Coral Methane broadens LNG supply chain

Coral Methane, the first truly multipurpose LNG carrier, is enabling a major extension of the industry's LNG distribution capabilities

Coral Methane is poised for a busy working life on Norwegian coastal distribution duties

The April 2009 delivery of the 7,500m^3 *Coral Methane* to Anthony Veder by the Polish Remontowa yard in Gdansk marks a new departure in the history of LNG ship construction. The ship is the first multipurpose gas carrier built to transport LNG, LPG and liquefied ethylene gas (LEG).

The ship has been designed to carry LNG to meet the requirements of a 15-year charter with the Norwegian gas utility Gasnor for the distribution of LNG along the rugged coast of Norway. The ship has been sized to meet Gasnor's current needs as well as any likely increase in demand for coastal LNG distribution over the life of the charter.

It is unlikely that Gasnor will be able to utilise the LNG-carrying capacity of *Coral Methane* on a full-time basis, at least during the early years of the contract as the utility extends its customer base and builds LNG delivery volumes. As a result, *Coral Methane* is also designed to be able to carry LPG and LEG. On those occasions when the ship is not required by Gasnor, it can be switched to service in Anthony Veder's existing pool of LEG and LPG ships. The provision of this degree of flexibility in the multipurpose gas carrier will effectively lower the net ship hire costs for Gasnor.

Coral Methane will complement the small 1,100m^3 LNG carrier *Pioneer Knutsen* and a fleet of LNG and compressed natural gas road tankers engaged in the distribution of gas along Norway's long coastline. Owned by Knutsen OAS, *Pioneer Knutsen* is the world's smallest LNG carrier; it is also fixed on a 15-year charter to Gasnor, this agreement having commenced in March 2004.

Gasnor AS was established in 1989 by a number of Norwegian and international energy companies to supply clean energy to industrial, transport and power sector customers sited at remote Norwegian coastal locations. Because the country has no long-distance pipelines, LNG is central to the distribution network. Gasnor has two LNG liquefaction plants – one at Kollsnes, near Bergen, and the

second at Karmøy – with a total production capacity of 140,000 tonnes per annum. The company's full control of the LNG supply chain is completed through its network of Norwegian receiving terminals. Of the 30 such facilities operated by Gasnor, eight are served by LNG carriers.

Coral Methane is built to a high standard and the ship's classification society, Bureau Veritas, has awarded the vessel the Cleanship Super notation. The ship effectively has two electrical generating systems. One system is able to run on LNG cargo boil-off gas (BOG) when in LNG service while the second consumes heavy fuel oil when in ballast or carrying other gas cargoes. Rolls-Royce designed, produced, delivered and commissioned the overall propulsion system for *Coral Methane*.

The contract with Anthony Veder for a complete gas/diesel-electric propulsion system represented a breakthrough for Rolls-Royce. After studying the options Anthony Veder and Rolls-Royce decided that operating both a diesel plant and a gas plant on the same ship, rather than a dual-fuel hybrid, offered the greatest potential for efficiency.

Compared to engines burning heavy fuel oil (HFO), gas engines achieve a 100 per cent reduction in sulphur oxide (SOx) and particulate emissions and an estimated 92 per cent reduction in nitrogen oxide (NOx) emissions. Furthermore, gas engines cut carbon dioxide (CO_2) emissions by up to 25 per cent.

