KONINKLIJK GALLOIS GENOOTSCHAP

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STUDIEKRING VOOR SCHEEPSWERKTUIGKUNDIGEN
MASTERS EN TECHNICI IN DE MARITIEME SECTOR

Eugeen Van Mieghem (1875-1930).....

De laatste jaren wordt het oeuvre van de Antwerpse havenkunstenaar Eugeen Van Mieghem internationaal herontdekt. Een stichting, een museum, tentoonstellingen in binnen- en buitenland, talrijke kunstboeken en bronzen beelden naar zijn werk brachten zijn beklijvende oeuvre terug in de belangstelling. Sinds 2010 is het aan hem gewijde museum, gesponsord door de Koninklijke Belgische Redersvereniging, gevestigd in het unieke Redershuis.

In het KMSKA (Koninklijk Museum voor Schone Kunsten Antwerpen) opent op 2 oktober 2025 een retrospectieve tentoonstelling.

Van Mieghem werd geboren in een herberg in het hartje van de oude haven op 1 oktober 1875 In zijn jeugdjaren werd hij geconfronteerd met het harde leven aan de waterkant. In 1892 kwam hij op een expositie in de Antwerpse Academie in contact met het werk van o.a. Van Gogh, Seurat, Meunier en de Toulouse-Lautrec. Er groeide bij hem een idealisme om de kunstenaar te worden van het havenvolk: de buildragers, havenmeisjes, emigranten, schippers en zwervers. Nadat hij in 1896 van de academie was weggezonden, werkte hij als scheepsbevrachter in de haven. Tijdens zijn tochten tekende hij in schetsboeken en werd hij vooral geboeid door de duizenden landverhuizers die met de schepen van Red Star Line vertrokken naar de Nieuwe Wereld. In 1901 exposeerde Van Mieghem op de Brusselse salon van La Libre Esthétique naast Franse impressionisten als Monet, Cézanne, Pissarro, Renoir en Vuillard.

Op 28 januari 1902 huwde hij met Augustine Pautre en datzelfde jaar werd hun zoontje geboren In december 1904 werd Augustine ziek nadat ze als naaktmodel poseerde. Van Mieghem gaf de laatste levensdagen van de jonge vrouw weer in een indrukwekkende reeks tekeningen en pastels. Na zijn eerste individuele expositie in 1912 in het Koninklijk Kunstverbond nam hij deel aan groepstentoonstellingen in Keulen en Den Haag. In 1920 werd Van Mieghem benoemd tot leraar aan de Antwerpse Academie en tot aan zijn dood op 24 maart 1930 nam hij bijna jaarlijks deel aan de belangrijkste Belgische tentoonstellingen. Na de Tweede Wereldoorlog verdween zijn oeuvre echter in de vergetelheid.

De oprichting van de Eugeen Van Mieghem Stichting in 1982 betekende een keerpunt.

In de Europese sociale kunst van rond de eeuwwisseling wordt zijn werk nu door internationale kunstcritici gesitueerd naast figuren als J.-F. Millet, de Toulouse-Lautrec, Steinlen en Käthe Kollwitz. Als geen ander heeft Van Mieghem het leven van de gewone mens, levend en werkend in een wereldhaven, getekend en geschilderd. In zijn weergave van het sociale sluit hij nauw aan bij de kracht en de authenticiteit van een Jean-François Millet. Net als deze voorloper in de sociale kunst heeft Van Mieghem zijn eigen omgeving nooit moeten verlaten om onderwerpen te zoeken voor zijn kunst. De wereld passeerde vóór zijn deur.

Tijdens de academische openingsceremonie 2024/2025 van de Antwerp Maritime Academy schonk de Stichting Eugeen Van Mieghem een tekening “Royersluis 1906” van de kunstenaar E. Van Mieghem.

Erwin Joos, de conservator van het E. Van Mieghem museum, gevestigd in het gebouw van de Redersvereniging, heet jullie van harte welkom voor een bezoek.

KONINKLIJK GALLOIS GENOOTSCHAP V.Z.W.

KONINKLIJKE VERENIGING
naar de eerste Erevoorzitter,
professor aan de Hogere Zeevaartschool,
wijlen Ingenieur Georges Gallois

STUDIEKRING VOOR SCHEEPSWERKTUIGKUNDIGEN
MASTERS EN TECHNICI IN DE MARITIEME SECTOR

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INHOUD

THE INGERSOLL-RAND ROTARY GAS ENGINE

DEATH ON LPG CARRIER IN ANTWERP ENGINE ROOM FIRE

VOLLEDIGE INHOUD

ADVERTEERDERS

VACATURES

79STE JAARGANG NR.1 JANUARI - FEBRUARI 2025

VOORDRACHTEN

23 januari 2025
geen lezing

20 februari 2025
AMA - ing. Tim Cools
Engine deck simulator (Kongsberg)

20 maart 2025
dr. Ward Van Roy
Airborne monitoring of compliance to NOx emission regulations from oceangoing vessels in the Belgian North Sea

Verenigingsberichten

DE MARITIEME NIEUWJAARSRECEPTIE:

De maritieme Nieuwjaarsreceptie zal worden gehouden op donderdag 16 januari 2025 om 19.00 uur op de Hogere Zeevaartschool Antwerpen, Mercatorzaal. Jullie zijn welkom.
Gezien de negatieve financies van KGG moeten wij op de kosten besparen. Daar we al enkele jaren opmerken dat er inschrijvingen gebeuren maar dat het lid niet komt met een eventuele partner moeten wij de kosten/persoon van deze personen betalen aan de organisator.
Daarom heeft het bestuur beslist van 25 € per inschrijving aan te rekenen bij de inschrijving voor de Nieuwjaarsreceptie op Argenta; BE36979983005681 met vermelding namen van deelnemers. Als het lid aanwezig is op de receptie krijgt hij zijn geld terug. De inschrijving en betaling bevestigd de deelnamen. Dus, vergeet niet u tijdig aan te kondigen en te betalen aan ons secretariaat van KGG. De uitnodiging is alleen voor leden en partners die het lidmaatschap al betaald hebben voor 2025. De nieuwjaarsreceptie is zoals voorgaande jaren samen georganiseerd met Koninklijk Gallois Genootschap, Koninklijk Belgisch Zeemanscollege, Mercatorkring, Koninklijk Marine Academie, de Belgische Maritieme Liga, het inrichtend Comité van de dag der zeelieden, het Nautische Instituut België en de Commandant van het Marine Detachement Antwerpen.

NAAMDRAGERS AMA ACADEMIEJAAR 2024/2025

Tijdens de 118de academische opening 2024/2025 van de Antwerp Maritime Academy werd Mevr. Eva De Maeyer (links) aangeduid als naamdrager van Nautische Wetenschappen.
Jos Notenboom (2de van links) werd gekozen als naamdrager voor de afdeling Scheepswerktuigkundige.
In de midden de laureaten-cadetten Robin Dzieziaw voor Nautische Wetenschappen en Noah Holmen voor Scheepswerktuigkundige. Zij werden genomeerd voor hun sterke thesissen.

DAG DER ZEELIEDEN

Ronny Van Peteghem, ex feestbestuurder van KGG, werd geëerd op de Dag der Zeelieden in september 2024 voor zijn verdienstelijke carrière op zee.

Nieuwjaarswensen 2025

Dear members, *keeping up modern technologies in maritime engineering also in 2025 demands a more thorough knowledge for our maritime engineers, ship builders, specialists and maritime sea going officers. It is expected to chance its role as a maritime engineer on board of vessels following up this modern technology is the reason that the Royal Gallois Society exists. What does 2025 have in store for us?*

In 2025, several notable trends in maritime engineering are expected to emerge, driven by technological advancements and a focus on sustainability:

1. ***Autonomous Vessels:*** *The development of unmanned ships and advanced automation technologies will continue to progress, enhancing safety and efficiency in maritime operations. This includes the integration of AI for navigation and decision-making.*
2. ***Digital Twin Technology:*** *The adoption of digital twins—virtual replicas of physical vessels—will allow for real-time monitoring and predictive maintenance, improving operational efficiency and reducing downtime and its application on our new engine deck simulator at the Antwerp Maritime Academy.*
3. ***Advanced Propulsion Systems:*** *Continued exploration of alternative propulsion technologies will be prominent as the industry seeks to meet decarbonization goals.*
4. ***Cybersecurity Focus:*** *As vessels become more digitized and interconnected, the need for robust cybersecurity measures will grow.*
5. ***Enhanced Energy Management:*** *Intelligent energy management systems will be developed to optimize fuel consumption and integrate renewable energy sources, leading to more efficient vessel operations.*

These trends reflect a broader shift towards innovation and sustainability in the maritime industry, with a strong focus on technology integration and environmental responsibility.
In effect of this shift into 2025, the role of the marine engineering officer or chief engineer on large vessels is expected to evolve significantly. Here are some upcoming trends:

1. ***Increased Automation:*** *The integration of automated systems in engine rooms will reduce manual monitoring tasks. Marine engineers will need to focus more on system management and troubleshooting rather than routine operations.*
2. ***Data-Driven Decision Making:*** *With the rise of IoT and big data analytics, engineers will increasingly rely on real-time data to make informed decisions regarding maintenance, fuel efficiency, and operational performance.*
3. ***Emphasis on Cybersecurity:*** *Training and protocols will evolve to address potential cyber threats to machinery control systems.*
4. ***Focus on Sustainability:*** *Engineers will play a crucial role in implementing and managing alternative fuels and energy-efficient technologies.*
5. ***Advanced Training and Skills Development:*** *As technology advances, ongoing training will be essential. Marine engineers will need skills in data analysis, automation systems, and alternative energy management.*
6. ***Digital Twins and Simulation Tools:*** *The use of digital twins will help engineers simulate engine performance and optimize operations, enabling predictive maintenance and enhancing decision-making processes.*

Specific for our society for the following financial year we need to stay budget neutral like in 2024, the board has so decided to send only digital invitations from our winter seminars to members with an email address. In addition, members will indicate in advance whether they wish to receive a digital magazine or a paper magazine subject to an additional charge. Five magazines are planned for 2025 like in 2024 with no magazine to our members in the summer months of July and August 2025. The subscription fee will stay the same as in 2024.

I want to thank you all for having such support from all members of our society and my board especially Katleen Bocklandt, our secretary, and my vice-president Tom Van Campenhout. Also, in these financially difficult times, I want to thank our head of finances and honorary president Rik Ghys for the excellent work regarding the follow up of our treasury. I want to thank our event organizer Herman Van Opstal for doing such great job organizing our events. For our beautiful Technical Magazine, which is still created under the lead of our editor-in-chief and Honorary President, Walter Van der Stighelen, I want to send my greatest gratitude to my Honorary President Tim Cools for the PR of our society. I thank our webmaster, Yves Peeters for his excellent renewing of the website www.gallois.be .The support of the board is amazing and nice to have. Our advertisers, I want to thank especially them for their financial support, even in these uncertain times, for without their support, our existence wouldn't be possible.

Finally, I wish you all a very happy and Good New Year!

dr. Marc Vervoort
VOORZITTER 'KONINKLIJK GALLOIS GENOOTSCHAP'
PRESIDENT 'ROYAL GALLOIS SOCIETY'

Similar but not identical:

How digital twins can serve class and designers

SSI

“ Het beheren van risico's om faciliterende technologieën te omarmen kan veerkracht opbouwen te midden van volatiliteit, zegt OrbitMI.

SOURCE: MARITIME REPORTER
JANUARY 2024

Demand for data that can inform strategies for asset management and performance monitoring is driving the wider adoption of digital tools in shipbuilding. Vessel designers are increasingly able to employ a software-driven approach that creates efficiencies and satisfies compliance.

Shipowners want visibility on assets over their lifecycle, and as the era of planned maintenance routines gives way to predictive interventions, shipyards are turning to 3D models to create digital twins to support decision-making.

This transition also reflects growing demand for review and approval of the design by class, using a common standard for data exchange.

Managing these complimentary demands requires a detailed understanding of the process for both vessel design and class review – and the differences that can leverage maximum functionality for designers while also simplifying approvals. What shipyards and design offices tell us, is that they need simple tools to manage the digital information and digital twin as a 3D model.

However, since the type and detail of information required depends on what stage of the vessel's design, build or operations is in focus, there is a need to work with all assets and information types – 3D or otherwise.

The growing use of 3D digital twins, coupled with a Product Lifecycle Management (PLM) approach to safety, efficiency and sustainably, gives shipyards the ability to manage sophisticated data models. These same models can initially be based on a shared 3D model for functional design and class approvals. That model can then evolve over the build cycle to suit the purpose of fabrication of the vessel and also provide class with an ‘as-built’ baseline.

Both class and the shipyard need to inspect assets prior to final delivery to ensure they conform to the original design. A 3D model supports that workflow, using software to more quickly and efficiently verify whether what was designed is what has been built.

But not all twins are the same. The options range from a completely identical twin to one that only shares some of the genetics. Certain static components that are critical to the structure are important to class but may not mean anything to the operator data which could be removed from one view and enabled on another, depending on the needs of the user.

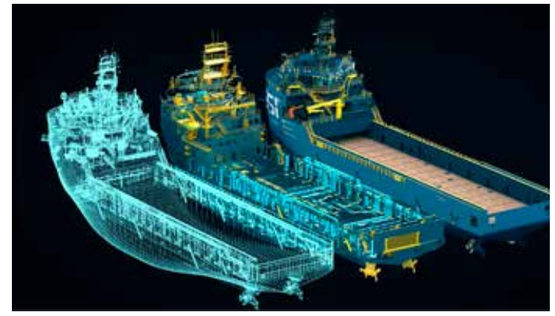
The need of the operator for example to track efficiencies of the vessel in operations may not require a 3D model at all, but a good understanding of the sensors on the vessel and the data they provide in real time is useful. Those sensors can be associated back to 3D modeled parts using a PLM system, building the digital thread - but they do not need the heavy 3D data.

Likewise, there is far more data and information contained in 3D plans created in SSI ShipConstructor than class requires for approval, but this is data core to the shipyard. For example, during initial functional design approvals, class will scrutinize the asset’s safety and strength, but that strength is a result of the vessel’s design, not its construction processes.

Later build stages such as detail design and the shipyard’s build strategy and fabrication capabilities will provide the information for ensuring the strength of what actually gets built. That early Digital Twin information and DNA can be built upon but is not needed in the earlier functional design stages.

Of growing importance to the 3D class approval process is the common standard developed by the OCX Consortium for exchange of data required for class approval. By creating conformity around data standards, the OCX Consortium approach simplifies the exchange of data between class and designers alike and promotes the use of 3D data that can be used across the lifecycle of the vessel.

The Consortium has continued to build momentum over the last six months, with a membership that represents a cross section of stakeholders and promotes the collaboration needed to further develop the standard in future. Greater interoperability enables shipbuilders and class societies to engage in a fully digital workflow and share the designer’s 3D model using a common specification.



CREDIT: SSI

wBeyond this, the use of 3D models can be incrementally extended into the process of design, production and asset operations. Adopting a product lifecycle management (PLM) approach to this process means that shipyards can create, store and transport all the data and metadata they need to support virtual workflows between departments and users.

All of that information can be sliced and diced to suit the purpose of vessel operations as well as training, monitoring, repair and potentially even recommission or decommission of the asset.

In building a virtual model, the designer can control which aspects of the twin they need to see and which elements are carried forward into the construction process and taken into vessel operations.

Employing a 3D model also enables the designer or yard to push the digital twin concept to an earlier stage of the design process - to conceptual and functional design - so that the model can be used through all the stages of the design and production process, including training the people that will work on the asset. It also delivers the ability to more easily re-use information generated through the design workflows in related projects.

The differences between the demands of class approval, shipyard production and vessel operations are not in conflict, but they do represent different applications. The model produced and the digital thread supported by PLM therefore needs to be suited for the purpose at hand. The reality of working with a digital twin is that greater complexity does not necessarily deliver better functionality. The ability to design a flexible model that can efficiently serve different tasks at different stages of design and vessel operations is the future for shipbuilding. ■

Author: Craig Tulk is the Product Business Analyst at SSI, responsible for ensuring SSI solutions fit the needs of shipbuilders. Prior to SSI, Craig worked with shipbuilders, advancing in roles as a 3D Modeler, Lead Designer, Detail Design Project Manager, and Business Development Officer. He is a SNAME member and for over six years has been paying back to the marine industry by performing various volunteer rolls for the society, currently as FVP – Knowledge Management.

The Ingersoll-Rand rotary gas engine.....

“The Cornerstones of Compression series has highlighted many significant products over more than 160 years of continuous progress. However, there were also some great engine and compressor ideas that were unsuccessful. This brief Cornerstones of Compression corollary series features several development failures.

