SWZ|MARITIME

Magazine for maritime professionals | Volume 143, February 2022 | www.swzmaritime.nl

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The Dutch are ready to lead the way

OFFSHORE TECHNOLOGY

Tackling biofouling

Hull must be clean for shipping to be green

WTIV giants

Getting ready for next-gen wind turbines

Zero-emissie kotter

Garnalen vangen in Natura-2000 gebieden

SEARCH

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www.bachmann.info
Contact: Ronald Epskamp

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Naval Architects consulting engineers

Zwijnenburg
IJsseldijk 97
2901 BR Capelle aan den IJssel
Tel: +31 (0)180 512700
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EDR Antwerp Shipyard
Industrieweg 11, quay 403, 2030
Antwerp – Belgium
T: +32 3 253 27 52
E: info@edr-antwerp.eu
www.edr-antwerp.eu
Commercial questions: philippe.
trouillard@edr-antwerp.eu

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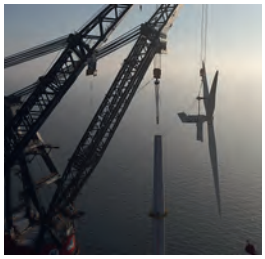
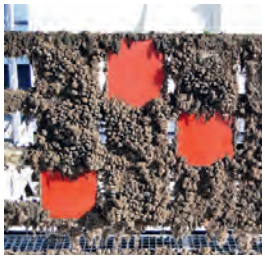
15 | Offshore special



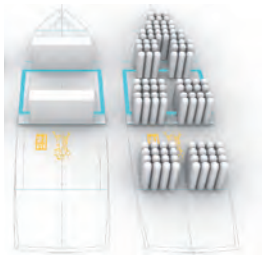
SWZ|Maritime dives into the offshore industry. Among the topics covered are the next generation of wind turbine installation vessels, floating offshore installation, the energy situation, future floating infrastructure and the Jones Act.

42 | Green shipping requires effective antifouling



The added drag caused by biofouling results in an increase in fuel consumption and an associated increase in greenhouse gas emission. This makes biofouling an issue that has to be tackled.

46 | Regels 'schone motor' van belang voor garnalenvissers



Om te kunnen blijven vissen in Natura-2000 gebieden, moeten garnalenkotters op termijn uitstootvrij worden. Kroes Marine Projects studeerde op de vraag wat komt kijken bij ombouw en nieuwbouw van zulke kotters.

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Cover: Huisman Equipment designed a wind turbine installation vessel (WTIV) that can install wind turbines with the tower, nacelle and propeller already assembled.

50 years of Dutch offshore industry

Except for publishing the very nice book "Won from the Waves" (see page 41), little attention was paid to the fifty-year anniversary of the IRO, originally established as Industrial Council for Oceanology. The members of this council represented various sectors of oceanology such as mining, coastal water technology, fishing and oceanological instrumentation.
Due to the oil crisis in 1973, additional marginal fields in the North Sea had to be put into operation. And just like in those years, when the Arabs punished especially the Netherlands with an oil boycott for supporting Israel, at this very moment in the ongoing Ukraine crisis and with rising energy bills, it becomes painfully clear how important it is for a nation to be in control of one's energy supply.
The Dutch government honoured the IRO with a particularly poisonous gift in the form of scrapping export credits for oil and gas related investments, forgetting that a big part of the world is still highly dependent on oil and gas for its energy supply. Just like this highly developed Dutch nation was and for the most part still will be for quite a few years to come.
All the more reason for the editors of this February edition of SWZ|Maritime to focus on important new developments in the Dutch offshore industry. A sector in which important players have already for some time understood that it is hugely important to be at the forefront of the energy transition with the construction of all the new offshore wind parks on the North Sea. When looking at the big four Dutch and Belgian dredging and offshore contractors, you can see that the knowledge and skills of IRO members are highly appreciated all over the world, in Europe especially, but also in Taiwan, Japan and the US, that has a special problem with its Jones Act, which restricts foreign involvement in maritime operations in US waters.
As an engineer with much experience in offshore projects, our editor Björn von Ubisch maps the global energy situation, discusses the Jones Act and interviewed IRO director Sander Vergroesen. And of course, in an offshore special you can't ignore one of the most important players in the development and construction of offshore equipment, Huisman Equipment, that again and again surprises the offshore industry with remarkable innovations. The articles of our colleagues Sander Klos on a new model for a shrimp trawler and Annelinde Gerritsen on a floating future and the importance of effective antifouling for green shipping from Job Klijnstra also deserve attention.

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

SWZ'S EDITORS

WSC presents zero carbon shipping pathways and asks IMO to take charge

The World Shipping Council (WSC), the lobbying group of the container liners and ro-ro carriers, has revealed its six critical pathways to zero-carbon shipping. The organisation now wants the IMO to provide the necessary regulatory framework that supports innovation in shipping.
The WSC presented its plans on February 10 in a press conference. According to Rolf Habben Jansen, CEO of WSC member company Hapag-Lloyd, these pathways are important steps the International Maritime Organization (IMO) should consider in determining how to move forward on decarbonising global shipping. Jansen said that players in the shipping industry need 'firm decisions' to tackle the 'massive amount of work ahead of us.'
In June this year, the 78th session of the IMO's Marine Environment Protection Committee (IMO MEPC 78) will consider further development of IMO's Greenhouse Gas (GHG) Strategy.
John Butler, President & CEO of WSC: 'Liner shipping understands the shared responsibility for greenhouse gas reductions in the maritime sector, and we don't underestimate the challenge. We are committed to decarbonising shipping and have multiple ideas and projects in the pipeline. But to be able to make these investments, to take the necessary risks, we – and all other maritime actors – need a regulatory framework that addresses the key strategic issues. We are now offering our perspective on the critical pathways the IMO should consider as it tackles this global challenge. Action is needed now by the governments of the IMO so as not to stall development, but rather to support ambitious innovators and front runners.'
The first pathway is: A global price on cargo combined with dependable and broad-based "buy down" programmes that effectively level the playing field among newer low and zero GHG ships and the tens of thousands of ships that will still be burning conventional fuels. This will play a large role in making it possible for companies to put zero GHG ships on the water and to operate them competitively.
Second: Transparent well-to-wake life cycle analysis of fuels, breaking out well-to-tank emissions and tank-to-wake emissions, combined with regulatory mechanisms to incentivise first-movers for use of alternative fuels that offer significant GHG reductions even if they are not available from fully renewable sources from the start.
Third: Integrated development of global production and supply of zero GHG fuels through partnerships between IMO member states and energy providers, as well as regulatory provisions that allow for flexibility in the initial stages of the energy transition, given that zero GHG fuels will not be available at the same time around the globe.
Fourth: A Green Corridors Programme to accelerate an equitable fuel and technology transition, introducing zero GHG ships and fuels across trade lanes where the necessary shoreside energy infrastructure is first available. This will speed up development of best practices and encourage IMO member states and interested parties to focus on government-to-government initiatives and coordinated public-private investments to build the necessary production facilities and supply infrastructure.
Fifth: New build standards that support the energy transition, such as requiring ships built after a certain date to be able to operate on zero GHG fuels or not allowing the construction of vessels that can only operate on fossil fuels after a certain date.
Sixth: Applied R&D for shipboard and shoreside systems that allow the safe use of zero GHG fuels is necessary to put zero-emission ships on the water. To avoid accidents and stranded assets, a significant increase in the level of R&D effort and investment is needed to develop the technologies necessary to use the most promising fuels on board transoceanic ships.

Dutch maritime universities of applied sciences launch joint research platform

Maritime Institute Willem Barentsz (MIWB), the HZ University of Applied Sciences, Hogeschool van Amsterdam and Rotterdam Mainport Institute/Hogeschool Rotterdam have joined forces to establish a platform for maritime applied research.
This platform will intensify cooperation and strengthen maritime research through knowledge and capacity sharing.
This not only gives an extra impulse to the further development of knowledge for the sector, but also makes a valuable contribution to keeping education up to date.
In addition to providing education, the maritime colleges conduct research. This takes place in research groups in which professors work together with teacher-researchers and students on practice-based research. The new cooperation creates more mass and synergy for maritime research. It also offers each institution the opportunity to focus on and specialise in specific fields. Lecturers from the four universities of applied sciences coordinate current and new research within the platform. The knowledge available in cross-over fields such as big data and security is also taken into account. Within the platform, the colleges will actively seek cooperation with research groups at TU Delft, Maritime Research Institute Netherlands (MARIN) and other universities and research institutions. A link will also be made with the colleges that are involved in research in the maritime domain within maritime secondary vocational education (mbo).
The maritime universities of applied sciences expect the platform to be an important step in strengthening the visibility and involvement of maritime education in the maritime research domain. Maritime education can make a valuable contribution to important themes for the maritime sector, such as energy transition, safety, blue growth, digitalisation and autonomous sailing, through practice-based research. The knowledge developed in this way will directly be available for education. As a result, students in maritime education are already dealing with important future challenges for the sector, both through research and within their curriculum.

Aanbevelingen Tuchtcollege nu gecategoriseerd op de website

In het verleden nam de Raad voor de Scheepvaart, voorganger van het huidige Tuchtcollege voor de Scheepvaart, vaak punten van lering voor de praktijk op in zijn uitspraken. Bij oprichting van het Tuchtcollege per 1 januari 2010 is deze wettelijke taak weggenomen en bij de Onderzoeksraad voor Veiligheid (OVV) terechtgekomen. In de praktijk is gebleken dat zeevarenden en het nautisch onderwijs toch behoefte hebben ook uit de uitspraken van het Tuchtcollege lessen voor de praktijk te trekken. Indirect konden zij daarvoor meestal wel aanknopingspunten in uitspraken van het Tuchtcollege vinden.
Tijdens gesprekken intern binnen het college en met externe partijen kwam de vraag aan de orde of het Tuchtcollege die lessen voor de praktijk niet meer expliciet zou kunnen formuleren. Na afstemming met de OVV – en de toezegging geen aanbevelingen te zullen doen in zaken waarin de OVV onderzoek doet – worden sinds medio 2019 in de meeste uitspraken van het Tuchtcollege aanbevelingen voor de praktijk opgenomen.
Deze aanbevelingen zijn nu gecategoriseerd op onderwerp en op soort schip terug te vinden op de website onder het kopje “Aanbevelingen voor de praktijk”. Bij elke aanbeveling staat een link naar de pdf van de desbetreffende uitspraak.

FPS joins Flagships project to realise second hydrogen inland container ship

Future Proof Shipping (FPS) has joined Flagships, a European innovation project, to bring the shipping company’s second zero-emission inland container vessel, the FPS Waal, to Europe’s waterways. Collaborative operations are set to commence this year with the vessel sailing on green hydrogen by summer 2023.
The Flagships consortium aims to raise the readiness of zero-emission waterborne transport to an entirely new level by deploying two commercially operated zero-emission hydrogen vessels in the coming years.
FPS will also operate the hydrogen-powered FPS Maas, which is to transport containers between the Netherlands and Belgium. This vessel is currently being retrofitted and is to set sail in September. Over the coming months, FPS will work closely with fuel cell technology experts Ballard Europe, ship design company LMG Marin, and project coordinators VTT. Together, they will collaborate across a broad range of activities to complete the engineering, fuel cell provision, and safety studies required for the vessel’s approval, by applying and further developing the existing regulatory guidelines.
‘The demand for more sustainable technologies in inland waterway transport is on the rise. With FPS joining us, we have two groundbreaking vessels part of the Flagships project. We aim to raise the readiness of zero-emission waterborne transport in Europe, this truly brings us closer to reaching our goal,’ says Jyrki Mikkola, Flagships Project Coordinator – VTT Technical Research Centre of Finland.
The first vessel in the Flagships project is the Zulu, a commercial cargo transport vessel that will run on hydrogen and will operate on the river Seine in Paris.

The retrofit of the FPS Waal will see the engine removed, and the zero-emission propulsion system including PEM fuel cells, hydrogen storage, battery packs and an electric drive train installed.

Maritieme Academie Harlingen neemt watersnijder in gebruik

De Friese gedeputeerde Friso Douwstra heeft op vrijdag 11 februari de nieuwe watersnijder van de Maritieme Academie Harlingen officieel in gebruik genomen. De watersnijder van Resato wordt gebruikt in de lessen metaalbewerking van vmbo Maritiem & Techniek. Met de machine kunnen leerlingen centimeters dik staal snijden in diverse vormen. De watersnijder is mede gefinancierd vanuit het programma Sterk Techniek Onderwijs. Hierin werken alle onderwijsinstellingen van Leeuwarden, Franeker, Harlingen, Sint Annaparochie, Vlieland en Terschelling samen om de instroom in het techniekonderwijs te verhogen en de kwaliteit van het onderwijs te verbeteren.
‘Het geeft enorm veel energie en vertrouwen in de toekomst om te zien hoe leerlingen al op jonge leeftijd met moderne leermiddelen worden voorbereid op de beroepspraktijk. Er is tegenwoordig veel behoefte aan technisch geschoolde jongeren,’ aldus Douwstra. ‘Wij zijn blij dat we dit soort moderne leermiddelen met behulp van het programma Sterk Techniek Onderwijs kunnen aanschaffen. Dit helpt ons echt om het technisch onderwijs te verbeteren,’ vult Arjen Mintjes, directeur van de Maritieme Academie Harlingen, aan.
Naast de officiële ingebruikname van de watersnijder heeft gedeputeerde Douwstra bij de Maritieme Academie Harlingen ook een stukje gevaren op de binnenvaartsimulator en is hij bijgepraat over kunstmatige intelligentie in de binnenvaart en het Europese project IWTS 3.0 (Inland Waterway Transport Solutions). IWTS heeft als doel binnenvaarttransport op kleinere en tot nu toe onbenutte vaarwegen in de Noordzeeregio te bevorderen en vergemakkelijken. Provinsje Fryslân neemt ook deel aan dit project.

‘BOTTLENECKS LOOM IF WIND TURBINES OUTPACE INSTALLATION VESSELS’

Wind turbines for offshore wind parks are growing so fast in size and especially height that bottlenecks will arise if there are not enough wind turbine installation vessels (WTIVs) capable of handling them. This warning was released at the beginning of this month by the Norwegian energy research and business intelligence company Rystad Energy. The Oslo based company is a world-leading analysis company for the offshore oil and gas industry and more and more also for the offshore renewables industry.

The research of Rystad Energy shows that offshore wind turbines are growing in size as technology advances and demand for renewable energy soars. Yet, installing them could cause a headache for operators as demand will outpace the supply of capable vessels by 2024. According to Rystad Energy, operators will have to invest in new vessels or upgrade existing ones to be able to install the super-sized turbines that are expected to become the norm by the end of the decade. Otherwise, the pace of offshore wind installations could slow down. According to another market researcher, IHS Markit, last year, there were sixteen wind turbine installation vessels with three to be delivered in 2022 and another three in 2023. 2024 will see the delivery of two such vessels followed by another one in 2026.

Wind turbines globally, excluding China, have seen a growth spurt in recent years, rising from an average of 3 megawatts (MW) in 2010 to 6.5 MW today, with the largest in operation clocking in at 10 MW. Turbines larger than 8 MW accounted for just three per cent of global installations between 2010 and 2021, but Rystad has forecasted that that percentage will surge to 53 per cent by 2030. The two latest offshore wind farms in development off the Dutch coast will get turbines of 11 MW. The wind parks planned still further away from the coast, to be developed from 2023, will probably see even bigger turbines.

Demand will rocket

As the energy transition accelerates, demand for offshore wind turbine installation vessels worldwide, excluding China, will rocket from eleven vessel years in 2021 to almost 79 vessel years by 2030. The need for installation vessels for turbines larger than 9 MW, which was nonexistent in 2019, will grow significantly by the end of the decade and reach 62 vessel years in 2030, Rystad Energy predicts. ‘When turbines were smaller, installation could be handled by the first-generation fleet of offshore wind vessels or converted jack-ups from the oil and gas industry. However, as operators continue to favour larger turbines, a new generation of purpose-built vessels is required to meet demand,’ says Martin Lysne, Rystad Energy's rigs and vessels analyst.

Unable to install new and larger turbines, the first-generation installation fleet has now transitioned into maintenance and repair services for installed turbines, while operators have upgraded other vessels’ cranes in order to remain competitive in the installation market. Dutch offshore contractor Van Oord has experienced first-hand how fast developments can go. When the company's first wind installation vessel Aeolus was delivered in 2014, the crane soon proved to be too small. In 2016, a bigger crane was ordered and in 2018 the original 900-tonne crane was replaced by one that can handle up to 1600 tonnes.

First generation vessels

Van Oord also took over two first-generation wind installation vessels from financially ailing shipowner Vroon, the MPI Resolution and MPI Adventure, that are also deployed for the construction and maintenance of offshore wind parks, but are not yet updated with bigger cranes. The third MPI ship, the MPI Discovery, went to Jan De Nul.

Boskalis operates the Bokalift 1 that features a 3000-tonne lifting capacity. DEME now has in operation the Orion, which can handle up to 5000 tonnes after the first Liebherr crane collapsed while being installed in Rostock. The two new crane vessels of Jan De Nul will have cranes with capacities of 3000 and 5000 tonnes respectively.

Global developments

In Europe, Asia (excluding China) and the emerging US market, turbine sizes are ramping up towards 2025 and beyond. Europe's first commercial 10 MW turbine was installed in December 2021 at Scotland's Seagreen offshore wind farm by Cadeler's Wind Osprey (1600 tonnes). A total of 114 turbines are lined up for the 1.1 GW North Sea project. At the Vineyard Wind development in the US, 13 MW turbines will be installed by DEME's Sea Installer after its crane upgrade. Jan De Nul's newbuild Voltaire (5000 tonnes) will debut at the Dogger Bank wind farm in the UK, installing 13 MW turbines. Cadeler has been contracted to install 14 MW turbines at the Sofia wind farm in the UK, and 14 MW turbines will also be installed at the Hai Long development in Taiwan. In addition, 15 MW turbines will be installed at the EnBW He Dreiht project in Germany, while many US developments, such as Coastal Virginia and Empire Wind, are also looking to install 15 MW turbines. Despite installing one 10 MW turbine at the Xinghua Bay wind farm last year, China is expected to lag behind Europe in average turbine size up to 2030. Although China will install some larger turbines in the coming years, most installations are expected to measure between 6 and 8 MW.

A lot of crane upgrades

Larger turbine installations require stronger cranes on installation vessels to lift heavier materials higher, and only a handful of purpose-built vessels available worldwide can install 10 MW+ turbines. As a result, many vessels have moved from Europe to China, where lower crane capacity vessels are still in high demand. Jan De Nul's Taillevent was sold to China last year, and DEME's Apollo has also recently been renamed and reflagged to work in the Chinese market. Excluding China, demand for 12 MW+ capable installation vessels is set to increase rapidly, taking a larger share of overall demand.

Out of the current fleet of purpose-built vessels, none are currently able to install 14 MW+ turbines. This will change towards 2025 as newbuilds start to be delivered and existing vessels get crane upgrades. Fred Olsen Windcarrier, DEME and Cadeler are all planning crane upgrades, with the Bold Tern, Brave Tern, Sea Installer, Wind Osprey and Wind Orca all upgrading to 1600-tonne cranes between 2022 and 2024, with options for other vessels to be upgraded.

And let's not forget the new offshore wind installation vessel that Van Oord has ordered to further strengthen its market position in offshore wind. The jack-up vessel can run on methanol and install wind turbines of up to 20 MW with a smaller carbon footprint. The vessel with a projected crane of 3000 tonnes will enter the market in 2024.

From oil & gas to wind

In addition to the purpose-built vessels, some semi-submersible heavy lift vessels originally developed for the oil and gas market are now also being proposed for turbine installation, such as Heerema Marine Contractors' Thialf and Sleipnir. Generally considered too large and inefficient for installing the smaller turbines of the past, these vessels have instead landed work in the offshore wind industry installing substations and heavy foundations. However, as the size of turbines increases, these units will fit right into the large cranes of heavy lift vessels such as the Thialf and Sleipnir. The Thialf will install 27 turbines – each measuring 9.5 MW – at the Arcadis Ost wind farm in the Baltic Sea in 2023, becoming the first floating vessel to install commercial wind turbines of this size. Heerema has said both the Thialf and Sleipnir are already capable of installing 15 MW+ turbines and, with some adjustments, these vessels could even install 20 MW turbines.

> Only a handful of purpose-built vessels available worldwide can install 10 MW+ turbines

Quickly outdated

Vessels built early this decade are already becoming outdated as turbines grow, making owners reluctant to commit to expensive newbuilds that could be obsolete before they are profitable. The cost to manufacture an installation vessel capable of installing 14 MW+ turbines ranges from $ 300 million to $ 500 million, but owners are opting for even bigger cranes in hopes of staying competitive for longer.

A 1500-tonne crane capacity with 150 metres lifting height is generally considered the requirement to install 14 MW+ turbines. Considering current pending orders, excluding vessels assumed to be operating solely in China, all eleven vessels will have cranes with a lifting capacity of more than 2000 tonnes, with some even opting for 3000 tonnes. Owners have one eye on the future, with some already stating they will be ready for 20 MW turbines by the end of the decade.

And the demand for newer and bigger WTIVs will not slow down for a long time to come. According to Clarksons Research, 2021 was a record year in the development of the offshore wind power generation industry. Last year saw not only a record number of start-ups, increasing global capacity to its highest levels, but it also spurred a record newbuild investment for ships required to execute the plans. Clarksons notes that a record number of newbuild orders were placed in 2021 and its data shows a total of seventeen WTIV orders placed, valued at approximately $ 2.5 billion. An additional nine options have also been booked, which could boost the order book further.

Based on a report of Rystad Energy.

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

The DP2 offshore construction vessel Les Alizés.

LAUNCHINGS

Les Alizés

At China Merchants Industry Holdings Co. Ltd., Haimen, Nantong, the DP2 offshore construction vessel Les Alizés (yard number CMHI-233, imo 9911032) was floated out on 2 January. Codralux S.A., Luxembourg (Jan De Nul), ordered the vessel at the end of November 2019. The Les Alizés will be equipped with a Huisman developed Universal Quick Connector (UQC) crane, an innovative monopile gripper with motion compensation, a fully automated monopile installation system and a lifting capacity of 5000 tonnes at 36 metres. The Les Alizés cannot only be used for the construction of offshore wind farms, but will also be equipped to dismantle oil and gas platforms. Wind turbines are still getting bigger and the latest designs can be over 270 metres high, with blades up to 120 metres long, installed on foundations weighing up to 2500 tonnes.

The details of the Les Alizés are: 58,167 GT, 61,000 DWT – Loa x B x D (d) = 236.80 x 52.00 x 16.00 (10.50) metres. Power is supplied by six MAN diesel generators (6 x 7200 kW) and two auxiliary generators (600 and 1700 kW) for driving, among others, four rudder propellers (4 x 3000 kW), two retractable rudder propellers (2 x 3250 kW) and two bow thrusters (2 x 2600 kW). The maximum speed is 13 knots. The vessel will have IMO Tier III Euro Stage V certification (Ultra-Low Emission vessel (ULEv) notation). The vessel will have a deck area of 9300 m^2 with a maximum permissible load of 30 tonnes/m^2. The helideck will have a diameter of 22.80 metres with a take-off weight of 14.6 tonnes, which is sufficient for a Sikorsky S-61N, S-92 or an Agusta-Westland EH-101. Accommodation will be provided for 150 people in 120 single and fifteen double cabins. Delivery is expected in the second half of 2022.

The first assignment of the Les Alizés will be the construction of the offshore wind farms Gode Wind 3 and Borkum Riffgrund 3 in the German zone of the North Sea, for which the vessel will have to transport and install 107 monopile foundations commissioned by offshore wind giant Ørsted. The name of the new installation vessel is derived from the French word *alizé*, meaning passat wind.

Voltaire

Just twenty days after Les Alizés, the Voltaire (yard number N966, imo 9899284), an offshore installation jack-up vessel for offshore renewables and decommissioning, was launched at the Cosco Shipping Shipyard, Nantong, on 22 January. It will be the second and – with a payload of 16,000 tonnes – largest jack-up vessel in Jan De Nul's fleet. Codralux S.A. (Jan De Nul), Luxembourg, ordered the vessel in March 2018 and the keel was laid on 25 March 2021. The Voltaire is designed to transport, lift and install the new generation of offshore wind turbines, turbine components and foundations. These turbines can be more than 270 metres high and have blades of 120 metres long, for which ever larger foundations have to be placed. The Voltaire can also be used in the offshore oil and gas industry and for dismantling offshore installations up to a water depth of 80 metres. The vessel will be

The offshore jack-up installation vessel Voltaire.