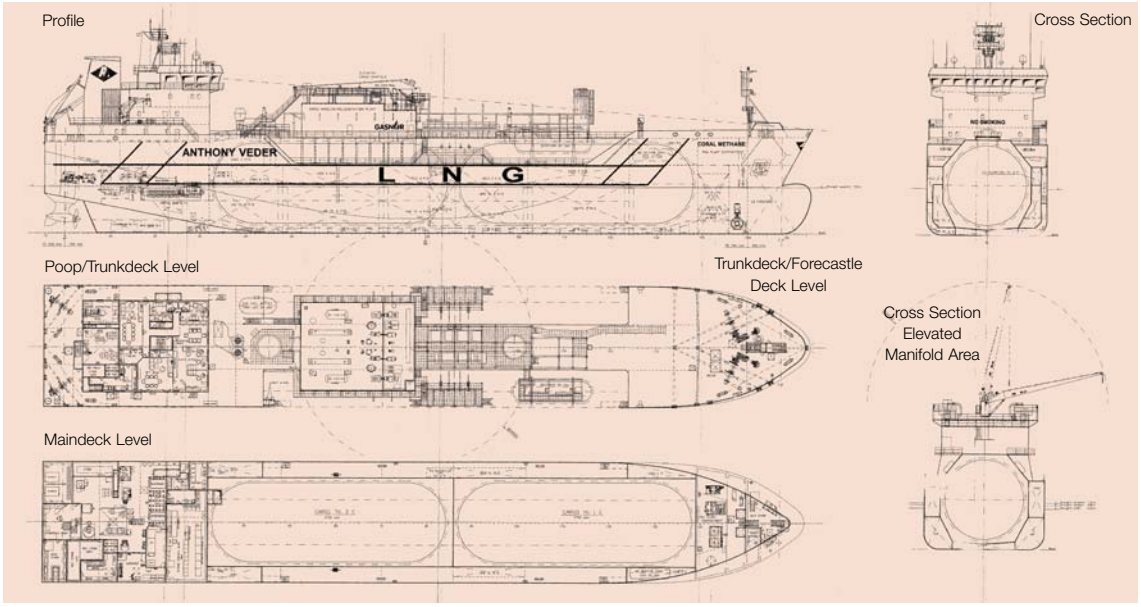
The Rolls-Royce package for *Coral Methane* encompasses two Bergen gas gensets and two Bergen diesel gensets, the electric system, a pair of Azipull 120 thrusters with pulling propellers and a bow tunnel thruster. The Azipull thrusters represent the first time such units have been utilised to propel a gas carrier. According to Rolls-Royce, these Azipull units provide the ship with high degrees of manoeuvrability and fuel efficiency.

The electric drive system that Rolls-Royce provided for *Coral Methane* embraces a new technology, i.e. low voltage (LV) water-cooled frequency converters. The two 2,500kW drives were assembled in the UK prior to shipment to Poland. Their installation on *Coral Methane* represented the first time that this product was integrated into a Rolls-Royce drive train configuration. Rolls-Royce points out that the drive is suitable for all commercial ships demanding a propulsion power up to 5,000kW per propeller.

On loaded LNG voyages cargo BOG will be directed to the Bergen gas engine-powered gensets, while the diesel gensets

CORAL METHANE

Shipbuilder	Remontowa, Gdansk
Shipowner	Anthony Veder
Ship operator	Anthony Veder
Technical manager	Anthony Veder
Flag	Dutch
Year built	2009
Containment system	IMO Type C tanks
Class	BV
Intended sphere of operations	Regional distribution
Length	117.8m
Breadth moulded	18.6m
Draught, design	6.3m
Deadweight	6,150 tonnes (butane cargo)
Cargo capacity, 100%	7,500m^3
Propulsion system type	Dual fuel
Propulsion power output (kW)	5,000
Service speed	14.0 knots
Main engines (four)	Rolls-Royce
Cargo system design	TGE Marine Engineering
Cargo pumps	Hamworthy Svanehøj
Inert gas generator	PSA system
Propellers	Azipull thrusters
Bow thruster	Rolls-Royce



will be run when the ship is in ballast or when gas cargoes other than LNG are being transported. Anthony Veder states that if BOG is available from the LNG cargo, *Coral Methane* will operate under all circumstances on the gas generator sets.