SOURCE: NORM SHADE • COMPRESSORTECH2
MARCH 2024

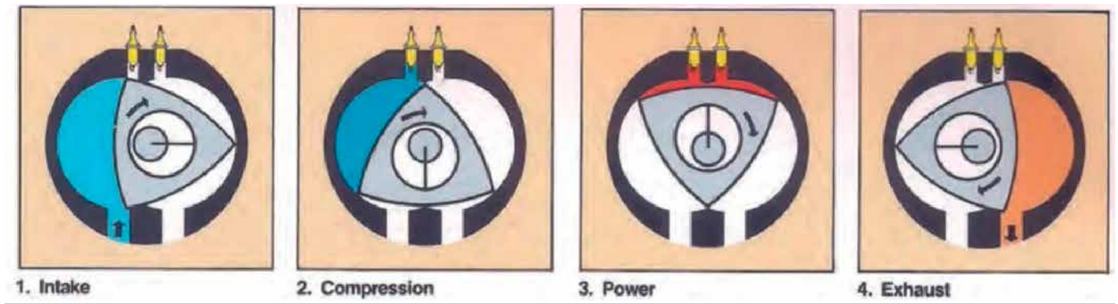
The rotary engine concept originated with Felix Wankel in Germany in 1929, but it wasn't commercially successful until shortly after World War II. In the U.S., Curtiss-Wright led early advancement of the Wankel concept for airplane engines, and through licensing, also for automobile engines. In the Wankel engine, the four strokes of an Otto cycle occur in the space between each bow-shaped face of a symmetric triangular rotor and the inside of an oval-like epitrochoid housing. The rotor is mounted eccentrically on the output shaft with gearing, such that the rotor turns at a slower speed than the output shaft. The simple, compact rotary design has a higher power to weight ratio than conventional piston engines, and it can have lower maintenance costs.

SEEKING A RELIABLE ENGINE

In the early 1970s, with separable high-speed balanced opposed reciprocating compressors becoming the norm in upstream oil and gas applications, Ingersoll-Rand (I-R) wanted a reliable engine to drive its high-speed RDS compressors. Seeing the potential of the Wankel rotary concept, I-R signed →

a license agreement with Curtiss-Wright in 1972 that entitled I-R to develop, manufacture and market industrial rotary engines packaged for pumps, generators and compressors.

I-R's objective of developing a natural gas fueled variable speed prime mover for reciprocating compressors in 500 hp (373 kW) increments at 1000 rpm involved a significant extension of the Wankel technology. I-R's heavy duty compressor drive engine, constructed with cast iron end housings and oil-cooled, nodular iron rotors, required an engine displacement of 2500 in3 (40 l). Up to that time, the largest successful Wankel built by anyone was only 90 in3 (1.5 l).



After two years of secretive internal development, the product was formally announced at the 1976 Offshore Technology Conference (OTC) and featured in the July 1976 issue of Diesel & Gas Turbine Progress. Two 1000 rpm rotary engine models were offered, with the model numbers relating to the displacement. The IR2500, rated 500 hp (373 kW), used a single rotary module. The IR5000, rated 1000 hp (746 kW), used two rotary modules coupled together. The first unit was secretly packaged with an I-R RDS compressor at Southwest Industries and set up for no-load demonstrations after the unveiling at the OTC. I-R had a movie company secretly make a film of the whole story of the engine design, development and introduction. These were handed out along with plastic models of the engine. This big splash about a "revolutionary" new product caught the gas compression industry totally by surprise.

The compact, naturally aspirated engines had a 9:1 compression ratio. Extreme precision and surface finishes were required on the engine combustion chamber surfaces. The distinctive triangular rotor drove the output shaft through internal gearing having a 3.0 ratio. By eliminating the conventional reciprocating engine's wearing parts and having fewer bearings and other parts, the rotary engine was forecast to have lower maintenance costs and longer service intervals.

For endurance testing, an extensive field testing program was established through I-R Compression Services in Tulsa, Oklahoma. This obtained valuable field experience through leasing the rotary-driven packages for natural gas production applications. A fleet of 13 units were packaged by Southwest Industries with 1000 rpm I-R RDS compressors, and these were installed with eight different customers on one-year compression contracts that included all service provided by I-R.

IR2500 rotary engine and RDS-2 reciprocating compressor barge-mounted gas production package in Louisiana, c.1977.

OIL CONSUMPTION PROBLEMS

By early 1977, the lead unit had accumulated over 8000 hours, but oil consumption was economically prohibitive despite otherwise reliable operation and a respectable 32% thermal efficiency. The oil consumption was improved with a design change, however the rotor apex (aka tip) seals that performed very well in the laboratory, were a consistent problem when required to operate 24/7 operation in the field with natural gas fuel that varied in quality and heating value. Observers from that time humorously claimed that "the engine housings were so hot in service they would glowed brightly enough to read a newspaper by at night." The excessive heat caused casing distortion and affected the special coatings and even the metal heat treatment of the housings and rotors.

I-R initially indicated that power modules would require change-out every 8000 hours, with the intent that this could be extended with further development. While I-R felt confident that more field development would resolve the apex seal issues, simultaneous laboratory development led to a 10% uprating of the engines, which tended to exacerbate the rotor apex seal wear that was occurring in the field.

IR5000 engine driving an RDS-2 reciprocating compressor in a Pennsylvania gas boosting installation, c.1977.

The first customer-owned unit was an IR5000 installed at National Fuel Gas' Heath compressor station in 1976. This was a station that was otherwise powered by reliable old Snow horizontals. Comments in a Coolspring Power Museum newsletter from that time described a field tour to the station to admire the rhythmic, comparatively quiet "chugging" horizontals. But it was interrupted by the "screaming" Wankel howling in the night.

Ultimately, 50 rotary units were placed into field applications, with 43 driving compressors and seven driving electric generators. The generator drives and 10 of the compressor drives were customer owned, with all the rest owned by I-R Compression Services. The last new unit was placed in service in late 1979, as the apex seals continued to be the engines' Achilles' heal.

Ultimately, the entire rotary program was a great idea that proved to be a commercial disaster for I-R. Although the company reportedly spent $10 million developing the rotary engines, which was a huge sum in the 1970s, it was said that twice as much was spent buying its way out of the product. Nevertheless, I-R lived up to its responsibility by replacing the customer owned rotary units, and presumably its own fleet units, with Waukesha gas engines.

As a side story, in the early 1970s I-R also had a conventional reciprocating gas engine through design and initial development. It reportedly looked like a good high-speed gas engine design, but the rotary won the day and the reciprocating engine never went into production. ■

Regulations spark interest in fuel homogenisers.....

> *The introduction of the EU Emissions Trading System and Fuel EU Maritime regulations have placed the maritime industry under unprecedented pressure to reduce emissions and improve fuel efficiency*

SOURCE: THE MOTORSHIP
SEPTEMBER - OCTOBER 2024

Serrated tapered rotor

The introduction of the EU Emissions Trading System and Fuel EU Maritime regulations have placed the maritime industry under unprecedented pressure to reduce emissions and improve fuel efficiency

As the European Union tightens its regulatory grip, shipowners and operators have sought alternative technologies to comply with these measures whilst maintaining operational efficiency.

Technologies like fuel additives, fuel homogenisers, and water-in-fuel emulsions offer shipowners a comprehensive solution to these challenges by optimising fuel performance, reducing harmful emissions, and lowering compliance costs.

The most stringent regulations are the EU ETS and the Fuel EU Maritime initiative which impose limits on CO2 emissions and fuel carbon intensity.

EU ETS is the cornerstone of the EU's efforts to reduce CO2 emissions across all sectors, including shipping. Extended to cover maritime emissions in January 2024, the EU ETS requires shipping companies to monitor, report, and pay for their CO2 emissions. The system applies to voyages within the European Economic Area (EEA) and 50% of emissions from voyages between the EEA and non-EEA ports.

EU ETS operates on a cap-and-trade basis, where companies are allocated emissions allowances or purchase additional credits, known as EU Allowances (EUAs), to cover their emissions. The price of EUAs has ranged between €80 and €90 per tonne of CO2 in 2024, and as the cap tightens, prices are expected to rise. Shipping companies are incentivised to adopt emissions-reducing technologies to lower their fuel consumption and reduce the number of EUAs they need to purchase.

EU ETS focuses on emissions from fuel combustion, measured using a "tank-to-wake" approach. This straightforward method calculates emissions based on the amount of fuel burned during a ship's operation, directly linking fuel efficiency to compliance with emissions targets.

Wake-up call for shipping

Fuel EU Maritime, however, sets progressive limits on the carbon intensity of maritime fuels. Unlike the EU ETS, which measures emissions from fuel combustion, the Fuel EU Maritime regulation takes a "well-to-wake" approach, covering the entire fuel lifecycle from production to consumption. This comprehensive framework aims to incentivise ship operators to adopt low-carbon fuels, such as biofuels, hydrogen, ammonia, as well as synthetic fuels improve fuel efficiency, and implement advanced emissions-reduction technologies.

It also imposes penalties for non-compliance, driving the industry to explore innovative solutions to meet the increasingly stringent emissions targets, but adoption of the well-to-wake model is highlighting the overall cost the green versions of the alternative fuels available to the maritime industry. They are still a long way from becoming mainstream, mainly due to the cost of producing the totally green versions, availability, and infrastructure, as well as safety and storage issues which can create a dilemma for the shipowner.

In order to comply with the new regulations, shipowners may need to take a longer term view before committing to these 'alternative' fuels by maximising the benefits of the current range of fossil fuels readily available worldwide and even consider blending fossil fuels with the likes of biofuels.

HOW FUEL HOMOGENISERS WORK

Fuel homogenisers, specialised fuel additives, as well as water-in-fuel emulsions are re-emerging as key technologies that can help the maritime sector meet these challenges. By optimising fuel combustion and reducing emissions, these technologies help ship operators to comply with EU regulations while improving fuel efficiency and reducing costs.

Fuel homogenisers are mechanical high shear devices that condition fuel by breaking down large fuel droplets into smaller, more uniform particles. This process improves fuel atomisation, which enhances combustion efficiency and reduces emissions. Fuel homogenisers are particularly effective with heavier fuels like Heavy Fuel Oil blends (VLSHFO) but also with Marine Diesel Oil (MDO), which often contain impurities and have high viscosities, and also biofuels.

Marine fuels (HFO and MDO) can contain impurities, such as large and long-chain asphaltene particles, water, sludge, or other contaminants that can affect combustion efficiency and have an adverse effect on engine combustion.

Inside the homogeniser, the fuel passes through the narrowing gap between a rotor and stator. The high-speed rotor generates strong centrifugal and frictional forces which grind down the larger particles in the fuel, reducing the size of asphaltene clusters, breaking emulsions, and homogenising fuel. The rotor also creates localised cavitation, where vapour bubbles form and collapse violently in the liquid This process helps break up fuel impurities and water into fine droplets, ensuring a more uniform and stable fuel mixture.

As a result of the mechanical forces, the homogeniser reduces the size of fuel particles and any water droplets to the micron or sub-micron level (typically between 1 and 5 microns). This fine dispersion is crucial for improving the combustion characteristics of the fuel. If water is present, it will be evenly dispersed within the fuel as a micro-emulsion. This prevents water droplets from causing localised hotspots in the combustion chamber, which could lead to corrosion or incomplete combustion. The reduction of asphaltene clusters improves the flow characteristics of heavy fuel oils and reduces the risk of clogging or uneven combustion.

Once the fuel is fully homogenised the fuel particles and any water content are evenly distributed. The fuel becomes more stable, less prone to separation, and more suitable for efficient combustion.

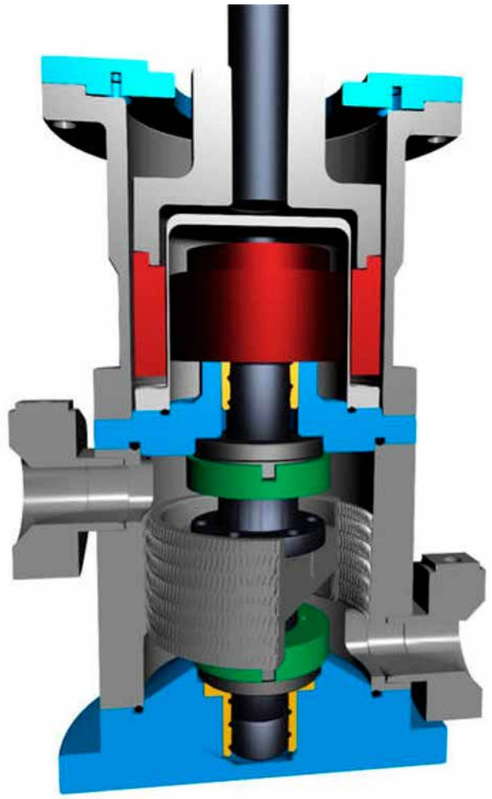
The finer fuel particles burn more completely, reducing unburnt fuel residues, black smoke and particulate matter (PM) NOx, SOx and enhancing engine efficiency. By ensuring a stable and homogeneous fuel mixture, the homogeniser helps optimise engine performance, leading to better fuel efficiency and reduced wear on engine components.

COMBINING HOMOGENISERS, ADDITIVES, AND WATER-IN-FUEL EMULSIONS

Looking at fuel additives as a stand-alone technology, the industry has cleaned up its act over the last 10 to 15 years, and while there are still some sceptics and some claims of 'snake oil', the simple fact is that fuel additives do work, all be it to varying degrees.

While some additives are claimed to be more effective than others, these differences are usually due to the fuel type (HOF, ULSHFO, or MDO) and dosage ratio which can range from 1200 to 150,000. Essentially most of them are very similar using a combination of detergents, antioxidants, corrosion inhibitors, organic surfactants, dispersants, combustion improvers, detergents, anti-foulants, metal-organic catalysts, detergents, and stabilisers. The fuel additive industry is reported to be worth almost $10 billion and expected to rise, suggesting its popularity is increasing.

Many shipowners are realising that by combining fuel homogenisers with targeted or specially blended fuel →»



Homogeniser setup

additives the compound effect of the benefits can lead to a significant reduction in fuel consumption and emissions, particularly black exhaust smoke and PM's.

This is a win-win by reducing fuel costs, and significantly improving the environmental impact of using readily available and cost-effective fossil fuels.

Taking the concept further, the combination of homogenisers with specific fuel additives (or stabilisers) and water to create a WiF (Water-in-Fuel) emulsion mix is gaining popularity and has been shown to be a very effective way of significantly reducing emissions, particularly NOx, while improving fuel efficiency. As with homogenisers and additives, there is also the additional payback in reduced maintenance in fuel pumps, injectors, and in the exhaust system.

Persuading marine engineers to blend 15-20% water into their fuel, when they have spent most of their careers trying to keep it out, can be a challenge, but it offers an effective way to improve combustion efficiency and reduce emissions. The main concerns are usually the potential of 'free water' in the fuel system which could cause significant damage to the engine.

However, the water in emulsion fuels is not present in free or bulk form but is finely dispersed in the fuel as tiny micro-to nano-sized droplets encapsulated in the fuel and are vaporised during combustion. The fine dispersion of water means that there is minimal risk of water coming into direct contact with metal surfaces in the fuel system or combustion chamber. The additives or stabilisers also help to maintain the homogenous mix and stop any stratification.

The key phenomena during the combustion process is the micro-explosion. The water encapsulated within the fuel droplet reaches its boiling point (100°C) much earlier than the surrounding oil, which requires significantly higher temperatures (typically 300-400°C). As the water vaporises, it generates steam within the droplet, with a rapid increase the internal pressure of the droplet, and pressure exceeds the surface tension holding the droplet together, resulting in the micro-explosion just before TDC (Top Dead Center), which can add to the pressure on the power stroke. The disintegration of the droplet into smaller particles also commonly referred to as the secondary atomisation, and as the many smaller droplets have a larger surface area-to-volume ratio, which enhances the fuel-air mixing, it makes it easier for the fuel to evaporate and combust more efficiently.

FUTURE-PROOFING MARITIME OPERATIONS

By integrating fuel homogenisers, fuel additives, and water-in-fuel emulsions, shipping companies can move closer to achieving substantial improvements in fuel efficiency and emissions reduction. Each technology addresses different aspects of fuel optimisation, creating a comprehensive system for improving operational performance and compliance with EU regulations.