The R3 carrier Celtic was completed at Urk.

equipped with a leg encircling Huisman crane with a lifting capacity of over 3000 tonnes. The lifting height above deck is 162.50 metres and by means of an auxilliary hoist 250 tonnes at 135 metres.
The details of the Voltaire are: 46,300 GT, 21,500 DWT – Loa x B x D (d) = 169.30 x 60.00 x 14.60 (7.50) metres. The length including the helideck will be 181.78 metres. A deck area of 7000 m^2 is available for equipment and materials with a maximum permissible load of 20 tonnes/m^2 up to 14,000 tonnes. The four spud poles will have a length of 130 metres. The area of spud cans is 4 x 250 m^2. Energy will be supplied by eight diesel generators (4 x 3535 kW and 4 x 2650 kW), among others to drive four azimuth thrusters (4 x 3000 kW), two retractable thrusters (2 x 2600 kW) and two bow thrusters (2 x 2600 kW). The emergency generator set has an output of 600 kW. As a ULEv (Ultra Low Emission vessel), the Voltaire will be equipped with exhaust gas filtration technology that complies with Euro Stage V directives on land and inland waterway emissions. Regardless of fuel choice or engine technology, exhaust gases will always be filtered. The Voltaire will run on gas oil. The dual exhaust gas filtration system consists of a selective catalytic reduction system (SCR) and a diesel particulate filter (DPF). The installation is able to run on 100 per cent second-generation biofuel, without modification. The maximum speed will be 11.5 knots. The helideck will have a diameter of 22.80 metres and a take-off weight of up to 14.6 tonnes, suitable for the Sikorsky S-61N, S-92 or Agusta-Westland EH-101. Accommodation is provided for 110 people in single cabins.
The DP2 vessel is named after the French writer, historian and philosopher François-Marie Arouet (1694-1778), better known as Voltaire, and an icon of the Age of Enlightenment.

DELIVERIES

Celtic

Hartman Marine Shipbuilding BV, Urk, delivered the Celtic (yard number 012, imo 9917672) to Celtic Beheer BV, Urk/Hartman Seatrade BV, Urk, on 16 December. The keel had been laid at Partner Sp z.o.o., Szczecin, on 31 July 2020 and the launching took place on 19 July 2021. The hull departed from Szczecin in tow of the mt Waterman three days later. The hull arrived at IJmuiden on 26 July for further transport to Urk for completion.

The details of the Celtic are: 3636 GT, 1090 NT, 4000 DWT – Loa (pp) x B x D (d) = 108.25 (101.55) x 14.00 x 10.00 (5.52) metres. The propulsion installation consists of a Wärtsilä main engine, type 8L20 (200 x 280), with an output of 1600 kW or 2174 hp at 1000 rpm on one controllable pitch propeller for a speed of 11.5 knots. The bunker capacity is 233.65 m^3.
The Celtic is a new type of Open Top R3 carrier and an extended version of the R2 carrier. This vessel is 14.7 metres longer and one metre wider and suitable to transport the latest generation of wind turbine blades.
Mid 2022, a second R3 Carrier, the Adriatic (yard number 013), is expected in Urk to be completed for Hartman Seatrade BV. In January 2022, a third R3 Carrier was ordered as yard number 014 and expected delivery in 2023. The Celtic departed from Urk to IJmuiden on 13 December. The next day, trials were executed on the North Sea. The Celtic sailed to Paldiski on 17 December for the first trip to Avonmouth.

Arklow Cloud

In Eemshaven, Ferus Smit, Westerbroek, handed over the Arklow Cloud (yard number 430, imo 9757149) to Cahore Shipping Ltd. (Arklow Shipping), Wicklow, on 28 January. The ship had been launched without ceremony on 17 December 2021. On 24 January, the Arklow Cloud was towed from Westerbroek to Delfzijl for trials on the Ems river the next two days. The Arklow Cloud is the seventh in a series of ten ice-class 1A Traders 5100, which the shipyard is building for the Irish shipping company.
The details of the Arklow C-ships are: 2999 GT, 1692 NT, 5094 DWT – Loa (pp) x B x D (d) = 87.40 (84.99) x 15.20 x 7.12 (6.26) metres. Propulsion is provided by a MaK main engine,

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

type 6M25 of 1740 kW or 2364 hp at 720 rpm on a controllable pitch propeller for a speed of 12 knots. The bunker capacity is 101 m³ heavy fuel oil (HFO) and 96 m³ marine gas oil (MGO).
Under management of Arklow Shipping Nederland BV, Rotterdam, the Arklow Cloud departed on 30 January for its maiden voyage to Ostermoor.

Wilson Flex I

Dayang Offshore Equipment Co. Ltd., Taixing, delivered the first vessel in a series of five, the Hanse Eco 4200 Wilson Flex I (yard number SH-100, imo 9911434), to Rhenus-Arkon-Shipinvest GmbH & Co KG (RHAS), Haren, on 11 January. The Wilson Flex I was laid down as RHAS I on 7 December 2020 and launched on 15 May. The design for the Hanse Eco was prepared by Groot Ship Design, Leek, in cooperation with RHAS, DNV, HSVA, Eekels, Coops & Nieborg and ABC engines.
The details of the Hanse Eco 4200 are: 2995 GT, 1563 NT, 4263 DWT – Loa (pp) x B x D (d) = 88.47 (84.96) x 14.55 x 7.35 (5.70) metres, propulsion is provided by an ABC main engine, type 6DZC (256 x 310), with an output of 1532 hp or 1127 kW at 1000 rpm, on a single fixed pitch propeller. The ship's propulsion system is equipped with SCR (selective catalytic reduction), support from an e-motor and a waste gas after-treatment unit to meet the IMO Tier III emissions standard, which will be compulsory for new vessels from 2025 onwards. The bow thruster has an output of 300 kW.
After commissioning, the five vessels are chartered on a long-term basis to the Norwegian operator of coasting and short-sea cargo vessels Wilson ASA, Bergen. The optimised design of the coastal vessels achieves several benefits, including the possibility of travelling open top without any hatch covers. The end-to-end deck also makes it possible to transport large quantities of particularly bulky goods. Operated by seven crew members, the new ships will sail on all the European short-sea traffic routes from the Baltic Sea to the North Sea, the Mediterranean and the Black Sea.
After delivery, the Wilson Flex I departed under Portuguese flag and homeport Funchal/Madeira for the maiden trip from Taixing to Yosu, where it will take on board its basic cargo for Europe. The Wilson Flex II to V will follow from the Chinese shipyard with intervals of six to eight weeks.

The Wilson Flex I is the first Hanse Eco 4200 in a series of five vessels.

Three ASDs 3212 for Engage Marine

Engage Marine Asset Co. Pty Ltd., Perth, Western Australia, commenced towage operations in Abbot Point, North Queensland, under the licence awarded by North Queensland Bulk Ports Corporation (NQBP) on 1 October 2021. For this concession, Engage acquired three ASD Tugs 3212 from Damen Song Cam Shipbuilding JSC, Haiphong: the Engage Rogue, Engage Raider and Engage Rebel. The first berthing was the bulk carrier Lowlands Dawn (2017 – 49,534 GT) at the North Queensland Export Terminal.
The technical details of the Bureau Veritas classed ASD 3212 are: 450 GT, 135 NT – Loa x B x D (d) = 32.70 (28.84) x 12.20 x 5.35 (4.00) metres. The propulsion consists of two Caterpillar main engines, type 3512C TA HD/D (170 x 215), total output of 5050 kW or 6862 hp at 1800 rpm on two RR azimuth thrusters, type US 205S with a diameter of 2800 mm. The tug can achieve a free sailing speed of 13.5 knots and a bollard pull of 80 tonnes. The bunker capacity is 132.84 m³.

Four ASDs 3212 for Cameron Tugs

Four new tugs joined the fleet of Cameron Tugs LLC (Edison Chouest Offshore LLC), Galliano, Louisiana, between September and December 2021. The ASD Tugs 3212 were built under class of American Bureau of Shipping and under licence of Damen Shipyards by Tampa Ship LLC, Tampa, Florida (the Emily and Jack, yard numbers 332 and 333), and Bollinger Marine Fabricators Inc., Amelia, Louisiana, (the Matthew and Morgan, yard numbers 334 and 335).
The details of the ASDs 3212 are: 498 GT, 149 NT – Loa (pp) x B x D (d) = 30.16 (28.23) x 13.00 x 7.55 (5.90) metres. Propulsion is provided by two Caterpillar main engines, type 3516C TA HD/D (170 x 215), with a total output of 5050 kW or 6772 hp at 1800 rpm on two Kongsberg azimuth thrusters, type US 255 P30 FP with a diameter of 3000 mm for a bollard pull of 83 tonnes and a speed of 13.5 knots. The bunker capacity is 185.92 m³. Accommodation is provided for twelve persons.

Name	Imo	Yard number	Launched	Delivered
Engage Raider	9863273	512568	15-Feb-2020	6-Sep-2021
Engage Rogue	9882671	512569	14-Apr-2020	1-Sep-2021
Engage Rebel	9882683	512570	24-Mar-2020	17-Sep-2021

The tree ASDs 3212 for Engage Marine.

The ASD Tug 3212 Engage Rebel.

Name	Imo	Yard number
Emily	9915703	512571
Jack	9915715	512572
Matthew	9915727	512573
Morgan	9915739	512574

The four ASD Tugs 3212 for Cameron Tugs.

Med Vega

The RSD Tug 2513 Med Vega (yard number 515016, imo 9905473) arrived at Bremerhaven on its own keel on 26 December. The tug was built by Damen Song Cam Shipyard JSC, Haiphong, and delivered to Medtugs on 7 October. The keel had been laid on 20 April 2020 and the launching was on 4 May 2021.
The details of the Bureau Veritas classed RSD (Rotor Stern Drive) 2513 are: 353 GT, 282 NT – Loa (pp) x B x D (d) = 24.73 (22.51) x 13.13 x

The Emily is one of four ASD Tugs 3212 built under Damen licence.

4.97 (6.20) metres. Propulsion is provided by two Caterpillar main engines, type 3516C TA HD/D (170 x 215) with a total output of 5050 kW or 6862 hp at 1800 rpm, IMO Tier III certified, on two Kongsberg azimuth thrusters, type US 255 P30 FP with a diameter of 3000 mm, for a bollard pull of 85 tonnes ahead or 80 tonnes astern and a speed of 12.6 knots. The bunker capacity is 82.8 m³.

Rondo

Damen Shipyards Changde delivered the fourth ASD Tug 2609 ICE to Rosmorport Far Eastern Basin, Vladivostok, on 10 December. The details of the ASD 2609 ICE are: 185 GT – Loa x B x D (d) = 26.45 x 9.54 x 4.30 (4.15) metres. Propulsion is provided by two Caterpillar main engines, type 3512C TA/C, with a total power of 2610 kW or 3500 hp at 1800 rpm on two Kongsberg azimuth thrusters, type US 205 with a diameter of 2000 mm, for a bollard pull ahead of 40.6 tonnes or 37.4 tonnes astern and a speed of 12.7 knots. The bunker capacity is 50.7 m³. Accommodation is provided for eight persons.

Name	Imo	Yard number	Delivered
Askold	9816488	512703	22-May-20
Peter	9816490	512704	26-Apr-20
Geliy	9899923	512711	28-Jun-21
Rondo	9899935	512712	10-Dec-21

Damen Shipyards Changde delivered four ASDs 2609 ICE to Rosmorport Far Eastern Basin.

HST Hazel

High Speed Transfers Ltd (HST Marine), Swansea, acquired a MultiCat 2309, the HST Hazel (yard number 571785, imo 9909596), from Damen Shipyards. The keel had been laid on 18 December 2020. The hull was launched on 14 June 2021 at Kozle and arrived in tow of the mt Zeus at Dordrecht on 13 August. The second launching was on 25 November 2021. Trials were conducted in Europoort on 15 and 16 December. After delivery, the HST Hazel was assigned as multi-role vessel for coastal towing, buoy maintenance, the support of floating wind projects, surveying operations and marine equipment tests.
The details are: 154 GT – Loa x B x D (d) = 23.33 x 9.60 x 3.20 (2.35) metres. The propulsion installation of two Volvo Penta engines is prepared for easy future conversion for IMO Tier III compliance. The bollard pull is 15 tonnes. The bunker capacity is 69 m³. The HST Hazel is fitted with a 15-tonne A-frame and a custom made plough for dredging projects. The deck crane has a lifting capacity of 25.1 tonnes at 5.79 metres outreach or 8.1 tonnes at 14.09 metres.

El-Alamein 1

On 16 January, Damen Shipyards, Hardinxveld, completed the first MultiCat 2712, the El-Alamein 1 (yard number 571824, imo 9928968), for the Suez Canal Auhority, Ismaila. The second, the El-Alamein 2 (yard number 571825, imo 9928970) is still being fitted out at Hardinxveld. The keels for both MultiCats were laid at Safe Sp. z.o.o., Gdansk, on 15 December 2020. The El-Alamein 1 was launched on 23 June 2021 and arrived in tow of the mt Ikar at Dordrecht on 10 July. After completion, the MultiCat undertook trials on the Merwede on 23 December. The hull of the El-Alamein 2 was delivered at Dordrecht by the mt Leopard on 12 August 2021.
The technical details of the MultiCat 2712 are: 2996 GT, 88 NT – Loa (pp) x B x D (d) = 27.27 (23.99) x 12.50 x 3.80 (3.05)) metres. The propulsion system consists of two Caterpillar main engines, type C32 TTA ACERT, 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

The RSD Tug 2513 Med Vega (photo Peter Pahl).

The Rondo is the fourth ASD Tug 2609 ICE for Rosmorport.

The MultiCat 2309 HST Hazel (photo A. Boer).

The El-Alamein 1 is the first of two MultiCats 2712 for the Suez Canal Authority.

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.

Aqua Helix

The Fast Crew Supplier (FCS) and Walk-to-Work vessel Aqua Helix (yard number 547701, imo 9885245) arrived at Damen Shiprepair, Schiedam, for completion on 20 December. By means of the floating sheerlegs Matador, the Ampelmann, a motion compensated gangway and electro hydraulically driven hexapod with continuous access up to 18 metres above sea level, was installed on 18 January. The FCS 7011 Aqua Helix was built at Antalya, Turkey. The keel had been laid on 24 June 2019 and the launching took place by two mobile cranes on 21 January 2021. Trials were executed on the Mediterranean Sea from 1 to 11 November. The Bureau Veritas classed Aqua Helix departed from Antalya on 9 December via Valletta, Gibraltar and La Coruña to Schiedam, where it arrived in the Wiltonhaven on 20 December.

The technical details of the FCS 7011 are: 1276 GT, 592 DWT – Loa (pp) x B x D (d) = 73.65 (70.00) x 11.20 x 5.50 (2.30) metres. Propulsion is provided by four MTU main engines, type 20V4000 M73L (170 x 190), with a total output of 14,400 kW via Reintjes VLJ 1930 on four controllable pitch Hamilton waterjets, type HT900, for a speed of 39 knots. The DP2 vessel is equipped with two retractable Veth bow thrusters (2 x 426 kW) and one Veth bow thruster in a tunnel (250 kW). The bunker capacity is 82.5 m^3 and the range at maximum speed is 650 nautical miles. The fore deck has a surface of 35 m^2 for cargo with a permitted load of 2.5 t/m^2. Accommodation is provided for eleven members and 122 technicians.

After a fully-integrated proof of concept trials in the North Sea, the Aqua Helix will be operated out of Den Helder for offshore wind and oil and gas operators in the North Sea by Aqua Helix BV, Gorinchem, and under management of Wagenborg Offshore Support Services BV, Delfzijl.

The Aqua Helix is a Fast Crew Supplier and Walk-to-Work vessel.

Rosfjord

Holland Shipyards BV, Hardinxveld, delivered the first of two fully electric double-ended shuttle ferries for Boreal Asset AS, Hammerfest, the Rosfjord (yard number HS2019-0678, imo 9913274), at Flekkefjord on 23 December. The hull had been launched at Flushing Maritime & Offshore, Sloehaven-Vlissingen, by the floating sheerlegs Matador 3 on 25 June. The ferry was completed at Hardinxveld and several trials were held on the Merwede and Haringvliet between 4 and 22 November. The Rosfjord departed from de shipyard on 6 December and arrived on its own keel in Flekkefjord eight days later.

The details of the Rosfjord are: 393 GT, 289 NT – Loa (pp) x B x D (d) = 49.80 (49.80) x 14.70 x 5.00 (3.00) metres and a capacity of 35 cars and 149 passengers. Wärtsilä supplied the two thruster motors (640 kW) for the electric azimuth thruster propulsion, batteries, onboard and shore-based battery charging equipment, the back-up generators, and various electrical systems.

Construction of the second ferry, the Lafjord (yard number HS2019-0677, imo 9913262), took place in Hardinxveld and started on the same date as for the Rosfjord, on 1 September 2020. The launching followed on 27 July. Trials were executed on 11 and 25 January 2022. The 469 GT Lafjord has as dimensions: L x B = 29.80 x 10.20 meters and has a capacity of ten cars and 99 passengers. Both ferries have a crew of three.

After delivery, the ferries will serve the Launes – Kvellandstrand v.v. and Abelnes – Andabeløy v.v. routes in the Agder province. In between trips, shore power will be used to rapidly recharge the ferries' batteries, allowing day-round operations on electric power. In case of an emergency, back-up Scania DI

The fully electric double-ended shuttle ferry Rosfjord (photo A. Boer).

16090M generators are installed, which are capable of running on bio-diesel.

Randsfjordferja Elrond

Holland Shipyards delivered the fully electric Randsfjordferja Elrond (yard number H2019-0459, imo 9905033) to Innlandet Fylkeskommune, Hamar, on 22 December. The keel had been laid on 22 June 2020. The ferry is intended for the service between Tangen and Horn on Randsfjorden, one of the largest lakes in Norway, as a replacement for the Randsfjordferja II (1950 – 153 GT, imo 8634443), which has been in service for 72 years. Lake Randsfjorden is not accessible by water, so the ferry was built as a construction kit in Hardinxveld and shipped to Norway in parts in August 2021. The prefabricated catamaran ferry was assembled on the shore and the first trial was held on 4 December. Official commissioning followed on 20 January.

The technical details of the Randsfjordferja Elrond are: 288 GT - Loa (pp) x B x D (d) = 32.00 (30.40) x 11.60 x 3.40 (2.00) metres. Power is provided by a battery bank from Corvus Energy, Bergen, with a capacity of 678 kWh to run two electric azimuth thrusters. A Scania D 113 SCR diesel generator is installed for emergency purposes. Accommodation is provided for 48 passengers in winter or 66 in summer and sixteen cars. The construction budget was NOK 85 million.

The Randsfjordferja Elrond was assembled on the banks of Randsfjorden.

Gerrit de Boer

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

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

No coal cargo policy

Shipping company Eastern Pacific Shipping (EPS) has instituted a "No Coal Cargo" policy and no longer carries coal as cargo on its commercially managed vessels. In its latest environmental guidance, EPS refers to last year's COP26, which resulted in the Glasgow Climate Pact, the first agreement that specifically targets the phasing down of coal. EPS revealed it has not carried coal on its commercial dry bulk fleet since April 2020. With the No Coal Cargo policy, EPS hopes to play a small role in making the commodity no longer economically viable, therefore increasing the demand for greener options. EPS is one of the world's largest shipping companies, owned by the Ofer family. It operates some 200 ships, including about forty dry bulk carriers. *(EPS 2022 ESG Policy/Splash 24/7)*

Carbon capture for LNG ships

Samsung Heavy Industries has won an approval in principle from the Korean Register for its newly-developed onboard carbon capture system that can be used on LNG powered ships. This technology uses an amine-based liquid absorbent to separate and recover carbon dioxide from the exhaust of LNG that is burned in a ship's engine. The company is currently conducting a technology performance test at a demonstration facility. It has also signed a carbon capture processing technology service contract with German chemical company BASF. The Korean builder plans to commercialise this technology for LNG powered ships by 2024. *(HellenicShippingNews)*

The carbon price needed to decarbonise

Closing the Gap is the title of a report recently launched by the Getting to Zero Coalition, outlining policy measures that could close the competitive gap between fossil fuels and zero-emission alternatives in shipping as well as enable an equitable transition. For international shipping to decarbonise, zero-emission fuels need to become the dominant fuel source by the 2040s, the report points out. Yet, the cost of zero-emission fuels must be significantly reduced to close the gap with fossil fuels. The report shows that the introduction of a relatively low carbon price in the 2020s that is gradually increased to around USD 200 per tonne CO_2 will make it possible to fully decarbonise shipping and create an industry that is powered solely by net-zero sources by 2050. This level of carbon price is in line with what is estimated by the International Energy Agency as needed across all industries to achieve the Paris Agreement goals, indicating that shipping is not a unique case. *(Splash 24/7/swzmaritime.nl)*

Electrically charged coatings

A research project led by marine biologists from Flinders University, Australia, has successfully demonstrated that electrically charged surface coatings can eliminate marine biofouling, potentially opening the way to new hull coating solutions. The "active anti-fouling" experiments tested a range of materials, coatings and electrical cycles and compared them to non-electrically stressed samples. Having initially tested their theories in small fish tanks, the researchers used real life facilities to test larger samples, then leaving them submerged for an extended period to see how much fouling developed. The most recent inspections indicated that the research is proving successful. *(The Naval Architect)*

Integrated NO_x aftertreatment

Swiss engine maker WinGD has launched what it says is the first marine two-stroke engine to carry its own NO_x abatement, drastically reducing space requirements and installation cost for shipyards. The integrated Selective Catalytic Reduction (iSCR) has been incorporated into a six-cylinder X52 low-speed engine. It is being installed on a 50,000-tonne tanker under construction in China for a Japanese owner. Because it is integrated directly with the exhaust manifold, less off-engine auxiliary equipment and piping is required, thus reducing space. Locating it directly upstream of the turbocharger, results in higher operation temperatures, which help NO_x removal. At the same time, the iSCR itself has little heat dissipation, and offers easy switching between IMO Tier II and III compliant modes. *(The Naval Architect/swzmaritime.nl)*

EU transport GHG emissions

The European Maritime Transport Environment Report was published last September by the European Maritime Safety Agency (EMSA) and the European Environment Agency (EEA). It includes the following overview of the share of the total EU transport GHG emissions by mode (2018 data): Road transport: 71.0 per cent; civil aviation: 14.4 per cent; maritime and inland navigation: 13.5 per cent; railways: 0.5 per cent; other: 0.5 per cent. *(International Chamber of Shipping)*

Record growth for offshore wind

2021 was another record year for offshore wind, with a record start up of 84 wind farms (3400 turbines, 18.5 GW), increasing global capacity by 58 per cent to 50.5 GW. This takes offshore wind to about 0.3 per cent of global energy supply. Energy modelling by Clarksons Research shows this could reach six to nine per cent by 2050. The "wind" vessel market reached nearly 1100 vessels by year end. *(Clarksons)*

OFFSHORE WIND HAS SOME SAFETY ISSUES

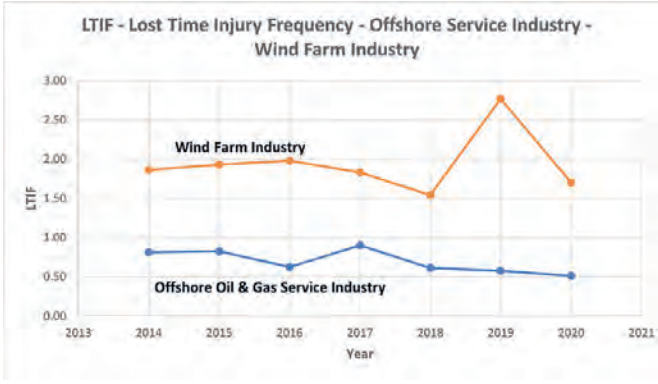
Lot of large installation vessels on the way

The rise of the offshore wind industry has seen a lot of new players enter the market. Their lack of experience in offshore seems to have contributed to relatively high accident and incident rates. At the same time, the ever larger wind turbines have led to a newbuilding spree of ever larger wind turbine installation vessels capable of handling these turbines. An overview of recent developments.

Certain organisations, like the G+ Global Offshore Wind Health and Safety Organization, are concerned about the accident and incident rates in the offshore wind farm industry. The personnel accident rate is about three times higher in the offshore wind farm industry than in the offshore oil and gas related service industry. The reason for this is most likely the fact that the wind farm industry has been taken over by companies with no or little understanding of the offshore environment. Traditional offshore companies such as McDermott, Saipem, Heerema, Allseas, and Subsea 7 play a minor role in the wind farm industry and a number of these companies entered the industry rather late. The companies dominating the wind farm industry are mainly investment companies, energy providers and quite a few dredging companies. The offshore oil industry is used to developing safety cases, safety assessments, Hazops (hazard and operability studies) and Hazids (hazard identification studies) for their operations while the wind farm industry is apparently not used to this type of strict and disciplined safety culture.

There are some incidents in the wind farm industry that have been published and below are some of them:

Photo: The wind farm installation vessel of Jan De Nul, the Voltaire (courtesy of Jan De Nul).



Lost Time Injury Frequency (LTIF) as reported to IMCA (International Marine Contractors Association) by members for offshore work in the oil industry (non drilling activities and means of reports from four different companies) and G+ Global Offshore Wind Health and Safety Organization 2020 incident data report.

