High-Pressure Gas Supply for Two-Stroke Dual Fuel Engines

a new challenge using LNG as a marine fuel

Driven by economic and environmental factors, LNG propulsion is a quickly developing technology for the shipping industry. Starting with medium speed four-stroke engines using natural gas as propulsion fuel, a number of new technologies have been developed in recent years including those for two-stroke engines. One of the major innovations was the introduction of slow speed, two-stroke diesel engines using dual fuel (natural gas & diesel mixture) technology by MAN Diesel & Turbo (MAN) in 2011.

The gas supply to MAN's dual fuel ME-GI engine is quite different from other fuel supply processes including those run on gas carriers. New challenges are:

- High pressure supply to the engine
- Controlling low pressure FGS to high pressure FGS during the ship's voyage
- Designing a Fuel Gas System (FGS) to meet High Pressure (HP) pump life and must be avoided to achieve required operational life of the HP pumps. Using a "boost" pump guarantees sub-cooled liquid is properly fed to the high pressure pumps and gives operators assurance the FGS meets all challenges operating at sea.

TGE and ACD have transferred the submerged pump technology to the shipping industry. ACD recently delivered the (Marine Supply Pump-Submerged) pumps to be installed in an Anthony Veder LNG ship to supply fuel. (See Figure 2)

)LJXUH 6XEPHUJHG YHUWLFDO MSP-34 "boost" pump

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The reciprocating pumps have inherent pressure pulsations at low pressure (minimum 2.5 - 4.0 barg) LNG supplied from the boost pumps to high pressure LNG. High pressure LNG is then discharged to a heat exchange system which vaporizes the liquid to gas. The high pressure natural gas is then fed to the engine's high pressure fuel control valves through a manifold system designed by MAN.

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TGE and ACD have put much effort into developing the Fuel Gas System and validating system design using simulation based on actual operation of a typical voyage. Given the size and complexity of the ship's engines, and the fact that duplicating 'real-world' operations in multi-HQJLQH DSSOLFDWLRQV LV GLIÀFXOW WKH G\QDPLF VLPulation model is a practical and reliable solution that investigates various aspects of the system's design through multiple operational processes.

TGE uses UNISIM™ modeling for steady state and dynamic process simulation. Very detailed modeling of the components including all piping sections, control elements and ACD's cryogenic pumps form the basis for thorough investigation of liquid (LNG) composition from the cargo/fuel tank to the engine. The simulation program shows how pressure and temperature changes of LNG impact FGS reliability and why a boost pump is required. The boost pump simply ensures a positive means to counter potential problems due to normal voyage situations that threaten sub-cooled liquid conditions to the high pressure pumps.

The critical aspect during operation is to avoid cavitation of the high pressure pump. Marine applications introduce new factors that impact cavitation scenarios

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compared to on-shore processes. These variables have been investigated in detail using the UNISIM™ model. Simulation has shown that cavitation does not occur(to fo

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