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INSIGHT FOR MARINE TECHNOLOGY PROFESSIONALS

Newcastlemax design runs on lng without loss of cargo capacity

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Deltamarin and GTT's LNG-fuelled Newcastlemax design has the same cargo capacity and dimensions as a standard 210,000dwt Newcastlemax but can carry enough LNG for two round trips from Australia to China or one round trip from Brazil to China.

LNG-fuelled Newcastlemax with Mark III membrane tank
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Classification society ABS granted Approval in Principle (AIP) for the design late last year, and the companies are now in discussion with leading mining companies and Newcastlemax shipowners. But the design is not limited to the iron ore market. Chin Lim, Product Line Manager for bulk carriers at GTT, says the vessel design is flexible enough for a range of trades and vessel sizes from Capesize to Very Large Ore Carriers, carrying not only iron ore but also coal or grain.

With the support of GTT, Deltamarin studied various arrangements for the LNG tank, until the AIP was granted for the tank located in the aft of the 50-metre wide vessel, behind the accommodation. By locating the tank here, it has no impact on available cargo space or the vessel's hull dimensions and is clear of any hazards associated with cargo loading and unloading.

Any changes to a conventional Newcastlemax design were kept to a minimum with the result that the introduction of the LNG tank, larger in dimension than the equivalent heavy fuel oil (HFO) tank it replaces, only required the relocation of the vessel's gensets and engine casing.

The design is compatible with both high and low pressure two-stroke main engines from MAN Energy Systems and WinGD. Due to its high efficiency and lower methane slip, the MAN

6G70ME-GI (16 MW) engine with exhaust gas recycling was selected as base case for the design. The fixed pitch propeller, rudder bulb and stator fins have been chosen to maximise propulsion efficiency. Electricity is generated by three dual-fuel auxiliary gensets, and heat is produced by a dual-fuel boiler.

As part of the vessel design process, the hull shape was optimised using the latest digital tools developed by Deltamarin. One, Deltaseas, was used to evaluate sea states on the selected routes, and the main engine can be optimised for the actual operation of individual vessels, reducing fuel consumption and emissions.

The designs incorporate GTT membrane-type LNG tanks with the LNG bunker fuel stored at atmospheric pressure. For vessels on the Australia to China trade, this tank will be approximately 5,500cbm for two round trips; for the Brazil to China trade, it will be approximately 7,500cbm.

This tank capacity would not have been possible if Type C technology were used, says Lim. GTT membrane tanks are more compact and have a useful volume 10-15% greater than Type C tanks, and this was enough to enable the larger capacity required for the Brazil to China trade. The tank, partially located below the main deck, can be increased in height to provide even greater fuel carrying capacity. The use of a single tank means that only one gas handling system is required, also saving space, complexity and expense compared to a Type C solution, says Lim.

The Mark III tank is directly supported by the ship’s hull structure, and the thickness used for the Newcastlemax design balanced cost and boil off rate, resulted in a relatively light tank that has reduced impact on the ship's fuel consumption. There cannot be any filling level restriction in a bunker tank, and the potential for sloshing was taken into account when shaping the tank. The resulting design underwent over a year of testing and sloshing simulation covering the whole range of North Atlantic sea states.

Maintaining a low operational pressure makes gas venting unlikely and facilitates faster bunkering with fewer bunkering personnel required. The design allows for bunkering from either side of the vessel by ship or barge. With current global infrastructure, it is anticipated that the Newcastlemax vessels will bunker at Singapore for both the Australia to China and Brazil to China trades. Singapore would also be conveniently located for seaborne metallurgical and thermal coal routes between Australia and South and East Asian destinations.

Another consideration is idle time, which is relatively high for typical Newcastlemax operations, i.e. up to several weeks. If the propulsion system is not using the boil off gas (BOG), pressure and temperature in the tank could increase, but GTT and Deltamarin have optimised the tank shape and insulation properties so that a reliquefaction plant is not required. The system has been designed so the natural boil off can power hotel loads, such as in port stays or at anchorage, through BOG compressors. When sailing, a vaporiser-pump is used to supply fuel to the power and propulsion systems.

The optimised hull and overall design with LNG propulsion provides fuel savings up to 35% and CO2 reduction up to 57% compared to previous ship design with VLSFO for the Australian iron ore trade. Deltamarin's calculations show that the vessel design is approximately 10% below the baseline of EEDI Phase 3.