- The DEME Orion crane incident on 2 May 2020 at the building yard in Rostock, Germany, where the crane hook disintegrated during a load test with half the designed Safe Working Load (SWL). There were no personnel injuries. The hook in question was never load tested.
- One of the turbines at the Borssele 1 & 2 wind farm in the Netherlands caught fire on 27 October 2021. The nacelle was damaged. The wind turbine had been installed in September 2020 and commissioned in November 2020.
- A floating wind turbine installation off Bilbao in Spain was knocked over when it was hit by 10-metre-high waves around dawn and low tide. This happened on 4 November 2020. This was a prototype installation and it was in the process of being removed from the location due to expected rough weather during the coming winter season.
- The Ormonde incident off the west coast of England on 21 October 2021, where a hub containing three pitch motors, three 61-metre blades, clamping tool, four electrical cabinets plus some other equipment was dropped into the sea during a hoisting operation. Over 130 tonnes of equipment was lost into the sea. The gripping hook failed, and the hook was apparently not the property of Van Oord. The vessel involved was Van Oord's jack-up MPI Adventure. After a week, debris from this incident was polluting the adjacent beaches. The wind turbine had initially been installed in 2011.
- Seaway 7 reported on 19 October 2021 that an incident with the main crane on board the Alfa Lift foundation installation vessel had occurred. There was an unplanned movement of the folding A-frame of the vessel's Liebherr HLC 15000 crane. There were no personnel injuries. Apparently, something went fundamentally wrong when the A-frame of the crane was lowered.
- The Zhen Jiang incident occurred on 4 July 2020 in the Yellow Sea north of Shanghai. The four-legged jack-up installation vessel could not adjust the airgap in relation to the rising tide. Apparently, the jacking mechanism did not work for some reason. This resulted in total flooding of the barge when the main deck became submerged and the internal watertight doors were not closed and could not be closed. There were no casualties.
- The Chinese wind turbine jack-up installation vessel Sheng Ping 001 was involved in an incident in which 61 of 65 persons on board were rescued. The other four went missing after they fell into the sea when the vessel suddenly developed a severe aft trim, up to about 20°, resulting in the main deck completely submerging. It looks like the crew "forgot" to pre-load the legs and had a "punch-through". The pre-loading takes time and time is definitely money in the wind farm industry. This happened on 24 July 2021 in the South China Sea.

The investors and operators seem to have a limited knowledge of crane operations offshore and of a floating object. Often crawler cranes are used on a floater and this leads to disaster as the crane is not designed for accelerations and off-lead of the hook/load. Sometimes the caterpillar tracks are welded to the deck, but this does not improve the situation as the crane is designed to be absolutely horizontal during operations and not experiencing an oscillating ± 5° or maybe more.

New wind installation vessels and projects

During 2021, orders worth over US $ 4 billion have been placed for offshore wind related vessels with a focus on alternative fuels and energy saving technologies such as battery-hybrid solutions. Seventeen wind turbine installation vessels (WTIVs) are on order plus nine options. Fifteen service operation vessels were ordered for approximately US $ 0.8 billion and 39 crew transfer vessels are on order.

The wind farm industry is apparently not used to the strict and disciplined offshore safety culture

The wind farm vessel market included some 1100 units by the end of 2021. Utilisation is at present about 83 per cent, but on the Chinese market utilisation exceeded ninety per cent in the second half of 2021. Day rates are up eighteen per cent for the newest types of vessels and even more in China.

Van Oord wind farm installation vessel

Van Oord has ordered a four-legged jack-up wind turbine installation vessel at Yantai CIMC Raffles in China, with a 3000-tonne crane from Huisman Equipment, wrapped around one of the jacking houses. Leg length is 126 metres suitable for water depths up to 70 metres. The vessel is 175 metres long.

The vessel will be able to operate on methanol as fuel for the powerplant. This in order to reduce harmful emissions and the CO_2 output is claimed to be reduced by 78 per cent or more. A 5000-kWh battery pack will also be installed in order to reduce peak loads and

regenerate energy. Delivery is expected in 2024. Knud E. Hansen designed the vessel. There is also an option for a second vessel.

Huadian Heavy Industry, Boqiang Heavy Industry Group

A Chinese group has signed a contract for a similiar vessel as the one ordered by Van Oord (see above) and this vessel will be chartered to China's largest offshore contractor, Huadian Heavy Industries. Delivery is expected in 2023.

Havfram together with J.P. Morgan

Norwegian company Havfram has ordered a similar jack-up installation vessel for up to 20 MW wind turbine installations at Yantai Raffles. Delivery of the first vessel in the series is expected in 2024. GustoMSC is the designer and the consortium of Havfram and J.P. Morgan is looking at the US and the Norwegian market.

Jan De Nul's jack-up Voltaire

Jan De Nul's new wind turbine installation jack-up Voltaire is expected to be ready to enter service in 2022. The main crane has a capacity of 3000 tonnes, a lifting height above deck of 162.5 metres and is delivered by Huisman Equipment. The auxiliary hoist is capable of handling 250 tonnes at 135 metres outreach.
The operating water depth is 80 metres with a leg-length of 130 metres, a payload of about 21,500 tonnes and the jack-up's accommodation houses 100 single person cabins. The size of the hull is 169.3 x 60 x 14.6 metres with a maximum draught of 7.5 metres.
The total installed power is 4 x 3535 kW plus 4 x 2650 kW giving a total power of 24.74 MW. The distribution tension is 3 x 6.6 kV at 50 Hz. The unit has 4 x 3 MW azimuthing thrusters for propulsion and position keeping aft, 2 x 2.6 MW retractable thrusters forward and 2 x 2.6 MW tunnel thrusters forward for position keeping. A dynamic positioning system of DP equipment class 2 will also be installed.
The maximum speed during transit is expected to be 11.5 knots. The vessel is further equipped with a helideck suitable for an Augusta-Westland EH-101 and a Sikorsky 61N helicopter.

Bold Tern and Brave Tern jack-up upgrades

In 2012 and 2013, Fred Olsen Windcarrier (FOWIC) had two WTIVs built, the Bold Tern and Brave Tern. These vessels were originally designed to install 3.6-MW wind turbines. Nowadays, the largest turbines can produce up to 15 MW. FOWIC then decided to upgrade the Bold Tern with a 1600-tonne crane, wrapped around one leg, from Huisman Equipment. The crane can lift 1600 tonnes at 157.5 metres above deck level and with an outreach of 31 metres. The auxiliary hoist can lift 400 tonnes 166.5 metres above deck level.
The operational water depth is 5.5 to 60 metres. Its pre-load capacity is 9800 tonnes. The jacking speed is 0.4 m/min lifting and 0.5 m/min lowering. The total installed power is 5760 kW, plus 2880 kW, plus 2 x 4230 kW.
The upgrade of the Bold Tern is taking place at Keppel FELS in Singapore. Delivery is planned for spring 2022. Sister vessel Brave Tern will be upgraded in the same way as the Bold Tern. This was announced at the beginning of January 2022.

Wind farm installation vessel ordered by Van Oord (courtesy of Van Oord).

Eneti orders three WTIVs

Eneti, former bulk carrier operator/owner Scorpio Bulkers Inc. and registered on the New York Stock Exchange, ordered three new WTIVs in November 2021 with Daewoo Shipbuilding and Marine Engineering (DSME). The first vessel costs around US $ 326 million with a delivery in the second quarter of 2025. The WTIV is designed by GustoMSC, now part of National Oilwell Varco. The 2600-tonne leg encircling crane will be delivered by Huisman Equipment.
The vessel can install turbines up to 20 MW capacity in a water depth of 65 metres. Fuel can be diesel oil, but the power plant can be adapted to run on LNG (liquified natural gas) or ammonia.

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

50 YEARS OF IRO

After half a century of offshore oil and gas, the future will be hydrogen

After taking a leading role in the offshore oil & gas industry over the past fifty years, the Dutch offshore energy supply industry intends to also lead the way for the next fifty in the development of offshore renewables. 'Our industry is at the forefront of the energy transition. Many of the developments needed for this transition will have to take place at sea. All efforts of our member companies are focused on the development of renewables like energy from wind, floating solar, tidal and wave energy,' says Sander Vergroesen, director of IRO, the Association of Dutch Suppliers in the Offshore Energy Industry, which is celebrating its fiftieth anniversary.

Sander Vergroesen: 'Hydrogen is the next chapter in our industry.'

And just like it has been for the last fifty years, with a lot of innovations in the exploration and exploitation of oil and gas taking place on the North Sea, the IRO director expects that a lot of innovations in renewables will also happen there. Vergroesen points, for example, to the Neptune Energy pilot to integrate three energy systems in the Dutch North Sea: offshore wind, offshore gas and offshore hydrogen by producing hydrogen from seawater on its Q13-a platform. The aim of the pilot is to gain experience in integrating working energy systems at sea and the production of hydrogen in an offshore environment. 'Hydrogen is the next chapter in our industry,' says Vergroesen. Vergroesen: 'Everyone is aware that we need to make the transition to more sustainable energy. Only some can make that transition faster than others.' He confirms that a relatively big part of the diverse 400 member companies is still involved deeply in the supply of the oil and gas industry, with just some already fully focusing on

Photo: As water depth increases, floating wind turbines become more interesting (courtesy of Wind Europe).

supplying the renewables industry. Vergroesen assures, however, that all of them are convinced that the energy transition towards renewables is the trend. Also, for the ones still involved with oil and gas, the objective is to do it as sustainably as possible.
The offshore energy supply industry in the Netherlands belongs to the top five of the global supply industry. Others are the supply industries in the US, the UK, Norway and France. Established half a century ago, IRO is an independent non-profit organisation that supports and promotes the interests of its members. The IRO members consist of a wide variety of both multinationals and SMEs (small and medium-sized enterpizes). They represent the entire supply chain within the oil, gas, offshore renewables (wind, marine and floating solar energy) and marine energy industry, with activities covering: engineering & consultancy, construction & fabrication, plant & equipment supply, contracting & installation, exploration & production and personnel & HSE.
The range of services that IRO provides varies from maintaining government and NGO (non-governmental organisation) relations and facilitating networking opportunities within the IRO community to participating in international trade missions and exhibitions as well as providing business intelligence and training courses.

Sander Vergroesen

Vergroesen is the managing director of IRO and responsible for its daily management. After two years serving as a Lieutenant at the Royal Netherlands Marine Corps, Vergroesen started at the International University of Hospitality Management in The Hague where he graduated as BBA in 1984. Since then, he gained more than twenty years of experience in various (senior) management positions in commercial services.
From 2009 to 2011, Vergroesen was active in the Arabian Gulf area and based in Dubai, where he served as owner's representative for iPS. Since 1 January 2012, he has been managing director of IRO.

Energy transitions

Some ten years ago, the Dutch offshore industry was fully focused on offshore oil and gas exploration and production. The dredging industry turned into the renewable energy transition and in particular the installation of wind turbines offshore. The traditional offshore industry joined the dredging industry in the focus on offshore wind farms. Even the traditional companies like Heerema and Allseas are now modifying their equipment to suit the wind farm industry. The traditional wind turbine is bottom supported and as water depth increases, floating wind turbines become more interesting. A number of Dutch companies are involved in this development.
DNV states in its report Financing the Energy Transition – Energy Transition Outlook 2021: 'Electricity demand will more than double by 2050, most notably in transport and buildings. By then, 69 per cent of electricity will come from wind and solar PV, compared with eight per cent in 2019 (the reference year for this report). By mid century, the total installed capacity of variable renewables will top 17,500 gigawatts (GW), rising from approximately 1200 GW today.'
You have the motion compensated gangway, developed by Jan van der Tempel, the Ampelmann, a development from the traditional heave compensated offshore gangway and the large cranes from Huisman Equipment as typical Dutch innovations. Dutch companies are also involved in "green" hydrogen production using energy from wind turbines and storage of hydrogen in old, now empty gas reservoirs. There is also work in progress with respect to making the oil and gas industry more sustainable and reduce its environmental impact.

'When it comes to knowledge and experience in offshore, Dutch companies have a very strong reputation'

The various IRO members are working together with companies from Norway, the UK, France and the USA. This cooperation works well and the IRO is represented at various trade shows in Aberdeen, Houston, Stavanger, Suriname, Mozambique, and Saudi Arabia. The international network is very important. 'Last November, we were in Abu Dhabi and they know how to find us there too, also for the development of offshore renewable energy. Clients from the international oil and gas industry know that Dutch companies are well equipped. When it comes to knowledge and experience in offshore, Dutch companies have a very strong reputation,' says Vergroesen.
The Dutch government has a somewhat strange energy politics as they have decided to shut down gas production, while Germany is encouraging gas production and usage. Some time ago, the Norwegian government said that it will do its very best to squeeze out all oil and gas that can be produced from the various fields. Norway also has an ambitious exploration programme with new licensing rounds. The Dutch government may give permission for drilling offshore, but not for drilling on land.
IRO also works through VNO-NCW and Nederland Maritiem Land. VNO-NCW can be seen as a lobby group with offices in The Hague and Brussels. It is very difficult to influence politics in The Hague and every little bit helps. The various ministers in the Dutch government are not always appointed with respect to their knowledge in a particular field, but other criteria prevail.

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

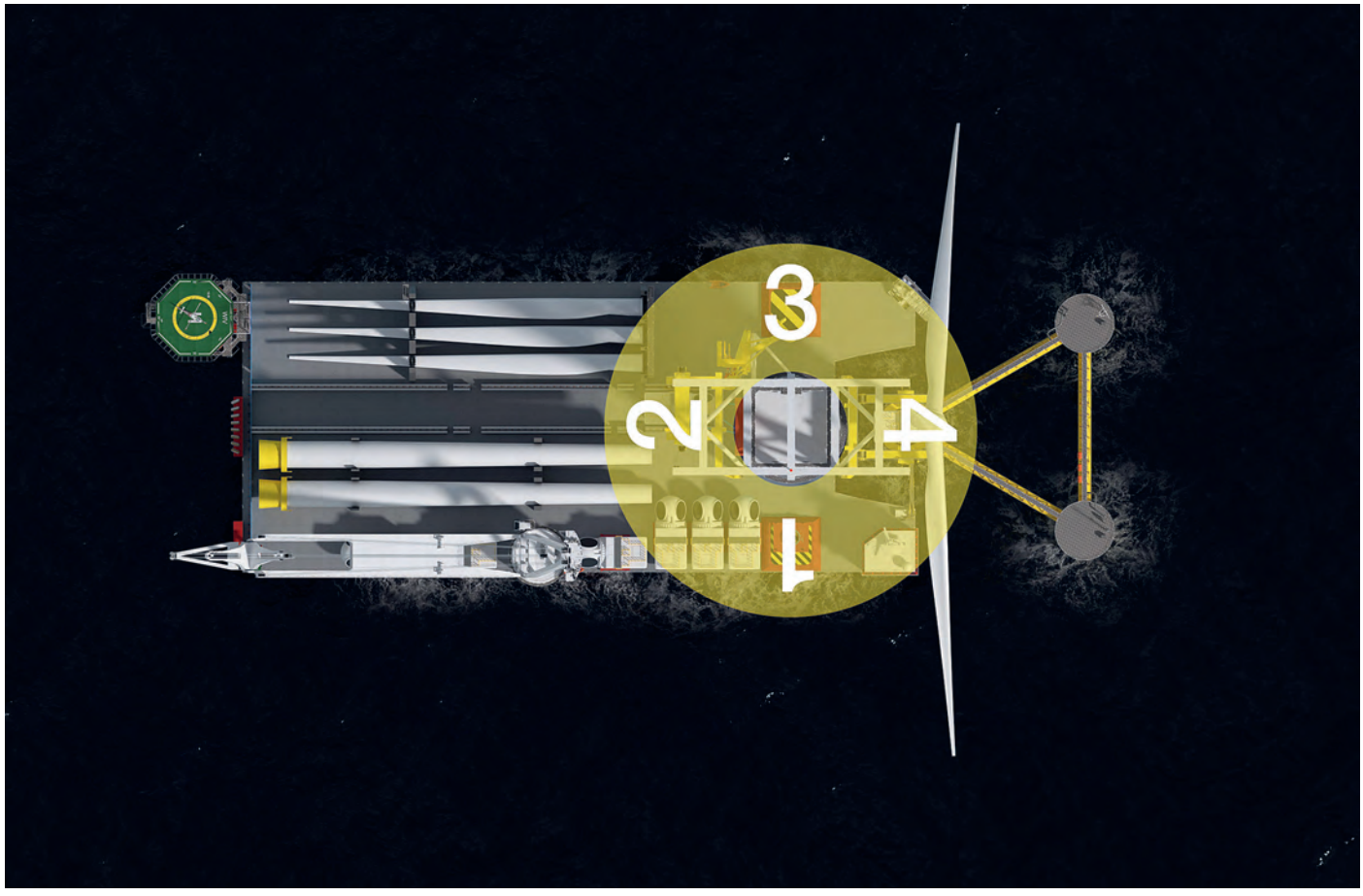
HUISMAN WIND FARM INSTALLATION VESSEL PROJECT

Huisman Equipment of Schiedam, the Netherlands, realised some ten years ago that the way wind turbines were installed offshore was dangerous and not the way offshore operations were normally handled. Huisman also saw opportunities for improving safety in the offshore wind industry, building on its experience in the heavy lifting and oil and gas industries. This involved assembling wind turbine parts onshore so far as possible, limiting the number of lifting operations, controlled lifting (no swinging loads) and robotics.

Something similar happened in the drilling industry some thirty to forty years ago. There were quite a lot of personnel injuries on the drill floor at the time. This because of the number of unprotected rotating machinery and the handling of chains and slings to couple and uncouple casing pipe and specially drill pipe. At a certain moment, the Norwegian authorities said: 'no people on the drill floor'. A number of Norwegian companies very quickly developed remotely controlled pipe handling and drilling equipment and the drill floor became remarkably safer.

At the time when Huisman's project started, some ten years ago, a large wind turbine offshore was 5 MW. Huisman investigated the possibility to assemble the topsides onshore and in a port of suitable size. A fast SWATH (Small Waterplane Twin Hull) vessel would

Photo: Wind turbine installation with tower, nacelle and propeller assembled. In this case, the tower is fitted to a floating foundation.



The workstations on board the WTIV.

bring out the assembled tower with nacelle and propeller to the site and land it on the bottom foundation sticking out some 10 to 15 metres above sea level. The mast on the installation vessel would have motion compensated (in X-, Y- and Z-directions) grippers to hold the assembled tower. This will save costs, as the assembly time offshore is much shorter and reduces the rate of incidents and accidents including damage to the equipment due to damage during assembly.

The WTIV will have a total installed power of 88 MW and eight azimuthing thrusters

Very soon, the size of the wind turbines grew from 5 MW to the now planned 20 MW and the length of the blades grew from 65 to 130 metres. Globally, there is a lack of sufficiently large ports for the assembly of wind turbines, so Huisman decided, we do it offshore. The relatively small SWATH vessel grew to a semi-submersible vessel with a length of 240 metres and a width of 88 metres. The beam of 88 metres is important as there are few drydocks in the world that can ac-

Propeller blade manipulator.

commodate vessels with a beam exceeding 90 metres. The deck-load is in excess of 20,000 tonnes.

Methanol-powered WTIV

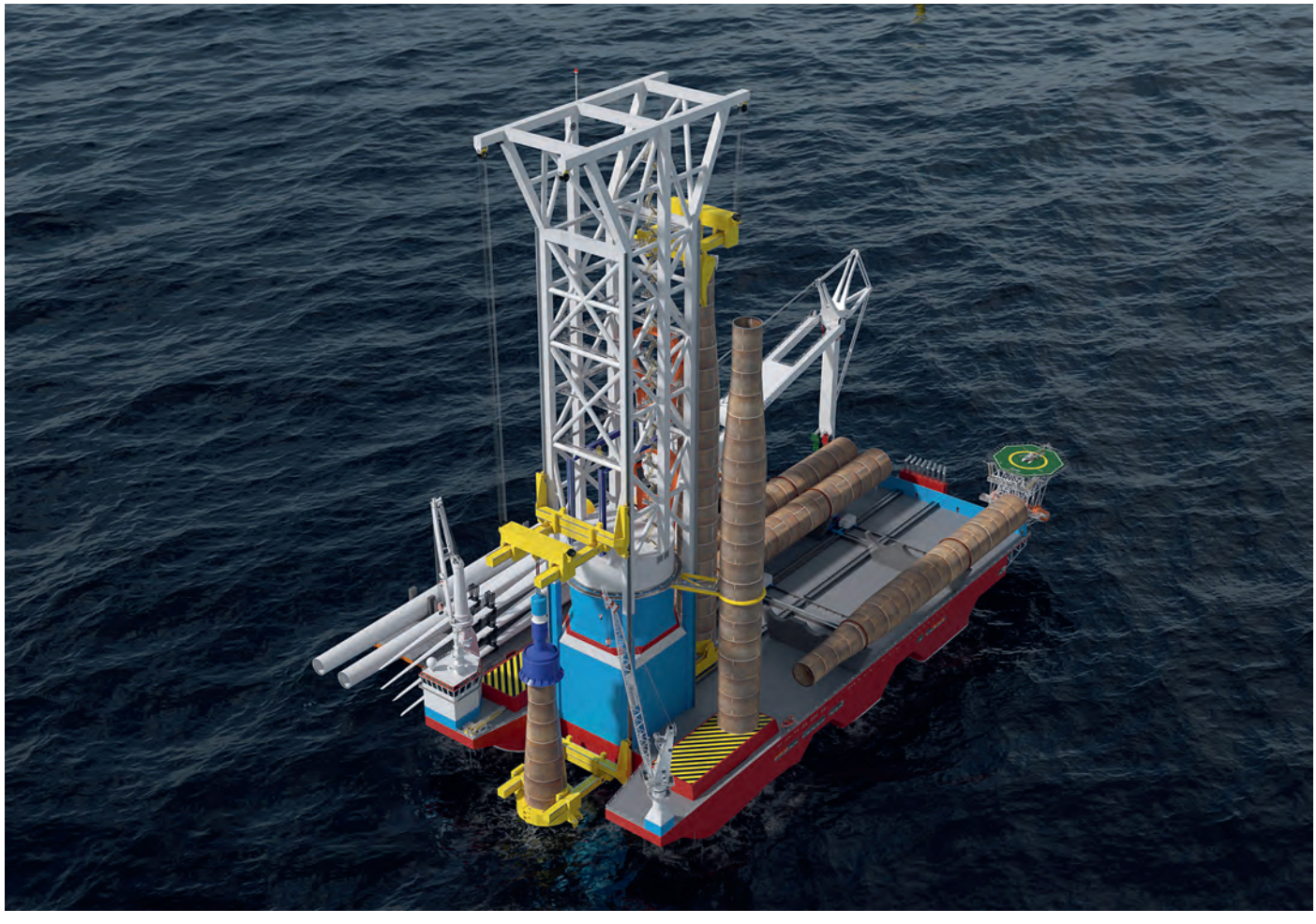
This wind turbine installation vessel (WTIV) will have a total installed power of 88 MW and eight azimuthing thrusters, each with a power of 5 MW. Thrusters are controlled by a Dynamic Positioning (DP) Equipment Class 3 system. This means a complete backup DP system is available in case the on-line system fails. Fuel is planned to be methanol. Accommodation is provided for 200 persons.
Huisman developed the WTIV concept in-house and the concept design is detailed by Shipyard De Hoop. Unfortunately, this shipyard went bankrupt at the end of 2021 and the work now continues with the engineering department of the shipyard that has started as its own entity.
The Huisman WTIV operation is based on the following assumptions:

- The foundation monopile is installed by the WTIV or by a third party. It is expected that two foundation piles can be installed by the vessel per day.
- Power and control cables are pulled in and hooked up by a third party.
- There is space for eight wind turbines on board (towers, nacelles and propeller blades, three per turbine). The tower is assembled and fitted out at the factory, loaded on the WTIV, and fitted out with the nacelle and propeller on board. The fitted-out tower is then placed on the foundation monopile already installed. It is assumed that one fully fitted out tower can be installed in one day.
- One or more supply vessels will keep the Huisman WTIV fully stocked with towers, nacelles, and propeller blades with hubs.

Wind turbine installation

The procedure for the installation of a wind turbine works as follows:

- The aft deck can carry six monopiles stored horizontally and five monopiles stored vertically in the tower. Each monopile is assumed to have the dimensions of Ø 12 metres, a length of 125 metres and a weight of 3000 tonnes.
- The rotatable mast on the WTIV has two workstations, one on starboard and one on portside, where the foundation piles are made ready for installation. When one foundation pile is ready for installation, the mast is turned 90° and the foundation pile is now in the forward position ready for lowering to the seabed.



Monopile installation.