The EU ETS and Fuel EU Maritime regulations impose stringent limits on CO emissions and fuel carbon intensity. By adopting fuel homogenisers, additives and emulsions, ship operators can reduce CO> emissions through improved combustion efficiency. This directly reduces CO emissions, allowing operators to earn carbon credits under the EU ETS Water-in-fuel emulsions and fuel additives help operators

Looking at fuel additives as a stand-alone technology, the industry has cleaned up its act over the last 1o to 15 years, and while there are still some sceptics and some claims of 'snake oil', the simple fact is that fuel additives do work, all be it to varying degrees stay within the carbon intensity limits set by the Fuel EU Maritime regulations.

By lowering emissions, operators can reduce their exposure to carbon taxes and potentially sell excess carbon credits.

The introduction of the EU ETS and Fuel EU Maritime regulations has placed the maritime industry under unprecedented pressure to reduce emissions and improve fuel efficiency. Technologies like fuel homogenisers, fuel additives, and water-in-fuel emulsions offer a comprehensive solution to these challenges by optimising fuel performance, reducing harmful emissions, and lowering compliance costs.

Investing in these technologies is essential for futureproofing maritime operations, achieving regulatory compliance, and contributing to the broader decarbonisation goals of the global shipping industry. ■

Is nuclear still a game-changer?.....

> *Nuclear propulsion, as a zero-emissions ship power concept, has been around for many years. Following successful use of the technology in submarines, naval vessels and icebreakers,the first nuclear-powered merchant ship was launched in 1959. The Savannah was funded by the US Government, as a demonstration of peaceable use of nuclear energy rather than as a source of revenue or to show off clean credentials.*

SOURCE: THE MOTORSHIP
SEPTEMBER - OCTOBER 2024

A small modular reactor (SMR) from Rolls-Royce could be used in conjunction with Topsoe's electrolysis technology to produce green hydrogen fuel

Although three other nuclear powered commercial vessels were subsequently built, there was considerable resistance to any wider adoption of nuclear power. These were mainly on grounds of building and operating costs, which in the case of Savannah, were significantly higher than similarly sized conventional ships, but also on the uncertainties around decommissioning and the safety concerns which prevented access to some countries' ports.

With the present focus on emissions and the environment, nuclear powered ships are being re-examined as a zero emission option, despite the original concerns still being present. Lloyd's Register recently released a study, Fuel for Thought: Nuclear, which concluded that nuclear power could transform the maritime industry with emissions-free shipping, whilst extending the life cycle of vessels and removing the uncertainty of fuel and refuelling infrastructure development, but regulation and safety considerations must still be addressed for widespread commercial adoption.

The report draws on nuclear's proven track record in naval applications, with the study pointing to the role of new small modular reactors (SM Rs) in bringing to market suitable low maintenance plant to meet the propulsion and energy requirements of commercial ships.

LR proposes a model in which shipowners lease power from reactor owners, separating the shipowner from the complexities of licensing and operating nuclear technology. The report sees SM Rs as offering a fresh approach to reactor design, with safety, efficiency, and modularity for streamlined production all regarded as potential benefits.

Stringent safety protocols would be paramount, with, in the short-term, LR's Risk Based Certification (RBC) enabling initial projects to demonstrate an equivalent level of safety to that achieved with conventional fuels. As well as SMRs, pressurised water reactors (PWR), micro reactors and molten salt reactors (MSR) offer other promising technologies for maritime applications. On the downside, perceptions of nuclear power safety and investment readiness levels currently remain low.

LR Power to X director, Mark Tipping, said: "Whilst its use in commercial shipping has been limited, by overcoming negative perceptions and a lack of investment levels, nuclear propulsion could provide immense value for the maritime sector in its decarbonisation journey, allowing for emissions free vessels with longer life cycles which require minimal refuelling infrastructure, or in best case scenarios limit the need entirely."

LR has joined with maritime and technology innovation company Core Power to conduct a joint regulatory assessment study on the regulatory feasibility and frameworks that would need to be established for a nuclear container ship using a fourth-generation reactor noted for high inherent safety to undertake cargo operations at a port in Europe. A.P. Moller-Maersk is to provide input from its experience as a shipping and logistics provider. The joint development project aims to develop a proposal for a nuclear-powered feeder ship to operate at a European port.

In another project, ABS is working with the Korea Research Institute of Ships and Ocean Engineering (KRISO) to advance commercial SM R-powered ships. ABS will provide analysis of applicable regulatory guidelines and international standards for the design of SMR-powered ships, while KRISO will develop core SMR-powered ship, including conceptual designs for the vessel and propulsion systems.

Patrick Ryan, ABS SVP and CTO said: "ABS is taking a leading role in the support of nuclear power projects in the maritime industry through our knowledge of international regulations and development of class-related related safety requirements. We are proud to apply our experience to these research projects with KRISO. With the increased focus on zero-carbon emissions, modern nuclear technologies offer the potential for decarbonisation in many areas of the sector."

Research by Dutch naval architecture practice C-Job Naval Architects has demonstrated the potential of nuclear power to become one of the main alternatives in the achievement of sustainable marine shipping. The outcome of the company's extensive research could benefit all stakeholders in the shipping industry, from companies and investors to port authorities and regulatory bodies.

C-Job research suggests that the use of nuclear energy on large ocean-going vessels could result in a g8% reduction in CO2 equivalent emissions, compared to conventional fuelbased systems. A follow-up study, presented earlier in 2024, has identified a method of converting nuclear energy to propulsion and electrical power that is said to be safe, has minimal space requirements, and offers favourable load response capabilities. The proposed system considers all the components in a nuclear power system on commercial vessels, including reactor types, shielding, heat exchangers, and turbines.

A further important benefit identified by C-Job is that nuclear propulsion could fundamentally change the capital and operational expenditures of ocean-going commercial ships, potentially making their operations more profitable. This is because the cost of fuel, as a part of operational expenditures, grows only marginally with the higher speeds of nuclear-powered vessels.

In two newbuild cases, a container vessel and a bulk carrier, C-Job determined that reactors with 25, 50, and 75 years of service life could all develop higher economic ship speeds than conventional fuel-based options. The additional installation costs associated with nuclear energy is offset by the previously-mentioned low fuel costs and by the fact that a reactor can be used for its entire service life, either in a second ship or by extending the service life of the first ship.

Niels de Vries, head of energy, C-Job, is another who sees nuclear leading to a fundamental change in ship finance: "A potential solution is to adopt a structure where ship owners pay 'rent' for the system's operational hours while specialist companies buy and own the reactors," he said

C-Job says it will continue to research nuclear energy for marine applications in its bid to reduce the shipping industry's harmful emissions, working with several stakeholders to scale down components and facilitate ship integration. As a result, the firm has received its first commission to conduct research into the design of a nuclear-powered commercial vessel.

De Vries continued: "It's only when owners become willing to invest and build [nuclear-powered] ships that we can develop a concrete framework for the use of nuclear propulsion systems."

SMR technology features in other maritime-related future fuel proposals beside providing the prime mover in ships. A project by Rolls-Royce SMR, Topsoe and consultancy ULC energy aims to use an SMR to provide electricity and heat energy to produce hydrogen using Topsoe's Solid Oxide

C-Job Naval Architects has carried out extensive research into the possible use of nuclear propulsion

Electrolysis Cell (SOEC) technology. Hydrogen thus produced will have significantly lower carbon intensity compared to conventional hydrogen and can therefore contribute to lowering global GHG emissions in hard to abate industries including shipping.

Sundus Cordelia Ramli, Topsoe CCO Power-to-X, said: "We're excited to investigate the potential of hydrogen from nuclear SMRs and our SOEC electrolysis technology together with ULC-Energy and Rolls-Royce SMR. With our SOEC technology, we can produce more hydrogen relative to influx of renewable power input when compared to competing electrolysis technologies. To enable net zero by 2050, we need to look into all possible technologies, and we're confident that our electrolysis technology will be one of the key components in the race for net-zero."

Safe and economical decommissioning remains an unanswered question. Several years ago, the view was that science would find a viable solution by the time the reactors reached their end of life. Maybe this is still a future hope? ■

Ammonia or nuclear – a question of safety

The question arose recently about whether the industry is doing enough to address the safety aspects of ammonia as fuel, and whether nuclear energy might be just as viable when it comes to zero-carbon ship propulsion.

Nuclear does indeed suffer from a poor public perception when it comes to safety. That's unsurprising when we consider accidents like Three Mile Island, Chernobyl and Fukushima, as well as smaller incidents on land and at sea. But those more serious accidents involved large reactors, with potential to cause widespread radiation. The more modern small modular reactor offers a higher degree of inherent safety, and being compact it can be housed in a solid, damage-proof enclosure.

Ammonia gas – whether used in a combustion engine or as a carrier for hydrogen to power fuel cells - is highly toxic and although inherently non-flammable, it can explode when heated. The use of leakproof double-walled pipework and containment vessels, as well as ensuring low storage temperatures, is essential. However, ammonia does not require the extreme low temperatures and high pressures necessary for some other gaseous fuels. The marine industry has experience of carrying ammonia gas as cargo, so using it as fuel for gas tankers should pose few challenges. It could be a different story when used as fuel for other vessel types, such as bulk carriers and container ships. On these ships, crew will need thorough training and familiarisation with ammonia as fuel. With the shortage of skilled seafarers this could be a challenge.

Maybe it is bunkering that could give nuclear an advantage over ammonia. Once charged with fuel, a nuclear reactor needs little or no attention. Ammonia is a different story. Although ship-to-ship transfers of ammonia have been conducted successfully, in everyday bunkering there is real potential for leaks and spills. And as ammonia has a relatively low energy density, ammonia fuel tanks can encroach on valuable revenue-earning space while nuclear requires no tanks as such.

The classification societies have worked hard to establish safe procedures for handling ammonia as well as protecting nuclear reactors. With the right precautions there is little reason to doubt the theoretical viability of either nuclear or ammonia for greener ship propulsion – but safety has to be the main consideration.

Five ways to counter AI driven maritime cybersecurity threats.....

> *Embed cybersecurity from the outset, turn risks into opportunities by identifying them early, build a cyber savvy workforce, get system level accreditation and foster supply chain co-operation, says consultancy Expleo.*

SOURCE: STEVE ELCE, HEAD OF CYBERSECURITY • UK AT EXPLEO • DIGITAL SHIP
2024

As maritime adapts to the challenges of the digital age, AI has emerged both as a powerful defence tool and a potential threat.

With 90% of global trade carried by ships, the sector is vital to the global economy, yet its growing reliance on interconnected technologies and digital platforms has opened new avenues for cyber-attacks.

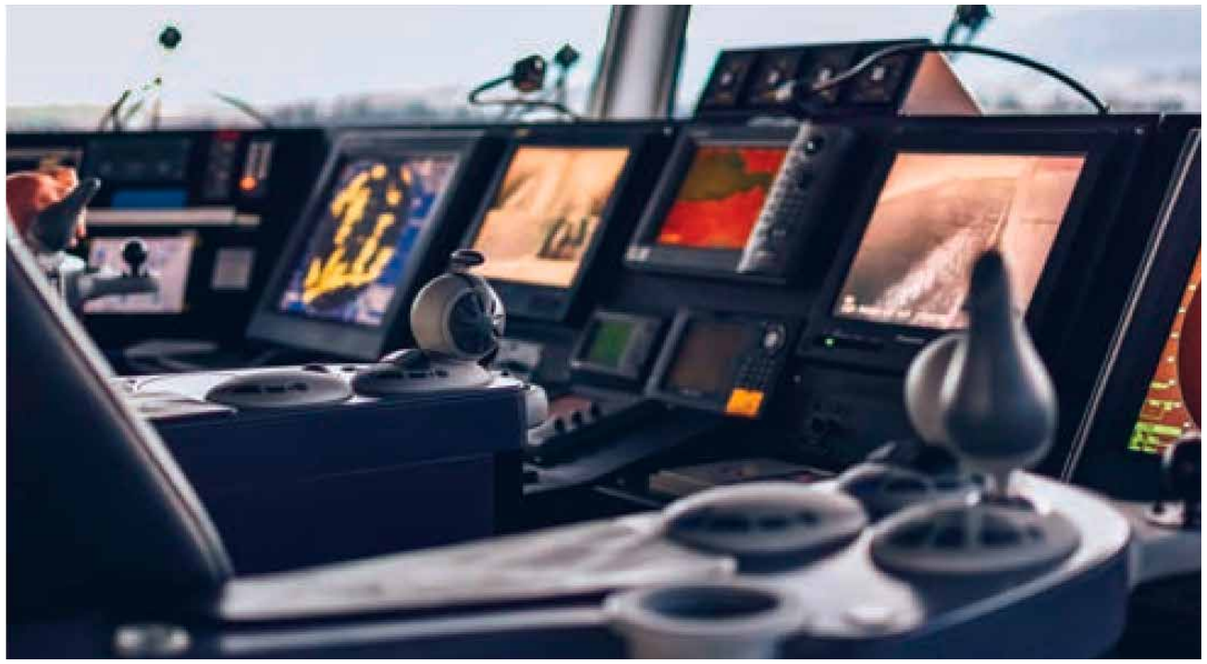
The financial impact of cyber-attacks in the sector is staggering, with some large vessels incurring downtime costs of up to $1 million per day.

In this complex environment, AI presents a dual-edged reality. While cybercriminals can leverage AI to carry out more sophisticated attacks, AI-driven tools also offer unprecedented capabilities for detecting and mitigating threats in real time.

RISING STAKES

Traditionally, cybersecurity in maritime relied on basic defences such as firewalls, antivirus software and network segmentation.

These measures provided a foundational layer of protection, but as ships have increasingly adopted advanced digital technologies. Such as automated navigation systems, onboard data analytics and real-time communication tools.



Bridge technology onboard a vessel

The attack surface has significantly widened. Today, the interconnectedness of various systems onboard vessels means that a single breach can potentially compromise critical operations.

Cyber-attacks can disrupt shipping and port operations and jeopardise communication systems. They also expose cargo to theft, leading to significant financial losses, and can even complicate geopolitical interests and relationships.

In January 2023, approximately 1,000 vessels were affected by a ransomware attack targeting a major software supplier.

Throughout 2022, Europe witnessed a series of ransomware attacks on various ports, including the port of Lisbon, one of Europe's busiest ports.

AI has emerged as a significant driver of cyber threats targeting maritime activities, introducing more sophisticated malware types and accelerating the development of new attacks.

This technology also plays a crucial role in combating these threats. AI tools enhance cyber defences and streamline processes, facilitating better adoption of and compliance with effective cybersecurity practices.

EMBED CYBERSECURITY FROM THE OUTSET

To counter the evolving cyberthreats, cybersecurity must be embedded into the design of every system, process and vessel from the very start of a project.

This 'secure by design' approach ensures that security considerations are integrated at every stage, from initial concept through deployment, reducing vulnerabilities and fortifying defences.

This allows for proactive mitigation of security weaknesses, ensuring that critical onboard systems, such as Automatic Identification System (AIS), Electronic Chart Display and Information System (ECDIS), and Automatic Radar Plotting Aid (ARP A) are resilient from the outset.

By embedding security protocols early on, maritime organisations can create strategies that are both adaptable to evolving threats and compliant with emerging regulatory standards.

A secure by design strategy also cultivates a culture of continuous security, where cybersecurity is not seen as a one-time implementation but as a continuous process throughout the system's entire lifecycle.

This involves ongoing monitoring, regular security updates, incident response planning and vulnerability management to ensure that systems remain secure over time.

TURN RISKS INTO OPPORTUNITIES

Identifying risks early in the design and development stages of maritime systems offers a crucial advantage: it enables the industry to pre-emptively address potential threats before they can be exploited.

AI plays a pivotal role in this process by analysing vast amounts of data from vessels, ports and communication networks to detect emerging risks and patterns that might be overlooked by conventional methods.

AI-driven tools can quickly identify vulnerabilities and anomalies in real time, allowing for proactive responses that help neutralise threats before they become significant problems.

Moreover, maritime organisations can use AI's predictive capabilities to forecast future risks based on evolving cyber-attack patterns.

For instance, during peak shipping seasons, the likelihood of cyber threats may increase due to heightened activity at ports. Companies can adjust their security measures, accordingly, ensuring that their defences are robust enough to handle the anticipated increase in threats.

BUILD A CYBER-SAVVY WORKFORCE

Despite significant advancements in AIdriven cybersecurity technologies, one vulnerability persists, human error. Research shows that human mistakes account for a staggering 68% of successful cyberattacks.

To effectively combat this challenge, employees must be equipped with the knowledge and skills to identify and respond to potential cyber threats, particularly those exacerbated by AI. Investing in regular training and awareness programs focused on AI-driven threats can help foster a security-conscious culture within an organisation.

Shipping companies can implement simulated phishing

exercises that incorporate AI-based attack scenarios, educating employees on common cyber threats such as email scams and social engineering tactics.

These simulations provide valuable hands-on experience in recognising and reporting suspicious activity, enhancing their ability to defend against sophisticated AI-enabled attacks.

