger is en er dus andere methoden nodig zijn om deze uitstoot te verminderen. Daarnaast laat onderzoek zien dat biomassa voor de productie van ammoniak een betere optie is dan de voorgaande methode, maar het kan niet de fossiele brandstoffen vervangen.

Commercieel nog niet zinvol

Het is beter aardgas als CNG of LNG direct te gebruiken als brandstof voor motoren en niet met elektriciteit of biomassa ammoniak te produceren. Biomassa zou in de nabije toekomst de enige bron zijn waarbij ammoniak kan worden geproduceerd zonder de uitstoot van broeikasgas CO_2. Commercieel is het nu nog niet zinvol.

Het gebruik in scheepsmotoren heeft nog een lange weg te gaan. Proeven die momenteel worden uitgevoerd geven dat aan. De eerste werkelijke proefnemingen in de praktijk worden verwacht in 2024/2025.

Ammoniak blijft een moeilijk te hanteren brandstof. Denk aan de veel grotere en zwaardere opslagcapaciteit. Ammoniak heeft per kg ook een erg lage energie-inhoud, de verbranding is moeilijk en de hoge giftigheidsgraad is een echt probleem. Daarnaast is ammoniak ongeschikt voor materialen als koper, koperlegeringen, nikkel en plastic omdat dit materiaal sterk wordt aangetast. Ergens richting 2030 zullen de eerste schepen standaard kunnen varen met als brandstof ammoniak.

De laatste stand van zaken, januari 2022

Wärtsilä: Belangrijke aandachtspunten zijn giftigheid, corrosie van

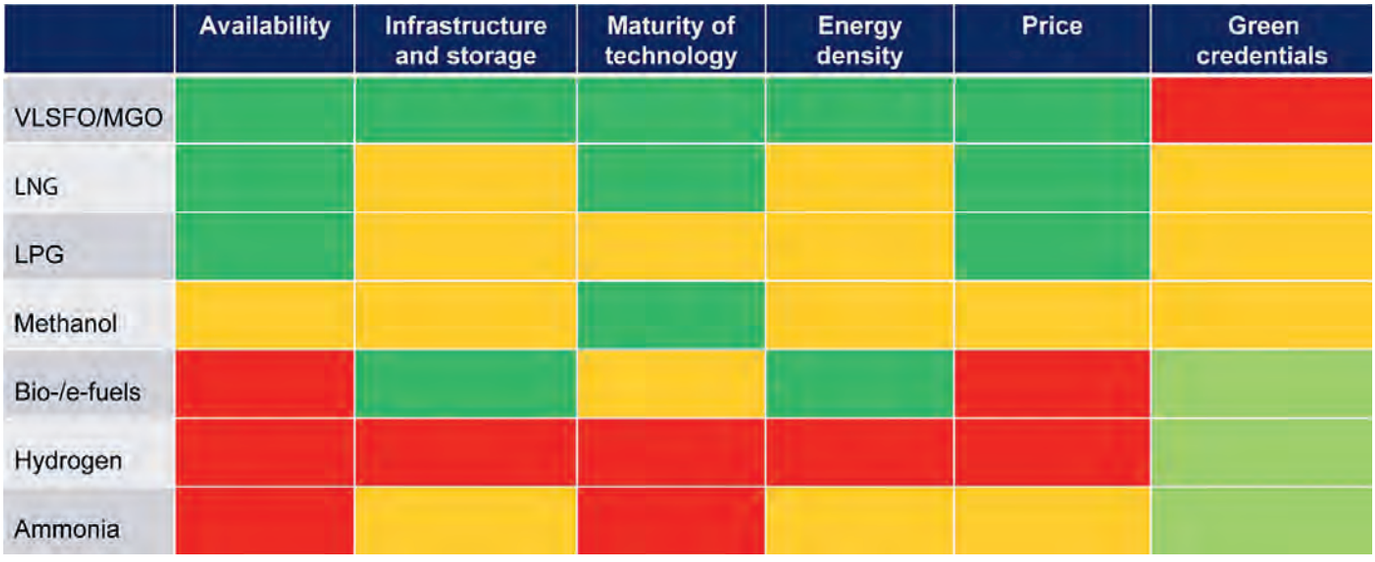
materialen, de trage ontsteking, NO_x-emissies en de opslag van ammoniak in roestvrijstalen tanks. Wärtsilä noemt ammoniak momenteel een *drop in fuel;* in kleine hoeveelheden kan het worden toegevoegd aan dieselolie. Aangezien ammoniak geen koolstof bevat, zou deze mix van brandstof dan minder CO_2 produceren. Zowel voor S1- als DF-motoren loopt er dit jaar een onderzoek.
Ook veldtesten aan boord van schepen staan gepland voor 2022. Het offshore-schip Viking Energy zal worden uitgerust met brandstofcellen die gevoed worden met ammoniak. De brandstofcellen hebben per stuk een vermogen van 2 MW. Een zusterschip, de Viking Lady, was van 2009 tot 2015 uitgerust met brandstofcellen die gevoed werden met LNG.
Man B&W richt zich met *two stroke crosshead engines* op *well-to-wake*: ammoniak geproduceerd met alternatieve energiebronnen, zoals elektriciteit geproduceerd met waterkrachtcentrales, wind- of zonne-energie.
MAN en Wärtsilä verwachten in 2024 op de markt te komen met tweeslag kruishoofdmotoren met als brandstof ammoniak in dual-fuel-uitvoering.
Noot: Het verbrandingsproces van ammoniak is niet hetzelfde als de eerder gebruikte brandstoffen. Gekeken moet worden naar belangrijke eigenschappen zoals ontstekingseigenschappen, verbrandingssnelheid en de eisen gesteld aan pilot fuel en emissies. Als er nu *green ammonia* beschikbaar zou zijn, is deze enige malen duurder dan VLSFO, *very low sulphur fuel oil* en LNG.

Cryogene brandstof

Ammoniak wordt vloeibaar bij -34°C of bij kamertemperatuur onder een druk van 10 bar. De opslagtemperatuur van vloeibare waterstof is -253°C, van LNG: -163°C en van ammoniak -33°C. Het zijn dus alle drie cryogene brandstoffen, dat wil zeggen, in vloeistofvorm hebben zij lage tot zeer lage temperaturen. Vloeibaar ammoniak kan ook worden opgeslagen bij een druk boven 8,6 bar en een temperatuur van 20°C. Niet gekoelde tanks moeten bestand zijn tegen een druk van ongeveer 18 bar.
Ammoniak heeft een grotere dichtheid dan vloeibare waterstof en waterstof is pas vloeibaar bij de extreem lage temperatuur van -253°C. In vergelijking met de bekende vloeibare brandstof HFSO, weegt ammoniak bijna tweemaal zoveel en heeft het driemaal zoveel ruimte nodig om dezelfde hoeveelheid energie op te wekken.

Kraken van ammoniak

De periodieke overcapaciteit van duurzame energieparken kan ingezet worden om waterstof en stikstof te produceren om vervolgens te laten reageren tot ammoniak. Het waterstof wordt via elektrolyse uit water verkregen en het stikstof kan uit de lucht gehaald worden, immers 78 procent van de atmosfeer bestaat uit stikstof.
Om een inwendige verbrandingsmotor goed te laten werken, dient een deel van de ammoniak via een katalysator te worden gekraakt tot waterstof en stikstof, het waterstof ontsteekt op het einde van de compressieslag van de motor, het ammoniak wordt vervolgens meeverbrand. Voor het kraken van ammoniak wordt restwarmte uit de uitlaat gebruikt en de motor zou dan kunnen werken met dertig procent waterstof en zeventig procent ammoniak. Op die manier kan men beginnen met de ammoniaktankers die al jaren ammoniak vervoeren als grondstof voor allerlei processen. Op deze tank-



Een overzicht van de stand van zaken betreffende alle huidige en toekomstige beschikbare brandstoffen voor de scheepvaart. De parameters zijn beschikbaarheid, infrastructuren en opslag, stand van de techniek, energiedichtheid, prijs en "groene" brandstoffen. Groen is hier de gunstigste, dan lichtgroen, dan geel en ten slotte rood. De bekende vloeibare koolwaterstoffen zoals zware olie en dieselolie scoren natuurlijk goed, alleen is het geen "groene" brandstof. Door alle regelgeving zal deze brandstof steeds meer naar de achtergrond geraken en waarschijnlijk tussen 2030 en 2050 geheel verdwijnen. Momenteel is LNG de brandstof die steeds meer wordt toegepast, hoewel de uitstoot van CO_2 maar vijftien tot twintig procent lager is dan de traditionele brandstoffen. Wel is natuurlijk de uitstoot van NO_x, SO_x en fijn stof veel lager. Methanol heeft nog behoorlijk wat verbeterpunten nodig en dat geldt nog meer voor ammoniak. Ook voor biobrandstoffen en e-brandstoffen moet nog veel worden verbeterd voordat het een acceptabele brandstof voor de scheepvaart is (bron: DNV).

schepen is namelijk al veel ervaring met de opslag en het koelen van ammoniak aan boord.
Alleen waterstof gebruiken is hier geen optie: de energiedichtheid van het waterstof als gas is erg laag en zelfs als vloeistof van 253°C onder nul heeft het nog steeds een relatief lage energiedichtheid. Ammoniak heeft trouwens ook een ongeveer drie keer zo groot volume nodig als de conventionele brandstoffen zoals dieselolie.