- The monopile is lowered into position at the forward end. It is held by two grippers that are motion compensated in three directions. The monopile is then injected into the seabed as planned.
- Later, when the power and communication cables have been pulled in and connected, the WTIV will come back loaded with towers (in one piece) and with nacelles and propeller blades.
- The tower is hoisted upright (workstation 2, facing aft) and the nacelle is lifted up (workstation 1, starboard) and the mast is rotated so that the nacelle is facing aft and then lowered onto the tower. The upending and lifting are done with hoists that run on the sides of the mast of the WTIV. The tower with nacelle is then rotated to portside.
- A special gripper then picks up the propeller blades and they are fitted one by one to the hub on the nacelle (workstation 3, portside).
- The complete assembly is then installed on top of the foundation/monopile (workstation 4, facing forward). During this operation, a third "gripper", just above the waterline, with position sensors ensures the position is maintained. A sleave is used to connect the two parts. The sleave will later be secured by bolts for a permanent connection.

This procedure and technique can be used for both fixed and floating installations. The WTIV ensures a parallel activity: while on the main side (forward) a fully assembled wind turbine is being installed on a foundation, a tower section will be up-ended at the aft side of the installation tower. During the installation process, equipment (foundations, tower, nacelles and propeller blades) can be loaded onto the WTIV utilising the 3000-tonne knuckle boom crane without interfering with other operations.

Current sequential process	Huisman WTIV continuous process
Loading in Marshall port	Onboard assembly of parts and installation of wind turbine tower assembly (no. 1)
Sailing from Marshall port	Loading components during assembly
Jacking up	Transit to next location
Preload of each leg (jack-ups only)	Installing wind turbine tower assembly (no. 2)
Installation mast	Transit to next location
Installation nacelle	Installing wind turbine tower assembly (no. 3)
Installation of three blades	Transit to next location
Jacking down	Installing wind turbine tower assembly (no. 4)
Transit to next location	Transit to next location

Comparison between conventional method of installation and Huisman method.

Advantages of the new installation method

The Huisman WTIV will give a twenty to forty per cent cost reduction when installing wind turbines offshore, compared to the more conventional procedures due to a shorter installation time. Because there is only one contractor, coordination is better as well. In addition, there are fewer accidents and there is less damage to equipment during installation and it offers a quicker return on investment. It should be mentioned that landing the legs of a jack-up on the seabed and the jacking up is a very delicate operation. A thorough survey of the seabed in advance is required to avoid cavities below the surface of the seabed. These cavities can cause a "punch through" and if that happens, the jack-up can collapse. To ensure a stable situation, each leg is then "pre-loaded" to maximum capacity using water ballast and the jacking system. This is also done to avoid an eventual "punch through". All this takes time.
Arriving on location with a dynamically positioned vessel involves only pressing the "on-location" button and that is it.

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

FLOATING FUTURE

Luctor, emergo et supernato – I struggle, emerge and float

The Dutch have a rich history of living in river deltas and finding solutions to protect the land from the sea. Climate change brings new challenges and asks for a next step: living on and with the water. A group of researchers and parties from a wide range of disciplines are shaping and testing possibilities for a floating future.

In the Middle Ages, we started to produce more dry land by extracting water from lakes and now a big part of the Dutch population lives beneath sea level. Citizens have much faith in the strong dykes we built, but living on land is becoming more and more dangerous, as the recent disasters in Limburg and Germany have shown. Next year, it will be seventy years since a big part of Zeeland was flooded. The flood museum also pays attention to the floating future in its anniversary exhibition. New solutions have to be found to live with the water. What will our country look like 300 years from now? Two key figures in the Floating Future project tell their story in this article: Olaf Waals, Manager Offshore of MARIN and Rutger de Graaf-van Dinther, co-founder of the Blue Revolution Foundation and Blue21.

As part of the National Research Agenda, the research question of the project team is how to keep the Dutch Delta liveable in the long term and protect the citizens from the sea. The goal of the research is to develop unique knowledge of floating building solutions to contribute to scientific, technical and societal breakthroughs for a sustainable future.

Knowledge development

The biggest challenges in this assignment are efficient use of space and a flexible attitude to climate change. How can we keep our densely populated country livable? More and more people want to live near the sea where the land is low and vulnerable to flooding, not only in the Netherlands, but also in big cities all over the world, like New York, Jakarta and Shanghai. This asks for innovations, new solutions and knowledge development. The knowledge about solutions for living afloat can become an export product for the Netherlands, complementary to the water management knowledge the Dutch are already famous for. New values are being created like new perspectives, new flexible solutions, smart and multiuse applications, experiences with interdisciplinary innovation and so on.

In the Floating Future project, knowledge is being developed in three scientific areas: technology, ecology and governance. The maritime engineering challenges are completely different than the common scope nowadays; a ship is built for a lifetime of 25 years, a floating island has to be designed for a lifetime of over 100 years. More sustainable and robust materials have to be applied and fatigue can be a bigger problem in the long term. Characteristics of materials like concrete and steel are re-evaluated for this purpose. The forces on the structure also form a big challenge, see later on in this article.

Questions that arise in the science of ecology are: What is happen-

Photo: Interconnected pontoons for floating storage.

ing underneath the structures? How does this effect marine life? Experiences with existing big floating structures and recently an expedition underneath the ice of the Antarctic indicate that the lack of sunlight not always causes the ecology to decrease, on the contrary, complete new ecosystems thrive underneath. How can we integrate and live alongside this ecology and maybe harvest from it in a sustainable way?

The third subject is governance, which treats three subjects: policy and management, jurisdiction and economy. Pernille van der Plank of the Utrecht Centre for Water, Oceans and Sustainability Law (UCWOSL) and responsible for the governance subject in this project: 'The most important questions are: How can floating platforms be integrated in spatial planning? How can we guarantee that the floating city forms an inclusive community and is not only a living space for the happy few? Which jurisdiction is applied to the floating platforms? All the existing (building) regulations are based on buildings that are constructed on ground. This means that we have to investigate how new forms of large scale building can be integrated in existing laws. A later question is if it is possible to create a viable form of floating structures that can be applied in port areas.'

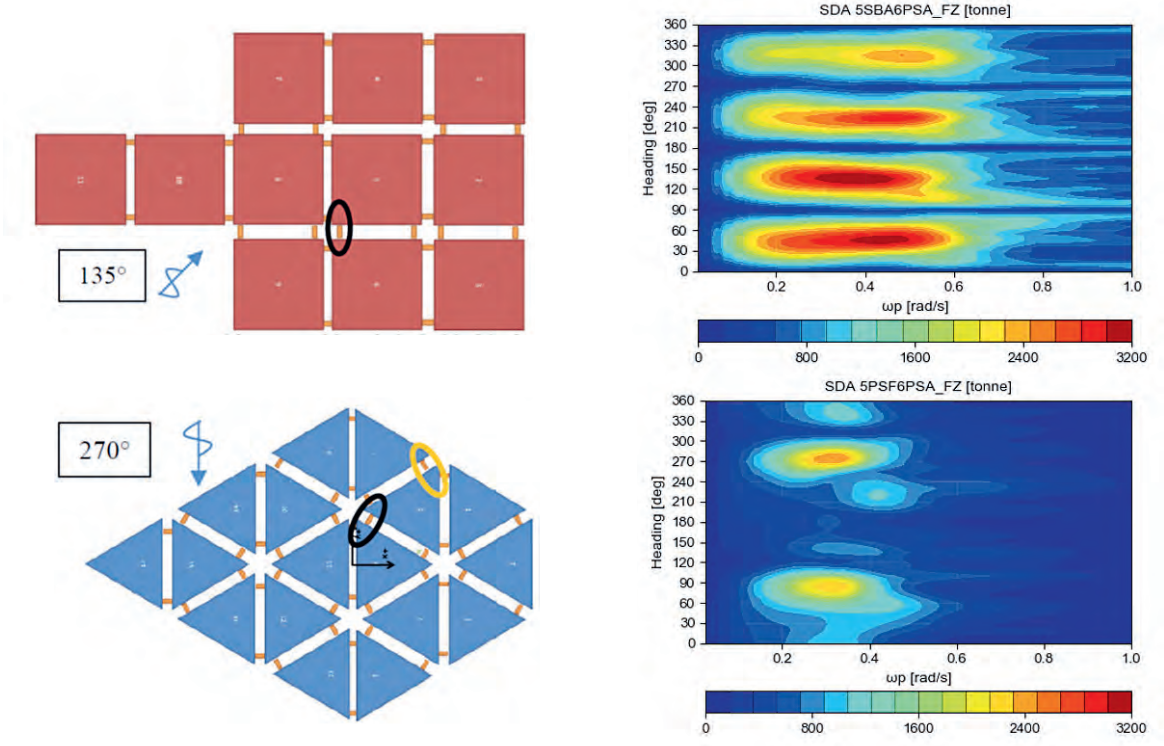
Floating rural development

In the project, the application of floating building will be evaluated for three purposes: floating housing, a floating energy island and floating port solutions.

For floating housing, society has to accept the possibility of living on water. Who wants to live on a floating island in the middle of the ocean? This asks for a tipping point in the way we think about housing. Trust is needed that large scale living on water is safe and comfortable. Therefore, the first applications of living on a floating structure will be in the port of Rotterdam and on inland waterways and lakes such as the IJmeer in Amsterdam. An important subject is movement: Do the people on a floating island feel movement or even get seasick? Tests at the MARIN basins show that you don't want to live at the edges of a floating island in big waves, but in the middle of the island, it could be both safe and comfortable.

> The integration of disciplines is actually the real innovation in this project

An application that is less demanding is a floating energy island. On this island, energy can be stored to support old and new infrastructures like wind energy, solar power, hydrogen and storage of fossil fuels. The current energy network on land cannot cope with the increase in sustainable energy. A sustainable fuel terminal can support the energy transition on land and sea in a flexible way. Next to energy storage, other objects can also be stored on the island, which gives a lot of opportunities for flexible port solutions. Storage on barges can easily be moved around the port sites. A much discussed option of floating constructions and infrastructure is to move or expand Schiphol Airport to the sea. This has already



Loads on rectangular and triangular floating platforms.

been tested in Japan and could be a very good alternative to an airport in a densely populated area. For this to happen, it is necessary to convince politicians with practical knowledge and experience. With the appearance of floating solutions, the separation between land and sea will fade away and a synergy between coastal protection and floating building will appear. There are also possibilities for floating islands offshore, but the North Sea is already very crowded. Some have suggested to submerge parts of the land again and make room for floating solutions more inland.

Interdisciplinary knowledge and cooperation

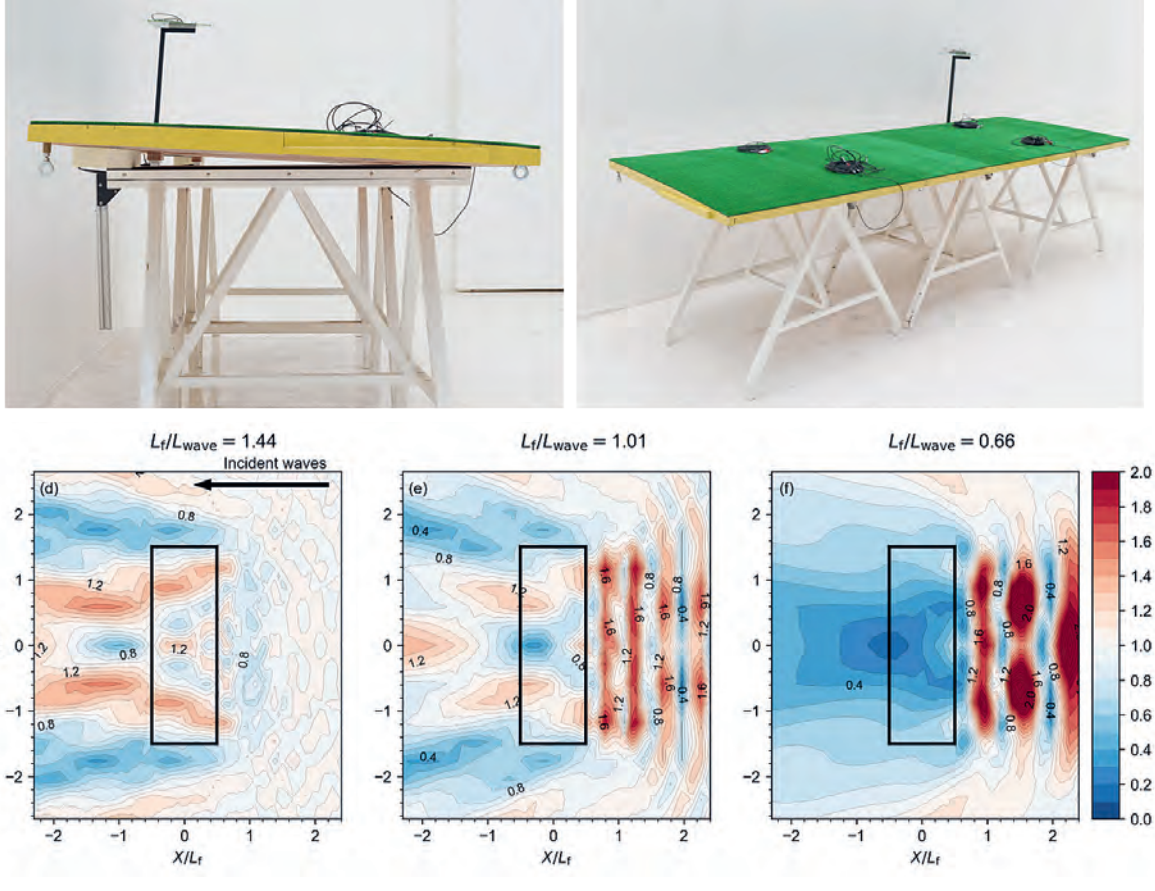
Engineering heroes of the old days like Stevin and Leeghwater had several areas of expertise and had a more integrated view on a subject. Nowadays, the focus is on deep specialisations and knowledge is more fragmented. In this project, the objective is to integrate different fields of expertise again. Multiple disciplines come together and create awareness, an open minded discussion and movement in all parts of the subject. A big group of civil and maritime engineers, architects, ecologists, lawyers and sociologists will investigate all the aspects of floating developments in the coming years. With these actions, a strong connection arises between several existing strong Dutch clusters like the civil, maritime and offshore cluster. The project team is proud of its big community; people from many knowledge institutes, governments, companies and end users work together and are motivated to contribute to this development and learn from each other. These parties all have their own culture and language, so taking time to get to know each other and creating an open mind is very important. The integration of disciplines is actually the real innovation in this project and takes place in an action research process.

Participatory action research

When research is done in close collaboration and with active participation of stakeholders around actual case studies, it is called participatory action research. The “action” in this process can be for instance case studies, pressure cooker meetings, measuring campaigns and participatory design workshops. This approach generates an energetic cooperation process.

The project is in a very early stage of a design process where thinking out of the box is the key. Results of the activities are being shared in open access journals and an online data management platform. Blue21 also developed a maritime engineering and 3D simulation toolkit for floating urban projects: HydroMEC+. Next to this, even civilians can contribute to the research via the Citizens Science Platform ClimateScan.

The study focus areas that have been initiated are: inland (such as rivers, polders and IJmeer); coastal port city (for example the Rijnmond area) and offshore. Applications that are studied are housing, energy and logistics. The next step will be an investment plan and a smooth follow-up in practical application projects.



Calculated transmitted wave field in shallow water conditions for different relative wave lengths.

As technology develops, floating platforms could move further out to sea (by Blue21).

Forces on interconnected floating platforms

William Otto and Joep van der Zande of MARIN have performed tests with different shapes and solutions, their results and thoughts on this subject are shared in the following paragraphs.

When designing a floating platform that consists of interconnected pontoons (see the picture on the first page of this article), it is important to address the degrees of freedom in the system. With rectangular pontoons, we see that the risk of an overdetermined system is larger because the pontoons are restricted on four sides. Especially for diagonal waves (45 degrees, 135 degrees, 225 degrees and 315 degrees), this can result in higher connection loads (red areas in the figure on the second page of this article). This can be avoided if the coupling design allows for more freedom in the local relative motion. When using triangular shapes, the peak loads occur only for two directions and they are much smaller for the same sea state and coupling type.

> When floating islands are applied in the North Sea, waves need to be dampened

Floating islands that are able to withstand mild sea states of a few metres of wave height were designed in the Space@Sea project as a first step. When floating islands are applied in harsher environments, such as the offshore North Sea, it is required to partially dampen the waves to reduce the motions of the island modules and the loads on the island and its mooring system. In the HybridEnerseaHub project, which looks at O&M (operations and maintenance) islands for offshore wind, this shelter is provided by an artificial reef with mild slope. The first picture in this article clearly indicates that the waves inside the wave barrier are reduced.

As an alternative, floating breakwaters may be used to attenuate the wave field and provide shelter for the island. A novel "floating beach" concept to enforce energy dissipation of incident waves through wave breaking was recently designed and tested by MARIN. The figure on the previous page (bottom panels) shows the calculated transmitted wave field in shallow water conditions for different relative wave lengths. Up next, MARIN aims to incorporate the floating beach concept into the design of a floating island with the ultimate objective to realise the feasibility of floating mega-islands in harsh environments in deeper waters. Amongst others, the Floating Future project will address this technical challenge.

Ing. Annelinde Gerritsen
Editor of SWZ|Maritime and independent maritime professional,
www.er-varen.nl, mail@nnelinde.nl

HEEREMA TRIALS FLOATING TURBINE INSTALLATION

Heerema Marine Contractors has tested its novel Rotor Nacelle Assembly (RNA) installation method offshore for the first time. The demonstration project, which also included testing of other installation techniques, was executed in collaboration with DOT and the Delft University of Technology to collect valuable operational data.

TEXT & PHOTOGRAPHY: HEEREMA MARINE CONTRACTORS / TU DELFT

The offshore wind industry is projected to produce 228 GW by 2030, enough to power over 68 million homes. To meet these targets, offshore wind turbines are progressively increasing in size and are being planned for installation in remote locations and deeper water depths. Due to these market developments, Heerema strategically developed the RNA method for the next generation of wind turbines.

RNA method

The largest technical challenge when using a floating installation vessel is the relative motion between the vessel's crane and the geostatic foundation of the offshore structure. With the RNA method, the rotor nacelle is assembled on board using a dummy tower. Once assembled with the blades in place, the rotor is lifted onto the wind turbine generator.

One specific point of attention within the RNA method is the blade installation, which has been identified as the most critical part of the turbine installation offshore for any vessel. To combat these challenges, Heerema has developed the guided root end positioning tool (GREPT). This in-house developed blade assembly tool enables

Photo: The single lift RNA was installed using DOT's Slip Joint connection (photo Heerema).

Heerema's GREPT in action (photo Heerema).

DOT's Slip Joint connecting the wind turbine's lower tower to the monopile foundation (photo TU Delft).

offshore handling and installation of blades safely and efficiently. The development of the RNA method has been ongoing over the last two years and has been tested extensively within Heerema's Leiden office based Simulation Center. The offshore test, which was executed in October, put the method into practice for the first time in Eneco's Prinses Amalia wind farm, the Netherlands. The test results will be used to continue improving the RNA method within the Simulation Center.

Slip Joint test

In addition to Heerema's RNA installation project, the offshore scope included testing DOT's Slip Joint connection. DOT is a Dutch company that develops offshore solutions and was founded in 2014 by Jan van der Tempel, who is also the founder and CEO of Ampelmann. Generally, wind turbine generators use bolted flange-to-flange connections between the subsequent parts, installed offshore using multiple lifts, whereas the Slip Joint is an alternative connection between an offshore wind turbine and its foundation. It works and looks like two paper cups upside down stacked on top of each other. The connection is based on friction, where the weight ensures a firm and stable connection. Installation is done by simply sliding the two parts over each other without the use of grout or bolts. This simple mechanism reduces material, equipment, and personnel costs and installation time.
Two separate Slip Joint connections were used during the FOX project (see text box below): connecting the wind turbine's lower tower to the monopile foundation and connecting the nacelle to the upper tower. Furthermore, a Slip Joint based seafastening was used to transport the complete tower section safely and to be able to transfer the load to the ship's crane in a controlled and efficient manner.

15 million data points

During the offshore test, Heerema assembled the complete wind turbine generator on board, which included the installation of blades using the GREPT. After that, the tower was installed on a pre-installed monopile. The single lift RNA was installed using DOT's Slip Joint connection and also thereafter with a flange-to-flange connection. After the test project was finalised, the wind turbine generator was disassembled and the monopile removed using a Vibro Lifting Tool.
During operations, Delft University of Technology (TU Delft) researchers were on board and collected a unique data set consisting of over 15 million data points, gathered by over a dozen motion tracking sensors, specially designed for this purpose. This data will be analysed by them to develop knowledge and validate methods for the installation of the next generation of offshore wind farms.

Vibro Lifting Tool

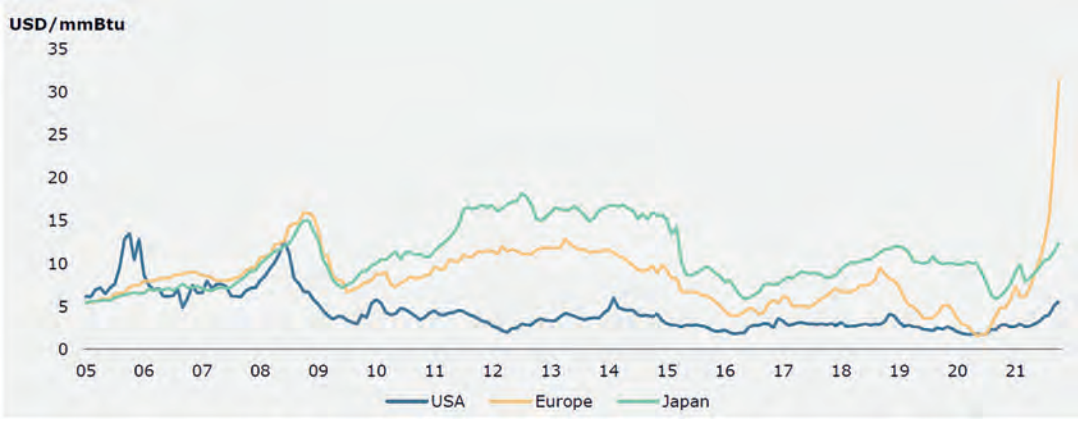
The monopile used was installed in 2018 as part of a previous test project known as SJOR. The SJOR project was the first time a Vibro Lifting Tool had been used with a dynamically positioned (DP) vessel for the installation of a monopile without the use of a gripper frame or similar. In October as part of the FOX project, the process was reversed to execute the removal of the monopile.
During removal, the test scope continued with extensive research undertaken in collaboration with Heerema Engineering Solutions and CAPE Holland. This action included a series of tests that were executed while reinstalling the monopile and again safely removing the structure before transferring it to Sleipnir's deck. This testing delivers valuable data that can be used to demonstrate the feasibility of monopile installation without the need for gripper frames due to the capabilities of Heerema's DP vessels and the Vibro Lifting Tool.

RESEARCH PARTNERSHIP

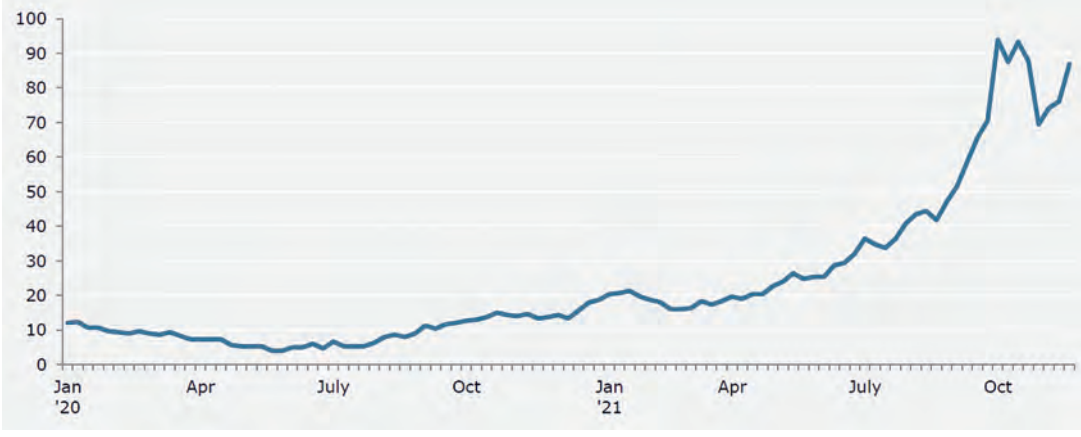
This demonstration project, known as FOX (Floating Offshore installation of XXL wind turbines), was a collaborative effort between Heerema, DOT, and TU Delft and was supported by the Dutch Ministry of Economic Affairs and Climate Policy and Eneco. The partners worked together with a wide range of subcontractors who have supported this test, including Heerema Engineering Solutions, F&B Group, Harco Heavy Lifting, Ampelmann, Sif, and CAPE Holland.

