DUAL FUEL: GustoMSC has proposed designs that would add LNG fuel capacity to mobile offshore units, including deepwater drillships. Photo: GustoMSC

Taking LNG fuel to new depths

Liquefied natural gas fuels a growing segment of the maritime industry. Could mobile offshore units be next to join the ranks of LNG-fuelled vessels?

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Environmental regulations regarding sulphur content in marine fuel have tightened over the years, and are set to become yet more stringent — the International Maritime Organisation recently issued global regulations that mandate a reduction in sulphur oxide (SOx) emissions from the current cap of 3.5% of fuel content to 0.5% by 2020.

Coupled with limits on the amount of nitrous oxide (NOx) and particulate matter in emission control areas, the new guidelines could build a case for greater uptake of non-traditional marine fuels such as LNG. Because they often operate in these environmentally protected areas, mobile offshore units such as drillships, jack-ups, construction vessels and semi-submersibles will be under pressure to comply with the regulations.

Its proponents point out that LNG is the one fuel that meets emission limits on all three counts — SOx, NOx and particulates — and that gas is a less expensive alternative to marine diesel oil and marine gas oil. But the offshore industry, recognising the logistical and technical challenges, remains sceptical.

Douwe de Jong would like to change that impression. De Jong, Project Manager R&D at Dutch offshore design and engineering company GustoMSC, recently completed a study that makes a case for LNG by examining the most relevant technical, operational and economic factors involved and proposes some designs that, with relatively minor modifications, enable offshore mobile units to incorporate LNG in a dual fuel system.

Industry scepticism is not unfounded, he says. LNG requires pressure-rated cryogenic storage and has a much lower energy density than traditional marine fuels. It needs up to 2.5 times as much storage space, often concentrated in one or several large compartments, unlike marine diesel oil or gas oil, which may be distributed throughout smaller tanks integrated with the structure.

"We've been looking at this for a while now. We started (a research and development) project a few years ago when this was becoming more relevant, just to get an idea of the technical impact and feasibility of applying LNG in offshore units. We concluded that, without a LNG-specific design approach, there was a high potential of ending up with significantly enlarged designs that undermine the emissions and fuel cost savings that LNG can offer," he says.

"We often encountered very conservative views on the feasibility of LNG," he continues. "And we decided, well, if we see a way to provide feasible designs, then it would be an interesting topic to put out there and get a dialogue going with potential future clients."

Design challenges

GustoMSC identified four vessel types that it deemed good candidates for LNG fuel, all of which feature in the company's design portfolio: a wind turbine foundation installation vessel; a wind turbine installation jack-up; a deepwater drillship; and a semi-submersible rig.

The wind installation vessels are "a very good match because they tend to operate in emission control areas and relatively close to shore," de Jong says. The "predictable operational profile" of a wind installation vessels enables optimisation of the LNG system, he says, based on the average of the operational profile. Bunkering logistics benefit from the local LNG infrastructure.

Power requirements for offshore construction and exploration units, however, vary widely over relatively short time spans, he says, and the vessels must often travel long distances from project to project. To achieve the same operational flexibility they have now using LNG alone would require very large tanks, and thus bigger, more expensive vessels.

De Jong has proposed several options that could help overcome these limitations. But they require some fresh thinking by vessel operators as well as further development of the LNG infrastructure, including the nascent practice of offshore ship-to-ship bunkering.

Dynamically positioned drillships and semi-submersibles, particularly those designed for harsh environments, use a lot of fuel. That means lower-cost LNG could provide "significant" savings, he says. "The financial picture could be very interesting" but much depends on the price climate for the underlying commodities, crude oil and natural gas.

On the other hand, units designed for harsh environments tend to operate farther from shore and the LNG infrastructure, "which might make the supply case challenging", de Jong says. But offshore ship-to-ship bunkering shows promise. "I think that's going to mature over the next one or two years, and LNG could be very feasible for these specialist harsh environment offshore units," he says.

The Rotterdam-Antwerp area "will soon have two decent-size bunkering vessels in the 5000 to 6500-cubic metre range", he adds. That will provide a combination of mobility, with ship-to-ship LNG transfer, and the supply volume critical to the feasibility of the vessel concepts.

In the US Gulf of Mexico, another active emission control area, plans are under way to introduce ship-to-ship using an LNG transfer articulated tug barge, he says.

GustoMSC's drillship concept "should be seen as an exhibition of the need to think different and take a broad approach to LNG", de Jong says. "You could try to solve the LNG supply challenge by implementing large tanks and increase the autonomy, but here we wanted to show that if you take, for instance, a drillship in the Gulf of Mexico, which operates with a supply chain of platform supply vessels, you can think about using exchangeable tanks, making use of an already existing supply chain and tap into the shore-side interface that you have at your shore base, allowing the use of land based LNG facilities. That could be an interesting possibility for a client looking to launch an LNG pilot project in a setting that doesn't yet provide offshore LNG bunkering."

Exchangeable fuel tanks would probably be some variation on the Type C pressure tanks already widely used on LNG-fuelled vessels. Portable containerised versions are in common use today, for road and rail transport of LNG. The cylindrical tanks are structurally self-supporting, relatively simple to manufacture and have "high operational flexibility regarding the allowable build-up of boil-off gas", he says, referring to the vapours created as the cryogenic fuel warms in response to the ambient environment.

Other storage options include membrane tanks, which conform to the shape of a surrounding support structure, and the Type B tank, a structurally self-supporting tank which features a primary barrier with external insulation. Both tank types have higher volumetric fuel storage efficiency than Type C tanks, de Jong notes, but with less flexibility regarding boil-off gas.

Membrane tanks are used widely in the global LNG carrier fleet and the technology is being actively marketed for other applications, such as LNG-fuelled vessels, he says. Additional research and development projects focusing on increasing the volumetric storage efficiency are ongoing.

While the proposed designs use Type C tanks as a base case, larger storage capacity offshore vessels such as semi-submersibles could be good prospects for alternative tank technologies.

Although newbuilds that include LNG as a fuel are "optimal" from a design standpoint, de Jong says retrofitting existing vessels is an option, "especially with Type C tanks, but also with in-hull tanks, depending on the arrangement. It really starts with the design — if we are given this consideration by our client, then we can guide our design process in that direction.

"What we've tried to do with these concepts is to show a very big design space of options and discussion topics."

Flexible thinking

A few things need to happen to boost LNG fuel's prospects in the offshore industry. Some, like improvements to the supply infrastructure, are under way. There are no significant technology hurdles, de Jong says, but uptake will require more "flexible thinking" about autonomy—for example, the role LNG can play in a dual fuel arrangement, depending on where and for what tasks the vessel will be used.

"I think the mobility of these vessels in the form of being able to do ship-to-ship (bunkering) offshore will be a big driver to uptake of this fuel, especially in offshore oil and gas," he says.

Most important, perhaps, is careful planning.

"For ship owners, I think it's very important to start talking to designers at a very early stage so that you implement optimisation that covers all the technical, operational and economical aspects," de Jong says.

"As designers, we try to take a holistic approach to these things and consider everything from technical to finance to vendors, and we think that's a real added value."