# Rederij Doeksen paves the way with pure LNG

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*Rederij Doeksen's catamarans are being constructed at Strategic Marine's Vietnam shipyard. Credit: MTU*

**Rederij Doeksen's newbuild ferries are ground-breaking in many ways, including being 100% fuelled by LNG**

Rederij Doeksen's two newbuild ropax ferries are distinctive as they are 100% LNG-fuelled – in contrast to the more usual LNG-diesel dual-fuelled model that many operators are using.

Strategic Marine is building the two vessels – general manager commercial, Mike Bell told *Passenger Ship Technology.* "LNG is the unique point of them, the fuel system is very different to the normal, traditional diesel engines. The fact that they are pressurised and temperature sensitive has to be taken into account" he said.

Currently being finished at Strategic Marine's shipyard in Vietnam, *Willem Barentsz* and *Willem de Vlaming*hare due to travel to the Wadden Sea area - where they will ply the route between Harlingen and Terschelling in the Netherlands - at the end of July this year. The vessels will then have final commisioning and trails upon arrival in Europe.

Rederij Doeksen managing director Paul Melles told delegates at the annual Interferry conference in October last year the key reasons why the ferry operator had decided to commission the newbuilds. The company wanted to replace old tonnage (its *Midsland* ferry that currently plies this route); meet the demand for two additional midday departures from Harlingen and Terschelling; add more car deck space; allow more flexibility (to adapt to seasonal effects); allow more daily turnarounds and increase capacity.

To meet these demands, it decided to use two smaller ropax ferries rather than one single, large ferry. The operator also wanted to increase the service speed from 12 knots to 14 knots to meet its new requirements.

Mr Melles commented “We wanted to increase the speed of the ropax ferry – but to do this to a 1,000 gt vessel on a 21 nautical mile shallow route would mean using a huge amount of power and create a disturbing wash in a World Heritage area.”

Instead, the ferry operator realised that building two smaller ferries to travel at 14 knots was achievable.

Other aims of the ferry operator focused on reducing the environmental impact by lowering NOx, $CO_2$, noise and increasing the efficiency of the ferries, leading to lower operational costs.

A reduced ship size means less wave-making and squat resistance, leading to less propulsion power used and reduced emissions and operational costs. Therefore, Mr Melles said the decision was made to construct the ferry out of aluminium.

**Water depth challenges**

Water depth was an important consideration. The Water depth goes down to 5 m in some areas, with some quite turbulent sea conditions.

It was decided that the most efficient hull form for the shallow waters the vessels would travel was long, slender hulls. “This also offers a safe and wide stable platform with no need to carry ballast water,” commented Mr Melles.

Rederij Doeksen head of operations Richard de Vries said “The round bilge of the two slender catamaran hulls, with the very sharp bows, give the underwater ship a nice line and, with the anodes and sea inlets recessed, it will certainly ensure a very low ship resistance.”

Mr Melles said the ferry operator's research concluded that the "most practical, reliable and clean energy source" for a 21 nautical mile ferry service for a fixed A-B route meant that an LNG-fuelled ferry with direct mechanical propulsion, using batteries for peak-shaving to power their bow thrusters, should be built.

Rederij Doeksen said other reasons for choosing LNG included that the price of fue has risen sharply in recent years. In contrast, the price of LNG is rising less fast and is more stable."This means that the extra investments of sailing on LNG can be recovered better. LNG is also less scarce than oil fuels. In addition, LNG is produced in different countries, making the price and supply less dependent on the local (political) atmosphere," the ferry operator explained.

LNG tankers from terminals in Zeebrugge, Rotterdam or Eemshaven will be deployed to fuel the ferries. The plan is to bunker once a week, so the ferry operator is creating a gap in the ferries' schedule for this.

**LNG engines based on diesel models**

A symmetrical propulsion system arrangement within the two hulls of each catamaran was agreed upon. Two MTU 16-cylinder V 4,000 engines were chosen – to be fed by two LNG tanks – with each driven by a Veth CRP azimuth propeller.

MTU director, application centre marine, Stefan Müller said the main challenge was that the "propellers need a propulsion system that is very focused on very good load acceptance."

To meet this challenge, the gas supply comes through a spark-ignition system to the engines, with an injector for every cylinder. Mr Müller said it was "very important" to have "individual combustion control for each cylinder" to meet the load requirements.

He explained that double-walled fuel piping was used, which is an IGF requirement for an "inherently safe" engineroom.

Another striking feature of the engines is that, according to Mr Müller, they are the first high-speed pure gas engine to be used with diesel-like performance.