THE ENERGY SITUATION

Oil and gas activities dropped drastically a couple of years ago when the Covid-19 pandemic began and the push for "renewable" energy started in earnest. Many analysts agree that future energy demand cannot be covered by wind energy and solar energy alone. It must be a mix of fossil fuels and nuclear, wind and solar energy.



Development of gas prices in Europe, Japan and North America. US$/mmBtu (metric million British Thermal Unit, 1 Btu = 1.055056 kW.s, source: Markets Businessinsider, World Bank).



Dutch TTF (the TTF Neutral Gas Price Index is the volume-weighted average price of all trades executed in all spot contracts, which delivers on a specific gas day ("D") on TTF) gas price in 2020 and 2021 (EUR/MWH, source: tradingeconomics.com).

The graphs above indicate that the international gas prices are quite consistent with time, but in Europe and in particular the Netherlands, the gas price is running out of control. This must have something to do with the ban on gas production in the Netherlands and the US ban on the Nord Stream 2 pipeline from Russia, through the Baltic Sea to Germany. At present, December 2021, the Nordstream 2 pipeline is being filled with gas after having been completed by the Russians in September 2021.

In its latest World Energy Outlook, the International Energy Agency (IEA) provided four different possible energy scenarios until the year 2050. The scenarios took into account announcements made by governments until mid-2021. The four scenarios are:

- Stated Policies Scenario (STEPS): Government will not implement additional measures to bring down CO_2 emissions. In addition, announced emission reduction targets will not be met. As a result, global energy consumption, including fossil fuels, will continue to rise in the coming decades. Global warming could be 2.6°C (fifty per cent probability) in the year 2100.
- Announced Pledges Scenario (APS): The climate commitments set by governments, such as for example net zero emissions in the EU in 2050, will be fully met and on time. Unfortunately, a lot of countries have not yet set their climate goals. As a result, global warming could still be 2.1°C (fifty per cent probability) in the year 2100.
- Sustainable Development Scenario (SDS): This scenario is the

Country	GDP growth 2009 vs 2008	GDP growth 2020 vs 2019	GDP growth 2021 vs 2020	GDP growth 2022 vs 2021	Oil demand in 2020 (m b/p/d)	As % of total
EU	-4.2%	-6.0%	+5.1%	+4.4%	9.8	11.0%
USA	-2.5%	-3.5%	+6.0%	+5.2%	17.2	19.4%
China	+9.4%	+2.3%	+8.0%	+5.6%	14.5	16.4%
India	+8.5%	-7.3%	+9.5%	+8.5%	4.7	5.3%
Japan	-5.4%	-4.7%	+2.4%	+3.2%	3.3	3.7%
Russia	-7.8%	-3.0%	+4.7%	+2.9%	3.2	3.7%
World	-0.1%	-3.2%	+5.9%	+4.9%	88.5	

Historical and expected GDP (gross domestic product) growth by country versus oil demand (m b/p/d barrel/per/day or 159,000 m³/per/day (source: IMF October 2021, BP Statistical Review 2021, please note: global liquids demand (including biofuels) was approximately 91 m b/p/d in 2020).

USD per barrel	2021E	2022E	2023E	2024E	2025E
US Energy Information Administration	72	72	56	60	63
World Bank	70	72	63	62	61
IMF	66	65	61	59	57
Bloomberg commodity analysts	71	72	68	72	71
Rabobank	72	82	83	84	85
Richard Brakenhoff	71	71	67	63	60

Brent oil price forecasts 2021-2025 (source: US Energy Information Administration STEO November 2021 and IEO 2021, World Bank October 2021, IMF World Economic Outlook October 2021, Bloomberg commodity analysts, Rabobank, R. Brakenhoff).

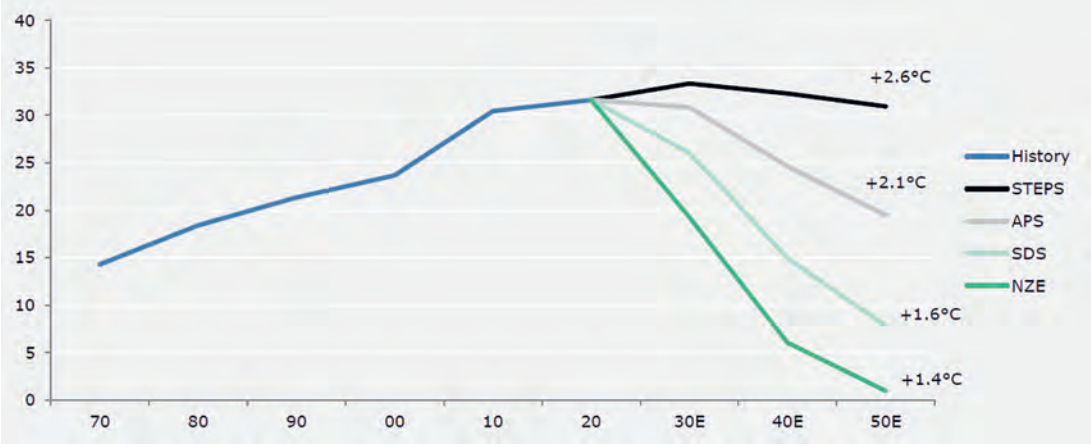
pathway to keep global warming well below 2°C in the year 2100. Governments will realise their goals, such as net zero emissions in the year 2050 in the EU, USA, UK, and several other countries, in 2060 in China, and in 2070 in the rest of the world. Global warming would be limited to 1.6°C (fifty per cent probability) in the year 2100.

- Net Zero Emissions in 2050 (NZE): All countries in the world should reduce their combustion related CO_2 emissions to zero in the year 2050. In addition, CO_2 emissions not caused by combustion activities should drop to zero as well. As a result, global warming would be limited to 1.4°C (fifty per cent probability) in the year 2100.

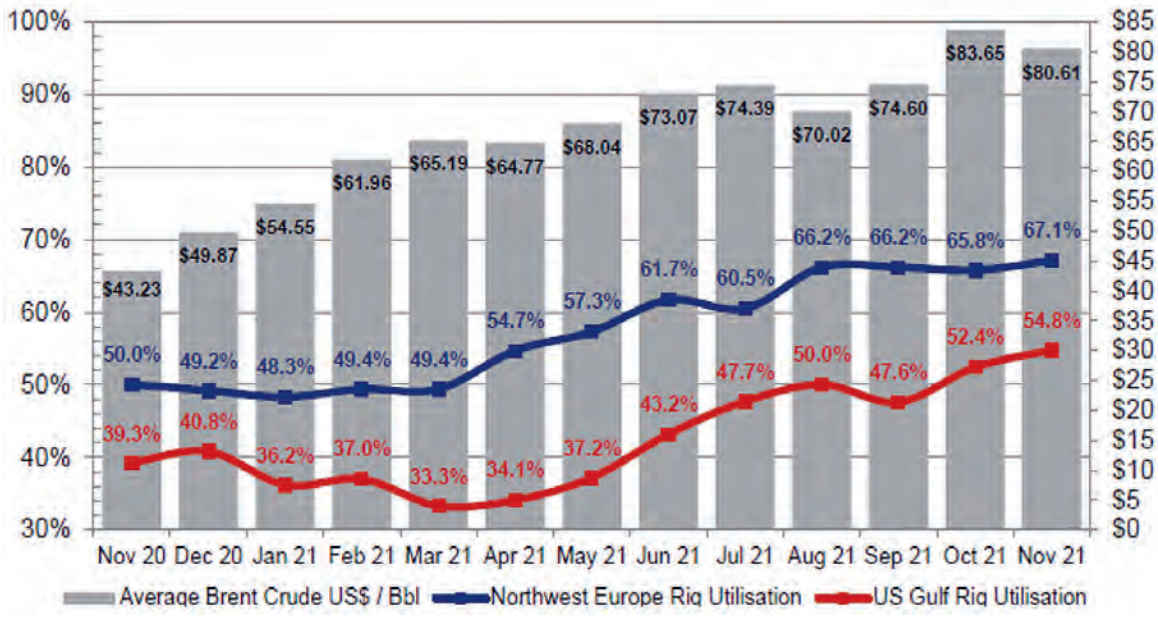
The graph below shows the historical global annual CO_2 emissions due to combustion activities as well as the forecasted emissions until the year 2050 using the above-mentioned four scenarios. Unfortunately, the outcome of the recent climate summit in Glasgow (2021) does not give a lot of hope that the SDS or NZE scenarios can be achieved, I believe. Particularly, a statement on phasing down the worldwide use of coal is rather vague. Coal emits more than fifty per cent more CO_2 compared to oil or natural gas. In the last thirty years, coal demand climbed by 68 per cent globally and according to the SDS or NZE scenarios consumption should drop by 78 and 89 per cent respectively, until 2050. If coal is still used in 2050, CO_2 should be captured and stored.

Oil and gas drilling rigs

The market for offshore drilling rigs is slowly improving, see the graph on the next page.



Global annual CO_2 emissions due to combustion activities 1970-2050 as well as the forecasted emissions until the year 2050 using the above-mentioned four scenarios (source: BP Statistical Review 2021, IEA WEO 2021).



Oil price vs contracted rig utilisation. 100 per cent is the total number of drilling rigs available (source: Seabrokers Seabreeze 2021-12).

Utilisation	Nov 2021	Nov 2020	Nov 2019	Nov 2018	Nov 2017
North Sea	67.1%	50.0%	66.7%	57.6%	47.4%
South America	72.5%	77.5%	81.3%	61.3%	75.8%
US Gulf	54.8%	39.3%	49.5%	51.3%	36.5%

Current estimated fixture rates

Premium harsh environment jack-up (ex CJ 70)	USD 90,000
Vintage harsh environment jack-up	USD 75,000
Sixth generation harsh environment semi-submersible	USD 300,000
Vintage harsh environment semi-submersible	USD 170,000
Sixth generation international semi-submersible	USD 180,000
Sixth/seventh generation international drill ship	USD 200,000

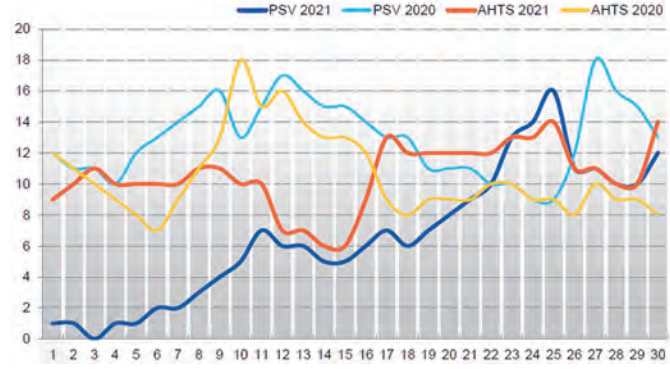
Contracted rig utilisation (top) and day rates (source: Seabrokers Seabreeze 2021-12).

As the rig market picks up, the offshore service vessel market will also pick up. Every drilling rig requires several supply vessels and prior to any drilling operation, various types of survey vessels are required.

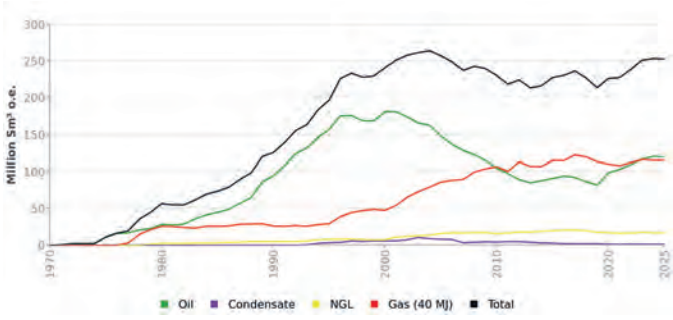
The number of drilling contractors are changing; for example, Noble Corporation (acquired the Dutch company Neddrill in 1996) and Maersk Drilling are expected to merge in mid-2022. Seadrill is expanding its activities and Stena Drilling is picking up some remains of Ocean Rig. Aker BP has agreed to acquire Lundin Energy becoming the second largest oil and gas producing company in Norway.

Brazil has released the offshore fields Sepia and Atapu in ultra deep waters offshore Brazil, about 100 nautical miles south of Rio de Janeiro. Bidders are Exxon Mobil Corp., Royal Dutch Shell Plc and eight other applicants. Petrobras (Petróleo Brasileiro), the Brazilian state oil company, will have a minimum share of thirty per cent, whoever wins. These are expected to be the last major oil fields to be auctioned out in Brazil.

Equinor ASA (former Statoil and Statoil Hydro) will drill about 25 exploration wells off Norway's coast in 2022. I bet that it will be among the last companies still producing oil and gas when the world has achieved net-zero emissions. Equinor claims that the production will be very environmentally friendly as hydro electric power is used for production and processing.



Daily North Sea offshore support vessel (OSV) availability, November 2021 (source: Seabrokers Seabreeze 2021-12).

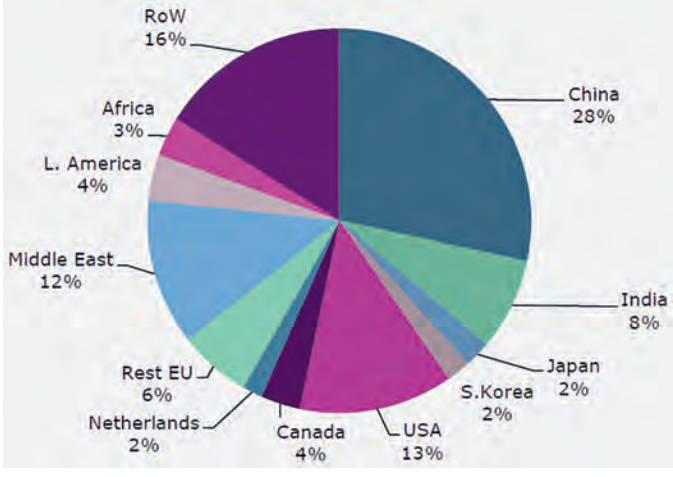


Historical and expected production in Norway, 1970-2025 (source: Norwegian Petroleum Directorate).

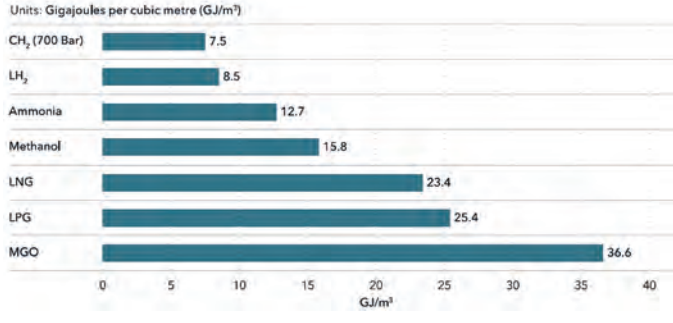
Renewables

Hydrogen is an attractive fuel, but at present of minor importance. Hydrogen production requires electrolysis and the electricity for this is generated by fossil fuels.

The production costs of "green" hydrogen are currently between US $ 3-8/kg H_2, which is much more expensive compared to the production of hydrogen by natural gas without carbon capture and storage (CCS) at US $ 0.5-1.7/kg H_2.



Global usage of hydrogen in 2020 (source: IEA Global Hydrogen Review 2021, please note: RoW = rest of the world).



Volumetric energy density of alternative fuels. CH_2: compressed hydrogen; LH_2: liquefied hydrogen; LNG: liquefied natural gas; LPG: liquefied petroleum gas; MGO: marine gas oil (source: DNV Maritime Forecast to 2050, Energy Transition Outlook 2021).

Ammonia and other alternative fuels

Ammonia is corrosive and an extremely hazardous substance. Compared to heavy fuel oil, ammonia weighs twice as much and requires three times more space to contain the same amount of energy. There is an EU project demonstrating the retrofitting an existing supply vessel, Viking Energy with a 2-MW ammonia driven solid-oxide fuel cell (SOFC) system. This is planned for 2024. There seem to be only four ammonia projects for ships above 5000 TDW initiated prior to 2020. Ten new projects have in the meantime started after 2020.

> Equinor may be among the last companies still producing oil and gas when the world achieves net-zero emissions

Methanol can be stored in integral fuel tanks adopted for its low flashpoint. Methanol burns without a visible flame, which makes a methanol fire difficult to detect.

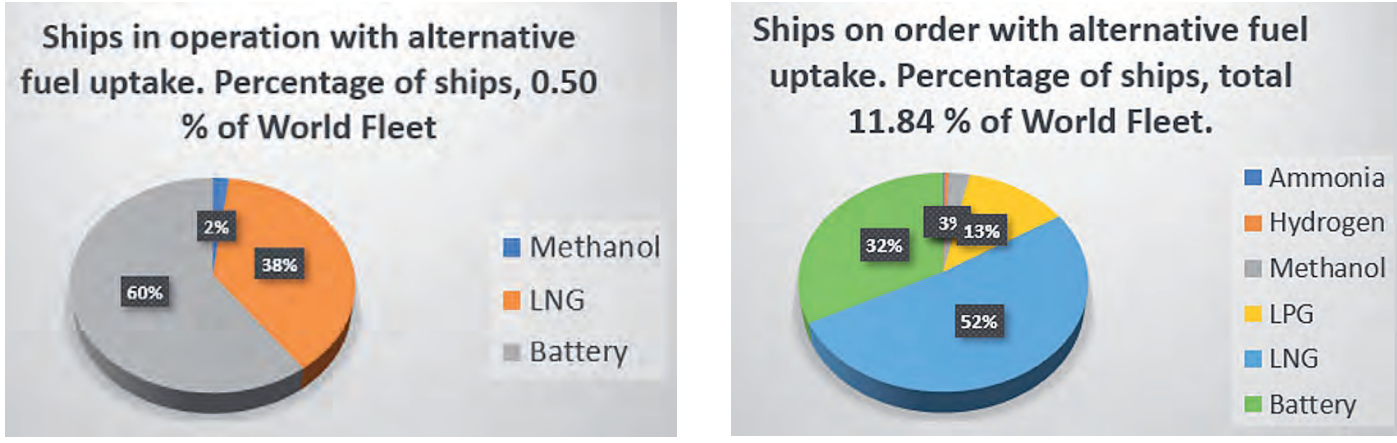
Two-stroke methanol engines are available with more than 100,000 hours of operation and four-stroke methanol engines are being developed. One test case is the Viking Line ferry Mariella. Since 2020, three new projects have been started with ships above 5000 TDW.

Fuel cells and batteries

Fuels cells can use a number of different fuels like hydrogen, LNG and methanol, depending on the type of fuel cell. Fuel cells normally require a battery bank, which acts as a buffer. The battery bank is constantly charged by the fuel cells, in order to ensure a power out-

Type of fuel	Fuel	Price (US $/GJ)
Fossil fuels	MGO	13.8
	VLSO	12.0
	LNG	7.8
	LPG	10.2
Carbon neutral fuels	Ammonia	22.9
	Methanol	29.8
	MGO	40.0
	LNG	30.7

Fuel prices applied in the Newcastlemax case study (seven different design options of bulk carriers related to immediate and future use of alternative fuels). The prices are given as future averages and reflect a scenario in which low-cost renewable electricity is available for production of carbon neutral electro fuels. VLSO is very low sulphur oil (source: DNV Maritime Forecast to 2050, Energy Transition Outlook 2021).



Uptake of alternative fuels for the world fleet as of June 2021 including ships in operation and ships on order (source: DNV Maritime Forecast to 2050, Energy Transition Outlook 2021).

put as required, depending on circumstance. The Lithium-Ion batteries are rather sensitive to high temperatures (above 650°C) and will then catch fire. This fire is almost impossible to extinguish as the batteries produce their own oxygen when burning. New types of batteries with a dry electrolyte are claimed to be "fire resistant".

The Glasgow statement on phasing down the worldwide use of coal is rather vague

Battery prices are expected to decline from say 100 per cent in 2019, to fifty per cent in 2024 and fifteen per cent in 2050.

Current costs and lifetime (seven to ten years) of fuel cell stacks with battery banks are the main barriers preventing widespread use. Compared to internal combustion engines, the cost of fuel cell stacks are many times more expensive. A fuel cell installation will also require more space and weight compared to a conventional machinery installation. On top of that, the fuel itself will require more volume and weight than the conventional fossil fuel.

Nuclear power

Nuclear powered ships have been around since 1955, mainly submarines and Russian polar icebreakers. Larger ships like container vessels, bulk carriers, tankers and maybe cruise ships can be excellent candidates for nuclear power.

The safety records for nuclear powered ships operated by the US Navy are excellent. The US Navy claims to have experienced no incidents with their nuclear power plants on board ships. The US Navy is at present operating some 69 nuclear submarines. The Navy of the Soviet Union and later the Russian Federation have had several issues with their nuclear power plants on board ships.

The largest 1000 ships of the world fleet of ships account for about ten per cent of global shipping emissions and about 0.3 per cent of total global emissions. Nuclear powered ships can also operate at higher speeds (say 30-35 knots) as the emissions are zero anyway. This will reduce transportation time considerably, which means the

		PEMFC	HT-PEMFC	SOFC
Technical characteristics	Stack lifetime	Moderate	Moderate	Moderate
	Electrical efficiency on hydrogen	50-60%	50-60%	~60 %
	Operation temperature	50-90°C	140-200°C	500-1000°C
	Tolerance for load variations	High	Medium	Low
	Sensitivity of fuel impurities	High	Low	Low
	Maturity	High	Low	Moderate
	Energy density	High	High	Moderate
Air emissions reduction potential on hydrogen (GHG, SO_x, NO_x, PM)		100%		
Relative cost (among fuel cells		Low	Moderate	High

Key characteristics of: Proton-exchange membrane fuel cell (PEMCF), high temperature PEMCF (HT-PEMCF) and solid-oxide fuel cell (SOFC) (source: DNV Energy Transition Outlook 2021 – Technology progress report).

total number of ships can be reduced.
The early nuclear power plants were of the type pressurised water reactors (PWR). These require active safety mechanisms. New nuclear designs are inherently safe, which means that a meltdown cannot happen even if the active cooling is lost. Current designs of nuclear power plants include:

- Small modular reactors (SMRs): Six different designs are intended for marine applications. The reactor plant is relatively small with power outputs from 5 MW to 450 MW.
- Molten salt reactors (MSRs): There are two different types: one with an open and one with a closed fuel cycle. In the closed cycle, the fuel needs to be changed every five years or so and in the open cycle the fuel is added and extracted/reprocessed during operation. The MSR technique is still under development and is not mature for commercial operation. The closed cycle is the most promising and it is regarded as very safe.

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

JONES ACT – PROTECTION OF THE US MERCHANT MARINE

The Jones Act is an act to provide for the promotion and maintenance of the United States of America's (US) merchant marine, to repeal certain emergency legislation, and provide for the disposition, regulation, and use of property acquired thereunder, and for other purposes. It prevents foreign flag ships to transport goods and passengers between mainland US ports and to and from Alaska, Puerto Rico, Hawaii and Guam.

The act was introduced on 5 June 1920, by the 66th US Congress. There are other Jones Acts in the US, but the one we are discussing here is about the US merchant marine. It was introduced by US Senator Wesley Jones. The act deals with the cabotage, or coastal trade between US ports. In short, it can be said that the Jones Act states that cargo and/or passengers can only be carried between two US ports by ships built in the US, owned by a US company and owners of the company must be US citizens, operated under US flag, and manned by US citizens and US permanent residents. The Jones Act also covers dredging and salvage.

History

At the start of the young nation, in the first congress on 1 September 1789, an "Act for Registering and Clearing Vessels, Regulating the Coasting Trade, and for other purposes" was introduced. This act limited domestic trades to US ships meeting certain requirements. The Jones Act was introduced in 1920 as a result of a shortage of ships during the first World War for the US military organisation. In order to secure sufficient tonnage for the US government in a crisis situation, the Jones Act was initiated.

The Merchant Marine Act of 1920 has been revised numerous times; the most recent revision was in 2006. There is a separate Passenger Vessel Services Act of 1886 (PVSA), which states that 'No foreign vessels shall transport passengers between ports or places in the United States, either directly or by way of a foreign port, under a penalty of US $ 200 (now US $ 762) for each passenger so transported and landed.'

It is today possible for passengers on foreign flag cruise ships to leave a cruise ship for a visit or an excursion on land in a US port, but they must leave the same port with the same ship. Passengers are not allowed to disembark and leave the vessel in a US port if they boarded in a US port without paying a visit to a foreign port.

Great seal of the United States of America.

Contents of the Jones Act

The Jones Act is about national security. It ensures that there is sufficient shipbuilding capacity and that there are enough ships and

Offshore support vessel IMR (Inspection Maintenance and Repair) Ross Candies, Jones Act compliant, designed by Otto Candies Design Group, consisting of the author and a Polish design office (MMC). Built by Dakota Creek Industries, Anacortes, Washington State, in 2010. The 100-tonne deep-water deployment and recovery system (the mast on portside) was delivered by Huisman Equipment in Schiedam, the Netherlands. The ship won the Ship of the Year award in the US in 2010.

skilled seamen to man the ships, for the needs of the US military organisation. The Merchant Marine Act of 1936 states that the US Merchant Marine must:

- be able to carry all domestic water-borne commerce;
- be able to carry a substantial portion of foreign commerce;
- be able to serve as a naval auxiliary in times of war or national emergency;
- be owned and operated under the US flag by US citizens 'insofar as may be practicable';
- be composed of the best-equipped, safest, and most suitable types of vessels;
- consist of vessels constructed in the US; and
- be manned by trained and efficient US citizen personnel.

