Background
The LNGreen project brought together experts from DNV GL, GTT and Hyundai Heavy Industries (HHI) as well as the shipowner GasLog to define the state-of-the-art, next-generation LNG carrier. Each of the partners contributed their unique know-how and experience to develop tomorrow’s LNG carrier using the latest technology, within the bounds of existing shipbuilding methods. The project was announced in June 2014 and completed in July 2015.

New LNG vessel concept
Traditional optimization has focused mainly on the hull form, propeller and rudder design - which LNGreen has too - but the inclusion of a system evaluation in the development process has produced significant benefits. The project developed an LNG carrier vessel concept which is about 8 percent more energy efficient than conventional designs and has increased its cargo volume capacity by 5 percent.

In other words, the vessel concept has a significantly reduced environmental footprint, a higher level of energy efficiency as well as an improved boil-off rate and cargo capacity - making it much better suited to future trading patterns than existing LNG carriers.

DNV GL has driven LNG carrier future concept design

The joint development project together with leading industry players of the LNG market set out to make an even better LNG carrier - one that ideally meets the trading needs of tomorrow with energy efficiency and increased capacity, among others.
Details of the project

Operating profile
Using operational data provided by GasLog and a forecast of future trading patterns as a guideline, a realistic operating profile was set for a 174,000 m$^3$ LNG carrier focusing on:

- Optimization at 15 knots and 18 knots rather than only at the contractual speed of 19.5 knots
- Major components redundancy assessment
- Alternative configurations and energy-saving devices assessment for predefined realistic voyages
- Major terminals compatibility compliance
- Regulatory compliance with the new Panama Canal and new IGC Code

Machinery configurations - DNV GL COSSMOS
Our in-house modelling and simulation framework, COSSMOS, was used to assess various machinery configurations for the LNG carrier with respect to energy efficiency, fuel costs and economics for a set of component options. The use of trading route characteristics and intended operational profiles was a key element of the assessment too.

The alternative machinery configurations were assessed at conventional and optimized hull designs. The simulations performed using DNV GL COSSMOS resulted in the quantification of the effects of different propulsion configurations, energy recovery variants and hull optimization:

- With the selected machinery configurations, the overall system efficiency can exceed 51.5 percent, compared to a 47.5 percent of the baseline.
- Combined with the optimized hull, the overall energy efficiency improvement is approximately 8 percent.

The payback period for the various energy recovery solutions is between one and three years, compared to the standard design.

Hydrodynamics performance and optimization
Hull optimization was carried out by HHI based on the operational profile and applying a new tank shape which can minimize the amount of void space around the first cargo tank. The performance evaluation of the new hull form has been carried out by comparing CFD simulations of HHI and DNV GL. Different CFD codes were applied for the resistance and self-propulsion performance evaluation, but different scale effects were also considered.

Cargo containment advancements
The cargo hold space design was enhanced by GTT:

- The cargo capacity was upgraded, from 174,000 m$^3$ of the base ship to an optimized volume of 182,800 m$^3$ within the same main dimensions and requirements of the new IGC Code.
- Mark III flex technology was applied to an innovative tank layout to enhance the cargo hold and to the benefit of a particularly low boil-off rate of 0.085%vol/day.

Project results
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