UNLOCK SYSTEM-LEVEL ACCREDITATION

Maritime systems are growing more complex, and cybersecurity requirements are becoming more stringent.

A 'secure by design' approach can help maritime organisations meet these challenges by providing comprehensive threat modelling at the design stage and conducting source code audits during testing phases.

This ensures that systems are accredited as secure across their entire lifecycle, from initial deployment to end-of-life.

Compliance with well-established standards like NIST and the recent NIS2 directive creates a unified approach to cybersecurity.

NIST provides a framework for managing and reducing cybersecurity risks, while NIS2 introduces enhanced security measures for critical infrastructure, including maritime operations.

Together, these standards ensure that maritime organisations adopt best practices, mitigating risks in an increasingly digital environment.

The upcoming UR E26 and UR E27 standards, effective from Jan 2024, will set minimum cybersecurity requirements for newbuild vessels and their critical on-board systems.

FOSTER SUPPLY CHAIN CO-OPERATION

The maritime industry operates within a complex ecosystem of external suppliers and third-party partners, including freight forwarders, customs agencies, and numerous service providers.

To effectively combat cybersecurity threats, collaboration across the entire supply chain is essential.

Any vulnerabilities left unaddressed can create openings for cyber-attacks that not only target individual organisations but can also escalate to affect multiple entities within the network.

Maritime organisations must prioritise ensuring that robust digital security practices are uniformly applied across all supply chain participants.

Lessons from past cyber incidents, such as the Maersk NotPetya attack, underscore the potential for widespread disruption when security gaps in the supply chain are exploited.

Establishing formal agreements with partners and contractors that clearly define cybersecurity requirements, including audit rights, will be key to mitigating such risks.

EMERGING THREATS

The increasing adoption of AI brings significant advancements in threat detection and response capabilities, yet it also gives rise to new cybersecurity challenges, including the emergence of malware specifically designed to manipulate AI models.

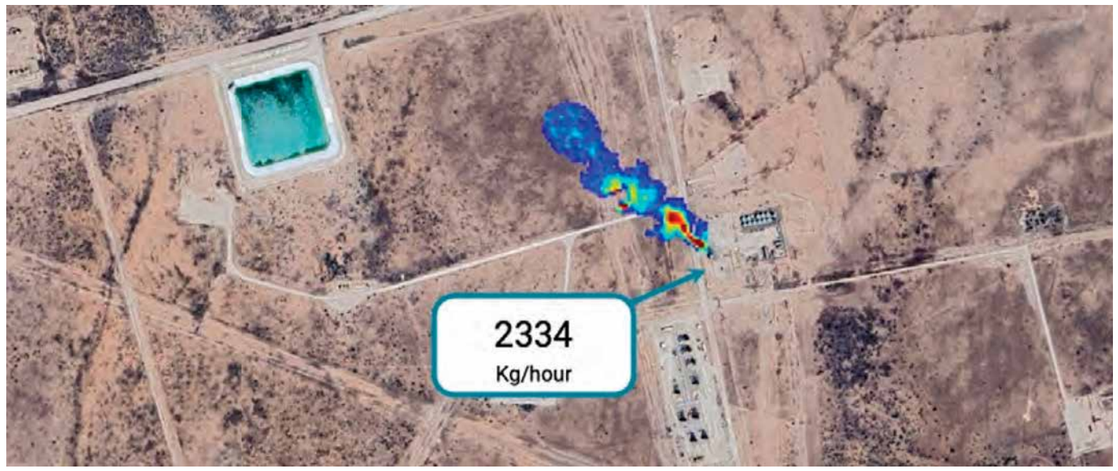
Adversarial AI (AAI) represents a new frontier in cyber threats, where attackers use AI to exploit and manipulate the very AI systems designed to protect maritime operations.

AAI could target anomaly detection models used to monitor ship navigation systems, feeding them false data to disguise the presence of an ongoing cyberattack.

This could result in ship rerouting, loss of control over automated navigation, or false alarms, all of which could disrupt operations. The maritime industry must address these emerging threats by investing in AI systems that are robust against adversarial techniques. ■

Momentick advances emission monitoring with satellite technology.....

SOURCE: JACK BURKE • COMPRESSORTECH2
NOVEMBER 2024



Emissions seen at a production site in Texas.

In the evolving landscape of environmental regulation and climate change mitigation, emission monitoring has taken center stage. Momentick, an emission intelligence company led by CEO and Co-Founder Daniel Kashmir, is at the forefront of this critical effort, leveraging cutting-edge satellite technology to provide comprehensive data on greenhouse gas emissions.

Founded with the initial focus on methane emissions from natural gas, Momentick intends to expand its offerings to include the monitoring of nitrogen dioxide and carbon dioxide (CO2) in the near future. This evolution reflects a growing recognition of the diverse range of emissions impacting our environment and the need for robust monitoring solutions.

INNOVATIVE APPROACH TO EMISSION MONITORING

What sets Momentick apart is its unique approach to data collection and analysis, Kashmir said. Instead of investing in hardware like satellites or spectrometers, the company has developed an autonomous algorithm that processes satellite imagery to identify and quantify emissions. This software-centric model allows Momentick to operate as a cost-effective solution for companies in the energy sector.

"Our algorithm not only detects whether emissions are present but also quantifies the emission rate in kilograms per hour from specific leaks," said Kashmir. "We provide clients with precise locations of these leaks, which is crucial for effective remediation."

Momentick partners with six satellite suppliers to achieve global coverage, offering monitoring capabilities every 48 hours. This frequency is set to increase to every 24 hours by 2025 as the company continues to expand its satellite partnerships.

The need for sophisticated emission monitoring is underscored by the challenges facing the oil and gas industry.

Many pipelines and refineries operate with aging infrastructure, leading to increased risk of leaks. According to the Environmental Defense Fund, only 7% of nearly half a million miles of oil and gas pipelines in the U.S. are actively monitored for emissions.

Kashmir emphasized the importance of historical data in their monitoring approach.

"We can track emissions over time and alert companies to persistent leaks, helping them save money and improve safety," he said.This capability is particularly beneficial for pipeline companies, which may not have the resources to monitor every segment of their infrastructure manually.

"We provide clients with precise locations of these leaks, which is crucial for effective remediation."

DANIEL KASHMIR, CEO Momentick

REGULATORY LANDSCAPE AND FINANCIAL IMPLICATIONS

As regulations surrounding emissions intensify, Momentick's services have gained traction not only among energy companies but also within the financial sector, insurance firms are increasingly interested in understanding the emissions profiles of their portfolios, prompting a demand for accurate and timely emission data.

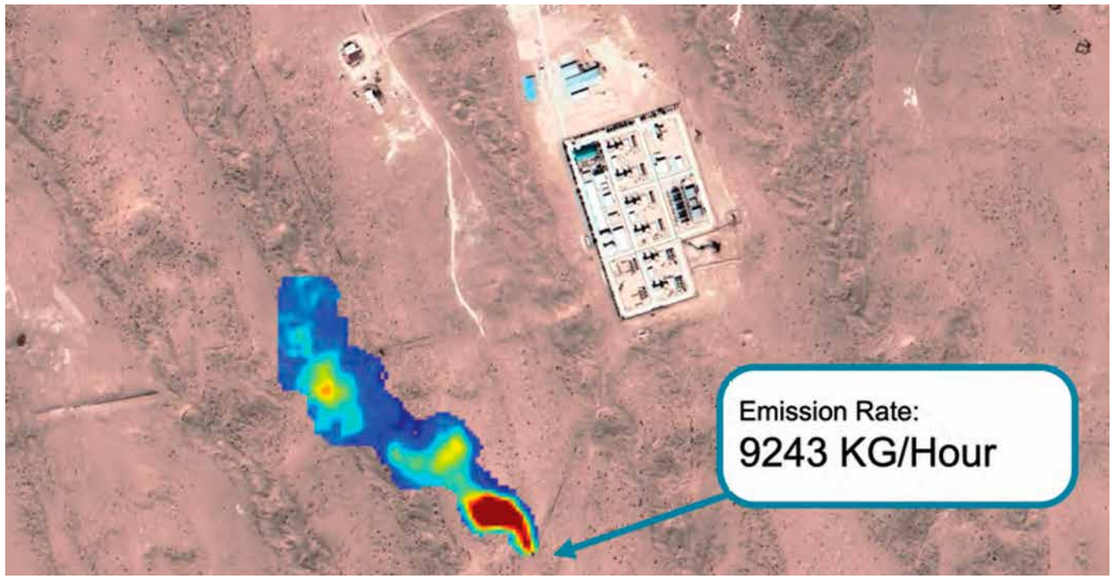
"We're helping companies reduce emissions not just for compliance but also for internal purposes. Understanding their emissions can lead to significant cost savings and risk mitigation," Kashmir said.

This insight positions Momentick as a strategic partner in an industry that is under increasing scrutiny from regulators and the public alike, he said.

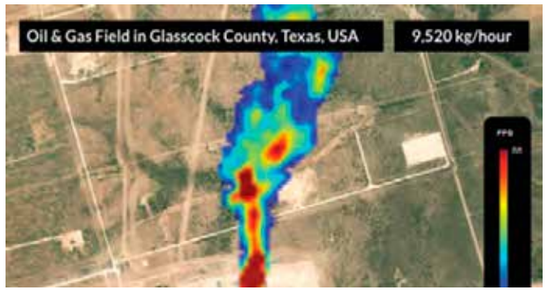
SATELLITE DATA

While other methods of emission detection, such as ground sensors and aerial imaging via drones, exist, Momentick's reliance on satellite data offers several advantages. Ground sensors are often limited in scope and effectiveness, while aerial monitoring can be prohibitively expensive and logistically complex.

"Satellites provide a cost-effective way to monitor vast areas with a frequency that is unmatched by other methods," says Kashmir. "We can cover entire regions and provide comprehensive data quickly, allowing companies to act on emissions before they become significant problems." →»



TUKMENISTAN Transmission pipeline in Korphezh.



FUTURE DIRECTIONS AND MARKET EXPANSION

Looking ahead, Momentick plans to continue expanding its capabilities within the emission monitoring space. The company is exploring additional gases and materials relevant to the energy sector and is considering applications in landfill emissions and coal mines.

Kashmir highlights the need for continuous innovation in emission monitoring.

"If you can measure it, you can reduce it. Companies need to know the reality of their emissions before they can take action to reduce them," he said.

As the energy sector grapples with increasing regulatory pressures and public expectations for transparency,

Momentick is well-positioned to be a key player in the effort to reduce greenhouse gas emissions. With its unique approach to data collection and analysis, the company is paving the way for a more sustainable future.

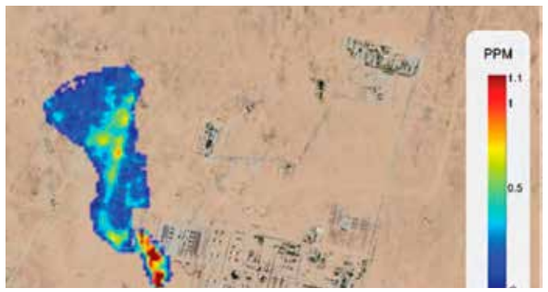
OFFSHORE METHANE

The company's technology opens up new possibilities for offshore methane detection and monitoring in satellite images by overcoming complex conditions that can prevent accurate emissions identification and quantification over water. These advanced solutions enable accurate methane detection over water regardless of weather conditions.

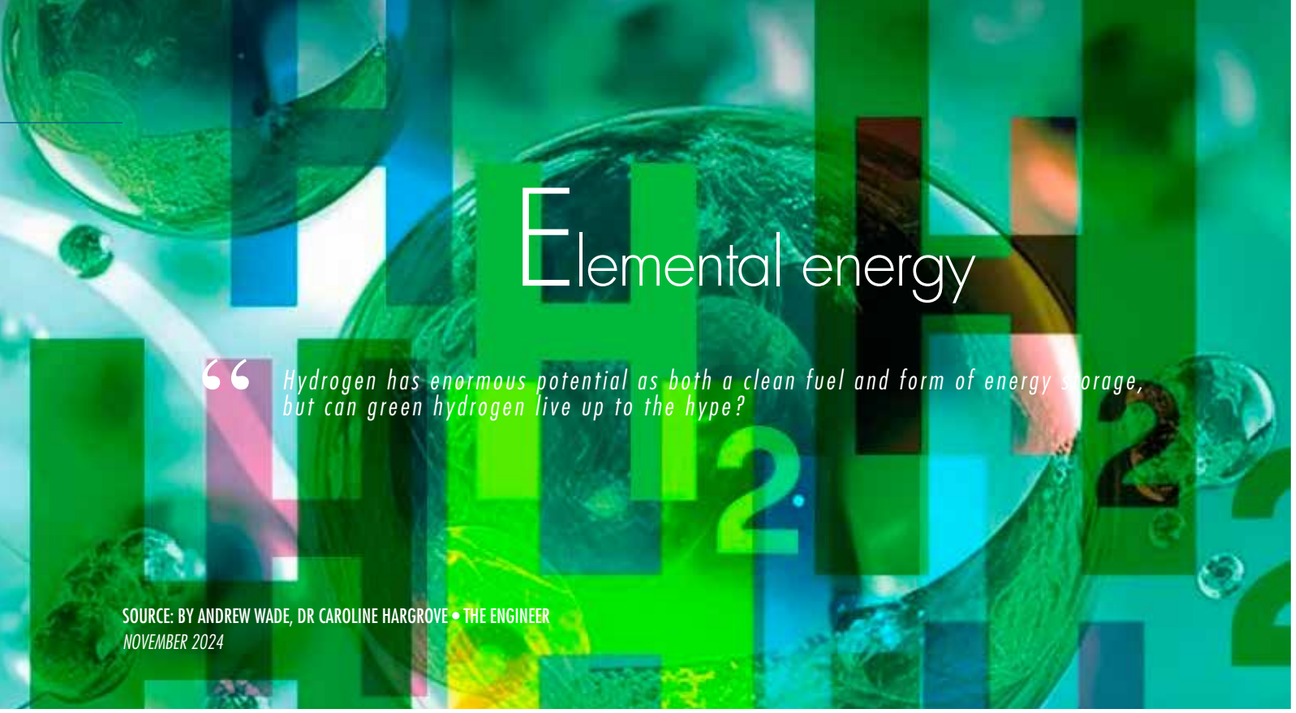
The advancements made by Momentick in emission monitoring offer a step forward in environmental accountability.

By harnessing satellite technology and sophisticated algorithms, the company is providing energy firms with the tools they need to not only comply with regulations but also to proactively manage their emissions.

With its innovative solutions and commitment to reducing greenhouse gases, Momentick is not just measuring emissions; it's helping to shape a more sustainable future for the planet. ■



A view of emissions from a facility in Uzbekistan found by Momentick's technology



Elemental energy

Hydrogen has enormous potential as both a clean fuel and form of energy storage, but can green hydrogen live up to the hype?

SOURCE: BY ANDREW WADE, DR CAROLINE HARGROVE • THE ENGINEER
NOVEMBER 2024

Considering hydrogen is the most abundant, fundamental element in the universe, it engenders no end of engineering complexity. Its potential as both a clean energy vector and a mode of storage has seen it hailed by many as a key pillar of the energy transition. Others, however, see it as a massive, inefficient folly driven largely by the fossil fuel giants, eager to continue selling us chemical fuels of whatever stripe they can, regardless of environmental credentials or practicality.

In 2022, global hydrogen production was valued at over $155 billion, with that figure expected to grow at an annual rate of around 10 per cent through to 2030. Virtually all of this hydrogen - 99 per cent - is derived from fossil fuels, predominantly steam methane reforming of natural gas. For every ton of hydrogen produced this way - known as grey hydrogen - 10 tons of CO2 is released into the atmosphere. If the CO2 is captured, the hydrogen is referred to as blue, something the oil and gas majors have a particular interest in, for obvious reasons.

There is a rainbow of other colour coded hydrogen variants, including turquoise (methane pyrolysis), pink (nuclear-powered electrolysis) and gold (mined from deep within the Earth's crust). As mentioned, no shortage of complexity.

Ultimately, however, a sustainable hydrogen economy will need to deliver green hydrogen, whereby renewable energy is used to power electrolysis, splitting water into hydrogen and oxygen. Surplus off-peak renewable power - think strong overnight winds - is often held up as the ideal companion for this green hydrogen future.

As is often the case with RD, the UK can claim to be a leader in fundamental hydrogen technology, though is perhaps falling short when it comes to implementation. In July 2023, this year's MacRobert Award - the UK's most prestigious prize for engineering innovation - was presented by the Royal Academy of Engineering to Ceres Power. Spun out of Imperial College in 2001, Ceres has long been a leader in the development of solid oxide fuel cells (SOFCs), an electrochemical technology that converts hydrogen (and other fuel sources, including hydrocarbons) into electrical power.