The Jones Act also covers seafarers' rights to compensation in case of injury and damage because of negligence of their employer or the shipowner, including acts of the captain or fellow crew members. The seafarer has up to three years from the time of the incident to file a lawsuit.

The Jones Act also states that seafarers must be trained and efficient. In my offshore experience in the Gulf of Mexico, this may not always be the case. On several occasions, I have had to draw the conclusion that a Mexican crew certainly has its merits compared to a US crew on offshore support vessels.

During the Desert Storm operation, foreign seafarers contracted by the US government refused to sail into a war zone while US seafarers cannot do that.

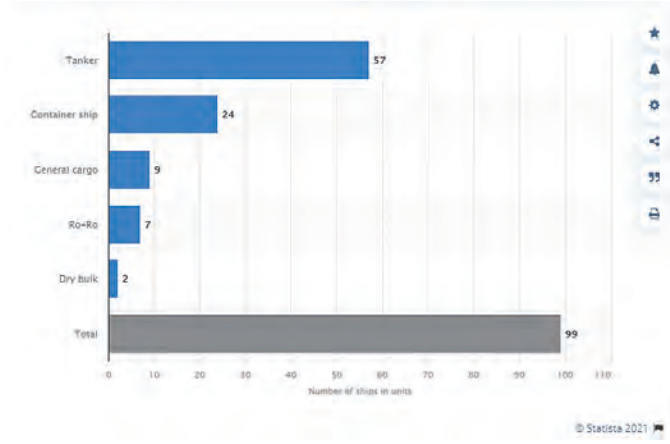
A number of US shipyards would not survive international competition if not for the Jones Act. There is nothing wrong with the US shipbuilding capability. They produce ships of good quality, when given the chance. Many shipyards survive on government contracts as these may at times be somewhat inflated. If the US shipbuilding industry should decline, it will prevent the US government from placing orders for navy and Marine Corps ships domestically. At present, foreign designs are built at US shipyards. The domestic design knowledge in the US, at least for civilian vessels, is not comparable with, for example, European design knowledge.

A number of US shipyards would not survive international competition if not for the Jones Act

The Jones Act also prevents foreign ships to penetrate US inland waterways and eventually sabotage installations and gaining access to restricted information. As dredging and salvage also fall under the Jones Act, only US flag ships and crew can be involved.

Exemptions and waivers

If there is a particular task to be carried out that has a certain significance to the US industry and there is no US ship able to carry out the task, then a foreign flag ship will be permitted to do the job. This is judged on a case by case basis. For example, after certain hurricanes like Katrina, Harvey, Irma and Maria (Puerto Rico) devastated the east and south coast of the US, foreign flag ships were permitted to for example deliver oil to certain US ports. After hurri-



US flag oceangoing privately owned merchant Jones Act fleet as of December 15, 2019, by ship type.

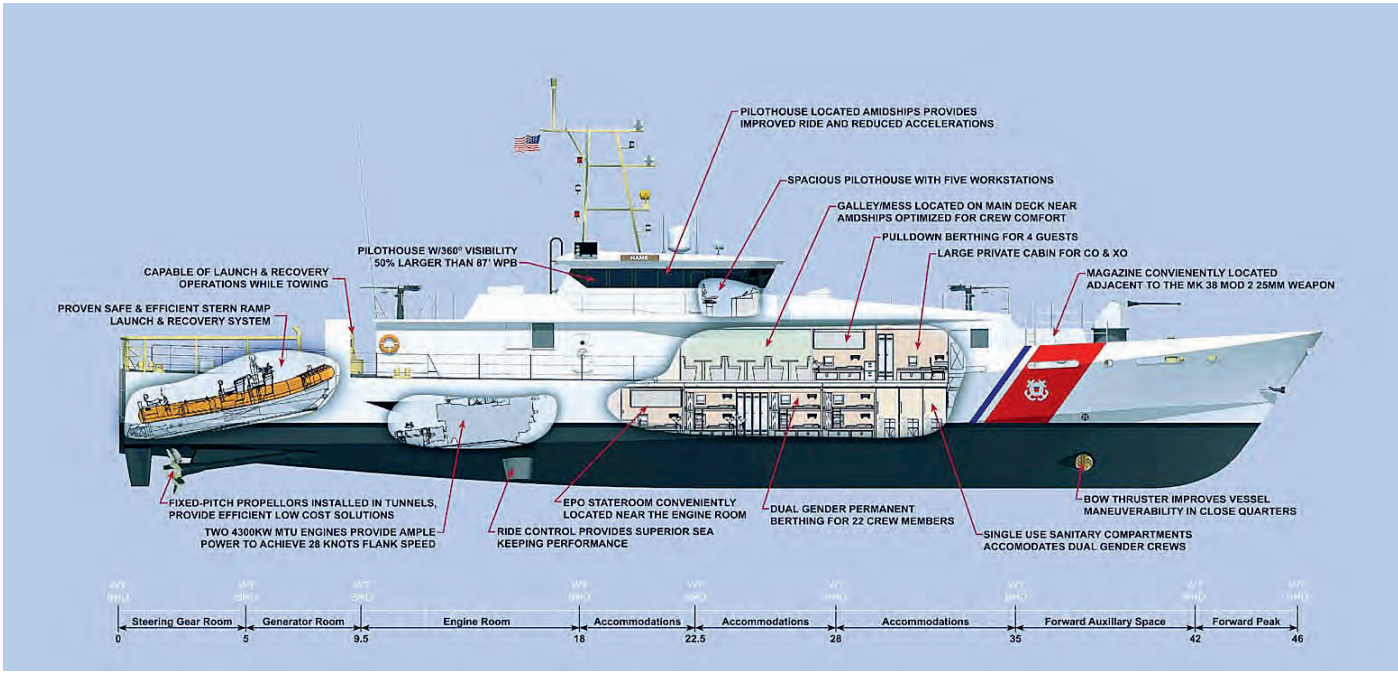
cane Katrina, agricultural products were accepted to be transported on foreign flag vessels as well. Another example is the Russian ice strengthened tanker Renda transporting oil from Dutch Harbor in the Aleutians (Alaska) to Nome, also in Alaska, in a kind of emergency situation.

In the offshore oil industry, offshore support vessels like pipelayers and heavy lift vessels have been permitted to work in US waters as there were no equivalent US vessels at the time. As soon as there are, the party for the foreign vessel is over.

In May 2021, a waiver was given for eight cargoes of oil from the southern US to New Jersey. This waiver was given by the Secretary of Homeland Security Alejandro N. Mayorkas: 'In the interest of national defence, I have approved a temporary and targeted waiver request to an individual company. This waiver will help provide for the transport of oil products between the Gulf Coast and East Coast ports to ease oil supply constraints as a result of the interruptions in the operations of the Colonial Pipeline. The decision to approve the waiver was made after careful consideration and consultation with interagency partners across the federal government. The Departments of Transportation, Energy, and Defense were consulted in order to assess the justification for the waiver request and ensure the approval of the waiver is in the interest of national defence.'

This had to do with the recent cyber attack on the Colonial Pipeline. Also, the Alaska cruise industry has a Jones Act waiver valid until February 2022. In the past, foreign cruise ships leaving the southern states made a visit to a Canadian port and then exchanged passengers in an Alaskan port. Or they made a roundtrip in Alaska and visited a Canadian port during the roundtrip. Canada has at present

The MV Jones Act Enforcer (courtesy of Offshore Marine Service Association).



Proposed modifications to the StanPatrol Vessels for the US Coast Guard.

closed its borders to all cruise ships, so the Canadian stop does not happen. There is now a proposal to exclude all foreign flag cruise ships cruising in Alaska under the Jones Act.

Critics

The Jones Act lobby is very strong in the US. It is more or less impossible to circumvent the act without a waiver, referring to a particular situation. The lobby is very alert and active and quick to react on anyone and anything that could possibly be a violation. On the other hand, as the Americans say: 'If you cannot beat them, join them'. One example is the IMR (Inspection, Maintenance and Repair) vessel Ross Candies (see picture).

There are many critics of the Jones Act claiming that ships and transportation are more expensive with it in force. Recently, the Offshore Marine Service Association (OMSA) reported a violation of the Jones Act referring to two foreign flag and foreign built derrick barges transporting cargo, in this case oil platform jackets, from one US port to another. A private organisation has modified a fast offshore crew boat/supply boat, now called the Jones Act Enforcer in order to be able to patrol the waters of the southern US. This was quite recently, in August 2021.

Many years ago, I understand, there was a fisherman (Norwegian ancestry) who wished to have a modern factory/fish-processing trawler. He purchased one of these mass-produced ships built in the US for US owners during World War 2; a Liberty Ship or a T1 Tanker. He cut out the part of the keel containing the registration number stamped or welded into the steel. This part was shipped to Norway and a new factory trawler was built around it. This ship was then introduced as a Jones Act compliant vessel, just slightly modified from the original as the registration number was still intact. This resulted in some major modifications to the Jones Act.

The upcoming US wind farm industry has triggered a debate if the wind farm installation and service vessels must be Jones Act compliant. As a result, a major newbuilding and ship converting programme is now underway in the US, in order to produce all the ships required. At present, the debate circles around the use of non-Jones Act compliant installation vessels for the actual installation and all parts are shipped out by Jones Act compliant supply vessels.

> Some claim ships and transportation are more expensive with the Jones Act in force

The US-Monaco company Eneti was in talks with US shipyards to build two wind turbine installation vessels with a US shipbuilder, but ordered the ships with Daewoo in Korea.

The US West Coast company American Seafood Company (ASC, Seattle and Dutch Harbor, Alaska) has been transporting frozen fish from the west coast to the east coast for the last twenty years. They do this on non Jones Act compliant foreign flag vessels via the Panama Canal. The fish is landed in New Brunswick, Canada. On the quay, there is a short railroad and the frozen fish is then transported some thirty metres down the quay and offloaded to trucks, which transport the fish to the market in the densely populated areas around New York and Washington DC. The ASC has now received a US $ 350 million fine for this. (The largest fine up until now has been US $ 10 million.) It turns out that according to the

A Damen design terminal tug for Edison Chouest Offshore.

Jones Act; if a Canadian railroad transport is involved, foreign flag ships can be used as mentioned above. This has now changed after twenty years of operation.

European shipbuilders

Rolls-Royce has for decades been established in the US, selling its equipment and designs to shipyards and shipowners. For example, the company Edison Chouest Offshore, one of the largest offshore support vessel operators in the Gulf of Mexico (GoM), had a number of its vessels, built by its own shipyard (North American Shipbuilding among others), designed by Ulstein and later Rolls-Royce, both Norwegian companies.

Vosta LMG, a Dutch-German company, has sold a number of designs of trailing suction hopper dredgers to US companies in order to be built in the US. Dutch shipbuilder Royal IHC has also sold at least one design of a trailing suction hopper dredger to Weeks Marine Inc.

Shipyard De Hoop in Lobith, the Netherlands, took over a shipyard in Louisiana and started building diesel-electric offshore support vessels with dynamic positioning (DP) systems. The first of its kind in the GoM, built according the Jones Act. Later, the client, Otto Candies LLC, took over the shipyard and production of the diesel-electric DP vessels. These vessels were initially the laughing stock of the GoM operators, but when people realised the fuel savings and the manoeuvrability of these vessels, everybody in the GoM switched to diesel-electric DP vessels with azimuthing thrusters instead of conventional shaft lines and rudders.

Dutch Damen Shipyards Group has sold a modified design of the Damen StanPatrol Vessel 4708 to the US Coast Guard in 2008. This design is called the Sentinel Class and 64 of these vessels have been and will be built by Bollinger in Lockport, Louisiana. The last of the series are expected to be delivered in 2025.

Edison Chouest Offshore has contracted Damen to design two offshore terminal tugs for offshore Guyana. The tugs will be built at one of the shipyards in Louisiana belonging to Edison.

In 2009, the Italian Fincantieri Marine Group took over two shipyards around Green Bay in Wisconsin, USA, one in Sturgeon Bay and the other in Marinette. Fincantieri builds commercial and navy vessels for the US Navy and the US Coast Guard there. Its latest newbuilding is a Great Lakes Bulker, the first newbuild of this type since 1983. Delivery is planned for 2022 at the Sturgeon Bay Shipyard.

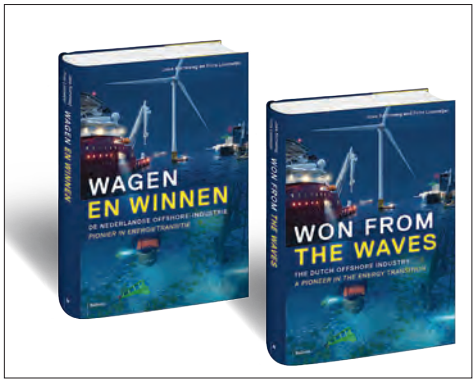
The Australian Austal Group took over a shipyard at the Mobile River opposite the city of Mobile in Alabama in 1999. Austal USA is at present building Littoral Combat Ships and Expeditionary Fast Transport Ships for the US Navy. Austal has also set up a training centre called AIDT Maritime Training Center in Mobile. In 2020, Austal took over the old bankrupt Bender Shipyard from Signal International. Austal has also developed a booming ship repair business at the new site.

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

GERRIT DE BOER, GERRITJDEBOER@KPNMAIL.NL

Wagen en winnen

Ter gelegenheid van het vijftigjarig jubileum van brancheorganisatie IRO is een boek verschenen met de titel "Wagen en winnen". De IRO werd in november 1971 opgericht tijdens de beginjaren van de olie- en gasontwikkelingen in Europa als een onafhankelijke non-profitorganisatie die de belangen van inmiddels 400 aangesloten Nederlandse toeleveranciers in de offshore energie-industrie ondersteunt en behartigt.



De Nederlandse offshore-industrie is in vijftig jaar uitgegroeid tot een pionier in energietransitie en behoort tot de top vijf van de wereld. IRO was bij oprichting de afkorting van Industriële Raad voor de Oceanologie. De raad werd toen gevormd door vertegenwoordigers van verschillende sectoren in de oceanologie, zoals mijnbouw, kustwatertechnologie, visserij en oceanologische instrumentatie. IRO is een cluster van toeleveranciers, te weten innovatieve bedrijven die in opdracht van de grote energiemaatschappijen platforms, transformatorstations en windmolens bouwen, transporteren, onderhouden en na gebruik ook weer opruimen. Ze spelen een belangrijke rol in de huidige energietransitie, die grotendeels op zee wordt gerealiseerd. De IRO-leden, afkomstig van zowel multinationals als mkb-bedrijven, vertegenwoordigen de gehele *supply chain* binnen de olie-, gas-, offshore renewable- en mariene energie-industrie, met activiteiten op het gebied van: engineering & consultancy, constructie & fabricage, *plant & equipment*, *contracting* & installatie, exploratie & productie en personeel & HSE (*Health, Safety & Environment*), voor zowel offshore *upstream* olie en gas als offshore renewables (wind-, mariene en drijvende zonne-energie).
In vijftig jaar wist de IRO met veel lef en technisch vernuft in te spelen op uitdagingen die ontstonden in een steeds kritischer maatschappelijk en politiek klimaat zoals de actuele energietransitie. Aanvankelijk verliep deze transitie van kolen naar olie en gas, daarna van olie en gas naar duurzame energie. Nadat in 1959 een enorme gasbel werd ontdekt bij het Groningse Slochteren, vermoedden experts al snel dat ook onder de Noordzee gas te winnen is. Bestaande en nieuwe bedrijven stortten zich vervolgens binnen de kortste keren op de olie- en gaswinning buitengaats. Zo ontplooide Nederland zich na de oliecrisis tot een van de belangrijkste offshore-landen ter wereld.
Als gevolg van de energiecrisis in 1973 moesten steeds kleinere velden in de Noordzee in exploratie worden genomen.
De vooruitzichten voor Nederlandse offshore-bedrijven ontwikkelden zich gunstig om een toenemend marktaandeel te veroveren in de installatiewerkzaamheden voor platforms en benodigdheden voor de olie- en aardgaswinning.
Met de focus veranderde in de loop der jaren de IRO mee. In november 1991 werd IRO een branchevereniging als Industriële Raad voor de Olie- en gasindustrie. In verband met de ontwikkelingen die gerelateerd zijn aan de transitie van traditionele fossiele energiebronnen naar hernieuwbare energie, heeft de vereniging in november 2016 naam en doelstelling weer aangepast met als doel de activiteiten van de leden beter te weerspiegelen. Als "branchevereniging voor de Nederlandse toeleveranciers in de offshore energie-industrie", richt IRO zich tegenwoordig naast olie en gas ook op offshore wind en andere vormen van hernieuwbare energiebronnen. De IRO speelt daarbij een belangrijke rol in het onderhouden van de relaties tussen overheid en ngo's en het faciliteren van netwerkmogelijkheden binnen de IRO *community* tot deelname aan internationale handelsmissies en beurzen, evenals het delen van *business intelligence* en nieuwe technologieën. In 2012 is het kantoor van Zoetermeer verhuisd naar de Willemswerf in Rotterdam waar vrijwel alle maritieme organisaties, waaronder Netherlands Maritime Technolgy (NMT), de Koninklijke Vereniging van Nederlandse Reders (KVNR) en Nederland Maritiem Land (NML) zijn gevestigd.
Om de offshore-industrie toekomstbestendig en duurzaam te maken, omarmt de IRO het initiatief van Young IRO: een platform van de volgende generatie jonge professionals. IRO steunt, vaak in samenwerking met de Nederlandse Olie en Gas Exploratie en Productie Associatie (NOGEPA), verschillende initiatieven om jonge mensen voor deze sector te enthousiasmeren.
In het jubileumboek Wagen en winnen hebben de bekende maritieme historici Joke Korteweg (1970) en Frits Loomeijer (1953) op voortreffelijke wijze de fascinerende ontwikkeling van de Nederlandse offshore-industrie beschreven. Bovendien is het geschreven op een prettige, toegankelijke manier en met verrassende koppen, zoals "Van gas erop naar gas eraf" en "To sea or not to be". Zij wisten lijnen vanuit het verleden door te trekken naar het heden en de toekomst. Zij werden daarbij ondersteund door een redactiecommissie bestaande uit Arjan Klijnsoon (oud-bestuurslid), Marloes Kraaijeveld (PR & communications manager), René Peters (bestuurslid) en Sander Vergroesen (directeur).
Met dit boek is een oer-Hollandse industrietak voor het eerst uit de schaduw gehaald. Voor het boek zijn niet alleen schriftelijke bronnen geraadpleegd, maar er zijn ook gesprekken geweest met IRO-leden, politici en andere deskundigen. Wagen en winnen is fraai geïllustreerd met veel foto's in kleur en zwart-wit, kaarten en tabellen. Het boek, waarvan ook een Engelse editie werd uitgebracht, wordt afgesloten met een lijst afkortingen en begrippen, een alfabetische lijst van alle bestuursleden, een lijst van de leden per 2021, bronnen en literatuur, een register en fotoverantwoording.
Wagen en winnen, 240 pagina's, afbeeldingen, formaat: 24,9 x 17,6 cm, ISBN: 9789463821841, prijs: € 29,95, Uitgeverij Balans, Amsterdam, info: www.uitgeverijbalans.nl/boeken/wagen-en-winnen/
Won from the Waves, ISBN: 9789463821858, prijs: € 34,95

GREEN SHIPPING REQUIRES EFFECTIVE ANTIFOULING

As for many ships fuel consumption may account for fifty per cent of operating costs, the added drag caused by biofouling has severe economic consequences. Increase in fuel consumption and the associated increase in greenhouse gas emission are obviously not in line with the concept of green shipping. This makes biofouling an issue that has to be tackled.

Biofouling is a serious issue for the shipping industry. It is a natural process that can happen in any type of water. Many factors such as temperature, salinity, geographic location, water quality and seasonal variability may have influence on the fouling process, but most severe fouling conditions are usually found in (tropical) marine water.

Major consequence of biofouling on a ship hull is that it will increase the surface roughness of the vessel and that will give added friction drag and increases fuel consumption. This is known from many papers in scientific literature. To illustrate how large the added drag effects can be: data published by Schultz [1] in 2007 reveal that the presence of a heavy slime biofilm may give a nineteen per cent increase in required shaft power to sustain a speed of 15 knots. For other categories of fouling, such as seaweed and barnacles, the increase in required shaft power even goes up to 33 per cent and 52 per cent respectively.

Biofouling is not only a problem for ship hulls, it also takes place in so-called niche areas (sea chests, water intakes, thruster tunnels, etc.) and it can give severe problems in seawater cooling systems. Moreover, biofouling in niche areas may give biosecurity risks with the spread of marine invasive species. However, this article is focused on fouling control on ship hulls and will not cover seawater systems and niche areas.

The following sections will give an overview of currently used fouling control coatings on seagoing vessels, an overview of methods suitable for performance testing of fouling control coatings and a small section on recent developments in in-water hull cleaning.

Antifouling coatings currently used in commercial shipping can be separated in two major groups: chemically active coatings, usually called self-polishing coatings (SPCs) and fouling control coatings that are biocide-free, commonly named fouling release coatings (FRCs). The first group has by far the largest market share, fouling release coatings perhaps account for ten per cent of the market.

Chemically active coatings

The efficacy of chemically active antifouling coatings relies on the release of toxic substances, so-called biocides from the coating. This way, a hostile environment is created close to the coating surface in which larvae and juvenile stages of fouling organisms cannot survive.

The working principle of chemically active coatings is based on controlled diffusion of water into the coating. Water soluble pig-

Photo: Biofouling diversity.

ments and biocides in the coating dissolve near the paint surface and leach into the seawater. By playing around with the composition of the polymeric binder paint, companies can produce antifouling paints with different polishing behaviour.
High speed vessels that have very little or short periods of idle time can use low-polishing products, whereas ships sailing at lower speeds or with lower activity (that is, longer idle times) may need coating systems with a higher polishing rate.

Self-polishing coatings have the largest market share by far

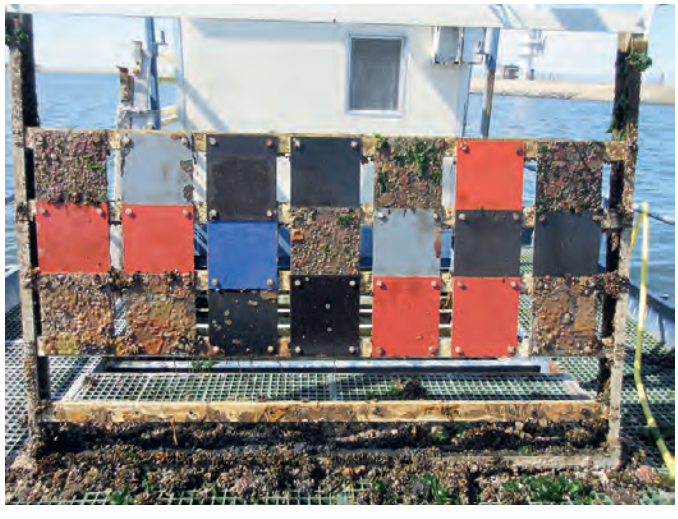
As is clearly indicated in the name, SPCs polish away over time, biocides and other paint components are released into the sea, so vessels with an SPC always need a recoat at the end of the predicted lifetime.
More than twenty years ago, the use of organotin based paints was forbidden under IMO regulation. Since then, antifouling paints with cuprous oxide (Cu_2O) as main biocide dominate the market. Copper content of these products may go up to fifty per cent on weight basis. Next to copper, other, so-called booster biocides may be present in order to give the product better activity against different groups of fouling organisms.
In the EU, antifouling products are regulated under the Biocidal Product Regulation (BPR). Authorisation of an antifouling paint is done on a large set of criteria that have to be met; an important criterion, apart from various toxicological requirements, is that the product has shown sufficient efficacy under relevant fouling conditions. Next to this, the environmental consequences of using a coating with biocides are evaluated in a dedicated risk assessment.
Only after approval of the biocide(s) and the coating product that contains them, a coating supplier is allowed to bring the product to the market.
In the Netherlands, there currently are 47 different antifouling coatings registered and allowed to be applied [2]. Out of these 47 products, seventeen have approval to be used on pleasure boats and can be applied by amateurs. All other products are registered for use on seagoing vessels and can only be applied by professional paint applicators.
Two relatively new biocides are now available that have sufficient activity to replace cuprous oxide in self-polishing paints. This way, effective copper-free antifouling paints can be made. In the Netherlands, paints with these biocides do not have a registration yet.

