

Lower Emissions in Shipping

CLEAN, SCALABLE SOLUTIONS



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The number of regulated shipping areas worldwide is increasing. Entry to these areas is not permitted unless vessels comply with strict environmental regulations. In response, thyssenkrupp Marine Systems has developed a system to provide ships with green energy from fuel cells. The associated controller system was developed together with Bachmann.

CO₂-neutral shipping is an ambitious goal. It requires regenerative fuels and extremely efficient energy conversion. Fuel cells with reformers offer a possible solution for the generation of heat and electricity on ships. Syngas can be reformed from the exhaust gas produced during the combustion of a hydrocarbon. Unlike internal combustion engines, when the reformat is converted in the fuel cell, no particulate matter is produced. Furthermore, due to low operating temperatures, only negligible quantities of nitrogen oxide are produced. The result: a greenhouse gas footprint that, based on efficiency alone, offers at least a 25 percent improvement over generators driven by internal combustion engines.

Simplified Design

To comply with emission regulations, diesel generators require various ancillary equipment such as particulate filters, catalytic converters, silencers, and exhaust gas monitoring systems. "With fuel cells, all of this is unnecessary," explains Keno Leites, Project Manager Fuel Cell Application at thyssenkrupp Marine Systems. Furthermore, as fuel cells do not emit sound or vibrations, vibration mounts and sound enclosures are no longer required. The mechanical design of a fuel cell is relatively simple, and it requires only slightly more space than a diesel engine unit.

Initial Milestones

A demonstrator with a rated output of 50kW, including energy storage, was built to verify the concept. It can be used to validate corresponding safety concepts, process operation and seaworthiness. Currently, automation is decentralized and structured according to existing classification rules. Therefore, subsystem reformers, fuel cells and energy management each have their own controller system, including

alarm management and an additional safety controller. A higher-level control system communicates with the ship and controls the energy management system for feed into the electrical system.

However, in the future, thyssenkrupp intends to integrate automation into one system, including carrying safety functions via the operational bus. "In contrast to other industries, integrated automation solutions are not currently permitted in shipping," explains the project manager. Together with Bachmann and the DNV GL classification society, a proposal to this effect has been drawn up and submitted to the International Maritime Organization IMO by the German Federal Ministry of Transport and Digital Infrastructure. "We will implement our solution as soon as we get the green light," Leites confirms.

Future Integrated

The automation solution developed with Bachmann makes it possible to integrate all subsystems into one controller system. For Leites, this is crucial: "This gives us a transparent software architecture with just one alarm system, hardware diagnostics for the entire system, and simple communication between subunits." On the M1 controller, all applications can be processed in parallel and independently of each other. Even the safety controller can be integrated as a separate hardware module. It tunnels the existing network via a certified 'black channel'.

Scaling is also simple: If higher performance is required, hardware can be centrally or decentrally expanded, and the appropriate number of software modules are instantiated and assigned to the hardware. "In this way, a system that has already been validated can easily be scaled and smoothly put into

operation," says Leites, describing one of the most important advantages of the envisaged automation structure. The diverse interfaces of the M1 automation system also allow integration into a wide variety of ship automation systems, thus opening up a wide range of applications for the comprehensive solution.

Only Advantages

According to Keno Leites, the integrated solution provides application reliability and scalability, reduced space requirement and significantly lower cabling costs. He is convinced that with series production, the current cost advantage of diesel units will be significantly reduced. The results also showed that the fuel cell generates enough energy for the on-board network and is even sufficient for low-level propulsion. The reduced emissions also enable ships to call at ports with stringent limits.

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