Het gebruik van ammoniak in scheepsmotoren heeft nog een lange weg te gaan

De Noorse rederij Hoegh Autoliners heeft een *Letter of Intent* (LoI) getekend met China Merchants Heavy Industry om een serie voor ammoniak geschikte Aurora-klasse autoferry's te bouwen. De eerste twee schepen met een capaciteit van 9200 CEU worden opgeleverd in de tweede helft van 2024.
De *multi-fuel*-voortstuwingsmotoren kunnen verschillende brandstoffen zoals biobrandstoffen of conventionele brandstoffen, inclusief LNG en ammoniak gebruiken. Als ze worden opgeleverd, zijn het volgens de rederij de grootste en milieuvriendelijkste autocarriers ter wereld.

Regelgeving nog een bottleneck

De realiteit als potentiële brandstof wordt echter ondersteund door drie toonaangevende instituten:

- DNV: "The best estimate future".
- Lloyd's Register: "The most competitive fuel with zero emission".
- International Transport Forum: "Pathways to zero-carbon shipping by 2035, a mix of ammonia and hydrogen".

MAN Energy Solutions onderzoekt momenteel het gebruik van ammoniak met een tanker voor ammoniakvervoer.
Onder de International Code of the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk" (IGC Code) is het verboden giftige stoffen als brandstof te gebruiken. De hele regelgeving is nog in ontwikkeling waardoor het gebruik als ammonia momenteel de eerste jaren niet mogelijk is.

De toekomst

1. Brandstoffen met een lage hoeveelheid koolstof (*low carbon fuels*) moeten worden ontwikkeld en getest om resultaten te boeken met het verlagen van de uitstoot van broeikasgassen. LNG-gebruik zorgt voor lagere emissies en zorgt voor een goede infrastructuur voor toekomstige brandstoffen zoals methanol en ammoniak.
2. Om tot lagere uitstoot van broeikasgassen te komen, moeten motoren worden ontworpen en getest die flexibel zijn voor verschillende brandstoffen: de zogeheten multi-fuel *engines*.
3. Het creëren van nieuwe brandstoffen, zowel vloeibare als gasvormige brandstoffen.

De eerste ammoniakmotor komt in 2024 beschikbaar (MAN ES). Motoren met als brandstof methanol zijn al beschikbaar, zowel tweeslag als vierslag motoren (Wärtsilä en MAN ES). Waterstof als brandstof is nog ver weg. Wel kan waterstof worden gemengd met andere gasvormige brandstoffen. Nu gaat het om twintig procent menging en in 2030 is een DF-motor beschikbaar voor alleen waterstof.
Voor ammoniak zijn aanpassingen van de brandstofinstallatie en de verbrandingsmotor nodig op het gebied van:

1. Opslag: het dient onder druk te worden opgeslagen in een cilindervormige tank of gekoeld tot -33°C in een aan de scheepsvorm aangepaste tank. Het materiaal van de tanks dient roestvast staal te zijn.
2. Alle brandstofleidingen dienen dubbelwandig te worden uitgevoerd en een stikstofinstallatie is noodzakelijk.
3. Koper en koperlegeringen mogen niet worden toegepast. Ook nikkel en zijn legeringen zijn verboden. Beide ondervinden corrosie door ammoniak.
4. De ammoniakvloeistof dient richting de brandstofpompen een druk te hebben van 80 bar.

Er zijn nog geen regels voor het gebruik van deze brandstof voor motoren.
Veel bedrijven zijn druk doende de technieken op "groene brandstoffen" te creëren, zoals groene waterstof, synthetische methaan, methanol, ammoniak, kerosine, gasolie en diesel. De synthetische brandstoffen zijn gemakkelijker op te slaan dan waterstof en kunnen eenvoudig worden toegepast.
Voor veel processen is erg veel energie nodig, met vooral zonneparken is het misschien mogelijk deze synthetische brandstoffen te produceren. Dit zal de komende vijf tot twintig jaar tot stand moeten komen.
Synthetische of e-brandstoffen worden geproduceerd met behulp van CO_2. De benodigde waterstof dient te worden geproduceerd met "groene" elektriciteit.
De toekomst zal leren welke brandstoffen we moeten gaan gebruiken in de scheepvaart. Eén feit staat vast: met de zeer noodzakelijke verandering van de conventionele brandstoffen naar minder vervuilende alternatieven gaan de kosten voor de totale voortstuwingsinstallatie behoorlijk omhoog en zijn nog vele technische aanpassingen noodzakelijk.

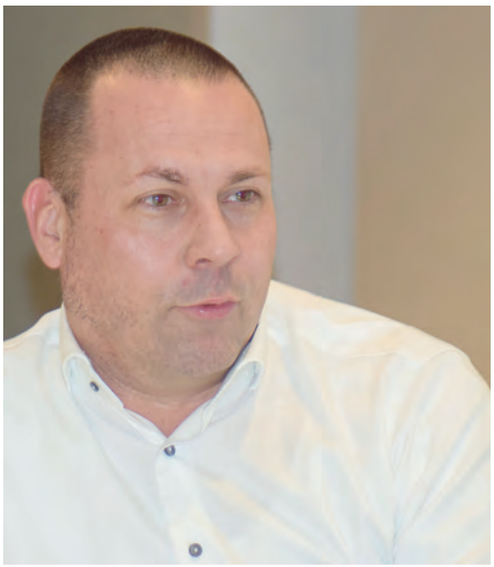
Kees Kuiken
Expert op het gebied van scheepsmotoren, geeft les en schrijft over diesel-, gas- en dual-fuel-motoren, en eigenaar van Target Global Energy Training, www.targettrainingcentre.nl

HBO EN MBO BELANGRIJK VOOR MARITIEM ONDERZOEK

In 2023 project professional doctor

In een vorig nummer berichtten wij over de samenwerking van vier maritieme hbo-instituten in een onderzoeksplatform. We praten daarover door met lectoren Herbert Koelman en Jeroen Pruyn. Volgens hen hebben de hogescholen al zo'n vijftien jaar ideeën om meer gezamenlijk onderzoek te doen. 'Maar het was altijd lastig daarvoor aansluiting te vinden bij grote maritieme bedrijven en technische universiteiten. Nu willen we één gezicht naar buiten creëren om een logische partner te worden.'

Begin februari spraken de lectoren met elkaar om te zien wat zoal mogelijk en wenselijk is. 'Dit is een kleine sector met dito opleidingen. De hogere hotelscholen bijvoorbeeld hebben duizenden studenten, NHL Stenden (Maritiem Instituut Willem Barentsz), Hogeschool Rotterdam, Hogeschool Zeeland en Hogeschool van Amsterdam samen net iets meer dan duizend,' stelt Koelman, werkzaam bij SARC en NHL Stenden. Pruyn, lector Duurzame havenstad en tevens hoofddocent Maritieme techniek en Rederijkunde op de TU Delft, doet er nog een schepje bovenop: 'We praten over een kenniscentrum zonder onderzoekers, dus het werk moeten wij als lectoren of als docenten zelf doen. Een lector heeft maximaal een halve dag per week tijd voor onderzoek. Dat schiet wat minder hard op dan op een TU, waar je enkele promoveerders aan het werk kunt zetten. Amsterdam heeft daarnaast geen maritieme lector en in Zeeland vormen diverse lectoren een pool, waarin zij hun aandacht moeten verdelen over meer onderwerpen dan maritiem alleen.'



Pruyn: 'Zelf de kar trekken' (foto's Sander Klos).