The cargo-handling plant on *Coral Methane* was designed by TGE Marine Engineering of Bonn in Germany and is able to handle LPG and ethylene as well as LNG. TGE has utilised its extensive experience of ethylene carrier cargo systems in the design of the IMO Type C insulated, pressure vessel cargo tanks on *Coral Methane*. Type C cargo tanks require no secondary barrier containment system and there are no partial filling restrictions. To enable the carriage of LNG at -163°C the engineering company modified its basic ethylene system design.

The model shows Coral Methane's pair of Azipull 120 thrusters with pulling propellers

The new ship's deepwell cargo pumps have been supplied by Hamworthy Svanehøj A/S, the manufacturer similarly modifying its standard LPG/ethylene pump design to accommodate the lower service temperature of LNG.

The ability of the modified Hamworthy Svanehøj deepwell cargo pumps to handle LNG was verified through a series of tests. In the final stages of the cryogenic verification programme the pump was tested utilising liquefied nitrogen at approximately 4 bar pressure and a temperature of -185°C. As a result of the successful outcome of the test programme, Hamworthy Svanehøj is now marketing a series of deepwell pumps in the 50 to 700 m^3/hour range to the LNG carrier sector.

The Hamworthy Svanehøj deepwell cargo pumps for *Coral Methane* are fitted with normal explosion-proof motors powered by frequency converters, enabling them to develop 210 mlc in LNG service and 120 mlc when handling LEG/LPG, at a rated flow of 450 m^3/hour for both duties.

"Our test programme, which was carried out in close co-operation with Anthony Veder, confirmed the main objectives of our LNG pump project," explains Hans Høyer Jensen, responsible for sales and marketing of Hamworthy Svanehøj deepwell pumps. "Not least, the tests demonstrated that the selected material modifications for the key elements were satisfactory and the selected clearances between the static parts and the rotating parts of the pump were correct for the specified temperature range of -163°C to +45°C. In addition, the standard sealing and bearing arrangement showed that it will not be affected by the lower service temperature."

Rotterdam-based Anthony Veder has owned and operated gas tankers since 1968 and over the past four decades has carried just about every liquefied gas shipped in bulk by sea. *Coral Methane* is the first LNG carrier in the fleet and the shipowner is confident that there is a growing market for the use of ships such as this in the regional and coastal distribution of LNG. "This is our first step in the LNG field and we are working on various projects to develop and utilise this concept in other areas around the world," states Anthony Veder managing director Jan Valkier.

Anthony Veder developed the newbuilding specification for *Coral Methane* and worked closely with TGE Marine Engineering, Rolls-Royce, Remontowa and various equipment suppliers to bring the project to fruition. The ship's propulsion system, gas plant, cargo tanks and associated cargo-handling equipment break new ground for gas carrier design.

Coral Methane is sized to accommodate growth at Gasnor. In addition, the ship's manifold arrangement has been designed to enable cargo transfers at both large and small LNG terminals. As a result, *Coral Methane* will also be able to load LNG at European LNG import terminals to supplement Gasnor's Norwegian production. Few, if any, modifications are required at the import terminal for such operations. For example, the ship will load at the Huelva import terminal in Spain later this year and talks are underway for similar operations at Zeebrugge in Belgium. In addition, the design of the two new terminals under construction in Rotterdam is such that *Coral Methane* will be accommodated at both facilities..

It is anticipated that the extent to which *Coral Methane* is engaged in the LNG trade will increase with time but the flexibility to carry other cargoes will enable the ship's employment opportunities to be maximised. There is also the potential to increase the scope of LNG distribution activities beyond Norway, to Sweden and other ports in the Baltic and North West Europe.

Anthony Veder also points out that there are many small-scale LNG distribution opportunities arising elsewhere that will prompt the construction of further specialist vessels like *Coral Methane*. The Skaugen Multigas ships now under construction are a case in point.

However, local LNG distribution projects also pose challenges, not least the economics of producing and handling LNG in small quantities. Co-operation amongst all the participants in the LNG supply chain will be needed to help spread the benefits of small-scale LNG distribution to other markets. *LNG*