Fouling release coatings

Fouling release coatings (FRCs) cannot prevent the attachment of fouling organisms, but the bond between the organism and the coating is weak due to physical properties of the coating surface such as: low surface free energy, low elastic modulus and smooth surface at a molecular level. With their physical working mechanism, FRCs do not fall under the definition of chemically active coatings and do not require registration under the BPR.
Due to the weak adhesion, attached organisms can easily be removed by water shear stress when a ship starts sailing at a certain speed. The speed at which such (self) cleaning takes place varies with the type of fouling organism and also varies between products of different suppliers.
Current commercially available FRCs are based on silicon elastomers and fluoropolymers. In newly applied condition, FRCs generally give better friction drag performance, but over time, after a few years, this advantage may gradually diminish.
Silicone based FRCs are more susceptible to mechanical damage and when the surface is damaged, the product loses its efficacy at that particular spot.
Costs of FRCs are substantially higher than those of SPCs, but the effective lifetime of an FRC can be significantly longer when it remains undamaged. Silicone coatings do not rely on polishing or depletion mechanisms like SPCs do.
In comparison to SPCs, the application conditions for silicone based fouling release coatings are more critical and not every shipyard has dedicated application facilities for FRCs available.
For a few years now, some silicone based products have come on the market that also contain a small amount of biocide. They can be seen as hybrid coatings that have good fouling release properties combined with chemical activity against specific fouling groups. These hybrid coatings also fall under the BPR, but in the Netherlands they have not been registered yet.
Another type of biocide-free coating that is often used on ice-going vessels is a hard coating without inherent antifouling properties, but good resistance to in-water cleaning. The frequency of cleaning depends on sailing area and operational profile of the vessel. Ferries in the eastern Baltic Sea are provided with hard coatings that are cleaned on a weekly or biweekly basis [3].

Other biocide-free technologies

The use of adhesive foils with antifouling properties has been known for some time already. One such product is provided with a



Rack with coated panels in a raft exposure test.

Polishing test on an antifouling coating.

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top layer of small nylon fibres that have a deterrent effect on barnacles. Some other products have a silicone based top layer with fouling release properties. So far, foil based products have mainly been used on pleasure boats; on large seagoing vessels they have only been tested on a small scale.

Ultrasound as an antifouling technology has already been available on the market for pleasure boats for a long time. Next to this, it has also found application for fouling control in seawater cooling systems. For hull application, tests have been conducted in the past, but always on vessels with an antifouling coating.

The last (physical) principle I want to mention here is fouling control by UV light. This technology is very effective against any type of fouling as long as the organisms are within range of the UV source. Recently, a UV cooler was brought to market that can be installed in seawater cooling systems on board ships. For hull application, the technology is still under development.

Performance testing of antifouling coatings

The major function of antifouling coatings is to keep added friction drag due to biofouling accumulation on a ship hull at a minimum. Performance testing of antifouling products, however, is mainly based on static raft exposure tests (ASTM D3623/D6990) or polishing tests in seawater (ASTM D4938). Both methods only give data that indirectly say something about friction drag properties.

The value of a static raft exposure test, however, is that it reflects a worst case scenario for an antifouling coating because fouling will only settle when a ship is laying idle. Therefore, a static raft test is an appropriate "simulated field test" according to the European Chemicals Agency (ECHA) when carried out as described in their BPR Guidance Document [4].

In such tests, coated panels are exposed in the sea for one fouling season during which regular inspections and photos are made. Data collected are percentage coverage by different groups of fouling organisms and from these data a Fouling Resistance (FR) rate is derived. The performance of an antifouling coating is evaluated on pass/fail criteria in the BPR Guidance Document. The test indicates the ability of a coating to prevent settlement of fouling organisms. As such, it is most suitable for efficacy testing of chemically active coatings: as long as a coating is leaching sufficient amounts of biocide(s), it will not foul. Except for registration purposes, a static raft test is also suitable as a pilot test to sort out whether a new type of (nano) coating has potential for antifouling applications.

For the biocide-free FRCs, the static test procedure is less suitable because these coatings do foul to some extent. Here, the criterion for performance evaluation should be: How easy can fouling be removed from the surface? To answer this question, research laboratory Endures has developed a dedicated test protocol that can simulate a ship's operational profile.

In this static/dynamic performance test, the raft is used for static exposure (simulating idle time) and a rotor drum in seawater for dynamic exposure (simulating a sailing vessel). Questions that can be answered then are:

- How much fouling will develop after different periods of idle time?

- At what (rotation) speed can such fouling be removed again?

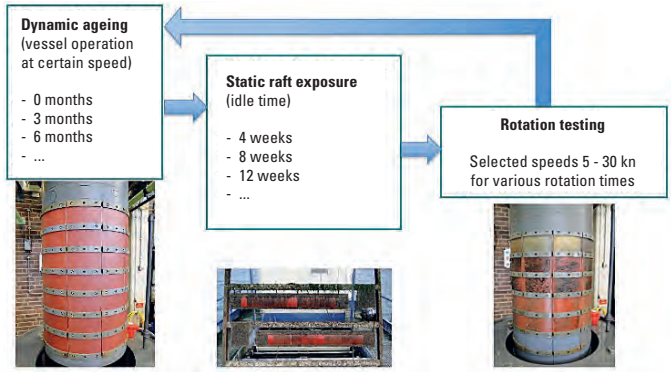
The answer to the first question gives an indication of the so-called idle day's tolerance of a hull coating. The second will reveal how fast a vessel should go (and for how long) to get rid of the fouling. Repeating the test cycle (several times) may reveal the long term performance under static/dynamic conditions (see figure with test protocol). This test procedure can be used for both FRCs and SPCs.
To establish the minimal speed required for self-cleaning of hull coatings, the same test equipment can be used. Here, the test protocol involves two steps: static exposure of coated panels to fouling for short periods, followed by rotating drum testing in seawater at increasing speed (5-30 knots) for several rotation times. Taking pictures of the coatings after each speed step will reveal the coatings' foul release properties. This way, different coating products can be compared on foul release properties at various sailing speeds.
Results from performance tests on fouling release properties or idle day's tolerance of hull coatings can give shipowners and operators relevant information regarding the choice of a suitable coating. Operating a vessel under conditions other than design speed or profile, may have consequences for the choice of a suitable hull coating.

In-water hull cleaning

Even effective antifouling coatings do not always keep vessels free from fouling. Especially when ships are operating at reduced activity, the hull may foul to an undesirable extent. This fouling can be removed by in-water hull cleaning.
Model studies of the US Navy [5] have shown that cleaning the ship hull can clearly reduce friction resistance. The largest reduction is obtained when cleaning the vertical sides, but cleaning the bow area or only the waterline also gives significant drag reduction when normalised to surface area.
Two types of in-water cleaning procedures can be discriminated:

1. Pro-active cleaning that is done at an early stage when only slime and incipient fouling have settled.
2. Reactive cleaning that is done at a later stage when larger fouling organisms (macro-fouling) are present.

Pro-active cleaning (often called hull grooming) needs to be done more often and can use softer cleaning tools; reactive cleaning may need more robust cleaning principles in order to remove hard fouling and the cleaning device should have a capture system for collection of wash water, coating particles and fouling debris.
In the Netherlands, a few companies already provide (reactive) hull cleaning services, with different devices and cleaning tools, always in combination with a capture system. To my knowledge, hull grooming actions have not been undertaken yet.
Regulation of in-water hull cleaning activities is getting increased attention. Countries like New Zealand and the United States are setting the scene [6] and have regulation in place. But the shipping industry also gets active now with BIMCO having published two guideline documents [7] for an industry standard and approval procedure for cleaning companies in 2021. And last year, the port of Bremen (Germany) stated in a press release [8] that it wants to stimulate pro-active cleaning on biocide-free coatings as a replacement of the use of biocidal coatings.



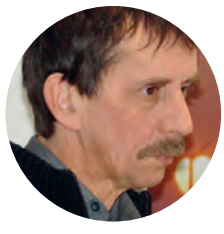
Experimental protocol in a static/dynamic performance test for antifouling coatings.

So far, the BIMCO guideline only talks about reactive cleaning with capture, the concept of hull grooming is not covered. Also not covered in the BIMCO documents is how cleaning might affect the condition and (long term) performance of the coating. Cleaning a self-polishing paint might give the risk of a reduction in layer thickness, biocide content and shorter effective lifetime. Silicone based coatings are softer than SPCs, so may need different cleaning tools to avoid damage.
For both types of coatings, there is hardly any information yet on what cleaning tools and protocol should be used without compromising the effective lifetime of the coating. This knowledge gap should be filled with dedicated research.

In-water cleaning has strong potential

The large majority of current antifouling products are chemically active coatings that emit biocides and paint components to the aquatic environment. Changing to biocide-free fouling control products may give a lower environmental footprint, provided that they show similar good performance. Changing to biocide-free products that have insufficient efficacy does not contribute to green shipping.
In-water cleaning has strong potential as an additional tool in ship hull maintenance. When used on a biocide-free hull coating, this will help the shipping industry to lower its environmental impact.

Endures BV, based in Den Helder, the Netherlands, is an independent contract laboratory for R&D and Consultancy on Corrosion Protection and Antifouling.



Job Klijnstra MSc, PhD
Expert Fouling Control & Material Protection at Endures BV,
job.klijnstra@endures.nl

REGELS ‘SCHONE MOTOR’ VAN BELANG VOOR GARNALENVISSERS

Studie naar mogelijkheden kotters in Natura 2000-gebieden te laten werken

Om te kunnen blijven vissen in Natura-2000 gebieden, moeten garnalenkotters op termijn uitstootvrij worden. Kroes Marine Projects studeerde op de vraag wat komt kijken bij ombouw en nieuwbouw van zulke kotters. Want hun uitstoot van stikstofoxide (NO_X) moet minder zijn dan 0,005 mol N/ha/j voor een vergunning volgens de Natuurbeschermingswet. De studie gebeurde in opdracht van Lammert Bolt, schipper-eigenaar van de garnalenkotter ZK 14, de Nederlandse Vissersbond, Vereniging Kottervisserij Nederland en de Internationale Garnalen Producenten Organisatie Rousant.

Foto: Innovatieve oplossingen zijn niet altijd makkelijk te plaatsen op kleine garnalenkotters.

De studie keek allereerst wat minimaal vereist is om qua NO_x-uitstoot snel te voldoen aan de regionale eisen. Tevens zijn oplossingen beschreven om nuluitstoot van schadelijke stoffen te bereiken volgens internationale richtlijnen, die op langere termijn waarschijnlijk leiden tot nieuwe milieuwetten. De studie moest inzicht geven in de voor- en nadelen van die oplossingen en de gevolgen ervan voor eigenaar, schip en het vaarprofiel. Voorbeeldschip was de garnalenkotter ZK 14 van Lammert Bolt.

De 23,5 meter lange ZK 14 werkt vooral op de Nederlandse Waddenzee en maakt tevens langere tochten naar het Duitse wad en Denemarken. De boot heeft een hoofdmotor met een afgesteld vermogen op de schroefas van 220 kW bij 1600 omwentelingen per minuut (omw/min). Een aangebouwde hydraulische pomp genereert het hydraulisch vermogen. Het elektrische vermogen komt van een generatorset met een vermogen van 52 kW bij 1500 omw/min. De garnalenkookpot heeft eigen verwarming, bestaande uit een ecoflam-brander van maximaal 125 kW.

Bij de laatste refit kreeg het schip een straalbuis om de schroef, wat een beduidend hogere trekkracht bij lagere snelheden opleverde. Een revisie van de hoofdmotor is aanstaande en wordt meegenomen in de (financiële) overwegingen voor ombouwoplossingen, omdat vroegtijdige ombouw deze revisie wellicht overbodig maakt.

Vaarprofiel

Het vaarprofiel omvat stomen naar de visgronden (inclusief koeling van het visruim en opwarming van de kookpot), netten halen, vissen en verwerken. Gemiddeld wordt 4,5 dag per week gevaren. Het totale dieselverbruik van generatoren, hoofdmotor en kookpot bedraagt 1250 liter/dag. Dit is globaal teruggerekend naar kWh, waarbij een gemiddeld specifiek brandstofverbruik van 217 g/kWh en een soortelijk gewicht gasolie van 840 kg/m^3 werd gebruikt. Bij 1250 x 0,84 = 1050 kg per uur is dit 43,75 kg = 43.750 gr / 217 = 201,6 kWh.

Wegen naar Rome

Om emissies te verlagen zijn er drie benaderingen: schonere en zuinigere motoren, alternatieve brandstoffen en/of energiedragers en alternatieve aandrijvingen. Heeft de keus van energiedrager (diesel/biodiesel/methanol/waterstof) vooral effect op uitstoot van fijnstof (PM), koolmonoxide (CO) en koolwaterstof (HC), daar beïnvloedt de "wijze van energieomzetting" (verbranding of elektrochemische omzetting) vooral de NO_x-uitstoot.

Een vrij snelle oplossing is de ZK 14 te voorzien van een SCR-systeem, ofwel een katalysator (selectieve katalytische reductie). Toevoeging van zo'n katalysator kan de NO_x-uitstoot met ruim 75 procent, de uitstoot van PM met 80 procent en van CO met 70 procent terugbrengen.

Tweede snelle oplossing is nieuwe motoren (NRMM Stage V) zetten, al dan niet gecombineerd met een elektrische aandrijving op de schroefas en schonere brandstoffen. 'Uitgaande van de emissiewaarden van een onderzochte Stage-V-verbrandingsmotor, 0,4 g/kWh, stoot een Stage-V-motor ten minste 95 procent minder NO_x uit dan de huidige verbrandingsmotor. De fijnstofuitstoot daalt ook met ruim 95 procent en koolmonoxide met 70 procent.'

GREEN SHIPPING

De studie is onderdeel van het programma Green Shipping Waddenzee (https://greenshippingwaddenzee.nl), dat de steun heeft van de provincies Groningen, Friesland en Noord-Holland, het Waddenfonds, Investeringskader Waddengebied en visserijorganisaties. Coördinator is FME. Het programma wil het mogelijk maken de Waddenvloot in 2030 fossielvrij te laten varen. Dat betekent innovaties op het gebied van CO_2-neutrale scheepvaart op de Waddenzee versnellen en (haven)faciliteiten ontwikkelen voor emissiearme en energieneutrale scheepvaart (onder meer opwekking van energieneutrale walstroom met gebruik van groene waterstof).

De nadruk ligt op minder CO_2-uitstoot, maar in de loop van het beschrijven van de projecten kwam de behoefte aan een oplossing voor de stikstofproblematiek naar voren. Deze voorstudie richt zich met name op de ombouw van de garnalenkotters van maximaal 300 pk. Ombouw zorgt voor de grootste versnelling, mede doordat nieuwbouw in deze sector beperkt gebeurt.

Toepassing van methanol als energiedrager in een verbrandingsmotor doet de NO_x-uitstoot met bijna 75 procent dalen. Fijnstofuitstoot is er niet meer en koolmonoxide neemt af met 95 procent. 'NO_x-uitstoot hangt vooral af van de verbrandings- en nabehandelingstechniek, maar bij gebruik van methanol als energiedrager wordt de NO_x-emissie ook zonder nabehandelingstechniek (SCR-unit) al veel lager.'

Overstap op een brandstofcel, dan wel methanol of (direct) waterstof, doet alle waarden van NO_x, PM, CO en HC tot nul dalen.

Kleine schepen

Kroes: 'Conclusie kan zijn dat de vloot direct overstapt van een verbrandingsmotor op een brandstofcel om nul uitstoot te bereiken. Maar scheepseigenschappen, vaarprofiel, regelgeving, beschikbaarheid van energiedragers en financiële gevolgen maken het minder eenvoudig. Groen geproduceerde methanol en waterstof zijn zeer beperkt verkrijgbaar, volumebeperkingen maken toepassing van waterstof op de ZK 14, in het huidige vaarprofiel, zeer ingewikkeld en voorwaarden voor opslag van zowel methanol en in grotere mate van waterstof hebben zeer ingrijpende gevolgen voor systemen en constructies.'

'Tegelijkertijd zijn de ontwikkelingen op het gebied van schonere motoren, alternatieve (duurzaam te produceren) energiedragers, maar ook brandstofcellen in volle gang en wordt voortdurend geïnnoveerd. Er zijn al maatregelen mogelijk die emissies significant reduceren. Ook is de "meest wenselijke technologie", wellicht de brandstofcel, op korte termijn en in bestaande schepen fysiek, logistiek en financieel nog lastig in te passen.'

'Huidige technieken en ontwikkelingen rond brandstofmotoren en katalysatoren reduceren emissies, maar of ze wetgevers kunnen overtuigen dat ze afdoende zijn voor verlenging/verlening van de Nb-wetvergunning, vergt aanvullend onderzoek,' stelt Kroes. 'De

REKENEN AAN DE CENTEN

De huidige motor + SCR refit is voor de ZK 14 wellicht een optie wat betreft de NO_X-uitstoot. Een SCR-unit en aanpassingen aan het uitlaatsysteem gaan zo'n 20.000 euro kosten. Daaraan voorafgaat enig engineeringwerk en na de installatie volgen inspecties en klasse/keurprocedures.
Omdat de eigenaar van de ZK 14 moet kiezen tussen een motorrevisie of aanschaf van een schone motor is het de vraag hoe de investering in een SCR-unit zich verhoudt tot aanschaf van een veel zuiniger en schoner alternatief, mogelijk tegen bijna dezelfde kosten als een revisie + SCR refit. Een Stage-V-motor Type-A kost zo'n 55.000 euro. De engineering en ombouwwerkzaamheden betreffen vooral de fundaties en voorzieningen voor het uitlaatgassen-nabehandelingssysteem. De investering van 85-100 K moet worden afgezet tegen de te verwachten brandstofbesparingen.
Een Stage-V-dieselmotor/HVO 100 inclusief PM-motor vraagt naast de kosten van de motor om een extra investering in de PM-motor en het accupakket. Dat brengt deze configuratie op in totaal 300.000 à 350.000 euro.
Een methanol-verbrandingsmotor van het Type-B vergt naast de basisinvestering van 117.000 euro aanpassingen aan de bunker, leiding- en opslagsystemen volgens de richtlijnen voor *low-flashpoint fuels* ter waarde van ongeveer 125.000 euro aan engineering en inbouw en een extra 75.000 à 85.000 euro aan systemen (tanks, leidingwerk, ventilatie en uitlaatsysteem).
Een hybride systeem, inclusief PM-motor en accupakket, voegt daar nog zo'n 175.000 euro aan toe. Vanwege de complexiteit *(LFL fuelled)*, benodigde aanpassingen en systemen kan de totale investering oplopen tot een half miljoen.
Methanol-brandstofcellen zijn nog in ontwikkeling, maar brandstofcel Type-C biedt een oplossing voor de kostbare investeringen en uitdagingen van waterstofopslag. Evengoed zijn aanzienlijke investeringen nodig voor vervanging van leidingwerk, installatie van veiligheidssystemen, ventilatie en aanpassing van tanks. Deze aanpassingen zijn zeer goed uit te voeren op de ZK 14. Bovendien zijn gecertificeerde brandstofcellen op korte termijn beschikbaar. Keur door klasse en het ombouwproces ten opzichte van niet-gecertificeerde oplossingen wordt daardoor goedkoper dan ombouw naar H_2-brandstofcellen.
H_2-brandstofcellen zijn nog erg kostbaar vanwege de complexiteit en gebruik van dure materialen als platinum. De opslag van waterstof is eveneens een flinke kostenpost vanwege inbouw van prijzige hogedruktanks. Ook het (naderhand) inbouwen van de veiligheidsvoorzieningen en constructieve cascoaanpassingen zijn duur. Met de snelle ontwikkelingen in brandstofceltechnologie, de stimulansen vanuit overheden en opschaling/massafabricage van compactere en minder complexe systemen zal de prijs van een brandstofcel de komende vijf jaar aanzienlijk doen dalen.

Engineering, ombouw en systemen

Voor alle onderzochte configuraties is na specificatie en berekening van voortstuwing en hulpbedrijf meer of minder engineeringwerk nodig. Onderstaande bedragen voor ombouw betreffen alleen geschatte uren voor cascowerk, inclusief klein materiaal/exclusief componenten en inkoop. Bedragen van de systemen motor/brandstofcel, accupakket en elektromotor zijn gebaseerd op cijfers van toeleveranciers. Bedragen voor overige systemen zijn geschat.

Volumebeperkingen maken waterstof op de ZK 14, in het huidige vaarprofiel, zeer ingewikkeld

resultaten daarvan geven wellicht aan welke aanpassingen nodig zijn wat betreft emissies, vaarprofiel (visuren/visgebieden), sanering van de vloot, financiering en wetgeving om een oplossing te vinden voor de NO_X-depositie.'

Voorlopige conclusies

Kroes concludeert dat de fossiele route op basis van verbrandingsmotoren voorlopig mogelijk en aantrekkelijk blijft. 'Nieuwe, schonere verbrandingsmotoren worden beter beschikbaar. Ook ontwikkelt zich de keten van *Hydrotreated Vegetable Oils* (HVO's) als alternatief of aanvulling op de fossiele varianten van diesel. Katalysatoren kunnen aanvullend op deze motoren oplossingen bieden voor de stikstofeisen in Natura 2000-gebieden vanaf 2023.'
Kroes bekeek geëlektrificeerde aandrijfsystemen als alternatief voor de verbrandingsmotor. 'Die kunnen worden gevoed door gebalanceerde energievoorzieningen op basis van accu's en waterstof-

Onderdeel	Huidige motor + SCR refit / Stage-V-motor	Stage-V-motor diesel/HVO100 icm PM motor	Verbrandingsmotor methanol icm PM motor	Brandstofcel methanol-H_2 icm PM motor
Engineering & klasse	€ 5-10.000 *	€ 30.000	€ 75.000	€ 100.000
Ombouw	€ 15.000 *	€ 50.000	€ 50.000	€ 100.000
Systemen:				
Motor/brandstofcel	€ 40k / 52k *	€ 52.000	€ 117.000	€ 120.000
Tanks	€ -	€ -	€ 25.000	€ 25.000
Leidingwerk	€ -	€ 20.000	€ 30.000	€ 50.000
Ventilatie & koeling	€ -	€ -	€ 20.000	€ 40.000
Uitlaatsysteem	€ 20.000	€ 25.000	€ 10.000	€ 30.000
Accupakket & laders	€ -	€ 120.000	€ 120.000	€ 120.000
Elektromotor	€ -	€ 40.000	€ 40.000	€ 40.000
Controle & monitoring	€ -	€ -	€ 10.000	€ 20.000
Totaal	**€ 100.000**	**€ 350.000**	**€ 500.000**	**€ 650.000**

** Kosten zijn afhankelijk van keuze refit+SCR of uitwisseling naar Stage-V-motor.*

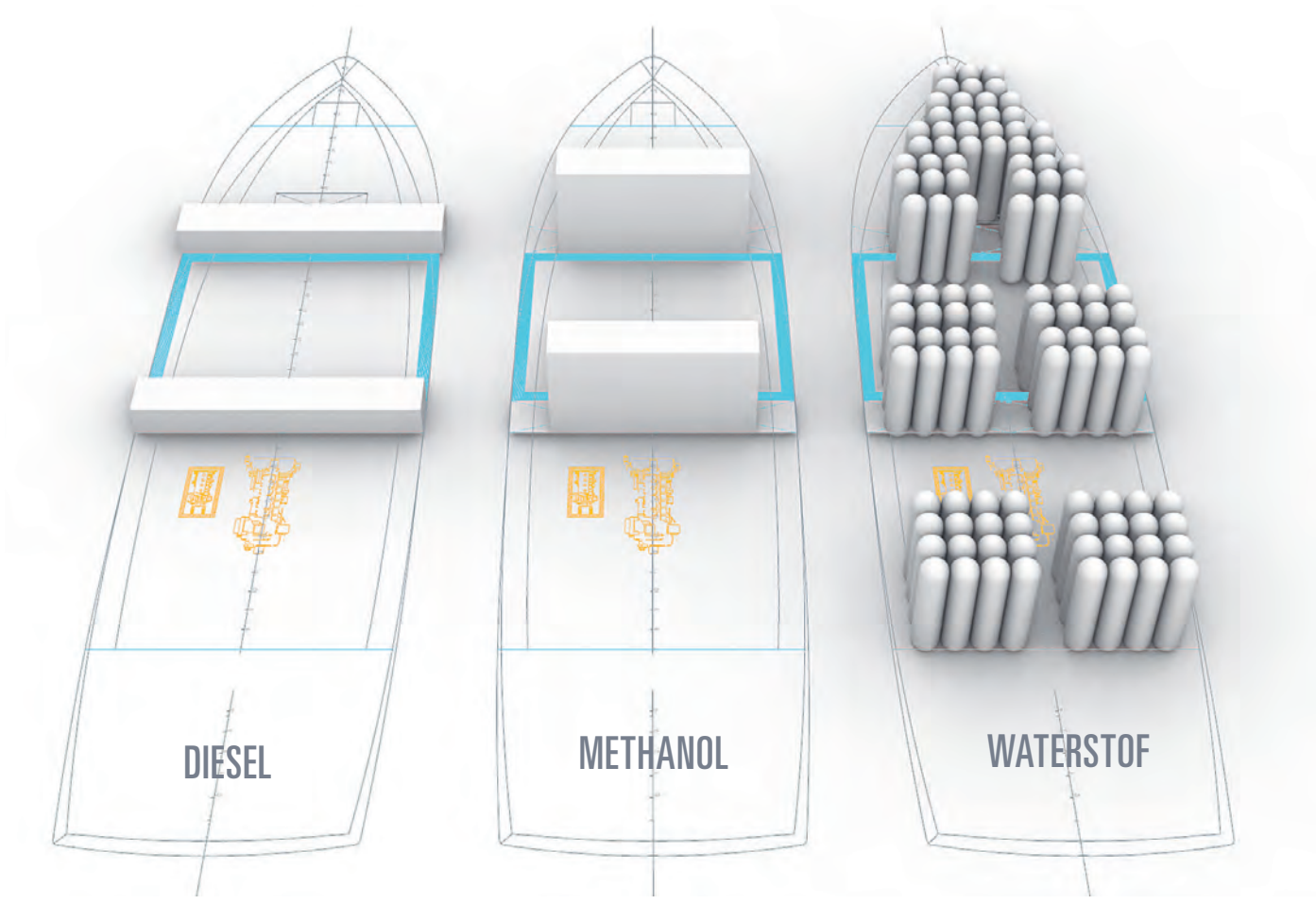
Operationele kosten HVO100

HVO100 is circa € 0,20/l, ruim dertig procent, duurder dan diesel. Opschaling van productie lijkt hand in hand te gaan met de groeiende vraag naar duurzaam geproduceerde diesel. De verwachting is dan ook dat de prijs van "groene diesel" voorlopig niet daalt. Het prijsverschil met fossiele brandstoffen zal mogelijk wel afnemen door fiscale maatregelen, beprijzing van CO_2-emissie en CO_2-belasting.
Qua kosten kan groene methanol nog niet met diesel concurreren. Opschaling, verbeteringen van het productiesysteem en verlies van fiscale voordelen van diesel zullen dat veranderen.
De kosten van (grijze)waterstof, momenteel nog zo'n € 10/kg, zal bij toename van het aanbod in 2022 vermoedelijk halveren. Andere vormen van waterstofproductie en -opslag veranderen de komende jaren het "brandstofcellandschap" drastisch, waarbij opschaling de prijzen zal drukken.
Vooralsnog zullen, mocht de ZK 14 op waterstof gaan varen, de brandstofkosten aanzienlijk hoger liggen dan van diesel en/of HVO.