Ceres has recently invested millions to tweak its core Steel Cell technology so that it can now also work in reverse, acting as an electrolyser that produces hydrogen using electricity. It's fair to assume this latest development played a key role in winning over the MacRobert panel. Chair of that panel, Professor Sir Richard Friend, hailed it as "a huge game changer for hydrogen generation', saying the conversion losses were the lowest he has ever seen.

Inputting ambient air, 150"C steam and electricity, the SOEC (solid oxide electrolyser cell) produces hydrogen with close to 90 per cent efficiency, according to Ceres. This is significantly higher than existing electrolysis technologies and could be a major step towards making green hydrogen price competitive with its grey counterpart.

One key factor driving that efficiency is the high temperature at which the SOEC operates, hitting around 600"C. Combining the technology with existing industrial processes, where heat is a by-product, promises even greater gains. By 2025, Ceres says it hopes to produce hydrogen at a levelised cost of $1.5/kg, comparable to the cost of grey hydrogen today.

"Ultimately, the USP of our technology is that it's so much more efficient if you have waste heat or heat in the system, and a lot of big industrialised systems do," Dr Caroline Hargrove, Ceres Power's chief technical officer, told The Engineer. "When you do, you start with at least 20 per cent more efficiency than PEM (Proton Exchange Membrane) and alkaline (electrolysis). And that's the market that we want to go after."

"Our CapEx is a bit higher, but because the efficiency is so much better, the levelised cost of hydrogen is also so much better with this technology. Therefore industries that are 24/7-on really benefit from that and these is the type of industries that hydrogen is core to decarbonise."

Those industries include steel, chemicals and e-fuels, where production takes place on a vast scale and huge amounts of heat are available. Having formerly held the CTO role at McLaren Applied, Hargrove has experience overseeing technology transfer to a variety of sectors. She joined Ceres in 2018 as a non-executive director and was appointed CTO in 2021, just as the company was investing millions into evolving its offering to include hydrogen production.

Ceres' Steel Cell technology is well established for fuel cell operations and has licensing partnerships in place with industrial giants including Bosch, Doosan and Shell. Adding electrolysis into the mix may well be a 'game changer', but as with all new technologies, it needs to prove itself in the field.

The company is currently developing two MW-scale SOEC demonstrator units. The first is due to be delivered to Shell's Bangalore RD centre in November 2023. The second is being developed in partnership with Linde and Bosch, sited in the latter's Stuttgart heartland. Operational in 2024, the two year demonstration will assess SOEC's suitability for large scale industrial applications.

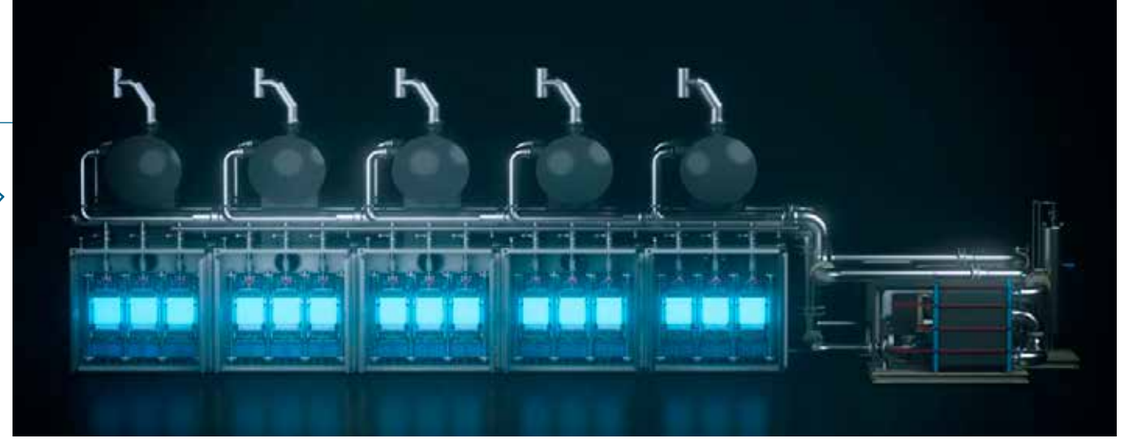
"(Bosch) will be doing this alongside Linde Engineering in order to see how it works," said Hargrove. "Like everything else, they want to see it work in electrolysis mode."

Data from the two demonstrators -assuming it lives up to the hype - will then be used to pitch other clients. These containerised MW modular units could then form the backbone for much larger deployments.

"There's interest in the market and they want to see proof points," Hargrove continued. "What we're working on in the background is what would a 100MW plant look like, because that's the kind of amount that you need in an industrial context."

Ceres may have designs on the 100MW scale, but there is a UK hydrogen player already at that point. Sheffield's

A 5kW SteelCell stack, and one of the MWscale SOEC units that Ceres is about to deploy



Above: Poseidon, a 20MW PEM electrolyser module recently unveiled by ITM Power

!TM Power - also in partnership with Linde - is building electrolysers for two IOOMW projects for Germany's RWE, set to be powered by offshore wind from the North Sea.

'We are building two 100MW projects for RWE at Lingen - the biggest PEM electrolysers in physical build today," Pedram Pazouki, ITM's product & engineering director, told The Engineer.

"The UK and Germany announced their first bi-lateral agreement on 26 September, which happened to be on hydrogen, and which underlines both countries' belief that an effective hydrogen economy will play a critical role in the energy transition."

Pazouki came across to ITM from Linde in early 2023. Much of his work since then has been focused on Poseidon, ITM's new 20MW PEM electrolyser module. Having gradually built its capabilities since it was founded over 20 years ago, ITM opened its Sheffield gigafactory in 2021. Poseidon now marks the next step-change in the company's ability to deliver on industrial scale hydrogen projects.

"Poseidon is a modular core electrolysis process unit - a building block enabling scale up," said Pazouki.

"It consists of skid-mounted units which can be prefabricated and pretested. This leads to reduced deployment times and low project costs. For a 400MW project for example, whether that be for indoor or outdoor installation, 20 Poseidon modules would be coupled."

As both Ceres and ITM can attest, Germany is ahead of most in terms of electrolysis deployments. Recently, the country doubled its 2030 green hydrogen target to 10GW. The UK also a has 10GW 'low carbon' hydrogen target for 2030, though that is expected to be a mix of both green and blue, with much riding on improved carbon capture technology.

Ceres' Hargrove may have skin in the game on the green side of the equation, but also believes carbon capture has a role to play. What's vital, says the CTO, is that grey hydrogen is phased out as quickly as possible. This would not only cut emissions, it would also provide the right market signals to the clean hydrogen ecosystem.

I WOULD PUSH FOR A DATE FOR BANNING GREY HYDROGEN

"I would push for - not just in the UK, but all of the EU at the very least - to give a date for banning grey hydrogen," said Hargrove. "Push CCS, which we desperately need as well. Because as part of the mix, we need better carbon capture technology."

Hydrogen today acts predominantly as a feedstock for things like ammonia and methanol, as well as in oil refining, where it is used in hydrocracking heavy petroleum sources into lighter fractions. This hydrogen is almost exclusively consumed at the point of production, stored only for short periods as a compressed gas or a cryogenic liquid.

The steam methane reforming that drives today's hydrogen economy accounts for almost two per cent of global greenhouse emissions. Even if a wider, more exotic hydrogen economy - one powering transport, green steel, and domestic heating- doesn't come to fruition in the way many envisage, existing hydrogen production will still need to be decarbonised. But for hydrogen to truly take off, innovative storage methods will be essential.

One UK company taking on the storage challenge is H2Go Power. Its core technology is a solid-state, highly porous nanoparticle-based material that essentially acts as a hydrogen sponge.

A patent-pending reactor module is certified to operate between 1-10 Bar and below l00°C, storing 1kg of hydrogen that can deliver 16 kWh of electrical energy. Scaled up and paired with electrolysers, containerised units will be capable of providing long-term, grid-scale storage, according to the company.

'We're agnostic to what we integrate with," said Dr Enass Abo-Hamed, cofounder & CEO of H2Go Power. "We don't have single blue hydrogen (project) today in the company, but our system is also colour agnostic.

'We don't build electrolysers, but we can integrate them into an end-to-end system or integrate our technology into existing systems."

Alongside its storage technology, H2Go has also developed an analytics platform that predicts the best time to generate and use hydrogen. Known as Hy Al, the analytics system is integral for maximising the potential of H2Go's storage hardware and can also integrate with third-party infrastructure, according to Abo-Hamad.

"Hy Al, alongside our smart hardware storage system, addresses the unique operational challenges that come with system design, production, storage, distribution and conversion of hydrogen as a commodity," she said.

"This is a SaaS platform. We have commercial customers working currently on some of the largest hydrogen projects in the world, multi gigawatts, using Hy Al to optimise the design of the project so decisions can be made based on intelligence."

This kind of intelligence will be vital if hydrogen has a prominent role to play in future energy systems. As renewables expand, the potential for 'wasted' generation also increases. Having outlets that can soak up and store excess clean power at any time of day or night will be essential.

"Maybe the (long term) solution is everything needs to move to electricity … but on that journey, hydrogen's got a massive part to play in helping, I think," Greg Howett, cofounder and CEO of The First Element, told The Engineer. "We can't control when it's windy, we can't control when it's sunny.

"There's wind farms in Scotland- for want of a better word - throwing electricity away. They haven't got consumers for it at the right times. And that's a problem that's only going to grow as we try and get more of the grid on to renewables."

The First Element's answer to this problem is the Smart Tank, which combines hydrogen production, storage and release in a single package designed for domestic use. The IoT-enabled device will track the price of electricity, generating hydrogen via electrolysis with cheap off-peak power.

I'm on Octopus. I pay 5p at night and I pay 35p in the daytime. So there's a massive differential," said Howett.

Having studied robotic engineering at university, Howett previously set up an advanced networking software business before founding The First Element in 2021. One of his co-founders is Professor Nigel Brandon, Dean of Imperial's Faculty of Engineering and also a co-founder of Ceres Power back in 2001. Brandon has decades of experience in fuel cells and electrolysers, but The First Element is working with third parties on the Smart Tank's storage component, which is a metal hydride carrier.

"On the hydride side, we've partnered with Professor David Grant, who's at the University of Nottingham. And David is one of the authorities on metal hydrides," said Professor Brandon.

Delivering all this affordably at consumer scale is a daunting task however. Electrolysers, for example, typically have expensive components like chemical membranes as well rare earth elements such as platinum and iridium.

'A lot of the technology relies on these rare earth metals," said Howett. "We want to scale this business, we want to have hundreds and hundreds of thousands of these tanks. How do we find an electronic solution that's affordable?"

According to Howett, an Oxford-based partner has a patent on a new type of copper nanotube catalyst that requires no iridium or platinum.

"If they can successfully develop that into a product that's reliable and that can last, then that could be an amazing opportunity," he said.

The First Element is currently developing a prototype Smart Tank, which it expects to unveil in the coming months. Resembling a mid-sized fibreglass propane bottle, it packs an impressive amount of technology into a tidy footprint.

Howett readily admits that electrification should be the first port of call in the energy transition. However, he believes there are numerous use cases where it is simply not an option, and the Smart Tank could fill those gaps.

"We're working with some progressive holiday parks," he said. "One's got 45,000 units. They all run on LPG. They're the biggest consumer of bottled gas in the UK. They cannot get any more electricity to site. They're all remote sites, they've got single phase power and they can't get upgraded. They know that LPG is going to be banned, but what are they going to do?"

Despite the UK's National Infrastructure Commission (NIC) recently ruling out hydrogen as a viable technology for domestic heating, Howett believes many niche cases will still exist. Once the Smart Tank is ready, the First Element plans to host a launch event showcasing it generating hydrogen, as well as powering a boiler and fuel cell. Howett is also keen on the idea of a hydrogen BBQ, something that first inspired the idea for the Smart Tank.

"It's the ultimate sort of cooking gas," he said. "It burns nice and hot. It's beautifully clean. It produces water vapour that improves the food moisture.

"I want to cook my sausages on hydrogen."

From decarbonising industry to moist bangers, hydrogen supposedly does it all. Now it's time to deliver on the hype. ■

A prototype design of The First Element's Smart Tank

Impact versus impact.....

“ Comparison of different filter modes for vibration measurement

SOURCE: BY JAN LOKEN, CUSTOMER SUPPORT, PROGNOST SYSTEMS GMBH, RHEINE, GERMANY • COMPRESSORTECH2
NOVEMBER 2023

ABSTRACT

Root cause analysis, impact detection and verification for reciprocating machinery such as piston and hyper compressors are always challenging. When talking about condition monitoring of reciprocating machines, vibration signals are an integral element used for monitoring of different components, such as crosshead, valves, frame, etc. Analysing vibration signals is a challenge for each monitoring system, and analysts needs to be aware of the filter configuration to take the right conclusion for proper action. The goal is to minimize nuisance alarms and maximize the capability of early (automatic) failure detection.

Filtering a vibration signal helps to avoid noise, but on the other hand it should be set in the right way to indicate problems and not conceal them. For the right procedure, filtering, and protection limit adjustment always must be considered together.

In the paper, signal analysis considerations and their consequences for failure detection will be explained, such as filtering, analysing RMS vs. Zero-to-Peak, Good vs. Bad condition, etc.

The paper introduces the theoretical background proven by real-life case studies as an add on the publication of Dr. Eisenmann and Mr. Franz4. It is showing different failures on crossheads, piston/ plunger, and valves.

1 INTRODUCTION

History has shown that within the fleet of reciprocating compressors numerous catastrophic failures result in significant losses. Although adequate machinery protection systems are available, they are not always in place or applied correctly to avoid catastrophic failures.

Numerous case studies with several different failure modes identify that appropriate frequency filter setting have major impact on the machinery protection system's ability to function as needed when critical conditions arise. Additionally, the application of RMS-based analysis instead of peak-analysis is also discussed.

This article discusses the most important aspects to consider when implementing machinery protection systems using crosshead acceleration and frame velocity on reciprocating compressors - specifically:

- Requirements and the Frequency Filter Setting Challenge
- Signal analysis consideration - Filter Setting / RMS / Peak
- Crosshead acceleration - Why - Where applied - Effective analysis approach
- Frame velocity - Why - Where applied - Effective analysis approach
- Conclusion

Knowledge surrounding proper low pass filter settings for acquisition systems performing critical shutdown function is very limited and often misapplied. 2 kHz is used in several ISO vibration standards such as ISO 20816-83. This paper illustrates why the common practice of setting low pass signal filters at 2 kHz introduces risk that serious failure modes go undetected compromising plant safety, health, and the environment.

Which frequency range should be used for the low pass filter for crosshead guide acceleration to provide the earliest and best representation of the compressor health? Figure 1 is an example of crosshead guide acceleration data from 0-7 kHz during an event showing what data would be missed if only 0-2 kHz verse 0-7 kHz are used.

In the case studies investigated, we can conclude that frequency filter setting is vital in detecting failure modes such as wrist pin seizures, developing cracks in pistons and piston rods.

2 SIGNAL ANALYSIS CONSIDERATIONS

2.1 RMS

Modern machinery protection systems apply a fully continuous online RMS analysis of focus signals such as

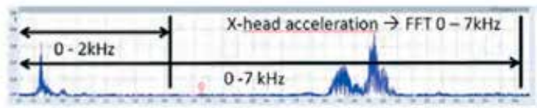


FIGURE 1: Crosshead guide acceleration data from O-7 kHz during an event (in"g").

crosshead acceleration and velocity. This is a beneficial approach specifically on reciprocating compressors where an early indication of damaging impacts is of the essence and RMS values are best to describe the energy within a given signal as calculated by the equation in figure 2.

$$x_{rms}=\sqrt{(1/n)\ (x\_1\hat{}2\ +x\_2\hat{}2+\cdots+x\_n\hat{}2)}$$

Figure 2: RMS value for an evaluation period represented by a number of "n" data samples is the square root of the arithmetic mean of the squares of the "n" values.

While the proper representation of contained energy is a positive factor, there is a risk that individual, high data samples get lost in the average. This is specifically the case if the number of total samples "n" in the evaluation period is high e.g., when the Xrms equation above is evaluated over one entire revolution of the rotating machine or one second eventually containing hundreds or thousands individual data samples. Furthermore, the reliable RMS computation and alarming in real time requires modern, redundant CPUs to handle this significant processor workload eventually occurring on multiple sensor channels in parallel.