Plannen volgen

Het gesprek van beide lectoren met collega's uit Amsterdam en Zeeland werd verder toegelicht door de programmamanager Water van SIA over de topsector Water en maritiem. Regieorgaan SIA bevordert kwaliteit en invloed van het praktijkgericht onderzoek van hogescholen door financiering en door samenwerking tussen hogescholen, bedrijfsleven en publieke instellingen te stimuleren. Pruyn: 'Er zijn geen nieuwe plannen gesmeed, alleen is nog eens uitgewisseld op welke expertisegebieden we samen onderzoeksvoorstellen willen indienen. Het was een nuttige kennismaking en we zien veel mogelijkheden voor synergie, die we op korte termijn gaan uitdiepen. In eerste instantie door elkaar te betrekken bij projecten (of projectvoorstellen), zodat we ervaring met elkaar opdoen. Later kunnen we kijken wat we doen met al lopende initiatieven.'
Het huidige basisbudget voor de maritieme lectoren komt via de reguliere onderwijsbegroting. 'De manuren zijn gefinancierd, maar elk serieus onderzoek moet extern worden gesteund, bijvoorbeeld door SIA of geïnteresseerde bedrijven.' Een verdeelsleutel zeventig-dertig (extern) is niet ongewoon. En een "serieus" onderzoek kan zomaar één miljoen euro vergen. Waarbij beiden benadrukken dat hbo-onderzoek in het algemeen praktischer is dan een PhD op universitair niveau.
Tevens is er oog voor groei van het aantal practoren, de mbo-evenknie van de hbo-lector. Volgens Koelman blijkt uit recent contact dat er mogelijkheden tot samenwerking zijn in onderwijs en onderzoek, bijvoorbeeld het onderzoeken van datasets in de minor Advanced Engineering Tools for ShipX (AETS).

Professional doctor

Tot de praktische zaken die nu al door de hoofden spelen behoren een promotieonderzoek naar het volgen en vastleggen van innovaties om die zo te verbeteren, er wordt gedacht aan het instellen van de in veel landen al gebruikelijke titel *professional doctor* en in maart hoopt Pruyn meer te weten over de aanvraag van een zeer breed nationaal onderzoek om de hele binnenvaartketen, dus de techniek, wet- en regelgeving en bunkering richting nuluitstoot te helpen.

Het project rond de professional doctor (PD) heeft een looptijd van zeven jaar en voorziet in een promotietraject aan het hbo. De Vereniging van Hogescholen trekt dit in samenwerking met het ministerie van Onderwijs. Pruyn: 'Het idee is gedurende vier jaar elk jaar twee nieuwe PD's te financieren, compleet met alles wat zij daarbij nodig hebben. Interessante vragen zijn wat een PD precies gaat doen en in hoeverre een PD verschilt van een PhD. Zoals het er nu uitziet, zal de PD zich richten op praktijkgericht onderzoek in bedrijfssituaties. Dus interessant voor een werkende hbo master, die graag meer onderzoeksvaardigheden wil aanleren. Dat is van meerwaarde voor onderzoeksafdelingen van bedrijven.'

De lectoren verwachten dat de eerste kandidaten in januari 2023 aan de PD-studie kunnen beginnen. 'De hbo-uitstroom is jaarlijks zo'n 200 à 300 en daarvan gaat vijf à tien procent al dan niet in deeltijd nu al een aanvullende master doen. Die extra onderzoekskennis is trouwens broodnodig als je kijkt naar de uitdagingen van de energietransitie, die alles op z'n kop zet.'

Pittige klus

Het platform vergt het nodige van alle betrokkenen. Pruyn: 'We zullen zelf die kar trekken en op zoek gaan naar docenten die warmlopen voor een bepaald onderwerp en voor kennisuitwisseling.'

ROL VAN HET MKC

Het Maritiem Kennis Centrum (MKC) streeft naar een (fundamentele) kennisbasis voor de Nederlandse maritieme industrie om de leidende innovatieve rol te behouden. Het vertaalt uitdagingen in plannen voor (fundamenteel) onderzoek en stelt die ter beschikking aan bedrijfsleven en onderwijs. Bij het MKC zijn onder andere NLDA, TU Delft, MARIN en TNO aangesloten.

In de MKC-stuurgroep zitten de CEO's van de partners. Maandelijks worden agenda's en plannen afgestemd, informatie uitgewisseld en plannen voor samenwerking gemaakt.

Namens grote maritieme bedrijven nemen de Damengroep, Royal IHC, RH Marine Group, Wärtsilä, Allseas en Heerema Marine Contractors deel aan het MKC. Ook de Defensie Materieel Organisatie (DMO) is gezien militaire toepassing betrokken. Daarnaast wordt samengewerkt met het midden- en kleinbedrijf via de brancheorganisaties die evenals het MKC deel uitmaken van stichting Nederland Maritiem Land. Wat betreft vraagstukken op het gebied van het mariene milieu is er samenwerking met NIOZ en Imares.

Koelman: 'Meer samenwerken met mbo.'

Tot de doelgroep behoren niet alleen (jonge) studenten, maar ook maritieme officieren, die na vijf tot zes jaar stoppen met varen en dan als dertigers een tweede maritiem beroep kunnen uitoefenen, via een master na hun varenstijd. 'We kennen voorbeelden van marofs die in grote gebouwen als de Erasmus Universiteit de bedrijfsinstallaties aan de praat houden. Op een schip doe je niet anders en deze praktijkmensen zijn goed in oplossingen bedenken, want waren aan boord op zichzelf aangewezen.'

Koelman benadrukt het belang van het 'ene onderzoeksgezicht' naar buiten en de koppeling met het Maritiem Kennis Centrum (zie kader).

Ook de specifieke kennis van de hogescholen speelt een rol. 'Zo is Zeeland sterk in baggeren en landaanwinning, concentreert Rotterdam zich op productie, toelevering en werven, zit Leeuwarden klassiek aan de (jacht)ontwerpkant en richt Amsterdam zich meer op havenlogistiek en dataverzameling.'

Wensenlijst

Gevraagd naar soorten onderzoek die zij op hun verlanglijst hebben, noemen ze de praktische inzet van alternatieve energiebronnen. En het "stokpaardje" van Pruyn: 'In het Maritiem Masterplan gaat veel aandacht naar oplossingen voor technische beperkingen, maar minder naar veranderingen in het (ontwerp)proces. Daarbij speelt mee, dat de technische kant sexyer is. Daardoor gaat veel tijd en aandacht naar motoren en *fuel cells* en te weinig naar ontwerpen, onderhoud en inbedding van alternatieve technieken aan boord. We hebben 25 jaar gedaan over de omschakeling van hout naar staal, maar nu moet het veel sneller en gelden oude vuistregels niet meer.'

Sander Klos
Freelance maritiem journalist en een van de redacteuren van SWZ|Maritime,
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UNIQUE HOSPITAL SHIP GETTING READY FOR ITS MISSION

Global Mercy – Part 1 of 2

The brand-new Global Mercy is the world's largest civilian hospital ship, with a self-assumed charity mission along the African West Coast. On board, free medical care is provided to thousands of the poorest people. The China-built hospital ship has a unique design based on experience with its older sister Africa Mercy. Two central decks are fully outfitted with surgery and hospital care facilities.

During its maiden voyage to Europe, the Global Mercy has paid a two-week goodwill visit to the Port of Rotterdam. The visit was to strengthen the bond with numerous volunteers, corporate sponsors, societal leaders, supporting churches and individual donors.

First of its kind

Some ten years ago, the Mercy Ships organisation started developing plans for adding substantial new capacity to its African hospital ship operations. All the ships they had had in operation so far were conversions of passenger ships or ferries. This had never delivered an ideal floating hospital facility, and investments, maintenance costs plus remaining lifetime of a converted ship also proved suboptimal. As a purpose-built new ship would have great advantages, Mercy Ships began raising funds. Founder Don Stephens entered into discussions with experienced maritime powerhouse Stena RoRo, who soon got commissioned to manage the new ship's design and construction. Stena gladly contributed its resources to the newbuilding project from Gothenburg, Sweden.

In 2013, Mercy Ships took the bold decision to build a novel and unprecedented type of hospital ship in China. The construction costs of about USD 200 million could entirely be covered by an array of corporate and private donations. Hence, the new ship would be able to commence debt-free with its lifetime mission in Africa.

Hospital ship design

'We began with Stena Seabird, an existing RoPax platform developed in-house in cooperation with Deltamarin,' remarks Per Westling, Managing Director for Stena RoRo. 'But during the design process, we developed it as a pure passenger ship with hospital services instead. You could say that we replaced the vehicle decks by operating rooms and hospital wards. But we also adapted the ventilation system and re-arranged the interior layout.'

