WORLD'S LARGEST GAS ENGINE OPENS UP THE
With the launch of the Wärtsilä 18V50SG gas engine, Wärtsilä now has two high-output, highly efficient prime movers when entering the market for large-scale power generation.
The new Wärtsilä 18V50SG is the world’s largest gas-powered generating set and is ideally suited for use in locations where a constant supply of gas is assured. On the other hand, when gas supplies cannot be guaranteed under all circumstances, the dual-fuel Wärtsilä 50DF is the right choice.

The new Wärtsilä 50SG is a four-stroke, spark-ignited gas engine operating on the Otto cycle and incorporating the lean-burn principle. It has been designed using the proven gas technology used in the smaller Wärtsilä 34SG engine. An important feature of this new gas engine in Wärtsilä’s portfolio is its exceptionally high power plant net electrical efficiency rating - more than 50% in combined-cycle mode.

"With an output of some 18 MW, the Wärtsilä 50SG is the largest gas engine in the world," says Thomas Hägglund, Vice President, Power Plants Technology at Wärtsilä. "With 24 of these units operating in combined-cycle mode, you get an output of almost 500 MW, a large power plant. We are now offering a competitive and efficient solution for power plants with baseload outputs of up to 500 MW, thus competing directly with gas-turbine-based technology."

**TRENDS ARE FAVOURING GAS-POWERED UNITS**

The first Wärtsilä 50SG installation will be commissioned in 2011 at the Aksa Samsun power plant in Samsun, Turkey, as part of an extension to the existing power plant. Wärtsilä has a strong presence in Turkey’s energy market, and expects to have delivered close to 3 GW of power
generating capacity by the end of 2011. Of the power plants
delivered to date, 85% run on natural gas.

“Turkey is a very important market for us and will
remain so. It is one of the locations where power produc-
tion using gas is expanding,” says Hägglund. “With a total
net electrical efficiency of more than 50%, our new gas
engine is a product for all global markets. Wärtsilä’s gas-
fired power plant solutions have previously been compet-
itive for facilities with outputs of up to 300 MW. With the
Wärtsilä 50SG we are extending that competitiveness to
plants larger than 500 MW.”

“While the ratio between power plant installations that
use gas and those that use oil varies in a cyclical manner,
the overall long-term trend is that gas is gaining ground as
a fuel for power generation, and this is also true in emerg-
ing markets. Many of the HFO (heavy fuel oil) power plants
being built today have been designed from the start with
the possibility of switching to gas in the future.”

**DUAL-FUEL TECHNOLOGY WHEN
GAS SUPPLIES ARE LESS RELIABLE**

“In the long run, the Wärtsilä 18V50SG gas-fired engine
will replace the Wärtsilä 18V50DF dual-fuel engine in large
power plants,” says Hägglund. Even so, for special applica-
tions and in certain circumstances, the dual-fuel solution is
the right choice for gas-fired power plants, even though
the SG engine design offers higher levels of efficiency.

The dual-fuel or “tri-fuel” Wärtsilä 50DF engine is a spe-
cial product that offers power plant owners considerable

**LEAN-BURN WITH
LOW EMISSIONS**

The Wärtsilä 50SG combines high levels of efficiency
with low levels of emissions. This is achieved by using
a lean gas mixture in the combustion chamber.

In a lean-burn gas engine, the word “lean” is used
to indicate that more air is present in the combustion
chamber than is needed for complete combustion of
the gas. Lean combustion reduces peak temperatures
and the quantities of nitrogen oxides (NOx) produced
are also lower. The higher the air-fuel ratio, the lower
the temperature.

In the Wärtsilä 50SG, the air-fuel ratio is kept very
high and efficient premixing of the fuel and air keeps
it uniform throughout the combustion chamber.

Maintaining the correct air-fuel ratio under all
conditions is essential. In the 50SG, an exhaust-gas
wastegate valve is used to adjust this. By using the
valve to control the proportion of the exhaust gas that
bypasses the engine turbocharger, the air-fuel ratio is
kept at the correct value regardless of load conditions.