He explained "The first parameter was to deliver a product that had a behaviour very close to that of diesel, with the same performance range and map. The engines' dynamic acceleration behaviour meets the requirements needed for this application."

Its engines are based on MTU's existing S4000 marine diesel engine

Rederij Doeksen explained just how important it was that the engines were based on the existing MTU diesel model in a press conference at Hamburg's SMM trade exhibition in 2016. Mr de Vries told the SMM press conference "Besides our aim to have a sustainable, innovative ferry, our guests depend on year-round reliable operations, and in our selection for a propulsion system, reliability was one of the primary requirements. We think that we can meet all these requirements with our catamarans."

He explained that the operator was keen for MTU to provide gas engines as the ferry operator was impressed by the "excellent performance" of MTU engines used in its current fast ferries. "We frequently insisted that MTU come up with a gas engine for the project, but unfortunately at the time we started the investigation for this project their planning for gas engines was not at the same stage as our planning," explained Mr de Vries.

But when Rederij Doeksen was in the final tender process for the ships with just two yards left, MTU announced it had proceeded with the gas engine. Rederij decided to order the MTU engines having been impressed by the "enthusiasm of the R&D people working on the engines and also their approach, and what the engine can do for us."
The IMO Tier III compliant engines will each deliver 1,500 kW. The power output per cylinder is 93-125 kW with an engine speed 600-1,800 rpm and fuel gas consumption of 9,561 kJ/kWh @ 100% power. The engine's cooling system consists of a separate circuit for charge air cooling.

The gas gensets are Scania-based units developed and manufactured by Scania distributor Sanfirden.

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The LNG tanks have been placed mid-ship. They came pre-fabricated and were inserted through the side of the vessel before they were plated in what Mr Bell described as a "straightforward process".

The engines are being positioned behind the tanks. Mr Bell said "They have created soft patches on the car deck through which it will be very easy to drop them into position when everything else on the vessels is complete."

**Waste heat to power batteries**

Waste heat recovery systems are being provided by Orcan Energy whose ePack system will be added to the main and auxiliary engines. The waste heat recovery systems are based on the Organic Rankin Cycle (ORC). Orcan Energy explained that the ORC solution works with a refrigerant (R245fa), which already “boils” at 15ºCat atmospheric pressure. Via a screw expander, the vapour will be directly converted to rotational energy. This screw expander operates at a much lower speed and has a flat efficiency curve over a wide operating range, in contrast to a steam turbine.

The outcome (active power) from the waste heat recovery system is 77 kW. This is converted into direct current by a frequency converter to charge the batteries. Both battery packs are charged during the mooring of the ferries via inverters, to deliver power to the two electric bow thrusters with a power of 77 kW each.

The Veth propellers also boost energy efficiency. They consist of two contra-rotating screws with two rudder propellers. Rederij Doeksen said they ensure efficient and low-noise propulsion. Because the power is distributed over two smaller screws, this gives less pulsating vibrations compared to one large screw and that improves the comfort on board. Smaller screws usually have a lower propulsion efficiency compared to screws with a large diameter. The two screw but, thanks to their contra-rotating arrangement, a higher efficiency is obtained than with a single screw with the additional advantage of more comfort due to less pulsating vibrations. The rear propeller of each pair uses the rotating wake of the front propeller and converts it into 10% extra propulsion force.

Aside from the LNG used by the ferries, they have many other environmentally-friendly and efficient features: solar power will be used for part of the hotel electric load; boilers are LNG-powered; low energy LED lighting is being used throughout the vessel; zinc-free anodes for cathodic protection will be deployed and silicon non-toxic anti-fouling is being used.

Mr Bell summed up “The entire design has been done to be as energy efficient and clean as possible.”

**Design particulars**

Capacity: 64 cars and 600 passengers

Truck lanes: 130 m

Speed: 14 knots

Propulsion system: Two MTU lean burn single fuel LNG engines each driving a Veth CRP azimuth thruster;

Class: Lloyd’s Register

**Main suppliers**

Construction: Strategic Marine

Vessel design: BMT Nigel Gee

Interior and exterior design: Vripack Sneek

LNG fuel system: Marine Service Noord Hoogezand

Waste heat recovery systems: Orcan Energy

Gas gensets: Scania (developed and manufactured by Scania distributor Sanfirden)

Contra rotating rudder propellers: Veth

Main engines: MTU

bron; http://www.passengership.info/news/view,rederij-doeksen-paves-the-way-with-pure-lng_51095.htm