'We extended the accommodation decks and developed further im-

Photo: Global Mercy leaving Rotterdam for Africa (courtesy Mercy Ships).

Global Mercy berthed during launching ceremony at Tianjin Xingang shipyard (courtesy Mercy Ships).

provements of the RoPax origin over time,' he continues. 'For instance, a hospital ship does not need equipment and facilities for quick turnaround of large wheeled cargo volumes in ports. Cabins on a hospital ship are bigger as the volunteering crew stays on board for long time periods. Public spaces and meeting rooms serve different functions to those on a passenger ship. And sailing speed does not matter, the ship sits in port for many months at a time and moves only once a year. In this project, we have already incorporated some elements from our growing RoPax construction standard.' All in all, you could describe it as a successful blend of hospital ship and Stena ferry.

Operating in African ports

The sailing/berthing ratio in the operational profile of Mercy Ships is almost the opposite of conventional passenger ships and ferries. In a typical annual cycle, hospital ships spend up to ten months berthed in an African port. With the remaining two months available for sailing to the next port and performing major annual maintenance works. Sometimes with a short stay in yet another regional port. Few suitable repair yards are available, let alone drydocks, along the whole African continent.

'Port conditions in Africa are the limiting factor,' says Jim Paterson. 'We know these conditions very well from past operations with our existing ships.' Paterson is a Scotsman from Glasgow who joined Mercy Ships back in 1987 as Chief Engineer. He has been on board all Mercy Ships ever since and led the Marine Operations Department for twenty years. As Executive Marine Consultant, he has been instrumental in overseeing the plans and building of Global Mercy.

'The African ports where we operate do not only restrict us in ship dimensions. Also, the water quality in harbours is extremely poor. Would you know that we employ volunteer divers to unclog our sea chests? And this hull is fitted with state-of-the-art systems for anti-fouling. Marine growth on the underwater parts when moored in tropical waters for such extended periods is a serious concern,' Paterson explains.

'We built the ship to be completely self-sufficient whilst berthed for extended hospital services in ports. We cannot rely on shore power.

> The construction costs of about USD 200 million could entirely be covered by donations

Although an IMO requirement in western ports in future, there is simply no stable electrical shore power available there. We have a powerful redundant diesel-electric power supply on board. Thus, we are able to supply some of our power surplus to provide shoreside clinics and their ancillary facilities with stable electrical power. The only thing we need from shore in these African ports is raw water. Our water treatment facilities on board (to Hatenboer standards) turn this into the high quality drinking water we need for hospital facilities and crew quarters,' Paterson concludes.

Campaign support in Africa

Mercy Ships operate in Africa's sub-Sahara region, mainly at the West-Atlantic coast. Typical ports called during successive health campaigns in West-Africa are Conakry, Freetown, Monrovia, Lomé and Cotonou.

Mercy Ships travels to African host countries only after official government invitation. This ensures co-operation of the government itself, local authorities and institutions, public facilities, churches, health services, utility providers, and port authorities. It is absolutely vital to ensure full local co-operation for the ground operations in any country. Preparations already start two years ahead of arrival.

Africa Mercy docked in Cotonou, Benin (courtesy Mercy Ships).

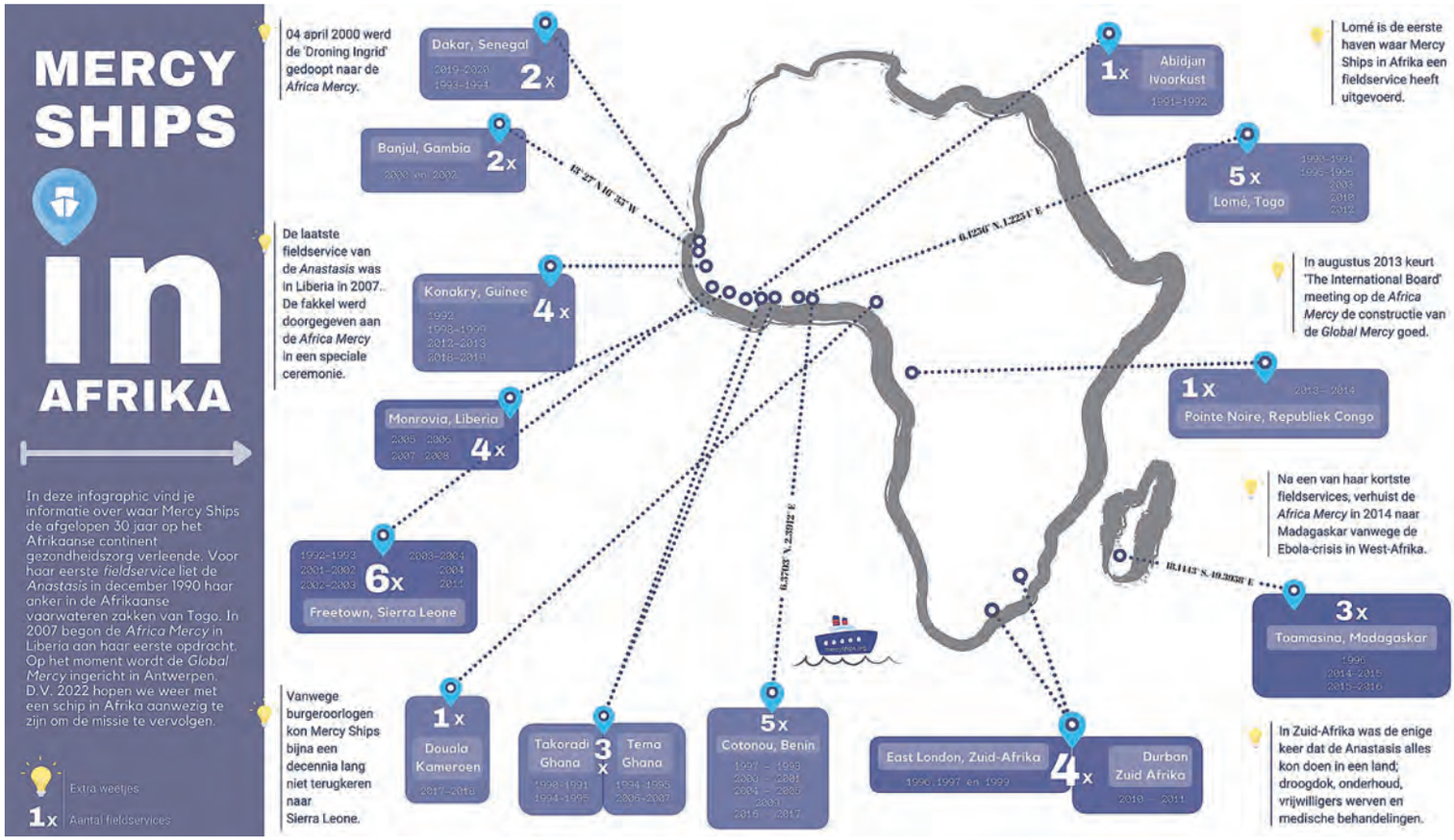
Advance Teams arrange all facilities and logistics needed for the medical services provided on board. And increasingly, co-operation with local hospitals and clinics, and educational institutes. The Advance Teams screen the patients earmarked for hospital treatment, and carefully plan their appointed admission to the hospital ship. Patients requiring major surgery with expected longer after treatment are scheduled early in the ship's campaign. They obviously need to be fully cured and recuperated, and in any case dismissed before the ship leaves port. The Advance Teams also set up temporary medical and dental out-patient treatment facilities on shore.

