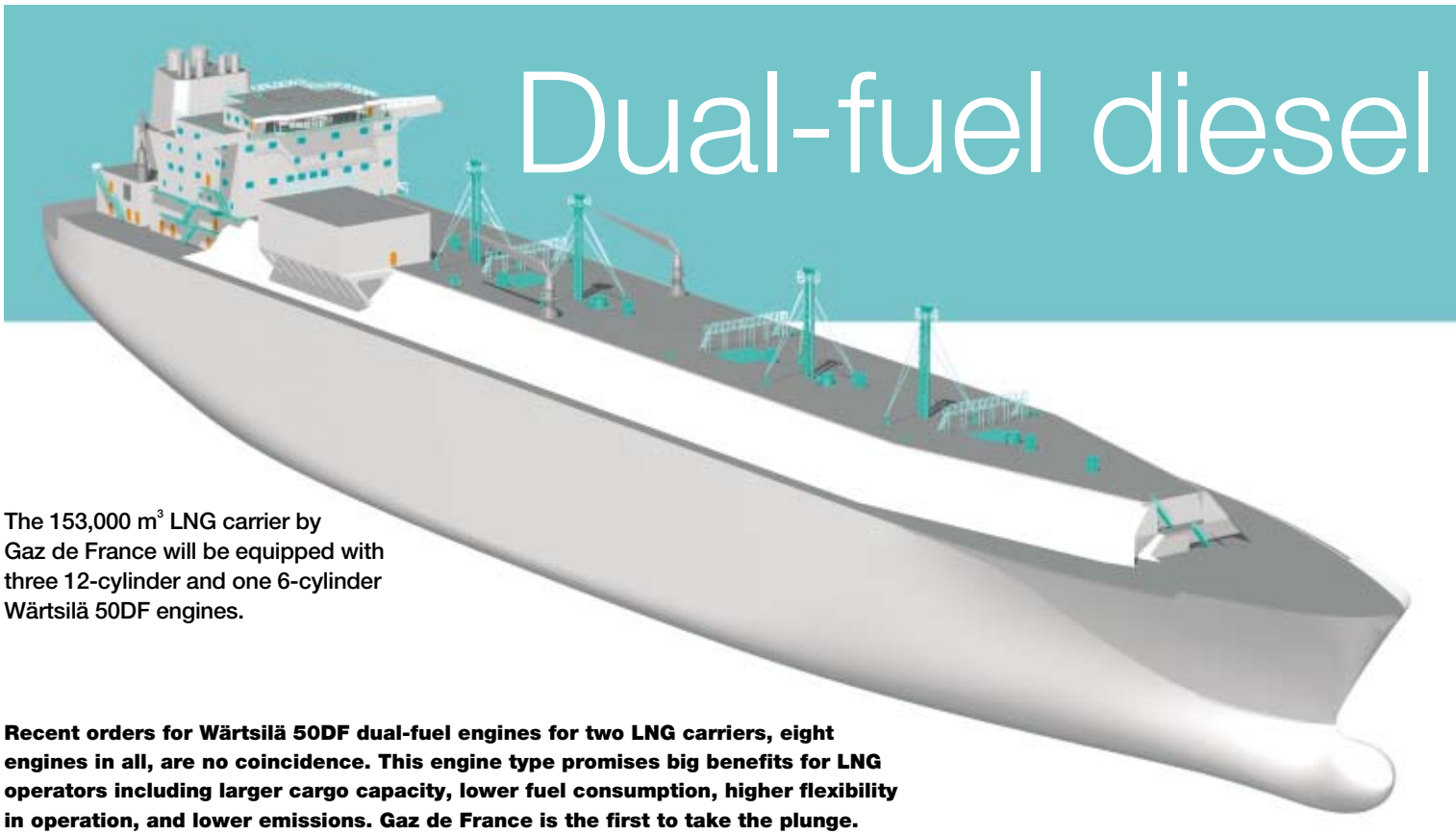
Dual-fuel diesel



The 153,000 m^3 LNG carrier by Gaz de France will be equipped with three 12-cylinder and one 6-cylinder Wärtsilä 50DF engines.

Recent orders for Wärtsilä 50DF dual-fuel engines for two LNG carriers, eight engines in all, are no coincidence. This engine type promises big benefits for LNG operators including larger cargo capacity, lower fuel consumption, higher flexibility in operation, and lower emissions. Gaz de France is the first to take the plunge. But surely not the last.

Until now, steam turbines have dominated as propulsion machinery for LNG carriers, with their apparent reliability and the ease with which they can burn the boil-off gas from the ship's cargo tanks while at sea.

The low fuel efficiency of steam turbines, however, has already encouraged almost all other shipping segments to switch to diesel-powered ships. As a result of both increased fuel efficiency and increased cargo capacity, an LNG carrier with dual-fuel electric machinery will deliver more natural gas to the offloading terminal even when gas is used as fuel throughout the voyage.

Dual-fuel electric propulsion

The order last autumn for a 153,000 m^3 LNG carrier by Gaz de France at Chantiers de l'Atlantique proves the point.

