

# Dual-Fuel Retrofit

## Industrial Co-Gen Plant



# Dual-Fuel Retrofit For Emissions Compliance, Fuel Flexibility, Eco-Incentive



*The TMG SPE industrial cogeneration plant at Vila Nova de Famalicão in Portugal*

## 51/60DF Retrofit, TMG SPE Cogeneration Plant

In 2008 MAN Diesel's PrimeServ after-sales arm carried out the first conversion of an existing twelve cylinder, vee configuration type 12V48/60 diesel engine to operation as a dual-fuel gas engine using the latest, advanced technology from the new 51/60DF prime mover. Since these engines are derived from a common platform, conversion involved only the addition and replacement of a limited scope of components and assemblies

The 12V48/60 engine operated on heavy fuel (HFO) in an industrial cogeneration plant at Vila Nova de Famalicão in Portugal. Owner Têxtil Manuel Gonçalves, Sociedade de Producao de Electricidade e Calor S.A. (TMG SPE), runs an adjacent textile works where the 50Hz electrical output of the plant feeds the local grid with recovered heat is used to raise process steam for production.

After logging over 88,000 operating hours in 11 years, TMG SPE decided to retrofit the 12V48/60 to full 51/60DF specification during a major overhaul.

## Results

With its 51/60DF dual-fuel gas engine, TMG SPE takes advantage of Europe's expanding natural gas infrastructure while retaining liquid fuel back-up, as well as achieving compliance with clean air legislation introduced since the engine's original commissioning.

Adapted to a local gas supply with nominal methane number of 75 and ambient air conditions the retrofitted 51/60DF produces the equivalent of 950 kW/cylinder under ISO conditions.

Emissions of oxides of nitrogen (NO<sub>x</sub>) are reduced considerably, particulate matter (PM) virtually zero and emissions of the greenhouse gas carbon dioxide CO<sub>2</sub> likewise significantly lower. The ability to switch from gaseous to liquid fuel at any load gives useful back-up operating mode.

Following the conversion the TMG SPE installation qualifies as a high efficiency, emissions-compliant cogeneration plant and receives a preferential price per kW for power supplied to the Portuguese grid.

## Scope of Work

### New Components and Assemblies

As well exchanging the original 480 mm bore cylinder liners and pistons for new 510 mm components - with pistons bowls adapted to gas combustion - the retrofit centred on the 51/60DF's common rail pilot injection and gas admission systems. New cylinder heads with pilot injectors and inlet manifolds with gas admission valves were fitted, as were new inlet cams and the pressure accumulators, solenoid valves and electrically driven fuel pump of the common rail pilot injection system.

### Turbocharger Upgrade

The turbochargers were overhauled and “rematched” to gas engine operation by fitting new nozzle rings and adapting other exhaust system elements. Since the 51/60DF engine is derived from the later “B” version of the 48/60 engine platform, it features a single turbocharger. The retrofit of a 48/60A with twin turbochargers thus involved the design of a “Y” connector to distribute exhaust gases to the two units.

### Technical data, MAN Diesel 51/60 DF dual-fuel engines, for Electrical Power Generation.

Engine cycle:	four-stroke
Number of cylinders:	
V-engines:	18, 14, 12
inline-engines:	9
Bore:	510 mm
Stroke:	600 mm
Swept volume per cylinder:	122.6 dm <sup>3</sup>
<b>Standard cylinder outputs</b>	
60 Hz (514 rpm) :	1,000 kW <sub>m</sub>
50 Hz (500 rpm) :	975 kW <sub>m</sub>
Power Range Electrical:	8,560 - 17,550 kW <sub>e</sub>

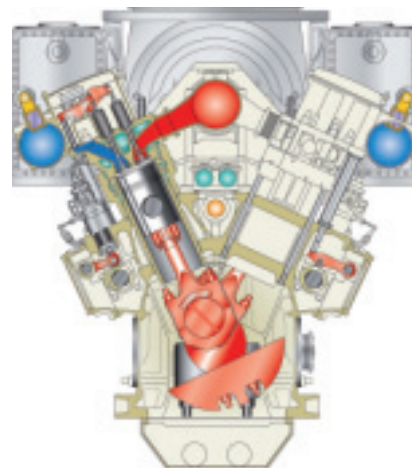
### Controls Upgrade

The engine was also equipped with a version of MAN Diesel's SaCoS Safety and Control System adapted to dual fuel engines. The system features online monitoring capability and a range of redundancy features. Together with the common rail pilot injection system, SaCoS DF allows the cylinder outputs of the 51/60DF to be precisely balanced and the engine to respond to knock signals on cylinder to cylinder basis. The use of CAN-Bus data communication considerably simplified engine cabling.

### 51/60DF Technology

In gaseous fuel mode an air-gas mixture is ignited by injection of a distillate fuel micro-pilot representing less than 1% of the energy needed to achieve the engine's rated outputs of 975 or 1,000 kW per cylinder at 500 or 514 rpm (for 50 or 60Hz power generation respectively). The distillate fuel micro pilot is injected via a common rail system.

In its liquid fuel mode, the 51/60DF operates as a normal diesel engine, injecting distillate or heavy fuel oil (HFO) through a normal injection system.



Cross section vee configuration 51/60DF dual-fuel gas engine

**MAN Diesel SE**

86224 Augsburg  
Germany  
Phone +49 821 322-0  
Fax +49 821 322-33 82  
powerplant@mandiesel.com  
www.mandiesel.com

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