'The only thing we need from shore in these African ports is raw water'

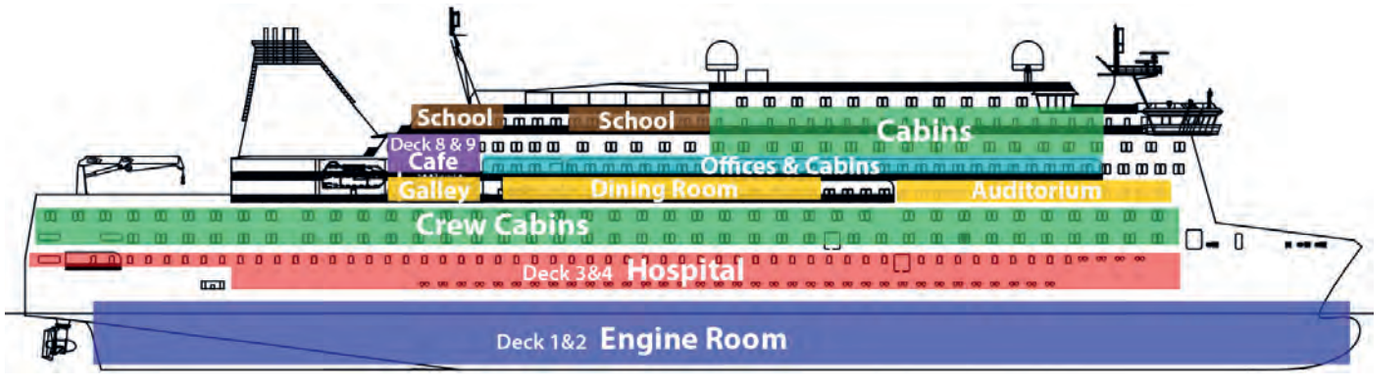
A daily stream of patients, accompanying family members, local staff and trainees needs to embark and disembark in a well-organised sequence. And this flow in turn needs to match with Mercy Ships' own cars and locally sourced inland transport facilities. The ship can handle limited amounts of building materials, office and medical facilities and transport vehicles for inland and port-based operations with its two store cranes fitted on the aft ship.

'Our ship's local supplies, the air freighted medicines and the sea transport containers imported through our European Distribution Centre in Rotterdam all require smooth co-operation with our trusted local handling agents,' says Cor van Esch, Procurement Direc-

Volunteer crew for Africa Mercy in Dakar (courtesy Mercy Ships).



Three decades of Mercy Ships operations in Africa.



Layout of decks inside Global Mercy (courtesy Mercy Ships).

tor of Mercy Ships Holland. The material and personnel flow in African operations is likely to increase in future, not only because Mercy Ships will now operate two hospital vessels, but also because it is going to expand its inland operations with education, healthcare and agriculture improvement programmes in countries of need.

Purpose-built hospital ship

Whilst Global Mercy's silhouette may resemble a RoRo passenger ship, inside the ship everything is designed and constructed with the sole purpose of providing a maximum of efficient and human-centred hospital treatments, with all the required amenities and supporting facilities laid out in a functional manner. Deck heights, room sizes, passageways, doors, stairs and lifts are all laid out for optimal service and easy personnel and material flow, thus combining a caring environment with ship-routine logistics performance.

Centrally positioned are the two fully rectangular decks with 7000 square metres of surgical suites and hospital wards. Above are the expansive crew lodging, restaurant, recreation and education facilities. The fully equipped nautical bridge is manned only at sea. On the open aft deck are two store cranes for ship provisions, shore materials and vehicles. Less visible to visitors and only accessible to authorised crew members are the machinery and storage spaces below the lower hospital deck.

The ship is equipped with four Wärtsilä W6L32 medium-speed diesel generator engines delivering 3360 kW each. Propulsion and steering go through twin 2850 kW ABB Azipods. The diesel-electric power system is constructed with fire safety and redundancy as criteria. Apart from uninterruptable essential hospital services, this also provides compliance with the modern-day SOLAS requirement for Safe Return to Port for this grade of passenger ship.

Hospital decks are fitted with dedicated systems for power supply, potable water, sanitary discharge, HVAC and oxygen supply. The ship's environmental footprint in African ports is minimal. The only wastes produced are treated water and ash. Any person visiting the ship or living on board enjoys the bright Scandinavian interior architecture of messrooms and meeting rooms. The central galley can serve up to 3000 meals a day.

Experience from Africa Mercy

For many years now, Africa Mercy is the only hospital ship in operation, with many crew volunteers knowing no other home away from home. The ship was originally built as Danish train ferry Dronning Ingrid and converted into a dedicated hospital ship by A&P Shipyard, Newcastle-upon-Tyne. The refit had cost USD 62 million and was regarded the largest ship conversion in the UK.

Commissioned by Mercy Ships in 2007, the ship has already completed fifteen medical campaigns in various African countries. The field experience gained by these operations has provided invaluable inputs to the design, construction and operational preparations for the Global Mercy. For instance, the Africa Mercy hospital facilities are not big enough once local doctors are brought in for training, and container storage and social space is limited.

After leaving Rotterdam, the Global Mercy has set sail to Tenerife for final completions. Then it will continue to Dakar, Senegal, for the naming in the presence of the Africa Mercy. Marine and medical crew will be transferred there to Global Mercy as Africa Mercy heads for an unpostponable maintenance stint.

Ship name	Africa Mercy	Global Mercy
Year built/converted	2007	2021
Shipyard	UK	China
Tonnage (GT)	16,500	37,000
Installed power (kW)	12,480	13,440
Deadweight (t)	4150	6523
Length (m)	152	174
Beam (m)	23.7	28.6
Draught (m)	6	6.1
Decks	8	12
Crew	474	641
Hospital beds	82	199
Hospital area (m2)	1200	7000
Operation theatres	5	6

Main particulars of Mercy hospital ships, compiled by the author.

Construction and testing

Tianjin Xingang shipyard in China was contracted early in the newbuilding project, with the advantage of incorporating many reputable European suppliers in the building specifications. As it was the

Vessel Management Team during Global Mercy sea trials (courtesy Mercy Ships).

Hologram tour by volunteering maxillofacial surgeon Dr. Mark Shrime in one of the operation theatres of Global Mercy (photo author).

THE GLOBAL MERCY EXPERIENCE

The ship's open house organised by Mercy Ships Holland inviting the public for a one-hour guided tour through the interiors of Global Mercy was a big success. In fifteen days, some 10,000 in-person visits were hosted along with 4300 virtual tours. Audio-visual displays and even holograms brought the unmanned hospital treatment facilities to life. Many visitors brought their friends and colleagues. Families with small children also took this rare opportunity to see the new ship from the inside. For some it was their first time on board such a large seagoing vessel. Did they realise that when the ship is moored in Africa, the young patients and their accompanying family members will come on board over the same central gangway, anxious to set foot on this miracle of a 21st century hospital? Visitors in Rotterdam left the aft ship over the same gangway where the healed patients will jump off to a happier life in Africa. To many young visitors the special hospital ship made a lasting impression. Says Mirjam de Vos, HR Director at the Wilhelmsen Group: 'I joined the tour with my husband, a professional architect, and my 3-year old son. It inspired us to talk about volunteering ourselves. I could certainly join in the HR sector, and we learned that my husband would be welcome to work in construction of Mercy Ships buildings onshore. And my son? He said he wants to be a doctor on board!'

SWZ|Maritime reporter Mariska Buitendijk also immersed in the Global Mercy Experience. A lively visit report with extraordinary Rotterdam blue sky photos can be accessed via the QR code.

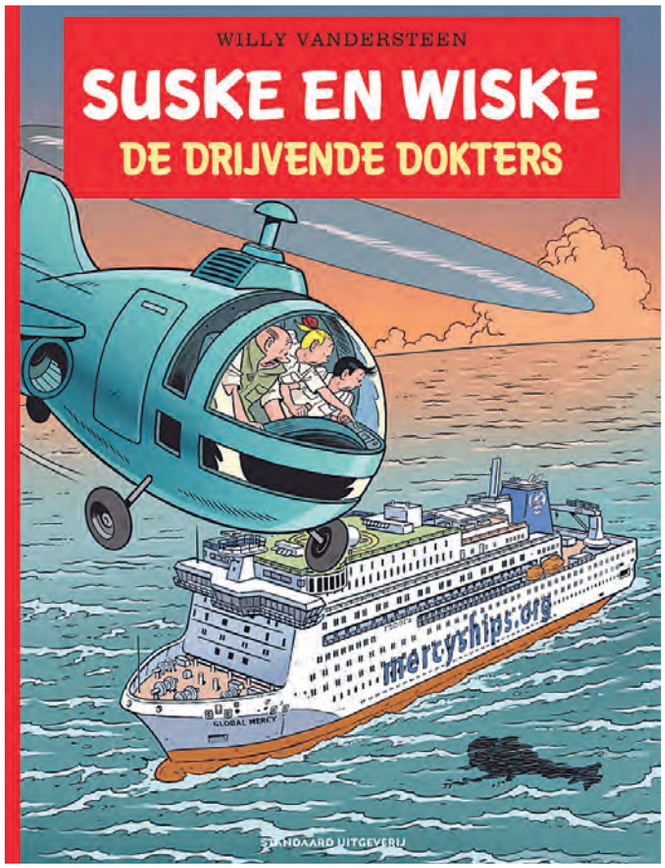
first ever passenger-type ship built to international regulations and standards in China, Stena RoRo fielded a strong supervision team, with a good mix of nationalities, and all discipline leads having many years of overseas newbuilding experience. Detailed design was carried out by Deltamarin, the Finnish ferry and cruise ship specialist.