2.2 Zero-to-peak analysis

Some systems take a different path by employing Zero-to-Peak (Peak) or Crest Factor analysis instead of RMS, like mentioned in Appendix D of ISO 20876-83. This addresses the effect that RMS analyses may undervalue high individual samples when evaluation periods are relatively long (e.g., l compressor revolution or 0.2 sec 300 rpm) and compares maximum values detected in that period against a set of Alert and Shutdown limits.

Unfiltered peak analysis however leaves users vulnerable for nuisance alarms, e.g., caused by isolated, high frequency events. non-repetitive signal spikes and sensor glitches.

In order to address these nuisance alarms some users apply a low pass filter (e.g., 2 kHz) so only the 0-2 kHz frequency content is analysed for its peak vibration content.

While the above strategy reduces nuisance alarms when using peak analyses, it also eliminates capability to detect many critical failure modes containing majority damaging energy in higher frequency ranges as will be discussed next.

2.3 Crosshead - acceleration sensors

Looking at the working principal of reciprocating compressors the crosshead clearly is a focal point. Here, the rotating movement of the crankshaft is transformed into a reciprocating (linear) movement of the piston rod. It is the central component where the major drive forces are transferred from the running gear to the crosshead and ultimately the piston rod assembly. To contain these forces into the right direction, the crosshead travels within the crosshead guide. The crosshead guide is the most direct connection of the running gear to the frame/crosshead guide and therefore is the best position to install vibration sensors. Therefore, API 6701 - (Annex P.4.3.4.4) recommends that crosshead accelerometers should be mounted in the vertical direction on the top or bottom of the crosshead guide as shown in Figure 3. API 6701 also stats that a monitoring system should be capable to monitor at least 2 kHz, with the add on "up to 7 kHz", which is useful in many cases (Chapter 3).

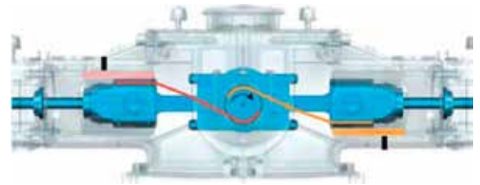


Figure 3: Proper placement of crosshead accelerometers- ideally these are installed vertically, external to the loaded crosshead shoe.

2.4 Frame - velocity sensors

The reciprocating compressor frame and crosshead guides are the stationary components anchored to the foundation to retain the compressor during operation. The frame/foundation is subjected to the normal unbalanced forces and moments from the reciprocating compressor inertial and gas loads as well as forces experienced during failure events. Transducers placed on the corners of the frame in the horizontal and/or vertical direction are used to detect issues with the support structure/foundation. Transducers mounted in the horizontal direction directly opposing each throw are used to detect impacts and mechanical issues. API 6182 also identifies high frame vibration as alarm and shutdown parameter but does not fully define what should be provided. API 6701 clause P4.3.4.2 and P4.3.4.3 identify the recommendations of frame monitoring and running gear monitoring respectively.

In many cases the acceleration sensor on the crosshead detects machine issues earlier like a frame velocity sensor, therefore following chapters focus on acceleration monitoring and filtering. Anyhow the velocity sensor is important as an additional information about low frequency vibrations at the machine and notable in this paper. →»

3 PRACTICAL EXAMPLES AND CASE STUDY MATERIAL FOR ACCELERATION SIGNALS

3.1 Seized wrist pin

During the commissioning and start-up of a new API 6782 compressor in H2 service the machine was suddenly tripped by the machinery protection system. A first data review revealed that crosshead acceleration amplitudes reached the default protective limits having saved the asset from consequential damage or loss of containment.

During a detailed analysis of the high-resolution data available this first case study is an excellent example illustrating the importance of high frequency (0-7 kHz) data for effective machinery protection with crosshead acceleration sensors.

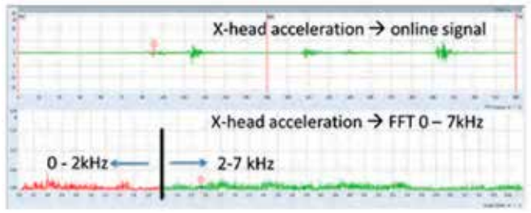


Figure 4: Good condition signal - Top: time waveform, online signal (0-7kHz) Bottom: Spectrum 0-7kHz.

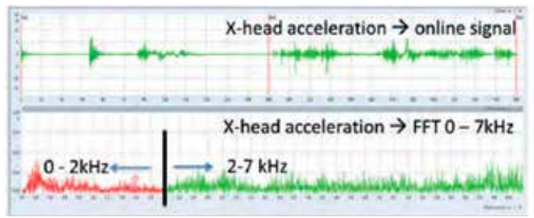


Figure 5: Bad condition signal - Top: time waveform, online signal (0-7kHz) Bottom: Spectrum 0-7kHz.

The wrist pin seizures detected did not involve true mechanical impacts typical of loose components (showing lower frequency content primarily below 2kHZ). Comparison of Figure 4 "Good Condition Signal" to Figure 5 "Bad Condition Signal" shows most of the failure related energy as well as relative signal change has higher frequency content above 2 kHz. To initiate the trip function prior to a catastrophic failure and potential loss of containment the full 0-7 kHz frequency spectrum suggested by API 6701 must be monitored.

3.2 Failed piston rod

A broken piston rod is potentially one of the worst-case failure scenarios for a reciprocating compressor. Detecting this critical failure mode timely and accurately is very important.

This end user suddenly experienced increased crosshead acceleration impacting which ultimately lead into an automatic shutdown of his protection system. The maintenance team found the piston rod failed within the thread region connecting the piston rod and crosshead as shown in Figure 6. This second case offers additional insights regarding the importance of proper frequency filter settings.

The online vibration and spectral data shown in Figure 7 represents a very characteristic crosshead acceleration signal of a reciprocating compressor with some limited vibration around the rod load reversal points and little to no energy content visible in the higher frequency section within the FFT spectrum.

Please note that those data plots following now titled with "bad condition" represent data from the revolution when the machine was automatically tripped by the machinery protection system. Before that the vibrations increased over time.

As shown in Figure 8 a true amount of energy was found between 4-5 kHz which made us apply different frequency filters to determine how important the appropriate filter setting really is to detect a case like this effectively.

Figure 6: Fragments of the piston rod thread region. Top view of the failed piston rod thread region.

When comparing the "good" (Figure 9 bottom) vs "bad" (Figure 9 middle) 0-2 kHz the measured online signals differ not much, and a machinery protection system would have missed this critical failure if the signal does not exceed and alarm or trip level.

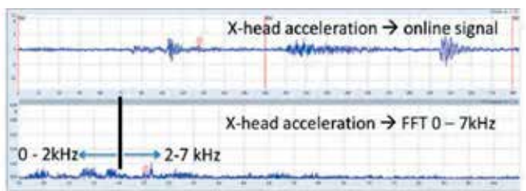


Figure 7: Good condition signal - Top: time waveform, online signal (0-7kHz) Bottom: Spectrum 0-7kHz.

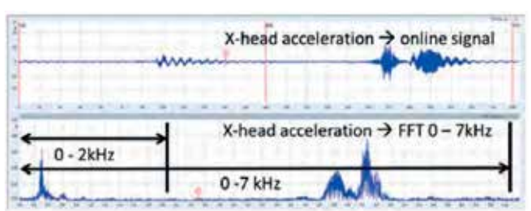


Figure 8: Bad condition signal - Top: time waveform, online signal (0-7kHz) Bottom: Spectrum 0-JkHz.

→ The failure however becomes obvious inside the online data set "bad" at 0-7kHZ (Figure 9 top) which shows a significantly different picture and lot of energy around

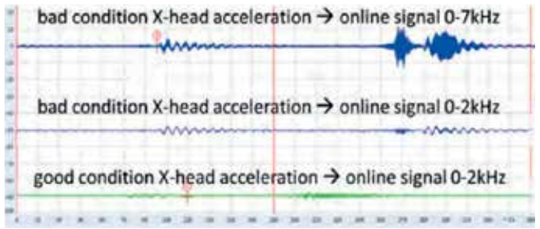


Figure 9: 360° crank angle signals applying different filters 0-2 kHz and 0-7kHz under good and bad condition.

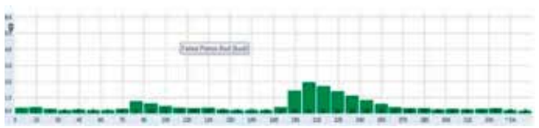


Figure 10: Good condition O- 7KHz RMS 36 segmented analysis

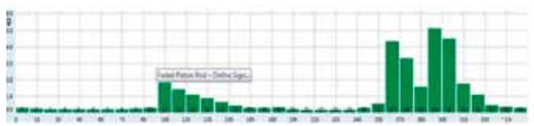


Figure 11: bad condition O - 7kHz RMS 36 segmented analysis.

270° crank angle (CA) and 300°CA not visible in the "bad" 0-2 kHz filtered online data (Figure 9 center).

This failing piston rod was automatically detected using a 36 segmented RMS analysis of the crosshead acceleration signal using the full signal bandwidth (in this case 0-10 kHZ).

It subdivides each revolution in smaller segments (e.g., 10-degree crank-angle wide increments) each with a dedicated protection limit. Areas with naturally higher vibration levels within each revolution (e.g., rod load reversal points) get the appropriate focus and at the same time solid ten-degree averages eliminate isolated spikes in each segment.

While we have discussed the basics of RMS vs. Peak analysis in a previous chapter, a 36 segmented RMS vibration analysis combines the best of both approaches.

Reviewing data plots of Figure 10 and Figure 11 above the effectiveness of this approach becomes apparent. Segments 27-33 (270-330%CA) show a massive increase in amplitude for 0- 7 kHz - some by more than factor 10.

However, even when applying a sophisticated analysis like the 36 segmented RMS analysis it should include higher frequency data. Figures 12 and 13 represent data employing a 2 kHz low pass filter. Between good (Figure 12) and bad condition (Figure 13), a much lower relative change in amplitude is found - and while under good condition worst acting segments show around 1g - values only increased to 1.3g as the piston rod cracked due to the fact that the majority of failure related energy is filtered out and not part of the evaluation.

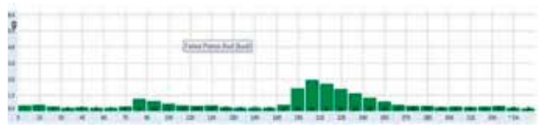
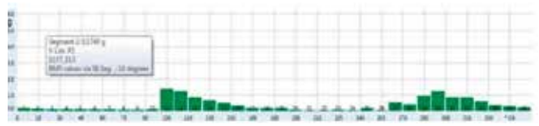


Figure 12: Good condition 0 - 2 kHz RMS 36 segmented analysis.



Figuur 13: Bad Condition 0- 2 kHz RMS 36 segmented analysis.

4 Conclusion and recommendations

The latest additions to API 6701 provide valuable information for machinery protection on reciprocating compressors. Specifically, the addition of crosshead acceleration is essential, and users should take care employing this powerful protection parameter at its best capacity. As we have demonstrated certain failure modes show majority of energy at higher frequencies (e.g.,4 - 7 kHz). This is why we suggest following API 6701 and employ full signal bandwidth 0-7 kHz ideally combined with a segmented RMS analysis - this way repetitive impacts are not missed at critical stage and RMS based segments represent a solid (e.g., 10°crank angle) weighted average, and single isolated signal spikes do not lead to nuisance alarms, which may occur using unfiltered peak analysis.

Modern machinery protection systems employing crosshead acceleration sensors in the first place and frame velocity as an additional layer of protection per recommendations provided within this paper will help detecting many critical failure modes in an early stage preventing catastrophic failures. ■

REFERENCES: 1 API Standard 670, 5th Edition, November 2014 - Machinery Protection Systems I2 API Standard 618,
5th Edition, December 2007 - Reciprocating Compressors for Petroleum, Chemical and Gas Industry Services / 3 DIN ISO 20816-8, December 2018, Mechanical vibration - Measurement and evaluation of machine vibration- Part 8: Reciprocating compressor systems

CITATIONS: 4 Paper based on "Why proper low-pass filter settings on crosshead vibration signals are crucial to minimize risk of missed detects', Turbomachinery and Pumps Symposia 2016, Presentation by Oliver Franz and Bob Eisenmann

Editors NOTE: This paper was first presented at the 13th EFRC Conference. Sept. 19- 21, in Zagreb, Croatia

Lifeboat self-launches causing two fatalities.

> *The free-fall lifeboat launching system on board a general cargo vessel underwent a substantial onboard service by a manufacturer certified service company.*

SOURCE: THE NAUTICAL INSTITUTE
OCTOBER 2023

As the lifeboat needed a replacement release cable, among other things, the release system had to be reset and secured. This was done as per specifications and confirmed by the attending class surveyor.

The morning after the servicing and before departure, the safety officer found that the lifeboat release pin at the hook position (aft top of the boat) could not be moved. This was not as expected, and he discussed the matter with the Master and the vessel's bosun, who agreed to look into the problem during the day.

Once underway, the issue of the stuck pin was discussed on bridge with the Master and the safety officer. The bosun, an experienced mariner and regular on the vessel, was tasked to prepare the required risk assessment and permit to work, which was apparently done in accordance with the procedures set out in the vessel's Safety Management Manual. Shortly after lunch, the bosun reported to the safety officer, who was OOW at the time. He informed the officer that he and another deck crew were proceeding to the vessel's stern to commence work on the safety pin.

Some 45 minutes after the bosun's call, the OOW noticed a lifeboat in the water astern of the vessel. He immediately called the bosun via VHF radio but received no response. The Master was informed. At the same time, another crewmember reported by VHF radio that the bosun was lying on the aft deck and that the lifeboat was missing, as was the second crewmember.

Emergency procedures were instigated but the missing crewmember could not be located. The bosun was found to have very shallow breathing and was prepared for emergency evacuation by Search and Rescue (SAR) helicopter. He was later declared deceased.

After further searches, the missing crewmember could not be found and was presumed to have fallen overboard. Search and Rescue units were activated, and search continued until darkness, without success. The lost lifeboat was retrieved and brought to shore for inspection. After close examination of the release gear and condition of the boat, it was reinstalled on board the vessel as it was undamaged.

Since the only persons on scene were the victims of the accident, and both tragically lost their lives, no information or details on how the work was conducted and how the situation evolved at the lifeboat could be assessed. The positions of the crew members could not be determined, nor the sequence of events elaborated. The launching arrangement showed no signs of failure or damage. The release of the free fall lifeboat seemed to have taken place as normal, but it was clear that the lifeboat maintenance securing and/or simulated launch device had not been connected at the time of the unintended release.

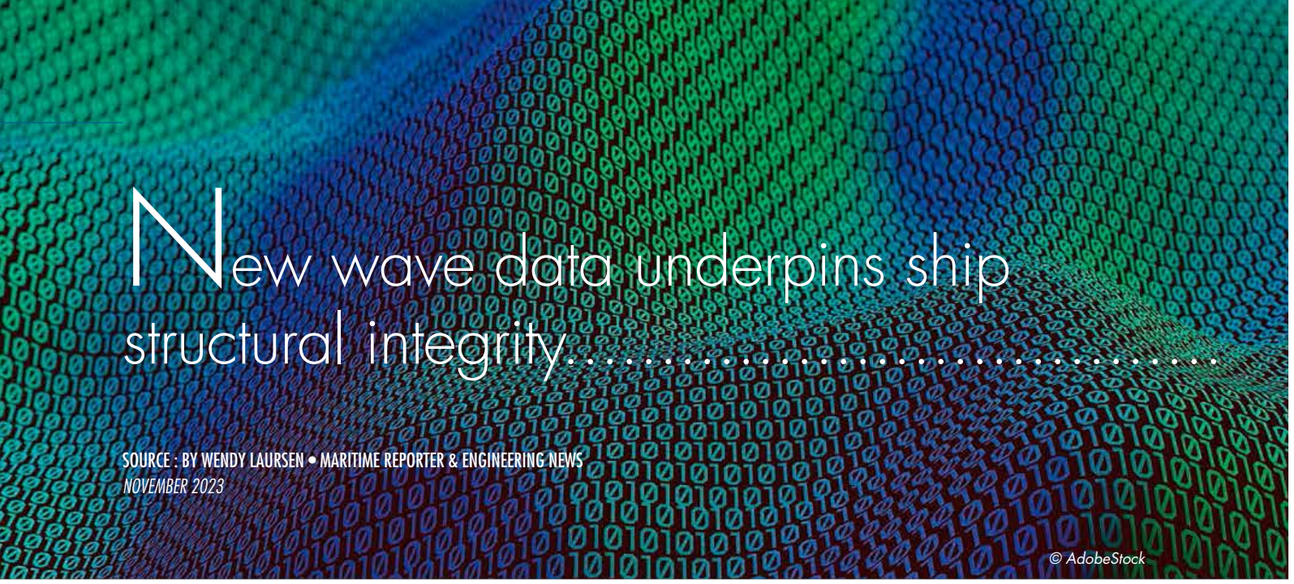
The lifeboat's release device at the helmsman's chair was found untouched and in a closed position. The safety officer's findings of a stuck hook safety pin prior to departure suggest that the hook might have been already in a 'released' state when the crew began their work. The lifeboat manufacturer's user's manual states 'If release hook safety pin cannot be removed off the hook casing without excessive force, the hook might be released. Secure boat release hook and check system.'