Currently, Newcastlemax vessels cost around $50-55 million to build. The price including an LNG fuel system is less than $65-70 million, says Lim. The specific payback time for the LNG system varies depending on the trade, and Lim refers to a SEA-LNG study published earlier this year on a 210,000dwt ore carrier sailing from Australia to China. The study illustrates

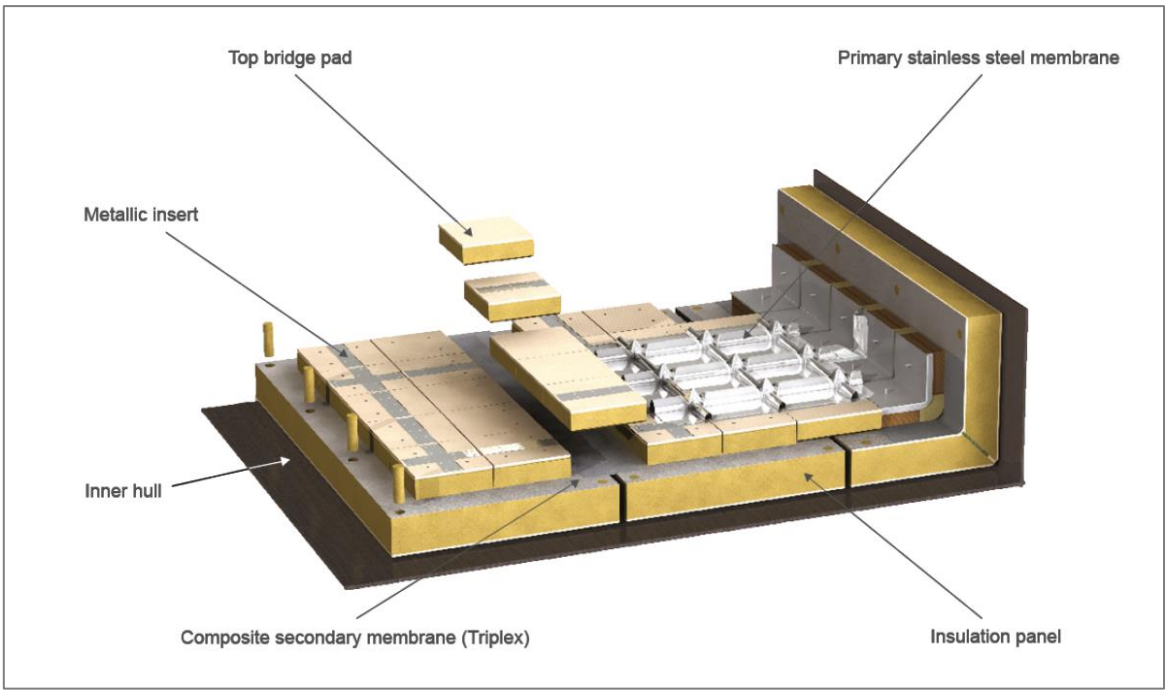
strong returns on investment for LNG as a marine fuel on a Net Present Value (NPV) basis over a conservative 10-year horizon. The modelling analysis is bolstered by compelling payback periods of two to four years for a newbuild Capesize on this major iron ore trade corridor.

The SEA-LNG study is part of a series of studies which also cover a 14,000 TEU container vessel operating on the Asia-US West Coast liner route, a dual study examining an 8,000 CEU Pure Car and Truck Carrier (PCTC) on the Pacific and smaller 6,500 CEU vessel on the Atlantic Trade Lanes and a 300K DWT VLCC sailing from the Arabian Gulf to Asia.

Membrane tank volumes can vary from 1,000cbm for passenger ships, to 10,000cbm for tankers, and close to 20,000cbm for very large container vessels, such as the Jacques Saadé-class 23,000TEU vessels operated by the CMA CGM Group. With an 18,600cbm LNG tank, these ships are the largest container ships in the world to use LNG as fuel.

Deltamarin's references include various vessels with LNG bunkering capabilities, and the company says GTT's technology is particularly suitable for greater range or larger ships. In close cooperation with GTT, Deltamarin has therefore created a unique portfolio of cargo and passenger vessels that save valuable cargo space compared to classic cylindrical tanks and enable the use of LNG for long ocean voyages.

The designs include a 2,300 TEU container feeder concept and a 8,000 CEU PCTC. The modularised GTT membrane tank solution employed can be adjusted in size from 1,000 to 5,000cbm, depending on the case vessel. Either one or multiple tanks can be integrated into the vessel, with the final fuel capacity being a trade-off between cargo capacity and bunkering intervals. The solutions are all scalable.



GTT's Mark III membrane tank technology
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