The ship, due for delivery in 2005, will be propelled by dual-fuel engines and electric propulsion. The heart of the system is four dual-fuel engines – three 12-cylinder and one 6-cylinder Wärtsilä 50DF – giving a combined output of 39.9 MW.

The ship will be the largest LNG carrier in service. It will be employed to carry liquefied natural gas (LNG) from Norway or Egypt, but is also designed for the alternative of trading on the spot market.

This is the second of two similar orders to Wärtsilä. In 2002, four 6-cylinder 50DF engines, with an aggregate output of 22.8 MW, were ordered for Gaz de France Energy's 75,000 m^3 LNG carrier, also being built at Chantiers de l'Atlantique in Sainte Nazaire.

Once delivered later this year, Gaz de France Energy will be the first LNG carrier in service featuring this new propulsion system. The membrane-type vessel will be employed to carry LNG from Algeria to France. The service speed is 16 knots, which can be achieved with three of the four generating sets. Like its newer sister ship, the vessel is also designed for spot market trading, such as voyages to the USA.

Optimized propulsion from Wärtsilä

"Wärtsilä has done extensive research to find a more attractive propulsion solution for LNG carriers," said Mikael Mäkinen, Group Vice President, Marine Division, when the second order was placed.

"We have studied the specific requirements of the LNG trade to determine the desired characteristics of the optimum propulsion plant, and we have now developed a number of attractive solutions."

Dual-fuel engines have so far been successfully applied in eight onshore power plants and a number of marine installations, including two FPSOs and two offshore support vessels. LNG carrier operators will be watching with interest when the first ship with Wärtsilä 50DF engines takes to the sea later this year.

Major benefits

The basic propulsion solution for these LNG carriers uses dual-fuel engines for electric power generation. The electric power is supplied to an electric propulsion system, fairly similar to the diesel-electric propulsion systems on modern cruise ships. The solution offers LNG carriers a number of significant advantages.

Greater earning power

Whilst making maximum use of the gas fuel (boil-off from the cargo of liquefied natural gas) to develop useful power, Wärtsilä 50DF engines have a much lower fuel consumption overall and thus lower operating costs than the conventional steam turbine plant.

Wärtsilä's calculations show that the earnings of a 145,000 m^3 dual-fuel electric LNG carrier sailing between the Middle East and Japan will be several millions of dollars per year higher than the annual earnings of a steam turbine powered ship of the same size.

Fuel flexibility

The Wärtsilä 50DF, derived from the successful Wärtsilä 46 diesel engine, is a true dual-fuel engine, using low-pressure

engines for LNG carriers

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natural gas as primary fuel. The engine can be run alternatively in gas mode or liquid fuel mode.

It is also fully capable of switching over from gas to liquid fuel (marine diesel oil) automatically should the gas supply be interrupted, while continuing to deliver full power.

When running on natural gas, ignition is triggered using a very small quantity of liquid fuel. Marine diesel oil can be used as a secondary fuel.

Lower emissions

The Wärtsilä 50DF engines also have much lower stack emissions than a steam plant. The NO_X emissions of the Wärtsilä 50DF engines are about one-tenth those of the equivalent diesel engines.

The combination of the engines' low fuel consumption and their maximum use of natural gas means the Wärtsilä 50DF engines also have low CO_2 emission levels.

Higher transport capacity

Being more compact than steam turbines, diesel-electric propulsion enables much improved flexibility in the machinery layout. This enables increased cargo capacity for a given displacement, or alternatively smaller ship dimensions for a given cargo capacity.

Further developments of the dual-fuel electric LNG carrier could include locating the prime movers on the main deck. Only the electric propulsion motors, sea water intakes with the necessary pumps, and the bilge and ballast systems, would still need to be arranged on the tank top. Added to space savings, this would simplify the arrangements for ventilation, fire insulation and extinguishing and escape ways.

Furthermore, dual-fuel generators can be delivered as compact, containerized, fully functional power modules. They can be tested before being lifted onboard, thus enabling savings in installation and commissioning cost and time. ■

The Wärtsilä 50DF

Developed from Wärtsilä's very successful type 46 diesel engines, the Wärtsilä 50DF engines have cylinder dimensions of 500 mm bore by 580 mm piston stroke. Available in configurations with six, eight and nine cylinders in line, and 12, 16 and 18 cylinders Vee-form, the Wärtsilä 50DF engines develop 950 kW per cylinder MCR at 500 or 514 rev/min for 50Hz and 60Hz electricity generation respectively.

Gas fuel is supplied at a low pressure (less than five bar) to the engines. In gas mode, the Wärtsilä 50DF engines operate according to the lean-burn Otto process. Gas is admitted into the air inlet channels of the individual cylinders during the intake stroke to give a lean, premixed air-gas mixture in the engine combustion chambers. Reliable ignition is obtained by injecting a small quantity of diesel oil directly into the combustion chambers as pilot fuel which ignites by compression ignition as in a conventional diesel engine.

The Wärtsilä 50DF engines use a 'micro-pilot' injection with less than one per cent of the fuel energy being required as liquid fuel at nominal load. Electronic control closely regulates the 'micro-pilot' injection system and air-gas ratio to keep each cylinder at its correct operating point between the knock and misfiring limits. ■