

New rules demand new solutions

Environmental regulations imposed on operators means that they must adopt new technology to comply with the new rules. In many cases the choice is LNG or HFO. Knud E. Hansen takes an informed look at the merits and demerits of both fuels on a medium sized cruise liner

Danish naval architects, Knud E. Hansen, have designed a medium sized cruiseship, ostensibly for a Greek operator to deploy in the Mediterranean, but the designers have made a comparison between the HFO fuelled version and its LNG variant.

According to the company's comparison, operating expenses for the LNG version were lower, including fuel consumption when the scrubber fuel consumption is included in the calculation. Scrubbers take out SOx from the exhaust when vessels are operating in Environmental Control Areas (ECA).

LNG-fuelled ships will not need scrubbers to meet the SOx rules cutting back on both capital expenditure and operating costs. In addition, the LNG ships will not need a selective catalytic reduction (SCR) to meet NOx rules, while HFO heating and purifying equipment would be unnecessary. Furthermore, there would be no need for

settling and daily tanks for the fuel and no waste chemicals.

Gas carriers often take advantage of boil-off gas; LNG is stored in liquid form at -163°C and will emit small amounts of gas as the liquid warms, this boil-off gas is used for main engine power, but a cruise vessel can take advantage of the boil off rate to cover the high demand in electric load in the hotel section of the vessel.

In these days where safety is an issue as well as the availability of LNG in some parts of the world, the ability to switch fuels offers the cruise operator an "extra degree of redundancy," explains Knud E. Hansen.

The designer also explained that the LNG version prompted them to explore more innovative solutions in terms of engine room and consequently funnel location. Such solutions, however, are no longer unique to the LNG fueled vessel as, considering the new machinery system redundancy requirements of Safe Return to Port rules, similar arrangements are now feasible for any diesel electric configuration with only limited impact on construction costs. And the final advantage according to Knud E. Hansen is that the bunkering process can take place with passengers onboard saving time in the operation of the ship.

The list of disadvantages is shorter, but could ultimately prove more costly, at least in the short term. Higher capital expenditure will be needed to build the vessel with all the safety features necessary for using a low flashpoint fuel.

Safety will necessarily be a significant issue and the crew will need special training in the use of equipment and the handling of LNG.

In addition, the LNG tank arrangement uses up a lot of technical space. Membrane tanks negate this effect compared to other types of tanks such

as Type C tanks, while the LNG tank structure adds up a considerable amount of weight.

Strict bunkering procedures require the isolation of the main fire zone (MFZ) although there are "no official regulations regarding the bunkering procedure, only universally accepted guidance," explains the designer. Bunkering LNG itself could also prove a difficulty in some parts of the world as the LNG supply and infrastructure necessary remains underdeveloped.

Meanwhile, a lack of experience in the design and operation of LNG powered cruise vessels means that investors are reluctant to risk being the first to make the investment.

Tank sizing was based on three operational scenarios. In all three of them there is the assumption that the energy requirements of the vessel can be covered relying solely on either LNG or HFO.

Scenario 1 includes five day cruises, with four trips per month with bunkering intervals at 14 days. In the second scenario there are 2.5 trips a month with 12-day cruises with bunkering intervals set at six-12 days.

Scenario 3 includes a 21-day transatlantic cruise, 1.4 trips per month, with bunkering intervals of every 10 days.

The outcome of this research was that an LNG tank of 2,000m³, would be sufficient to cover the vessel's needs for the first 2 scenarios, while for the third one, a future retrofit and potential addition of a tank could be an option.

The pilot fuel has been calculated as the equivalent to 5% of the LNG thermal capacity that is onboard. Additional MDO to comply with the safe return to port rules and for redundancy purposes would also need to be taken into account.

For the two versions of the cruiseship design there are potentially small changes in the dimensions of the vessel, but the

TECHNICAL PARTICULARS

Reference Vessel

| | |
|------------------------|---|
| Loa: | 250m |
| Breadth: | 34m |
| Depth: | 9.5m |
| Design draught: | 7m |
| Service Speed: | 18 Kn |
| Persons onboard: | 2650 |
| Propulsion: | podded electric thrusters |
| LNG Version | |
| • | 6 medium speed dual fuel engines. |
| • | LNG as main fuel, in combination with MDO for pilot fuel and compliance with SRP rules. |
| • .. | Membrane type of tank for LNG storage |
| HFO Version | |
| • | 6 medium speed diesel generators |
| • | HFO in all normal operating conditions |
| • | Scrubbers and possible SCR/EGR. |



midships. The vessel will include two engine rooms located fore and aft of the LNG tanks.

A reduction on the amount of equipment that will be required in the LNG version offers the possibility of rearranging the machinery area to gain space. This will also necessitate changes to the crew cabins location, crew public spaces and provisions area.

Changes in the vessel's profile due to double funnels, located on the centreline will also mean changes to the external open deck arrangement and facilities that would be combined with the two funnels.

On the LNG version the membrane tanks are preferred as these types of tank use the available space more efficiently. According to the naval architect: 80% of

the vessel's inner hull volume in the certain compartment that will accommodate the membrane, will constitute the membrane. There is a difference of 30-40% in the usable volume of the area where the tank is located between Type C and membrane tanks."

In addition, there is "no minimum filling limit in membrane tanks (no thermal stresses restrictions as in type C tanks)".

Irrespective of the type of tanks, cruiseships can turn the potential problem of boil off gas to an advantage through the powering of the hotel areas.

"Managing the boil off gas on a cruise vessel is not considered a major issue, due to the extended hotel load," says Knud E. Hansen. "Often, boil off gas is

produced on purpose to cover the needs in electrical load."

When this is not the case, the 'excess' boil off gas can be used in various ways, including the innovative combination of an LNG fuelled vessel with significant battery storage onboard. The boil off gas can be used for battery charging via DC electric storage, increasing the LNG efficiency onboard while offering an eco-friendly solution.

The excess gas can also be used to fuel the auxiliary boiler and produce steam for various purposes or to fuel the incinerator. Other solutions, including gas combustion units, which just waste the energy, and reliquefaction units, are costly and apply mostly to other, more specialised types of vessel such as gas carriers. **NA**

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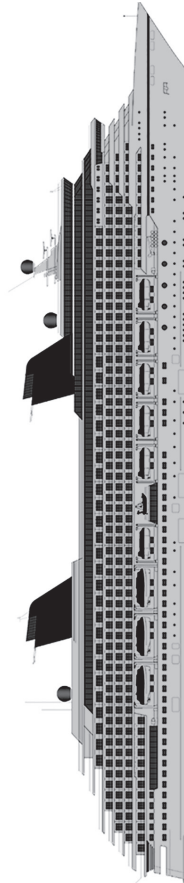




Feature 3 | LNG/LPG

Comparison of a 250m cruiseship powered by HFO or LNG

LNG VERSION



HFO VERSION