Motortype	Energiedrager	Verbruik			Brandstofkosten		Toelichting
(Diesel huidig = Caterpillar 3405 E)		G/kW	Kg/dag	Kg/jaar	Kg	/ Jaar	
Verbrandingsmotor	Diesel huidig	217	1050	241.500	50,4	€ 121.716	€ 0,60/ltr x 0,84 = 50,4/kg
Verbrandingsmotor-hybride	Diesel huidig – HVO100	217	1050	241.500	63,2	€ 152.628	€ 0,80/ltr x 079 = 63,2/kg
Verbrandingsmotor-hybride	Stage V – Diesel	196	948	218.040	50,4	€ 109.892	€ 0,60 /ltr x 0,84 = 50,4/kg
Verbrandingsmotor-hybride	Stage V – HVO100	196	948	218.040	63,2	€ 137.801	€ 0,80/ltr x 0,79 = 63,2/kg
Verbrandingsmotor-hybride	Methanol	470	2275	523.250	41	€ 214.532	€ 410/ton = € 0,41/kg
Brandstofcel	Methanol	422	2041	469.430	41	€ 192.466	€ 410/ton = € 0,41/kg

In vergelijking met een SCR-unit op de huidige motor of installatie van een Stage-V-motor zal toepassing van methanol in een brandstofmotor of brandstofcel, wellicht op korte termijn meer inspecties, afstelling en service tot gevolg hebben. Over de onderhoudskosten voor deze vrij nieuwe systemen willen/kunnen leveranciers nog geen uitspraken doen. Het aandeel onderhoudskosten in de totale operationele kosten zijn daarom buiten beschouwing gelaten en komen in een volgend project bij de bestek- en engineeringfase aan bod.

brandstofcellen. De opslag aan boord van de nieuwe energiedragers verschilt, waterstof lijkt in gecomprimeerde gasvorm geschikt voor dagtrips en methanol in vloeibare vorm voor meerdaagse trips. Als deze rendabel toepasbaar zijn, adviseren wij de op waterstof gebaseerde brandstofcelsystemen en tanks bovendeks (achter de stuurhut) te plaatsen. Voor methanol kunnen de tanks onderdeks.'
Aanpassen betekent voor het schip: elektrificatie en opslag van de nieuwe energiedrager, brandstofcelsystemen worden geleased en het schip moet *"plug and play"* worden opgeleverd, gereed voor gebruik van gestandaardiseerde energiesystemen op basis van methanol of waterstof. 'Als TNO-berekeningen van de diverse systemen uitwijzen dat een Stage-V-motor of een methanol-brandstofmotor niet aan de NB-wetvergunningseisen kan voldoen en een brandstofcelconfiguratie (zoals methanol of "direct" waterstof) de enige oplossing is, dan is een goede afweging tussen ombouw en



Deze afbeelding vergelijkt de benodigde volumes van diesel, methanol en waterstof op basis van energie-inhoud, uitgaande van vier dagen vaartijd tussen bunkeren (bron besproken rapport).

VAN TIER TOT STAGE

De emissienormen voor uitlaatgassen verschillen per land en toepassingsgebied: Tier, Euro en Stage. Euro is de Europese norm voor wegverkeer, Stage is de Europese norm voor offroadverkeer (non-road mobile machinery), die tevens geldt voor de binnenvaart, en Tier (Transcript Individual Engine Regulations) is de norm in de VS, die de International Maritime Organization (IMO) hanteert voor de internationale scheepvaart.
Aangezien de ZK 14 op binnenwateren, kustwateren en internationaal opereert, geldt zowel Stage als Tier. Die zijn niet exact gelijk, maar wel redelijk vergelijkbaar, omdat fabrikanten hun motoren op een zo groot mogelijke klantenkring afstemmen. Voldoet een motor aan Tier 3, dan is dat vergelijkbaar met Stage 3.
Waar de Stage 3- en 4-normen grotendeels stroken met de Amerikaanse (Tier 3/7) en Japanse normen, lopen ze voor Stage 5 weer verder uiteen. Zo is US Tier 4 haalbaar zonder filters.
De Stage-5-normen hebben betrekking op de uitstoot van CO, HC, NO_x en roetdeeltjes. Vooral die laatste norm is veel strenger (van 0,025 g/kWh naar 0,015 g/kWh). In deze studie voldoet een Stage-5-motor ruimschoots aan Tier 3.

nieuwbouw nodig. Nieuwbouw biedt het voordeel dat een efficiënter lijnenplan en een lichter schip direct invloed hebben op verbruik, emissies en operationele kosten. Volumebeperkingen van bijvoorbeeld waterstof en veiligheidsmaatregelen zijn eenvoudiger op te lossen in een schip ontworpen voor gebruik op brandstofcellen. TNO-onderzoek van de diverse systemen en gedetailleerde berekeningen voor om- en nieuwbouw moeten tonen wat dé transitieoplossing voor de garnalenvloot op korte en lange termijn is,' aldus Kroes.

Sander Klos
Freelance maritiem journalist en een van de redacteuren van SWZ|Maritime,
info@mediamaritiem.nl

BEWARE OF GANTRY CRANES

Mariners' Alerting and Reporting Scheme

Gantry crane fatality, stevedore crushed: Mars 202201

Edited from official MAIB (UK) report 12/2021

A small general cargo vessel was berthed to discharge a cargo of fine coke. In the early morning, five port stevedores boarded the vessel to discharge the cargo; a foreman, a stevedore coordinator, a front-end loader driver and two others. A sixth team member remained ashore to operate the discharge grab crane. It was the role of the stevedore coordinator to liaise between the crane operator and those working in the cargo hold.

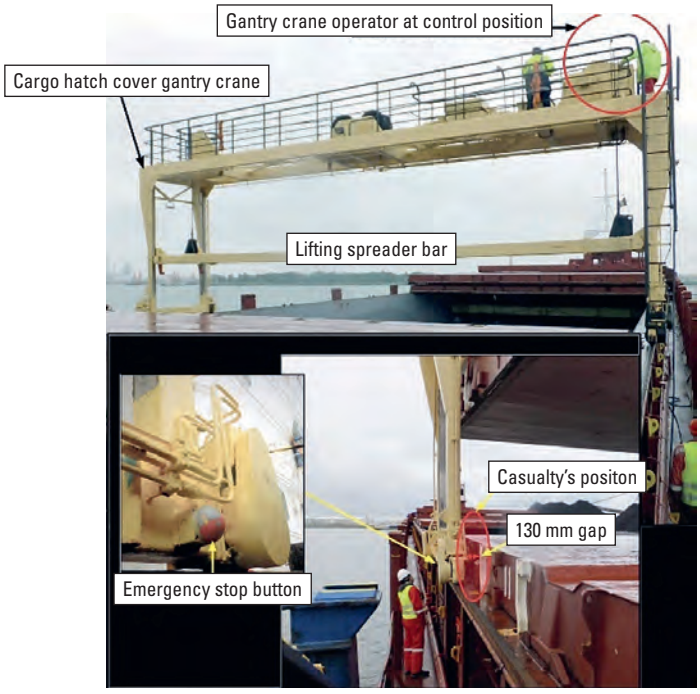
The foreman discussed the discharge plan with the vessel's chief officer and then briefed the other stevedores. The foreman explained that the aft end of the hold would be unloaded first and informed his team that hatch covers 7 to 11 would be moved aft once the area was unloaded. The foreman then went ashore while the other stevedores remained on board.

Editor's note: Are gantry cranes a clear and present danger, as the MAIB states? In Mars Reports alone, which are probably a subset of all such occurrences, six gantry crane accidents are now recorded. Apart from the present report, these include Mars Report numbers 98058, 201460, 201525, 202068, 20222. From these reports, almost all with fatal consequences, the over-riding contributing factor seems to be that the gantry crane operator was not aware of the victim's precarious position. Just as driving a motor car would never be done "blind", gantry cranes should never be driven so either. Continuous track assessment should be the norm. This can be achieved by dedicated banksmen or, for example, wide-angle camera lenses positioned on the gantry legs and sending images to the crane operator. Clearly, emergency stop buttons alone are proving insufficient to eliminate fatal accidents.

When cargo discharge began, the stevedore coordinator directed the shoreside grab crane operator from the vessel's port side walkway via handheld radio. To see into the hold, he climbed up the vessel's fixed ladders and leaned over the top of the two-metre-high hatch coaming. The chief officer monitored the cargo operations and the list and trim of the vessel, and ballasted as required.

At one point, the gantry crane was needed to handle the stacked hatch covers. The chief officer checked that the crane's path was clear on both sides of the main deck and then climbed up to the crane's control position and began the manoeuvres. At about the same time, the stevedore coordinator went to check on the progress of his colleagues in the aft part of the hold, walking aft along the port walkway.

As the chief officer drove the gantry crane over hatch cover position 10, the crane suddenly stopped. He did not know why the crane had stopped, but the stevedore foreman had seen the stevedore coordinator's head appear above hatch cover 11 on the port side and immediately realised that there had been an accident. He raised the alarm. The stevedore coordinator was found wedged between the aft leg of the gantry crane and hatch cover 11, a gap of approximately 130 mm. Although rescue and medical attention were immediate, the stevedore coordinator had suffered extremely severe injuries and was declared deceased at the scene.



Position of the gantry crane operator and the victim.

Investigation findings

The official investigation found, among other things, that:

- The stevedore coordinator almost certainly knew the gantry crane was moving, but was probably confident that he could move out of its path in time.
- The ship's gantry crane operator did not stop the crane because he did not know the stevedore coordinator was on the crane track.

Lessons learned

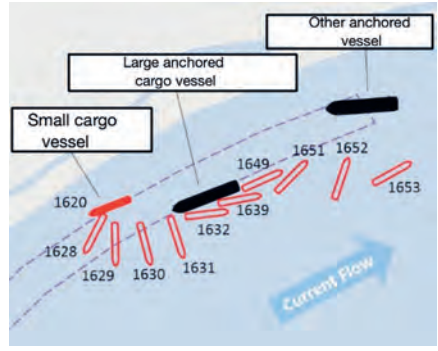
- Gantry cranes, as presently configured and operated on most ships, seem a clear and present danger for crew and stevedores.
- Without a clear view of both tracks in real time or feedback from dedicated banksmen spotting the tracks, driving a gantry crane blind will always be a hazardous endeavour.

Anchorage disaster movie: Mars 202204

As edited from NTSB (USA) report DCA16FM018

A small general cargo vessel was due to travel downriver. While still on the berth, the pilot determined that he would not be able to reach the end of the daylight-only restriction zone before darkness fell. He discussed a plan with the master to begin the transit, but go to an intermediate anchorage for the night. The only available anchorage was an area approximately 1.1 miles in length and 100 metres wide. That area already had three vessels at anchorage and river currents were running strong due to high water conditions.

The transit downriver was without incident. With the assistance of two tugboats, the vessel was anchored at 16:00 using both anchors, placed at the ten and two o'clock positions respectively. By about 16:17 the anchor chains had become taut and the stern of the vessel was about 152 metres from the bow of a much larger general cargo vessel anchored astern. At about 16:26, as the pilot boat approached to disembark the pilot, the vessel's bow swung quickly into the river current. By the time the pilot regained the bridge, the ship was almost perpendicular to the river. The pilot requested 'half ahead and starboard', but the engines were not able to overcome the force of the river current, and the anchors dragged. A few seconds later, the pilot informed the master that they were going to collide with the bulk carrier anchored astern. The pilot radioed the two tugboats that had been assisting during the anchoring, requesting that they return as quickly as possible. The ship's whistle was used to sound the danger signal and warn of the impending collision.



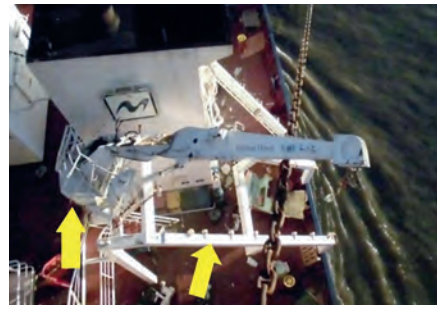
The vessel drifted until its propeller caught the starboard anchor chain of the larger vessel anchored astern.

About fifteen minutes after being "safely" anchored, the vessel was being carried by the current at a speed of 5.5 knots. The vessel drifted until its propeller caught the starboard anchor chain of the larger vessel anchored astern. The entanglement pulled the drifting vessel's propeller shaft outward, damaging reduction gears and cracking the gear box.

Subsequently, the small cargo vessel drifted toward the port anchor chain and bow of the larger anchored vessel. The anchored vessel's port anchor chain caught and then wrapped around the drifting vessel's stern crane, holding the vessel in place as the current pivoted it around the bow of the bulk carrier. The crane and the stern mounted lifeboat of the drifting vessel were destroyed. The highest point on the drifting vessel's aft deckhouse was well below the main deck of the larger anchored vessel, and the bridge wing of the drifting vessel was torn off.

The larger anchored vessel began to manoeuvre under power as the bridge team tried to mitigate the consequences of the collision. Their initial manoeuvre of coming ahead caused the drifting vessel to list. With no propulsion, the bridge wing torn off, the ship listing, and the anchor chain of the large vessel still wrapped around the stern, the drifting vessel's crew mustered on their vessel's main deck near the cargo hatch covers. The list became so great that it was decided to abandon ship, and the crew transferred onto one of the tugboats that had returned to the scene.

A few minutes later, the anchor chain of the larger vessel broke, freeing the drifting vessel. Once released from the chain, the vessel floated free, and the crew returned to their ship as it drifted down the port side of the larger vessel. The vessel was subsequently corralled by five tugboats and the situation stabilised. Damages to the drifting vessel were confirmed at over USD 2 million.



Stern crane and lifeboat torn off by large anchored vessel's anchor chain.

Investigation findings

The official investigation found, among other things, that the anchorage used was originally designed for three vessels, and was normally occupied by only two. At the time of the accident, there were four vessels anchored there. After the accident, local authorities reassessed the risks of the anchorage for high-water periods and decided to limit occupancy to one vessel.

Lessons learned

- While hindsight is said to be 20:20, we can still learn from this accident that even competent local authorities can underestimate risks in a waterway system. The reassessment of risks subsequent to the accident demonstrates that indeed, lessons were learned.
- In tight anchorages and strong currents, main engines should always be on standby and the vessel's position checked as if the vessel is underway. In this case, the vessel went from being anchored to a disaster movie within fifteen minutes. Thankfully, no injuries to crew were incurred.

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

LEZINGENPROGRAMMA KNVTS MAART

Afdeling Zeeland

Subject: A precautionary approach to developing nodule collector technology
Thursday March 17th, 7:30 PM CET
Speakers: Kris De Bruyne, Project Manager GSR, and Harm Stoffers, Design Manager GSR of Global Sea Mineral Resources NV (member of the DEME group)
The basis of GSR's research and development (R&D) strategy was developed in 2013 following a desktop study, which defined an integrated concept of operation. A key component of the deep seabed mining system is the Seafloor Nodule Collector (SNC). The SNC has a significant influence on the overall operational environmental impact and on the achievable production rate; two criteria that are critical in developing a responsible mining operation. Additionally, given that commercial deep-seabed mining operations are unprecedented, the SNC is the sub-system involving the highest number of information and knowledge gaps, such as the environmental impact and effects, its response to soil characteristics, trafficability and nodule collection methodology.
Hence, from all the systems identified, GSR decided to focus its first efforts on the SNC system and more specifically on a pre-prototype. This feasibility study consisted of a step-by-step approach and culminated in the design, building and testing of the Patania II (PATII). Following successful trials conducted with PATII at 4500 metres water depth in the Clarion-Clipperton-Zone (CCZ) in 2021, the final phase will commence, which will culminate in a trial of a commercial-scale SNC. GSR remains committed to responsible deep-sea research and technology development, one step at a time.
Location: Headoffice Damen Naval, De Willem Ruysstraat 99, Vlissingen. Please register in advance by sending an e-mail to: j.broekhuijsen@damennaval.com.

Afdeling Rotterdam

Webinar: Arctic shipping
Donderdag 24 maart, 19:30 uur
Spreker: Björn von Ubisch, Director Ubitec BV
Als onderdeel van een KNVTS-breed initiatief hebben de verschillende afdelingen de handen ineengeslagen met als doel minstens eenmaal per kwartaal een webinar te organiseren dat aansluit op een recent themanummer van SWZ|Maritime. Als eerste van dit initiatief zal de afdeling Rotterdam een webinar faciliteren dat aansluit op het januarinummer met als thema "arctic shipping". Björn von Ubisch zal aan de hand van recente ontwikkelingen in de Arctic een en ander uiteenzetten en daarbij inspelen op de actualiteit. Details en verdere informatie zullen via de website van SWZ en de KNVTS, alsmede de diverse social-media-kanalen, met u worden gedeeld.
De andere afdelingen zullen dit opvolgen met een webinar over een ander SWZ-thema later in het jaar, daarmee hopend op een interessant aanbod van lezingen en actualiteit voor de leden en andere geïnteresseerden, ook in periode van eventuele versoepelingen vanuit overheidswege.
Meer informatie: het webinar zal worden opgenomen. Na de presentatie is er een half uur voor vragen en antwoorden. De link voor de registratie vindt u op de website van de KNVTS. Er is geen deadline voor registratie.

The Patania II being launched.

Afdeling Rotterdam (Vossnack)

2022 memoreert het 100ste geboortejaar van dhr. Ernst Vossnack, voormalig hoofd nieuwbouw bij Nedlloyd Rederijdiensten en dit mag dan ook niet ongemerkt voorbijgaan. Het doet ons daarom deugd dat een aantal leden het initiatief heeft genomen een start te maken met het archiveren en publiceren van het omvangrijke werk van Vossnack. Dit uitgebreide werk dat de zeer interessante periode omvat van ongeveer 1950 tot 1985 van scheepsontwerpen, rompvormontwikkelingen, schip-schroefinteracties en onder andere de impact van GT-scheepsmeting op het scheepsontwerp is op een aantal vlakken nog steeds zeer actueel. In een volgende editie verwachten wij u over dit initiatief verder te kunnen informeren en daarin iets meer te delen over een eventuele publicatie in SWZ|Maritime ondersteund met een gelijktijdig webinar later in het jaar.

Afdeling Noord en Amsterdam

De afdelingen zullen informatie over te organiseren lezingen, zodra bekend, plaatsen op de website van de KNVTS.

NIEUWE PLANNEN EN ONTWIKKELINGEN BINNEN DE KNVTS

Het hoofbestuur kondigt met genoegen aan dat Johan Baggerman per 14 februari 2022 is aangesteld als algemeen secretaris van de KNVTS. Hij heeft ruime ervaring in vergelijkbare posities binnen branche- en beroepsverenigingen en de maritieme branche. Het bestuur ziet ernaar uit om samen met Johan de lopende zaken met verve op te pakken en nieuwe plannen te ontwikkelen en ten uitvoer te brengen. Hij is aangesteld voor vier dagen in de week en zal als eerste aanspreekpunt voor de leden gaan fungeren. In de nabije toekomst zal hij zich nader bij de KNVTS-leden introduceren.
Er zijn mooie plannen in ontwikkeling binnen de eerder benoemde, strategische speerpunten van de vereniging. Het Event & Webinar United Team, opgericht om tot een verbeterde afstemming van lezingen en een eenduidige communicatie te komen, zet met enthousiasme goede stappen. Met het oog op de ontwikkeling van kennis van en interesse in het maritiem-technische werkveld, zal bij de diverse opleidingsinstituten geïnventariseerd worden waar de KNVTS mogelijk kan bijdragen. In het kader van de internationalisering zal naast de Nederlandse website een Engelse versie worden ontwikkeld.
Daarnaast is er een mooi plan in ontwikkeling om volgend jaar in mei of juni het 125-jarige lustrum van de KNVTS te vieren met een symposium op het gebied van duurzaamheid en digitalisering. Tot slot wil het bestuur alle KNVTS-leden vragen mee te denken over potentiële gegadigden voor een nieuw te vormen "Commissie van aanbeveling". Het doel is om personen van statuur uit het technisch-maritieme cluster aan de vereniging te verbinden.
Vanzelfsprekend nodigt het bestuur elk lid uit zich te melden als hij of zij een bijdrage wil leveren aan een of meerdere van de genoemde plannen en ontwikkelingen.
Eric Schiphorst, lid hoofdbestuur

IN MEMORIAM

De heer J.P.G. van der Hee is 27 januari 2022 op 84-jarige leeftijd overleden. Hij was het laatst woonachtig in Vlissingen en is werkzaam geweest als scheepsmetaalbewerker bij Koninklijke Schelde Groep. Hij was bijna 23 jaar lid van de KNVTS.

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

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SWZ is de eigenaar en uitgever van de titels Schip & Werf de Zee en SWZ|Maritime. Het bestuur van SWZ wordt gevormd door de participanten in SWZ (KNVTS en Stichting de Zee), die elk vier bestuursleden benoemen uit de doelgroepen van de lezers en bestaat uit de volgende personen:
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Ir. J.Th. Ligtelijn (MARIN), secretaris
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Verschijnt 11 maal per jaar

Hoofdredacteur: A.A. Oosting
Eindredactie: mevr. M.R. Buitendijk-Pijl, MA
Redactie: G.J. de Boer, Ir. H. Boonstra, Ir. A. de Bruijn, M. van Dijk, mevr. Ing. A. Gerritsen, Ir. J. Huisman, Ir. J.H. de Jong, Ir. W. de Jong, H.S. Klos, Capt. H. Roorda, B. von Ubisch, MSc, E. Verbeek, L. van Geffen (SG William Froude)
Redactie Adviesraad: Ir. A. Kik, Dr. Ir. H. Koelman, Ir. W.J. Kruijt, Ir. G.H.G. Lagers, T. Westra, J.K. van der Wiele
Aan SWZ|Maritime werken regelmatig mee: B. Kuipers, Ir. G.H.G. Lagers, H.Chr. de Wilde

Redactieadres
Zeemansstraat 13, 3016 CN Rotterdam
Telefoon: 010 – 241 74 35 (alleen voor redactieaangelegenheden, voor abonnementen en lidmaatschap KNVTS: 010 – 241 00 94, secretariaat@knvts.nl)
E-mail: swz.rotterdam@knvts.nl
Website: www.swzmaritime.nl

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Het is voor abonnees ook mogelijk de digitale online bladerversie te lezen op www.swzmaritime.nl/pdf-archive met de daarvoor bestemde exclusieve inloggegevens.
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