The working hypothesis of the investigation is that the service company technician did not properly reset the release mechanism in the closed position. When the crew tried to free the safety pin the hook released fully, allowing the boat to launch in free fall to the sea. The bosun probably fell to the deck while the other crewmember fell overboard and drowned.

The safety officer had initiated the task and verbally instructed the crew members but had not checked the situation at the boat deck during the work as he was still on OOW duties

LESSONS LEARNED

- Adherence to the on board safety procedures and other instructions available such as the manufacturer's information manual is a prerequisite for safe operations.
- A toolbox meeting and verbal preparation and instructions are best done at the work location to allow better understanding of the situation and a discussion of the hazards and mitigating strategies.
- Proper supervision is a key element for safer operations. ■



New wave data underpins ship structural integrity

SOURCE : BY WENDY LAURSEN • MARITIME REPORTER & ENGINEERING NEWS
NOVEMBER 2023

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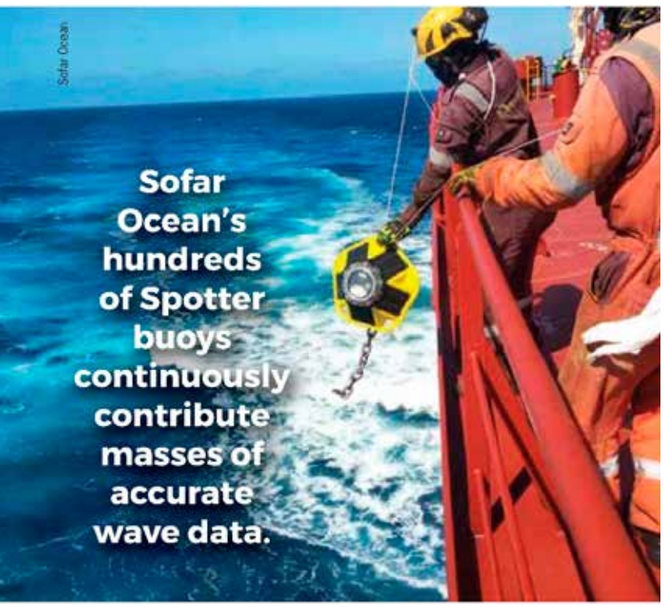
The loss of the Stellar Daisy in 2017 was a tragic reminder of the importance of wave data to ship design and operation. The vessel sank in the South Atlantic Ocean, with 22 of 24 crewmembers lost. The structural failure of the vessel was attributed to several factors including material fatigue and the forces imposed on the hull as a result of the weather conditions.



Survey requirements for some vessel types have since been tightened, but even before this tragedy, work was underway to evaluate the wave data used to determine ship structural integrity requirements. In 2016, the International Association of Classification Societies (IACS) began a re-evaluation of the scatter diagram and wave spectra that define the environmental conditions used for its wave load, fatigue, and seakeeping calculations.

The resulting Version 2 of IACS Recommendation No. 34 is based on several sources of wave data, including altimetry (measurements from satellite), hindcast models (re-analysis of past weather), and wave buoys. These new, more modem, data sources represent a significant improvement in the quality of data, given that previous wave data was collected in the second half of the 20th century from visual observations onboard ships. The most recent data dated back to 1984.

It's difficult to characterize how wave height has changed over that time. While maximum significant wave height (18.5m) in Version 2 is larger than before (16.5m), the mean significant wave height is less.

Like IACS, wave and weather analysis companies rely on a wide range of data sources. "Every day, we ingest about 2.25 million discrete data points," says Dr. Rafael Soutelino of MetOcean Solutions. This data comes from modelled data from global weather and marine models as well as satellite, lightning, weather station, wave buoy, current meter, and tide gauge data. Some data is displayed directly on the company's MetOceanView interface, and some is shown to provide comparisons with the system's modelled data, for example wave buoy data is displayed on a graph comparing observed to forecasted wave height.

That comparison was pertinent on February 14, 2023, the day that Tropical Cyclone Gabrielle hit New Zealand. Port of Napier's Wave Rider Buoy measured significant wave heights of up to 6m before waves broke it free from its mooring. The forecast was 5.4m. MetOcean's subsequent analysis suggested that a sea state with wave heights of 6m would occur on average only once every 3,000 years at the location.

Dr Tim Janssen, Co-Founder and CEO of ocean buoy and data specialist So far Ocean, says that if we liken the amount of data generated each year to the distance between the Earth and the sun, the amount of data we generate about the ocean would only get us 100m from the Earth's surface. While Sofar Ocean's hundreds of Spotter buoys already continuously contribute masses of accurate data, he sees the current global data gap ready to be drastically reduced through Bristlemouth, the first open ocean connectivity standard. A collaboration between Sofar and strategic partners in the public and private sector, Bristlemouth delivers plug-and-play hardware interfaces to simplify connectivity between devices and is expected to accelerate the development of scalable ocean sensing systems and applications.

Boosting the scope of wave monitoring could, for example, much more accurately detect and predict the impact of climate change. Based on what we know now, can we say that wave conditions are already affected? "If you get better at sensing, you can actually inadvertently create biases. If your sensor is more accurate now, you could have the perception that measurements are increasing when in reality you don't know what impact the change in device has had. The same thing goes if you observe in more places. That might tilt your average wave height up or down," Janssen says.

Many forecasters use the same mathematical models- it is the data fed in to those models that determines how accurate the results will be. "Is the climate changing? Absolutely," says Janssen. "Is it going to change our weather systems over the ocean? 100%.

"By applying accurate weather forecasts predicting the wave height and direction days ahead, and combining this with vessel specific response models, the captain gets alerts if the estimated vessel movement along the planned route exceeds acceptable limits." - Petter Andersen, SVP, Shipping Digital, StormGeo ⇾

"Is the climate changing? Absolutely. Is it going to change our weather systems over the ocean? 100%. Do we know exactly what that is looking like? No, I don't believe we do yet. This speaks to our urgent need to rapidly expand ocean data collection at scale."

- Dr. Tim Janssen, Co-Founder and CEO, SofarOcean

Hull stresses can be measured directly from installed sensors.

IACS researchers have determined that while Version 2 does not include any climate forecasts, IPCC projections of changes in extreme wave height are unlikely to affect the scatter diagram.

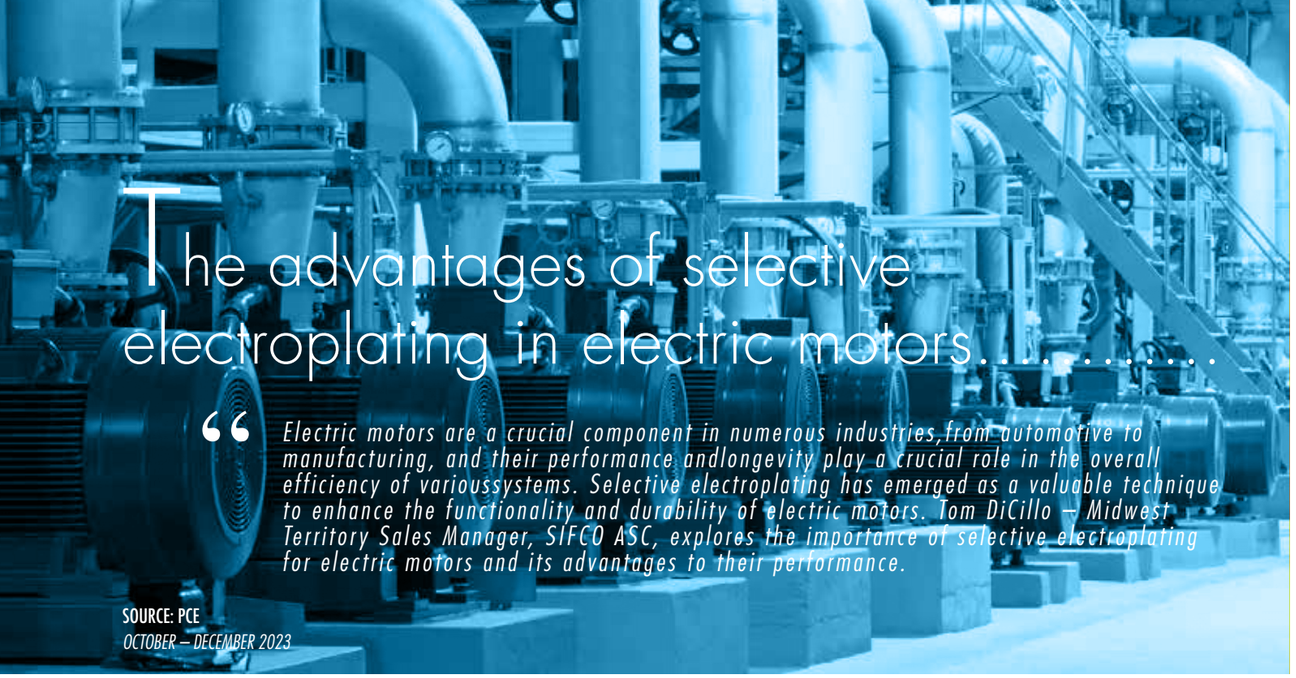
Day-to-day forecasts are, however, particularly vulnerable to the "butterfly effect." Previous work by ClassNK indicates that as atmospheric circulation has the nature of chaos, if there is an error in an initial value, the error in the predicted value will increase exponentially over time. Wave forecasts, therefore, are often limited to about 10 days.

Digital solution providers, including Sofar, are giving captains more sophisticated voyage planning tools so they can adapt their voyage plans to avoid adverse weather and therefore protect crew, vessel and cargo.

And that's the purpose of Storm1Geo's s-Planner Seakeeping module. Wave data is an essential component for planning a safe and efficient voyage, says Petter Andersen, Senior Vice President Shipping Digital at StormGeo. "By applying accurate weather forecasts predicting the wave height and direction days ahead, and combining this with vessel-specific response models, the captain gets alerts if the estimated vessel movement along the planned route exceeds acceptable limits."

Hull stresses can be measured directly from installed sensors, and this enables navigators to receive early warning when there is a significant probability of exceeding stress and fatigue limits set by class societies - for example with Light Structures' SENSFIBTM technology. "The application of structural health monitoring data is starting to become more diverse," says Terje Sannerud, Chief Commercial Officer at Light Structures. "It can be utilized in condition-based inspection routines to identify the development of cracks in a structure as well as in risk-based inspection programs where the established Fatigue Design Factor can be measured against the accumulation of actual fatigue. Both examples have the potential to reduce the cost of maintenance over a vessel's entire designed lifecycle, while of course ensuring better safety, especially during extreme weather incidents."

He says that the investigation report into the loss of the Stellar Daisy does not mention if any form of hull monitoring solution was installed, but if it had been, the effects of stress and fatigue could potentially have been addressed prior to the tragedy. ■



The advantages of selective electroplating in electric motors.....

Electric motors are a crucial component in numerous industries,from automotive to manufacturing, and their performance andlongevity play a crucial role in the overall efficiency of varioussystems. Selective electroplating has emerged as a valuable technique to enhance the functionality and durability of electric motors. Tom DiCillo – Midwest Territory Sales Manager, SIFCO ASC, explores the importance of selective electroplating for electric motors and its advantages to their performance.

SOURCE: PCE
OCTOBER – DECEMBER 2023

Electric motors in industrial settings often run continuously or for extended periods, leading to increased mechanical stress and wear on components. The constant rotation and friction can cause the degradation of internal parts over time. High temperatures and excessive heat can lead to the deterioration of insulation materials, bearing lubricants, and other critical components, reducing efficiency and increasing wear.

Selective electroplating primarily serves to replenish metal in a component's worn areas, allowing for the complete part to be salvaged and reused. This technique involves the targeted deposition of metal onto the worn sections, effectively restoring the part's functionality and extending its operational lifespan. By precisely applying metal only where it is needed, selective plating offers a cost-effective and sustainable solution for maintaining and refurbishing various industrial components, reducing the overall environmental impact associated with replacement. This protects the motor's lifespan, enhances reliability, and ensures consistent performance. Additionally, selective electroplating reduces downtime significantly, enhancing productivity in industrial processes.

APPLICATION WITH EXTREME PRECISION

The process is performed with extreme precision. Technicians use specialised equipment and techniques to deposit a specific layer of metal onto only a component's damaged or worn area. This precision ensures that only the necessary repairs are made, avoiding unnecessary alterations to the rest of the part. One of the critical advantages of selective electroplating is its ability to maintain the original dimensions and tolerances of the component. Because only the affected area is plated, there is minimal alteration to the overall shape or size of the part. This is crucial in electric motor repair, as deviations from original specifications can negatively impact motor performance and efficiency.

Selective electroplating can be applied to components with intricate or complex geometries that are challenging to reproduce through traditional machining or replacement methods. It allows for precise metal deposition in hard-to-reach areas and is a highly effective repair technique in electric motor maintenance and other industries. It excels in providing localised, precise, and efficient repairs, thereby conserving materials, reducing costs, and ensuring the repaired components meet or exceed their original specifications. This makes it a valuable tool for prolonging the life and reliability of electric motors in various industrial applications.

MAIN AREAS OF APPLICATION

The SIFCO Process focuses on several primary application areas, such as bearing housing, commutators, and rotor journals. End bells, which house the bearings that support the motor shaft, experience fretting corrosion during operation. The SIFCO Process is used to plate these bores to size with nickel deposit Plating a worn bearing housing can take less than thirty minutes and is a cost-effective alternative to machining the bore oversized and pressing in a pre-machined sleeve or flame spraying and machining to the print dimension.

DC motor and generator slip rings can develop copper oxide films, which reduce electrical conductivity and cause arcing and pitting, especially during locked motor start-up. Corrosive environments can also cause excessive damage and shorten life. Worn or corroded contact areas can be quickly restored to factory-like condition. Copper can be built back to dimension, and a silver conductivity and protective layer can be added during the same plating operation.

Some operators approach selective plating cautiously due to using chemicals labelled as 'hazardous.' In reality though, selective plating is a safe process that requires only standard personal protective equipment and a common-sense approach to health and safety. The particular application of chemicals minimises waste and disposal requirements, which makes it the preferred choice.

ENVIRONMENTALLY SUSTAINABLE

There is also the contribution to environmental sustainability that selective electroplating offers. By targeting specific areas, manufacturers can reduce the use of plating chemicals and materials, minimising waste and the associated environmental impact. Furthermore, selective plating is a permanent repair. The ability to restore and prolong the life of electric motor components through selective electroplating reduces the need for frequent replacements, leading to reduced waste generation and resource consumption.

SPECIALISED TRAINING

Education and training in selective electroplating play a big part in the maintenance and longevity of electric motors. With years of experience and expertise, SIFCO ASC has developed a comprehensive training programme tailored to the unique needs of selective electroplating applications. The training course encompasses theoretical knowledge and practical hands-on experience, ensuring participants understand selective electroplating principles, processes and best practices. However, selective electroplating, like welding and thermal spray, requires a well-trained operator.

However, this industry is experiencing a skills gap as older operators retire, resulting in losing plating experts. To address this, SIFCO ASC offers a re-education course to train or re-train operators on the proper use and benefits of selective electroplating at facilities that previously used the SIFCO Process but have lost their operators due to retirement or employee turnover.

SIFCO ASC combines application knowledge acquired through global research and development investment, engineering expertise, and practical insights from the company's service technicians to provide comprehensive training whether for those who have previously purchased SIFCO ASC equipment or newcomers to the technology, full training is available to ensure a thorough understanding of the process and achieve successful repairs.

Highly-skilled instructors lead the training sessions with advanced teaching methods and state-of-the-art equipment. This enables participants to develop the skills necessary for precision plating in targeted areas. Whether achieving selective plating on complex geometries, repairing critical components, or enhancing product performance, SIFCO ASC's training programme equips individuals with the proficiency and confidence needed to excel in selective electroplating

TRUSTED AND RECOMMENDED REPAIR METHOD

The world relies on electric motors for transportation, infrastructure development and industrial improvements. Therefore, efficiency is paramount. Selecting the correct maintenance and repair solution can lower costs, enhance performance, and minimise failures. The SIFCO Process, a trusted and recommended repair method endorsed by the Electrical Apparatus Service Association (EASA) and meeting various industry, military, Aerospace Material Specifications and federal specifications, offers superior finishes and many benefits, including quality, durability, cost savings, portability, and time savings. ■

Death on LPG carrier in Antwerp engine room fire.....