Before construction and outfitting of the accommodation decks, the site team had the shipyard building a scale 1/1 mock-up of a deck's section. This set a clear benchmark on agreed workmanship and prevented endless discussions on standards. Unfortunately, equipment and material deliveries to China and provision of expert manpower were hampered by transport and travel restrictions imposed during the Covid-19 pandemic. This affected, for instance, the sophisticated solid and liquid waste handling systems to be installed on board.

Eventually, the ship was delivered to Mercy Ships by the yard in June 2021 after successfully passing extensive deep-water sea trials. Strict HVAC system performance requirements were tested and proven for noise and vibration in the delicate hospital areas and crew quarters. Now the ship was ready to undertake its first and longest sea voyage to Europe, passing through the Suez Canal.

Patient treatment and care

Mercy Ships provides a range of surgical treatments ranging from orthopaedic foot and bones corrections, congenital deformities reliefs, fistula repairs, skin tumour removals, cleft lip and palate corrections to eye surgery and dental care. Those who are treated within the same day will stay in the general outpatient, eye and dental clinics. Those who will receive more elaborate surgery will be made comfortable in the wards, with 200-bed capacity. This capacity is split into acute care and self-care beds. For the latter,



Belgian comic strip "De Drijvende Dokters" (courtesy Standaard Uitgeverij).

patients are assigned an innovative bunk bed with the bottom tier allocated to their accompanying family member.
Surgical deck 3 is isolated from public facilities and accessible to authorised medical staff and their patients only. Around the centrally positioned six operating theatres all required support facilities are laid out. Needless to say, the hospital can avail of the latest radiology equipment for X-rays and CT-scans. And laboratories, pharmacy and hospital supplies are on standby. The emphasis is on planable and specialised surgical care that does not require long-term aftercare or rehabilitation and contributes to quality of life.

Simulation lab training

When the Global Mercy leaves a port, having completed some 3000 medical treatments, it wants to leave a lasting improvement of local healthcare behind. That is why local students are trained in classrooms, an OR simulator, and a simulator lab using the latest virtual-reality and augmented-reality equipment. In the simulation lab, trainers can simulate local conditions and limitations in order to teach best medical practices in low-resource operating situations.

Medical outfitting and commissioning

On its maiden voyage to Europe, Global Mercy first docked in the Port of Antwerp. All medical outfitting equipment was brought on board and some already installed. The flagship attracted a lot of attention during its first official port visit and already celebrated huge support from European companies and volunteers. It even got its own comic book: the well-known Belgian comic Suske and Wiske titled "De Drijvende Dokters" was launched. Before departure, the ship was stocked and partly crewed to proceed to Rotterdam.
'Not only commissioning the usual ship's marine systems, but also new medical systems inside the ship simply takes time. Unlike most ship operators, we are luckily not under commercial pressure for first public operations,' clarifies Dutch Chief Engineer Irik Mallie. 'We'd better have our facilities thoroughly tested and our medical crew fully trained before we enter African port operations. Being docked now in Rotterdam is excellent, there is no way you can commission these high-grade operation theatres, with advanced systems and delicate software, once the ship is in transit or in Africa.'

> There are no plans to return to Europe once the ship starts operating in Africa

Rotterdam port visit

Dutch Director Martijn Provily has prepared for the visit to Rotterdam with his staff and some 300 bi-lingual volunteers. 'It is a unique opportunity for us to let as many Dutch people as possible see our mission up close,' he says. 'And possibly the only opportunity to get on board the ship here in Rotterdam, as there are no plans to return to Europe once the ship starts operating in Africa.'
One of the key Dutch staff in attendance is Hendrik Jan Groeneveld, an independent businessman who works as a volunteer one day per week for Mercy Ships Holland. He is their Companies Ambassador and engages Dutch companies to pledge and effect support for Mercy Ships. He asks companies persuasively for at least one of his four favourite Ms: Manpower (volunteers), Media exposure, donation of Materials, or Money as direct financial support.
During the Rotterdam port call, he seizes the opportunity to organise a series of fundraising events on board and ashore. This way he forges strong corporate partnerships like the Mercy Ships Network. This network unites over sixty Dutch companies donating under their voluntary Corporate Social Responsibility.

Global Mercy Part 2 will appear in SWZ|Maritime's May 2022 issue.

Martijn van Wijngaarden
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ADVANTAGES AND CHALLENGES OF VERY FAST HYDROFOILS

Expertise of both maritime and aeronautic communities required

Although hydrofoils are a proven concept for reducing resistance at high speeds, many research topics and design optimisations remain open before their full potential can be unlocked. Flying Fish, a young Dutch company specialised in maritime innovation, presents the main advantages, challenges and potential solutions for these challenges of hydrofoil design.

Hydrofoils have a long history in high speed ships. Hydrofoils are wings, mounted under the hull of a vessel. They generate a lifting force when the vessel is at speed, thereby lifting the hull out of the water. This reduces resistance and improves comfort.

As early as the start of the twentieth century, speed records on water were set with experimental hydrofoil boats, such as the Bell HD-4. Popularity peaked in the seventies and eighties, when several fast ferries and military vessels were equipped with foils. In recent years, the promise of increased speed and spectacle at reduced energy consumption led to an introduction into the sports and racing world, with the America's Cup as most famous example.

Advantages

The speed of a boat is limited to the point where the total resistance meets the installed thrust. A strong resistance reduction has two direct advantages: firstly, less energy is required to sail at a given speed. Secondly, with the installed power, higher top speeds can be reached. Since most of the resistance is a direct result of contact with the water, most resistance-reduction techniques are based on reduction of the wetted and frontal area of the hull. For example, the frontal area of a catamaran is significantly smaller than that of a monohull, and a planing hull merely skids over the water surface with the bottom of the hull.

Beyond displacement

Hydrofoils are simply the most extreme case of hull-water contact reduction. A set of foils mounted under the hull lifts the entire boat out of the water at high speeds. As is the case for planing hulls, this brings the craft in a completely different sailing regime, incomparable with displacement mode. Instead of floating, the boat is flying like an aircraft, but with its wings submerged in water.

The flying mode presents some striking advantages over the displacement mode. As mentioned before, resistance is reduced by up

Photo: TU Delft Solar Boat 2016 fully foiling on Dutch waters.

to 75 per cent at high speeds. While increasing the maximum speed, this also reduces power consumption, potentially reducing both capital investment for the propulsion unit and operational expenses on fuel. If power is sufficiently reduced, this opens the way to zero-emission high-speed shipping.
Under design conditions, flying on hydrofoils introduces another advantage. Since the hull is above the waves and the foils are below, comfort on board will increase. Control surfaces on the foils provide complete control over the attitude motion of the craft. This allows for making coordinated turns and cancelling pitching motion. On top of that, the smooth ride reduces noise on board and wave disturbances for surrounding boats or shorelines.

Systems engineering

In foiling conditions, a hydrofoil boat behaves more like an aircraft than like any other vehicle or vessel. Unlocking the potential of these boats therefore requires a systems engineering design process similar to that of aircraft to ensure the advantages can be realised. In such a process, the full craft, vessel or vehicle is designed as a complete system, in which each subsystem contributes exactly as required.
As an example, consider the effect of a heavier engine on hydrofoil performance. While flying, the efficiency of a craft is defined by its dimensionless lift-to-resistance ratio (L/D), which represents the lift that is generated for each unit of resistance. This ratio is primarily set by the foil design and configuration, but during operation greatly depends on the angle of attack and flow characteristics of the foils. When designed for maximum range, the systems engineering design process will always strive to place the craft as close to the maximum L/D under cruise conditions. This is an intricate balance between the total weight of the craft (which should equal the lift in cruise), the foil design and arrangement and the control system. If we simply replace the engine for a heavier one, we need more lift during cruise, driving us away from the optimal angle of attack. This will add resistance. Not just because we are heavier (an increase in L), but also because the entire craft became less efficient (a reduction of L/D). The extra thrust we have gained by installing the larger engine may well be spent entirely on this loss of efficiency, if we manage to take off at all.

New challenges

The hydrofoil design process thus introduces new requirements for the system as a whole. Apart from the design of foils and their configuration, new challenges arise in structural, propulsion, and control design. Consider for example that the entire weight of the boat will be introduced into the hull at only a few strut positions (rather than as a distributed load), that the propellor needs to remain submerged while flying and that roll control becomes the primary way of steering.