To achieve the highest efficiency and lowest
emissions, each cylinder in the engine is individually
controlled by the Engine Control System (ECS) to
ensure that both the air-fuel ratio and the ignition
timing are correct. Stable and well-controlled
combustion is guaranteed by a high-energy ignition
system located in the precombustion chamber.
fuel flexibility. A good example is the large 300 MWe power plant in Sangachal, Azerbaijan which began operating in 2008. The plant is equipped with 18 generating sets, each of them powered by an 18-cylinder Wärtsilä 50DF engine delivering 17 MW.

“Sangachal is a real success,” says Hägglund. “The plant is primarily designed to run on natural gas, but gas supplies during the winter cannot always be guaranteed. If there is a supply problem, the engines can be switched over to HFO, and they can also use light fuel oil. Power output is the same with all three fuels.”

**Gas Power Needed for Back-up Windpower**

“Among the gas engines in our portfolio, the largest volume product is the Wärtsilä 34SG,” says Hägglund. “Sales have grown significantly in the last 5-6 years, and Wärtsilä now has a strong presence in the baseload sector, where gas-fired plants provide grid stability, backing-up the expanding production of electricity from wind energy. This is especially true in the US.”

“In the US, where the level of installed windpower capacity is growing rapidly, Wärtsilä has now delivered approximately 1 GW of gas-fired plants as backup generating capacity and for grid stability,” he says. “These grid-connected power plants typically have a maximum output of 100-200 MW, and the latest ones can achieve full output in just five minutes. If wind speeds suddenly drop, compensating power has to be fed into the system quickly to prevent the grid becoming unstable.”

Wärtsilä gas engines also have both high total efficiency and high partial efficiency, providing the high levels of operational flexibility required for windpower backup applications. “Gas-fired reciprocating engine technology is the only solution that can deliver the rapid starts and stops required when backing-up windpower generating facilities,” says Hägglund. “Wärtsilä has now installed some 45 GW of power plants in 166 countries.”

**DUAL-FUEL ENGINES NOW IN LAND-BASED APPLICATIONS**

Development of lean-burn, spark-ignited, Otto cycle gas engines started in 1992, and the first Wärtsilä SG gas engine design was released in 1995.

“The use of gas engines for combined heat and power generation (CHP) started in the late 1990s,” says Thomas Hägglund, Vice President, Power Plants Technology at Wärtsilä. “Larger gas engines were soon developed. By using 20 cylinders, the maximum output of the 34SG engine was raised from 8 MW to 10 MW. The Wärtsilä 34SG has become Wärtsilä’s most successful gas-fired engine design.”

The dual-fuel Wärtsilä 50DF was originally developed for the marine sector and has now been on the market for about 10 years. A “tri-fuel” version able to run on natural gas, light fuel oil or HFO was introduced in 2007.

“In marine applications, the Wärtsilä 50DF engine has been a great success - the fuel flexibility it offers is especially valuable for LNG carriers,” says Hägglund. “On an outward journey, when the vessel has a cargo of LNG, it can use that fuel to power its engines. After the LNG has been offloaded, the carrier can run on cheaper HFO.”

Demand for dual-fuel solutions for land-based power production has emerged during the last ten years. The first Wärtsilä 50DF for installation in a power plant was delivered to Turkey in 2004 and can run on either HFO or natural gas. The first tri-fuel Wärtsilä 50DF engine delivered by Wärtsilä for a power plant is operating at the Sangachal power plant in Azerbaijan.

**More than a Million Running Hours**

The first Wärtsilä 50DF engines used for marine propulsion were started up in October 2006. More than a hundred have now been commissioned and are powering vessels world-wide. The hardest-working have completed a total of more than 20,000 running hours.

The first Wärtsilä 50DF to be used in a power plant application was started up in March 2005. Approximately 40 Wärtsilä 50DF engines are now being used to generate electricity in land-based locations, and some have completed a total of more than 36,000 running hours.

The grand total for all Wärtsilä 50DF engines in operation now exceeds one million running hours.