> *A third engineer died from smoke inhalation after an engine room fire on liquefied petroleum gas/ ethylene carrier Moritz Schulte, in Antwerp, Belgium, in August 2020.*

SOURCE: TANKEROPERATOR
OCTOBER / DECEMBER 2023

This is a synopsis of the full report by The UK Maritime Accident Investigation Board (MAIB). The fire happened while the cargo of ethylene was being discharged.

The third engineer was working on the fuel filter of an auxiliary engine. The fuel system had not been effectively isolated.

A spray of fuel under pressure hit both the third engineer and the hot exhaust of an adjacent auxiliary engine, where it ignited.

Other crew members closed the space to limit the spread of the fire, but subsequently discovered that the third engineer was missing and had last been seen in the engine room.

The master prohibited the use of a CO_2 fixed firefighting system, in case it could inhibit breathing.

The vessel's search and rescue team made two attempts to enter the engine room, but both were unsuccessful due to smoke and heat. →»

marinetraffic © Etienne Verberckmoes

Post-fire AE1 fuel filters

With the third attempt, staff made a 'sweep' of the area of the engine room where they thought the third engineer might be, but did not find him.

A shore fire team found the third engineer, an hour after the start of the fire. He was recovered ashore but died 9 days later from the effects of smoke inhalation.

The investigation found that the maintenance job was unnecessary, conducted in an unsafe way, and at an appropriate time, without any risk assessment having been done, and in the absence of any direct supervision.

It found that the vessel had a full range of safe systems of work in place.

Analysis of the third engineer's training programme activity log found that only two of the 65 rank-specific tasks he was required to undertake before his promotion to third engineer had been completed with the requisite evidence.

It also found that the training system permitted line management to confirm that training had been completed without evidence being provided.

This facilitated his promotion twice when he was not ready.

The investigation also found there was no evidence of the vessel crew having completed 'poor visibility enclosed space rescue drills' or 'escape drills using Emergency Escape Breathing Devices.'

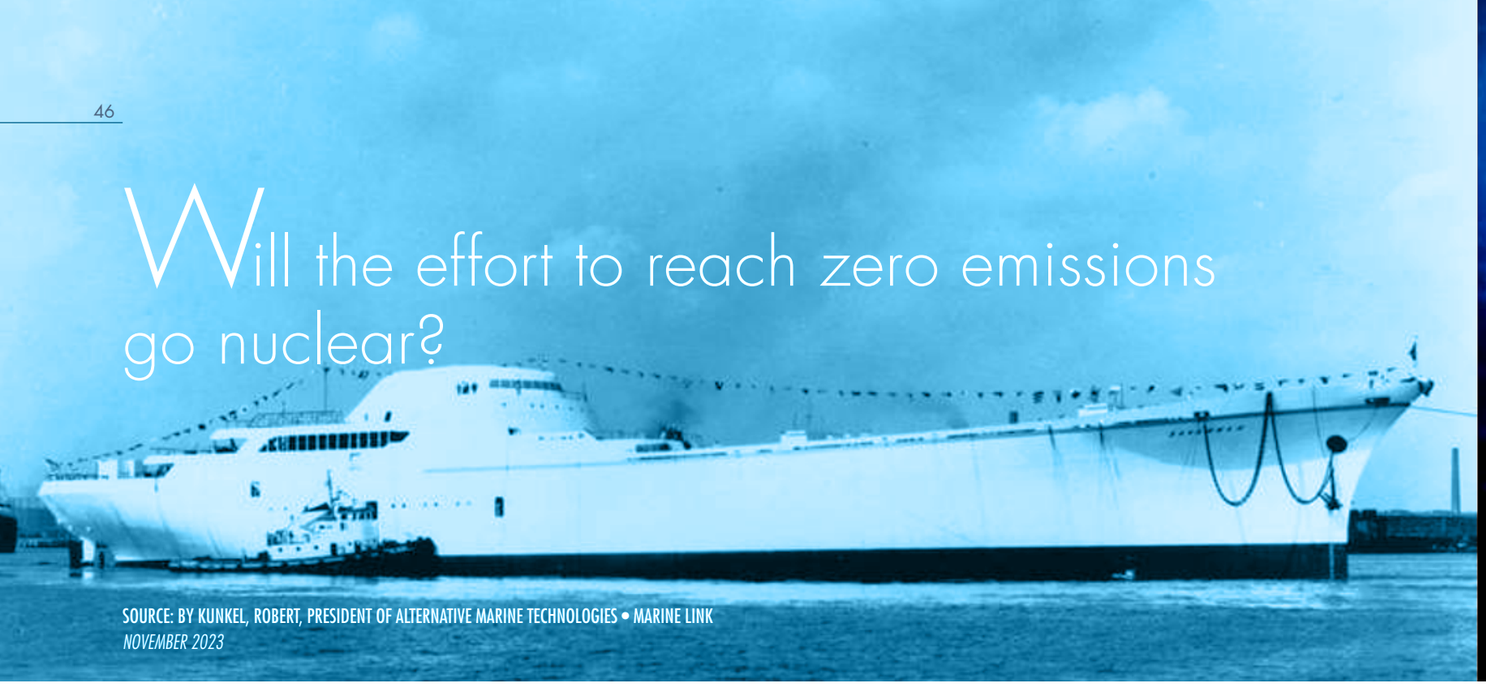
The company's own investigation identified 32 actions relating to communication, crew and competence management, safety management and technical management.

The company has since equipped its four vessels that were built before July 2003 with additional Emergency Escape Breathing Devices.

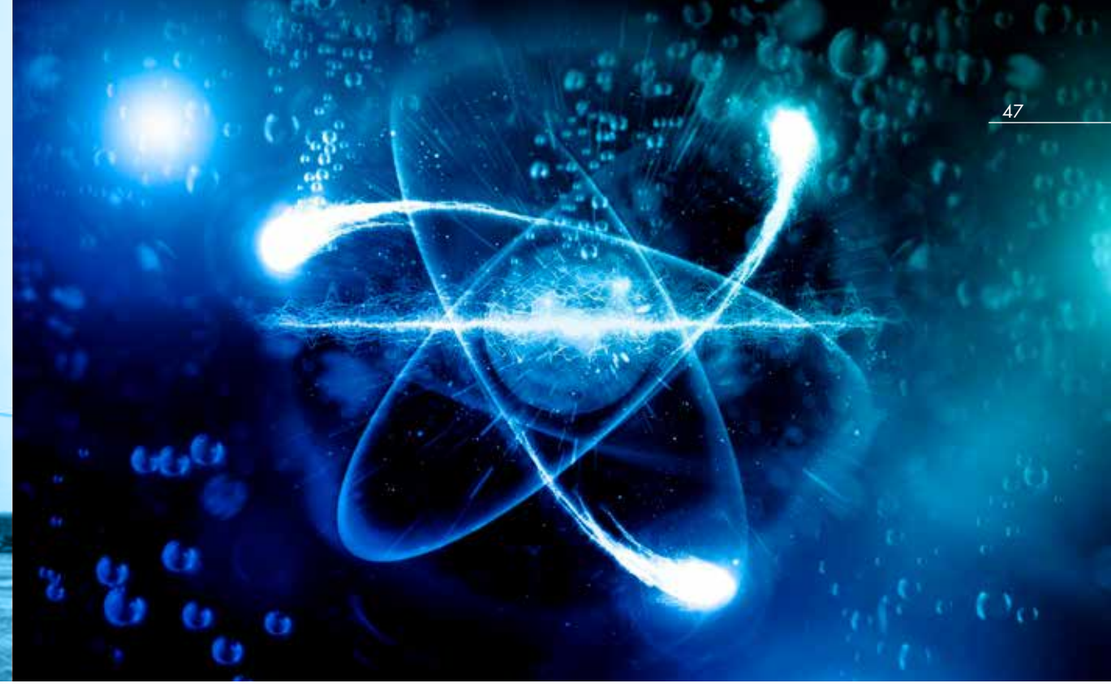
As a result of the actions already taken, no further recommendations have been made by MAIB. ■

AE1 fuel filters, showing three-way cock position as found post-fire and AE1 left-hand fuel filter cover and split O-ring seal

Will the effort to reach zero emissions go nuclear?



SOURCE: BY KUNKEL, ROBERT, PRESIDENT OF ALTERNATIVE MARINE TECHNOLOGIES • MARINE LINK
NOVEMBER 2023



Launched on July 21, 1959, the 21,000-ton NS Savannah, propelled by a pressurized-water reactor, demonstrates the feasibility of commercial ships propelled by nuclear energy. (Photo: Oak Ridge National Laboratory)

On December 8, 1953 President Dwight D. Eisenhower addressed the 470th Plenary Meeting of the United Nations General Assembly. The speech he delivered is often recognized as his effort to introduce "Atoms for Peace", a program to move nuclear fission and technology away from weapons development and into clean energy.

As a result of that effort and program, the NS Savannah was built and delivered as the first nuclear-powered merchant ship. She was built in the late 1950s at a cost of $46.9 million and launched on July 21, 1959. Despite rumors and industry scuttlebutt, the vessel actually traded and carried cargo and was deemed to have completed its mission as a technical success.

The Savannah has been moored in a Baltimore port since 2008. Last fall, its nuclear reactor was removed as part of its decommissioning. As we continue discussing the use of nuclear energy, keep in mind that the Savannah remains a recognized floating nuclear facility by the NRC. The decommissioning continues in capable hands with members of the U.S. Maritime Administration who have been associated with the vessel for many years.

The Savannah was not the only global merchant vessel that looked to employ nuclear propulsion. The Russian built LASH carrier Sevmorput continues to operate under government control to this day.

Move forward to current day requirements and regulations addressing alternative energy to power the national grid and the maritime industry's efforts to reach zero emissions, there is an indication that advanced nuclear technologies may be the path to achieve both goals and meet President Eisenhower's final statement in his Atoms for Peace speech:

"To hasten the day when fear of the atom will begin to disappear from the minds of the people and the governments of the East and West, there are certain steps that can be taken now".

On September 28, 2023 we were invited to attend a Congressional Briefing on Advanced Nuclear Technology in the Maritime Industry in Washington DC. The meeting was well attended with congressional support, and the briefing was followed by an American Bureau of Shipping (ABS) Global Forum – The Role of Advanced Nuclear Technologies in the Maritime Energy Transition.

The ABS Forum gathered many maritime and energy sources to discuss the capability of new nuclear technologies. A well-orchestrated collection of shipowners, operators, port authorities, shipbuilders, designers, regulators and nuclear industry representatives were in attendance.

While many attendees may have been skeptical about where the forum discussions would lead, ABS Chairman and CEO Christopher J. Weirnicki's opening remark, "This is a generational moment," proved to be an understatement after listening to all of the panels. His quote could have well been included in Eisenhower's original address to the UN.

A driving force behind the ability to continue the research beyond the opening forum is the development of Small Module Reactors (SMR). SMRs are a class smaller than conventional nuclear reactors, which can be built in one factory location, shipped, commissioned and operated at a separate site. The term SMR refers to the size, capacity and modular construction. It does not define the reactor type and the fission process applied. SMR types range from scaled down versions of exiting reactor designs to the latest Generation IV designs.

SMRs typically report an electrical output of less than 300 megawatts (MW) and/or less than 1,000 MWs of thermal energy. Many SMR proposals recommend stacking units to achieve the required energy output for each application.

To address the SMR for grid energy, the systems are developing to quickly replace coal fired power plants, diesel powered plants and natural gas. The modular design allows the energy source to be upgraded while retaining the remaining working platform of the power plant. The simple modular designs have fewer moving parts reducing failures that lead to current reactor accidents. SMRs use less radioactive material, significantly removing the risk of a nuclear disaster on the scale of Fukushima.

SMRs can be the solution to the U.S. energy problems as we worked toward mobility electrification. Offshore wind is facing huge economic issues and other headwinds on its path forward. Solar is experiencing similar problems. Both have actual efficiency issues when compared to current fossil fuel energy distribution. SMR nuclear energy does not have that problem; and with that said, getting that message across is easier said than done.

The global SMR market was reportedly valued at US$9.7 billion in 2021 and is projected to grow at a compound annual growth rate of 3.2% to reach US$11.3 billion by 2026. There are over 19 companies developing designs worldwide, and Russia & China report SMR systems in operation. The technology, no different than the Savannah, can be a technical success. The energy investment can lead to reduced costs for maritime applications. The issue moving forward will be defining the economics and moving past the perception of risk with regard to historical nuclear power: security, uranium fuel development, transportation and final storage of spent fuel material being paramount.

The economics goes beyond ship construction and propulsion costs. Imagine an industry that employs a fuel source that is good for 15 to 25 years. No need for the costs of developing the infrastructure to bunker ammonia, hydrogen or the proposed list of alternative fuels offered to meet IMO emission goals.

Building a financial model to address not only the capital costs required for new ship design, the SMR modular application, insurance, crew training and welfare, and the ability for the market and vessel type to save lost time for bunkering and repairs is, in our opinion, the next step to determine if the concept is viable. The propulsion application can actually allow us to reach zero emissions and successful sustainability within the IMO 2050 goal, while most of the current alternatives are merely temporary solutions. And with that, our financial and technical network intends to work closely with industry sources to analyze the economics and move this concept forward. ■

Payback promise from new bulbous bow……

> *Vehicle carrier and logistics specialist Wallenius Wilhelmsen has implemented a vessel upgrading project entailing the retrofit of a new form of bulbous bow. The scheme promises average fuel savings of at least 6% and a corresponding cut in the recipient ship's CO2 emissions by 1,400t per annum.*

SOURCE: THEMOTORSHIP
NOVEMBER 2023

Marking the completion of the first phase of the programme, the 7,620 CEU-capacity PCTC Aniara re-entered service last month after foreship rebuild in China. Installation of the prefabricated, replacement bow section was accomplished within the anticipated three-week drydocking timeframe at the Zhoushan premises of repair yard IMC-Yongyue.

Wallenius Wilhelmsen
Precision work at IMC-Yongyue: bow section changeover on a PCTC.

Similar enhancements are being made to three more units of the fleet, the Oberon, Tijuca and Tirranna, all of the same class completed in 2008/2009.

While the original bulbous bow design had been optimised for one very specific draught and speed, Wallenius Wilhelmsen's investigations into potential improvements were predicated on an evaluation of actual operating profiles, which showed that ships were sailing at a greater range of draughts and lower speeds for a significant portion of the time. In such conditions, the as-built bulbous bow performed below par, creating additional resistance, to the detriment of vessel hydrodynamic efficiency.

A revised optimum design, tuned to typical service profiles, reducing resistance and promising significant fuel savings, was subsequently arrived at by the shipowner's technical team in partnership with designers from the South Korean companies DSEC and Hanwha (formerly DSME).

The 6% medio gain in fuel efficiency may well be exceeded. "We can expect even larger average savings if actual operating speeds are reduced in the future, because the new design compared to the old will perform much better at lower speeds," counselled Adam Larsson, Wallenius Wilhelmsen's senior manager of energy efficiency and performance. "Worth noting is that at some operating conditions, such as lower draught (about 8m) and 14-knot speed, the savings can be as much as up to 30%," he added.

Mr Larsson had initiated the project based on a fleet screening, by checking suitable retrofit candidates and defining a representative operating profile for optimisation. The work with the Korean consultants to develop and verify the performance of the new bulbous bow design entailed extensive use of computational fluid dynamics (CFD) simulations and physical scale model tests carried out in South Korea.

For the Aniara, the precision-designed, 23m bulbous bow section weighing 137t was prefabricated in two months, then coated and lifted into the drydock by means of floating crane. Wallenius Wilhelmsen has previously ventured into bulbous bow conversion endeavours, and states that the current upgrades will not be the last. ■

INNOVATION: OUR SOURCE OF ENERGY

30 years of experience and a commitment to continual innovation and development, has resulted in EXMAR being a leading player in the transportation of LPG and other liquefied gas products. Our large, modern fleet and operational excellence has helped create maximum efficiencies and long-term mutually beneficial collaborations with some of the industry's foremost global players.

EXMAR also leads the way with energy efficient hull designs and the latest innovations in ballast water treatment and scrubber systems. This, along with ongoing technical development and the expertise of EXMAR's people, ensures our clients in the LPG energy sector continually benefit from state of the art, cost efficient innovation.

EXMAR