Cavitation asks more

To give a taste of the design process, consider the design of the hydrofoils alone. From experience in the aerospace industry, we can identify two main aspects of wing design: the air foil selection (cross section) and planform design. The presence of the water-to-air boundary adds a third consideration: surface piercing.
In the aerospace industry, airfoils are often selected from NACA series. These airfoils, characterised by a specific set of shape parameters, were defined and tested by the predecessor of NASA in the first half of the twentieth century. For each wing cross-section in the series, the lift, resistance and moment curves are known, as well as the stall behaviour (dramatic loss of lift) at high angles of attack. These series provide an excellent basis for hydrofoil design, when the results are translated from aero- to hydrodynamics. However, what is missing from these datasets is the cavitation phenomenon, which does not occur in air. Although the theory provides

The TU Delft Solar Boat of 2016 illustrates how small the waves of a hydrofoil ship can be at 17 knots.

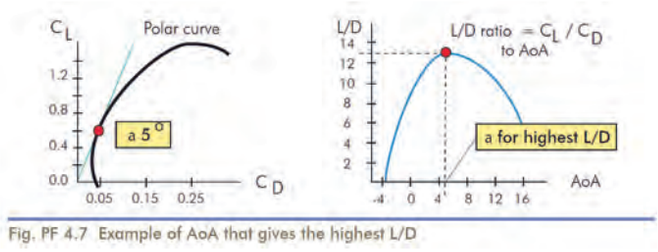


Fig. PF 4.7 Example of AoA that gives the highest L/D

This graph shows the important coefficients that are used to design a hydrofoil.

some guidelines to prevent cavitation (for example by using thin foils), an experimental series of foils is still lacking.

Give and take

While the airfoil profile defines the hydrodynamic forces and moments on a cross-section, the total force on the wing is equally influenced by the planform of the wing. In general, the shape of a wing can be characterised by the span, chord (length of the cross-section), taper (ratio of the tip chord to the root chord), sweep angle (forward or backward) and an-/dihedral angle (downward or upward respectively).

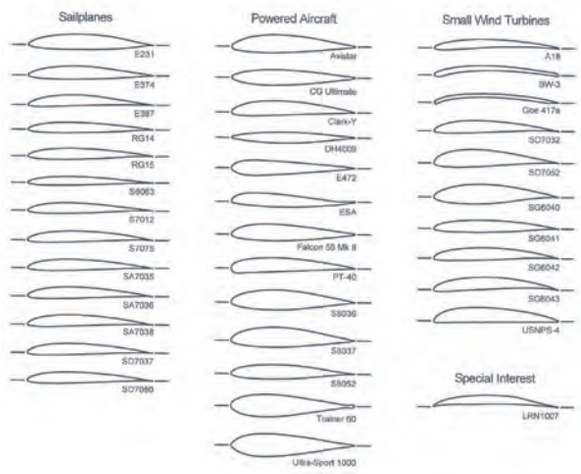
Wing design is an intricate game of iterating on these parameters to get the desired performance under all conditions. The total lift is roughly set by the area of the wing. As a general guideline, the most efficient wing (best L/D) is one that has an elliptical distribution of the lift over the span. By putting little lift at the tip of the wing, vortices that induce resistance are reduced. This condition, combined with structural considerations, generally drives the aspect ratio (slenderness defined as span squared over area) and taper ratio. Backward sweep and dihedral angle improve the stability of rolling and yawing motion, but consequently reduce manoeuvrability. Due to many cross-couplings between these parameters, however, wing design is always an iterative process.

T or V?

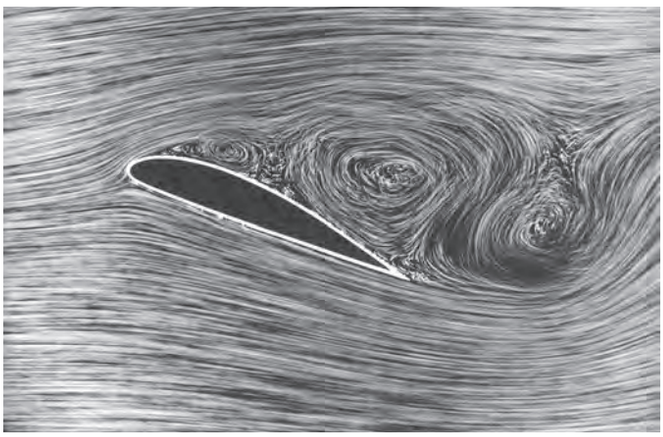
The water surface presents new opportunities and challenges for the hydrofoil designer. Since the lift on a foil in air is negligible, the level of submergence is a simple and effective way to passively control the total lift. This concept is used by V-foils for height control. Due to their large dihedral angle, the tips of the foils always stick out of the water. When the boat accelerates, it raises out of the water, reducing the foil area under the water surface that can create lift. The downside of this design is that the surface piercing causes increased resistance and increases the chance of ventilation: a dramatic loss of lift due to air being sucked into the water around the foil. An (inverted) T-shaped foil is more resilient to this phenomenon, but requires active height control.

Complex task

Barely scratching the surface of hydrofoil design, it is safe to say that development of these high-speed craft is a complex task, which requires expertise from both the maritime and aeronautic communities. Flying Fish is designing foiling boats for various applications.



A selection of different foil shapes that can be selected to illustrate the variations. In total, there are thousands of these shapes that one has to choose from while designing a hydrofoil. Every shape has its own characteristics.



This figure shows the vortexes around a hydrofoil while it is in action.

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Harlinger zeelieden in WO II gebleven

Bij Flevodruk verscheen een herziene en bijgewerkte uitgave van Harlinger zeelieden in WO II gebleven. De eerste druk verscheen in 1995 naar aanleiding van de onthulling van het Zeemansmonument aan de Waddenpromenade in Harlingen.

Het boek beschrijft de lotgevallen van Harlinger zeelieden die tijdens de Tweede Wereldoorlog om het leven kwamen, in totaal 24 opvarenden van zowel de koopvaardij als de Koninklijke Marine waarvan de namen sinds 1995 zijn ingebeiteld op het monument. Sindsdien kwam veel nieuwe informatie beschikbaar die in deze uitgebreide herdruk is verwerkt en bovendien was de eerste druk al lang uitverkocht. De originele zestien hoofdstukken bleven grotendeels gehandhaafd, maar sommige zijn fors langer geworden door het beschikbaar komen van nieuwe feiten. Acht nieuwe hoofdstukken zijn toegevoegd over uit Harlingen afkomstige zeelieden die de oorlog wel overleefden. Dat betreft onder meer Jan en Elly Klugkist, die in de avond van 14 mei 1940 met hun coaster Friso met bijna 100 Joodse Nederlanders uit IJmuiden vertrokken. Twee etmalen later werden de vluchtelingen veilig in Poole geland. Nieuw zijn ook de oorlogsbelevenissen van zeeman Aron de Vries, de enige Joodse Harlinger die aan de Holocaust ontkwam. Een interview met de vader van de auteur, scheepstimmerman Lolke van der Wal, die de strijd op zee overleefde, is eveneens nieuw. Op de lotgevallen van eerste machinist Willem de Vries, die na de torpedering van de Rooseboom van de KPM de laatste weken van zijn leven in een sloep op de Stille Oceaan dobberde, wordt dieper ingegaan dan in de eerste druk mogelijk was. Ook nieuwe informatie over de Slag in de Javazee is opgenomen. Eveneens nieuw is een hoofdstuk over de totstandkoming van het Zeemansmonument

in Harlingen. Het boek is geschreven door maritiem historicus dr. Johan van der Wal, die meerdere boeken op zijn naam heeft staan, waaronder één over de ondergang van de Simon Bolivar, die in november 1939 op Duitse mijnen liep, en een boek over de Terschellinger zeelieden tijdens de oorlog, dat in 2001 werd bekroond met de Lutineprijs.

Harlinger zeelieden in WO II gebleven, formaat 23 x 16,5 cm, 176 pagina's, afbeeldingen, Uitgeverij Flevomedia BV, Harlingen, ISBN: 9789491276415, prijs: € 19,95, info: www.flevomedia.nl/boekwinkel

FUMIGATED CARGOES REQUIRE EXTREME CARE

Mariners' Alerting and Reporting Scheme

Fumigation fatality: Mars 202209

As edited from official BMA (Bahamas) report published 19 November 2020

A small general cargo vessel with seven crew berthed to load a cargo of corn in bulk. Loading commenced after preparation and cleaning of the hold. The gas tight integrity of the hold was not tested before loading, even though it was intended to undertake in-transit fumigation after loading.

