

ENGINEERING
TOMORROW

Danfoss

Case story | VACON® NXP Liquid Cooled Drive

MS Nadorias: upgrade to high-efficiency hybrid propulsion delivers fuel savings

15%

Fuel savings and
15% less CO₂
emission



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VLT | **VACON**

The vessel MS Nadorias was retrofitted in 2014 and is now powered by a diesel-electric hybrid propulsion system from HSP using VACON® NXP Liquid Cooled Drive

The MS Nadorias is an inland container carrier built in 2009 for the ship owner Sendo Shipping. The vessel is operating in the inland waterways in the Netherlands between Groningen, Amsterdam and Rotterdam. After 5 years of successful operation, the owner decided to upgrade the ship's conventional propulsion system: a single diesel engine and a single propeller.

Big potential in conversion to hybrid

Koedood Dieselservice BV and Hybrid Ship Propulsion BV (HSP) performed the retrofitting project. They analysed the mission profile of the ship together with Sendo Shipping and found that

for 60% of the time the ship only needed a fraction of the full engine power. There was thus a big potential for fuel savings by converting to a diesel electric hybrid propulsion system with 2 smaller generators.

With the conventional direct drive configuration, there is a mechanical connection between the diesel engine and the propeller. So, the propeller speed is directly proportional to the engine speed. This means there are many situations in which the engine does not operate in optimal working conditions. This inefficiency is greatly reduced by the diesel-electric drive because there is an electric transmission between the

generator and the propeller. Electrical transmission allows the speed and pitch of the propeller to be optimized for best efficiency compared to mechanical transmission.

The challenge was finding space in the engine room. They solved this problem by replacing the original main engine with a new compact system comprising new engine and a high torque shaft motor. The two new generators were placed in the bow of the ship and the electrical power was fed back to engine room at the stern through two new cables. The generators can run either as single units or in parallel.

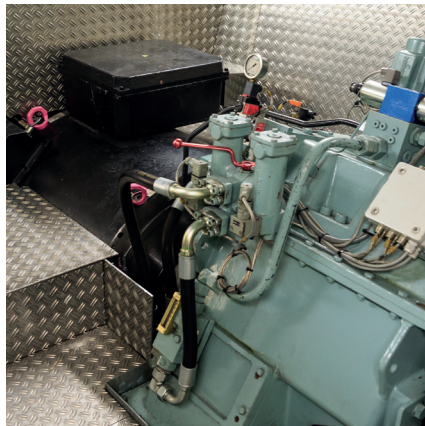


Benefits

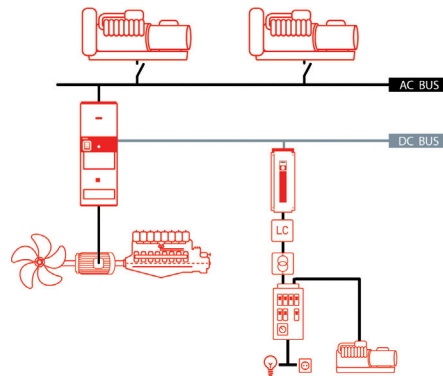
- 15% reduction of fuel consumption, which results in both reduced greenhouse gas emissions and reduced fuel expenses
- Less noise on board the vessel
- Demonstration of the effectiveness of hybridization in inland shipping

There are some unknowns about the effectiveness of hybridization of inland vessels. Before the retrofit, there was some doubt about the extent of the savings potential, because there are additional components and transmission losses associated with hybridization. The MS Nadorias demonstrates however, that it is indeed possible to retrofit a vessel to achieve reductions in fuel consumption as well as CO₂ emissions.





Main diesel engine with shaft motor



Single line diagram

15% fuel savings

A new main switchboard equipped with VACON® NXP Liquid Cooled Drives was installed in the engine room. To eliminate the need to run a separate generator for the ship's 50 Hz on-board grid when sailing, they also built a VACON® NXP MicroGrid inverter into the switchboard. The purpose of this unit is to convert the variable frequency from the new generators to a fixed 50 Hz clean ship's grid. This is much more fuel-efficient than operating a diesel generator at low load with a poor fuel efficiency.

The brothers Dominic and Sebastiaan van der Meer and their business partner

Edwin Groen who own the company together are very satisfied with the new propulsion system:

"We save more than 15% on fuel due to the hybrid propulsion system. The ship is travelling on the same route before and after the conversion and we have been able to compare the fuel consumption over a long period. The ship runs 98% of the time in electric mode and the crew has become very skilled in operating the ship in economy mode without the need for "full throttle". As another positive side effect, the ship is extremely quiet as the 2 small generators are located far from

the bridge and accommodation area. We went from a noise level of 60 dBA in the wheelhouse to just 42 dBA, which is really quiet."

Reduced emissions

Also the emission level of air pollutants has been greatly reduced, since the 205 kW generators are operating in the most efficient power range; and additionally, thanks to the exhaust gas cleaning system. The reduction in emissions comprises:

- 15% CO₂ savings
- 60% less PM10
- 97% NO_x savings

**"We save more than 15% of fuel due to the hybrid propulsion system",
Dominic and Sebastiaan van der Meer, co-owners, Sendo Shipping.**

Dominic van der Meer with the VACON® Liquid Cooled Drives



60% less maintenance cost

When the ship is empty, it can run on one generator only. When fully loaded it runs on both generators. The 1250 kW main diesel engine is only used in extreme and rough weather conditions like ice and strong wind (on average: 1-2 hours per week). This also means that the cost for service and maintenance on the main engine has been greatly reduced. The MS Nadorias has 60% less maintenance cost and higher uptime than its sister ship.

Future plans

Sendo Shipping owns a fleet of 3 ships, and has already planned to upgrade another sister ship. For the next new-build they have decided to order 100% electric propulsion – and due to the good experience with Danfoss VACON® drives and HSP they will most probably use the same suppliers again.



MS Nadorias

The MS Nadorias is an inland container carrier built in 2009 for the ship owner Sendo Shipping. Koedood Dieselservice BV and Hybrid Ship Propulsion BV upgraded the ship with a unique hybrid propulsion system.

MS Nadorias

Type of ship:	Inland water container carrier	Propulsion and power generation:	A single propeller with 1 Mitsubishi 1250 kW main engine and a 385 kW Baumüller high torque shaft motor powered by a VACON® NXP Liquid Cooled Drive.
Ship owner:	Sendo Shipping		2 x floating frequency generators 2 x 205 kW with Mitsubishi diesel engines.
Yard of conversion:	Koedood Dieselservice, Rotterdam		The 50 Hz electrical ship grid is generated by a VACON® NXP MicroGrid inverter, which is also liquid-cooled.
Main waterways:	The inland waterways in Netherlands between Groningen, Amsterdam and Rotterdam		
Year:	Built in 2009. Converted in 2014		
Length:	110 m		
Breadth:	11.4 m		

Hybrid Ship Propulsion BV

Hybrid Ship Propulsion BV (HSP) in Rotterdam offers tailor-made hybrid and electrical propulsion solutions with high reliability and maximum performance. Its services include:

- Design, delivery and installation of electric propulsion
- Design of mechanical construction and the layout
- Software installation
- Installation of monitoring and control equipment

As of 2016, HSP has 15 ships in operation on their reference list, both new builds and retrofit projects. Commercial director, Henri Krusinga explains: "Initially we focused only on river vessels but we have also seen a big potential for hybrid and electric propulsion on harbour tugs and ferries – where fuel savings potential of 20-25% can be achieved"

<http://www.hybridshippropulsion.com/index.php/nl/>