Fumigation specialists arrived at the vessel once loading was complete. They verbally confirmed with the master that the hold was suitable for fumigation. Several bags of aluminium phosphide fumigant were then placed in the hold. The plan was to provide a dose of 1 g of active ingredient per cubic metre of cargo. The hatches were closed, and the master was given a briefing document pack and gas detection equipment for testing for the presence of the fumigant inside the accommodation and engine room. The chief officer was given training on the use of the gas detection equipment. According to these instructions, tests were to be conducted every eight hours.

The general cargo vessel had several bags of aluminium phosphide fumigant in its hold.

The vessel departed the next morning with the favourable tide. At 0800, the chief officer carried out an initial check for the presence of the fumigant. He tested two locations in the accommodation and one in the engine room. These checks were repeated at 2000 that evening and at 0800 the following day. During this period, the weather deteriorated and the master adjusted the passage plan to reduce the motion of the vessel. At approximately 1030 on the second day out of port, a significant wave caused flooding in the galley and store through the ventilation trunking. The accommodation ventilation flaps were shut and the ventilation system stopped.

After lunch, the crew who were not working retired to their cabins. By 1245, several of the crew were experiencing headaches, fatigue and severe nausea. This was attributed by various members of the crew to either seasickness, a reaction to the food eaten at lunch, or the presence of exhaust gas in the accommodation. None were aware they were actually suffering from fumigation poisoning.

With the exception of the chief engineer, who went to the engine room, the affected crew either remained in their cabins, or went to the bridge or on to the boat deck to get fresh air. At about 1800 that day, when the master became aware that at least three of the crew were unwell, the possibility of fumigation poisoning was raised.

The atmosphere in the accommodation was re-tested and the presence of deadly fumigation gas was confirmed. Local authorities were immediately informed of the situation and assistance was requested.

The crew were then moved to the ship's office and master's cabin, where windows could be opened to increase the flow of fresh air. Some time before 1900, one crew member returned to his cabin unnoticed.

About one hour later, a rescue helicopter arrived at the vessel. A winchman was lowered onto the deck, but poor weather conditions and a technical issue with the helicopter meant the helicopter had to return to base without the winchman or affected crew. The vessel re-routed to the closest port.

By now, three members of the crew were in a serious condition and the crew member who had returned to his cabin was found there unresponsive.

An hour later, a second helicopter arrived with a medical team. They were able to stabilise the three crew, who were evacuated by boat when the vessel approached the port pilot station. They eventually recovered in hospital. The unresponsive crew member was declared deceased.

Investigation findings

The official investigation found, among other things, that:

- No consideration was given to the potential knock-on effects of closing the ventilation flaps of the accommodation, thus stopping the ventilation, or the additional risk posed by the fumigated cargo.
- By the time the vessel accommodation's forced ventilation was stopped, there was a positive pressure of fumigation gas in the hold. Stopping the ventilation and closing the ventilation flaps resulted in positive pressure being lost in the accommodation, allowing the fumigant to enter the accommodation via the sanitary ventilation system and, to a lesser extent, other entry points.
- At least two members of the seven person crew (28 per cent) were not present for the chief officer's fumigation briefing. It would appear that the briefing did not highlight the risks of the operation or symptoms of poisoning enough to alert the crew when taken ill, even for those that were present.
- The periodic monitoring of the accommodation and engine room atmosphere was not conducted at the required eight hour frequency and did not detect the fumigant in time to avert lethal levels of exposure. Additionally, the fumigant's "carbide additive" did not provide sufficient olfactory warning (smell) to indicate the fumigant's presence.

Lessons learned

- The suitability of a vessel for fumigation is a critical factor and could mean the difference between life or death. This problem has been seen in the past, as in Mars report 200880, and in particular in the following report. Companies must have adequate procedures in place to assess the suitability of a vessel to carry fumigated cargoes.
- The BMA report on which this Mars report is based lists seven other instances where fumigation gases have caused fatalities or very serious illness to crew (2008-2020). The common factors from these occurrences were:
  - Crew unaware of effects of exposure to fumigant gas.
  - Symptoms were confused with food poisoning or seasickness.
  - Ineffective or inadequate periodic testing regime.
  - Lack of effective physical barriers between fumigated cargo space and accommodation.
- When in-transit fumigation of cargo is planned, extreme care should be taken to assess the integrity of ventilation trunks, shared bulkheads, duct keels and electrical conduits that might allow passage of gas into accommodation or working areas.
- Masters and crew of vessels used for in-transit fumigation must be aware of the potential impacts of changing ventilation arrangements, such as adjusting closing devices or flap settings, air conditioning and closed loop ventilation; this could create a vacuum that draws in the fumigant gas.
- Periodic atmosphere monitoring is not as effective as continuous monitoring.
- All crew must be fully aware of the risks and mitigation measures required to carry fumigated cargo safely. All should be briefed on the particulars of the fumigant's smell, effects of poisoning and actions to take if exposed.

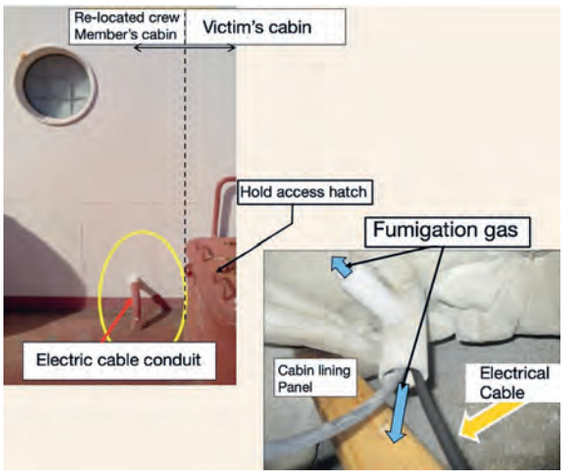
In-transitit fumigation fatality: Mars 202210

As edited from official MAISSPB (Hong Kong/SAR) report published 2019

A handy-sized bulk carrier was loaded with wheat, and the cargo was fumigated after completion of loading. When the fumigation procedure was undertaken, the hatch covers, ventilators and access hatches to all five cargo holds were sealed. The vessel then departed for a trans-oceanic voyage. The crew had been briefed on the dangers of fumigation gas and the master told the crew to stay alert for the smell of garlic or decaying fish as this scent had been added to the gas to allow easy detection.

During the first three days of the voyage, phosphine gas readings were taken at regular intervals at the upper deck accommodation and the forecastle deck. All readings were 0 ppm. On the fourth day, the gas test results showed that the accommodation on upper deck contained 0.1 ppm of phosphine gas. (According to best practices, an eight-hour average respiratory exposure to phosphine gas should not exceed 0.3 ppm and a short-term exposure should not exceed 1 ppm.) On the same day, a crew member remarked he had noticed a bad odour in his cabin. A test in the cabin showed no phosphine gas, but the crew member was relocated to another cabin. The next day, a phosphine gas reading of 2 ppm was measured at the upper deck alleyway. The master called muster stations and instructed all crew to evacuate their cabins at once. The engine cadet did not appear at muster, so two crew went to his cabin where he was found in a state of partial paralysis. The victim was taken outside for care. A phosphine gas reading of 9 ppm was measured in his cabin, which was next to the cabin of the crew member who had been relocated the previous day.

Over the next hour, the victim's vital signs deteriorated. A request for radio medical advice was sent and cardio-pulmonary resuscitation was carried out, but the crew were unable to revive the victim. His body was brought ashore at a port of refuge two days later.



A conduit used to run the electric cable between the accommodation and No. 5 cargo hold allowed the phosphine gas to infiltrate the accommodation area.

Investigation findings

The official investigation found, among other things, that a permanent access light for the aft access ladder of No. 5 cargo hold had been installed during construction. A conduit was used to run the electric cable between the accommodation and No. 5 cargo hold. The conduit ends were not sealed, contrary to best practices and classification rules. This defect allowed the phosphine gas to infiltrate the accommodation area and enter the crew cabins.

Lessons learned

- As in the previous report, the suitability of a vessel for fumigation is a critical factor and could mean the difference between life or death. In this case, a "man-made" defect rendered the vessel unsuitable for fumigation.
- Deadly fumigation gases can take several days to infiltrate accommodation areas, even when a clear passage exists, as in this case. Continuous or very frequent testing is the best defence against this danger.

All Mars Reports are also published online, www.swzmaritime.nl.

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