

GE
Oil & Gas

Small Power Generation

for Industrial Applications



Small Power Generation

Small Power Generation continues to be an important segment of Electrical Energy production. The increasing demand for energy has to be satisfied while considering the impact on the global environment. Renewable energy resources, optimum use of conventional resources and alternative fuels such as biomass are all part of the solution. Small Power Generation plays an important role in industrial applications. Small size cogeneration or combined cycle plants sited close to municipal and industrial energy consumption can deliver power and thermal energy with high fuel efficiency and low emissions, and with modest space requirements.

GE Oil & Gas has long-standing experience in manufacturing gas and steam turbines for industrial power generation applications, offering energy recovery solutions that minimize environmental impact.

For example, our GE10 single shaft gas turbine is a highly reliable engine, featuring the simplicity of operation and maintenance and low operating costs demanded by industrial customers. The GE10-1 together with steam turbines is an ideal match for combined cycle applications.

GE Oil & Gas can offer to its customers complete solutions from feasibility studies to the actual turnkey cogeneration plant construction through a network of local partners, global aftermarket services and customized financial solutions together with GE Energy Financial Services.



Gas Turbine Distribution Agreements

In order to better serve customer needs in the small power generation segment, GE Oil & Gas has implemented a series of reseller agreements with partners located around the world. Our partners are turnkey providers and are very cognizant of the requirements related to industrial and small municipal power generation applications, including local regulations.

These agreements provide us with a widespread local presence through partners that remain in close touch with our Customers, understanding their requirements and delivering electric energy production or cogeneration plants tailored to customer needs and compliant with existing legislation.

GE Oil & Gas manufactures the gas turbine in its Florence plant, conducts complete testing to verify compliance with the requested technical specifications and guaranteed performance, and finally dispatches it to our partner for customised installation.

Our partner can also carry out all off-skid component purchasing (such as, ducts, filter chamber, etc...) and other actions necessary to complete the plant.

Balance of Plant

Thanks to our long term experience in the construction of gas compression modules and synergy with other GE businesses, Oil & Gas can supply pre-engineered or customized options for power islands and turnkey power plants including the thermal cycle design.

GE Oil & Gas also supplies auxiliary equipment for steam turbo-generator plants including:

- Customized exhaust cross sections
- Condensers
- Condensate extraction pumps



GE10-1 Gas Turbines

The GE10 is a heavy-duty gas turbine in the 12 MW range, available in both single-shaft and two-shaft versions. It is an evolution of the field-proven PGT10A and incorporates the latest in aerodynamic design in a compact and versatile package arrangement. The design of the GE10 has been highly refined based on the extensive experience gained operating in all types of environments. There are over two hundred PGT10A/GE10 units running under conditions ranging from the cold of Alaska and Siberia to the heat of the desert and the humidity of the tropics. Its efficiency and operational flexibility make the GE10 a cost-effective choice for all applications. The gas generator

consists of an 11-stage, high efficiency, axial flow compressor and a single combustion chamber able to burn a great variety of fuels from liquid distillates to residuals, to all gaseous fuels, including low btu gas. The GE10 combustion system is available in both conventional and DLN configurations. The DLN system is a simple, field-proven design that guarantees operation at 15/25 ppmv NOx. The GE10 standard combustor can also utilize steam and water injection for NOx reduction and power augmentation. Further reduction of emission levels is a constant objective of our continuing combustion development and test programs. A Dual Fuel DLN version is available (Gas Fuel + Liquid).

Design Information

Gas Turbine:

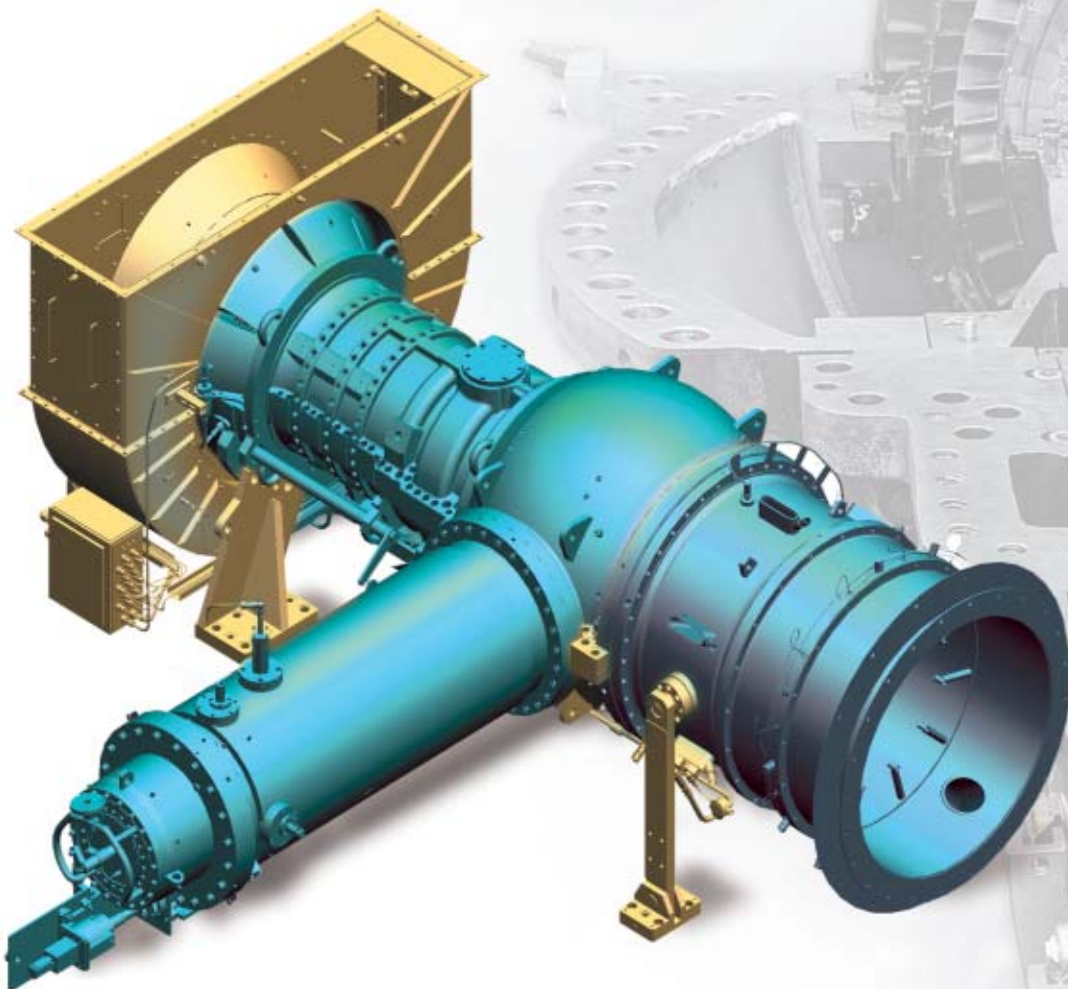
- 11-Stage Axial Compressor
 - Horizontal Split Casing
 - Single Vertical Can Combustor
 - Diffusive / DLN / DF Combustion Systems Available
 - 3-Stage, Axial Flow Turbine
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Gear Box:

- 1500 rpm Epicyclic
 - Acceleration Vibration Transducer
-

Generator (50/60 Hz):

- 6-11 kV
 - 4-pole, 3-phase Brushless Exciter
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GE10-1 DLN Specifications

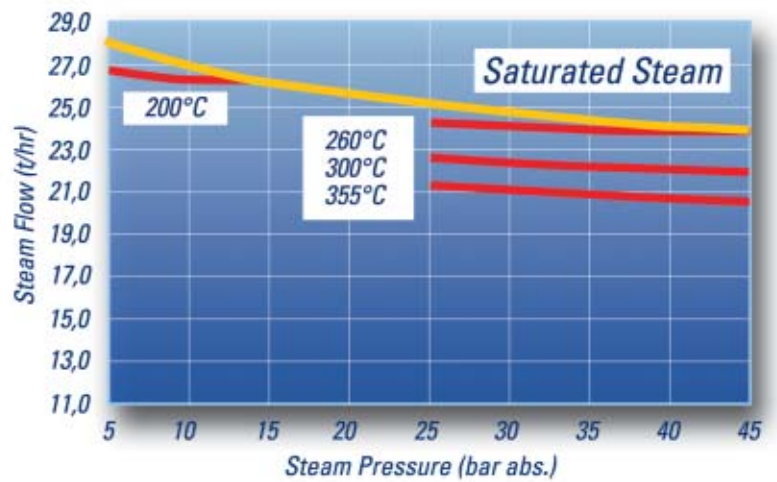
ISO Conditions with zero inlet and exhaust pressure drops at sea level, 60% RH, 15 °C ambient temperature and natural gas

Power Output (kW)	11,250
Heat Rate (kJ/kWh)	11,530
Exhaust Flow (Kg/sec)	48
Exhaust Temp (°C)	480
Turbine Speed (rpm)	11,000
Pressure Ratio	15.7
Efficiency (%)	31.2
NOx Emissions (ppmvd @ 15% O ₂)	
Gas DLN	15/25
Liquid DLN	85
CO Emissions (ppmvd @ 15% O ₂)	
Gas DLN	25/20
Liquid DLN	20

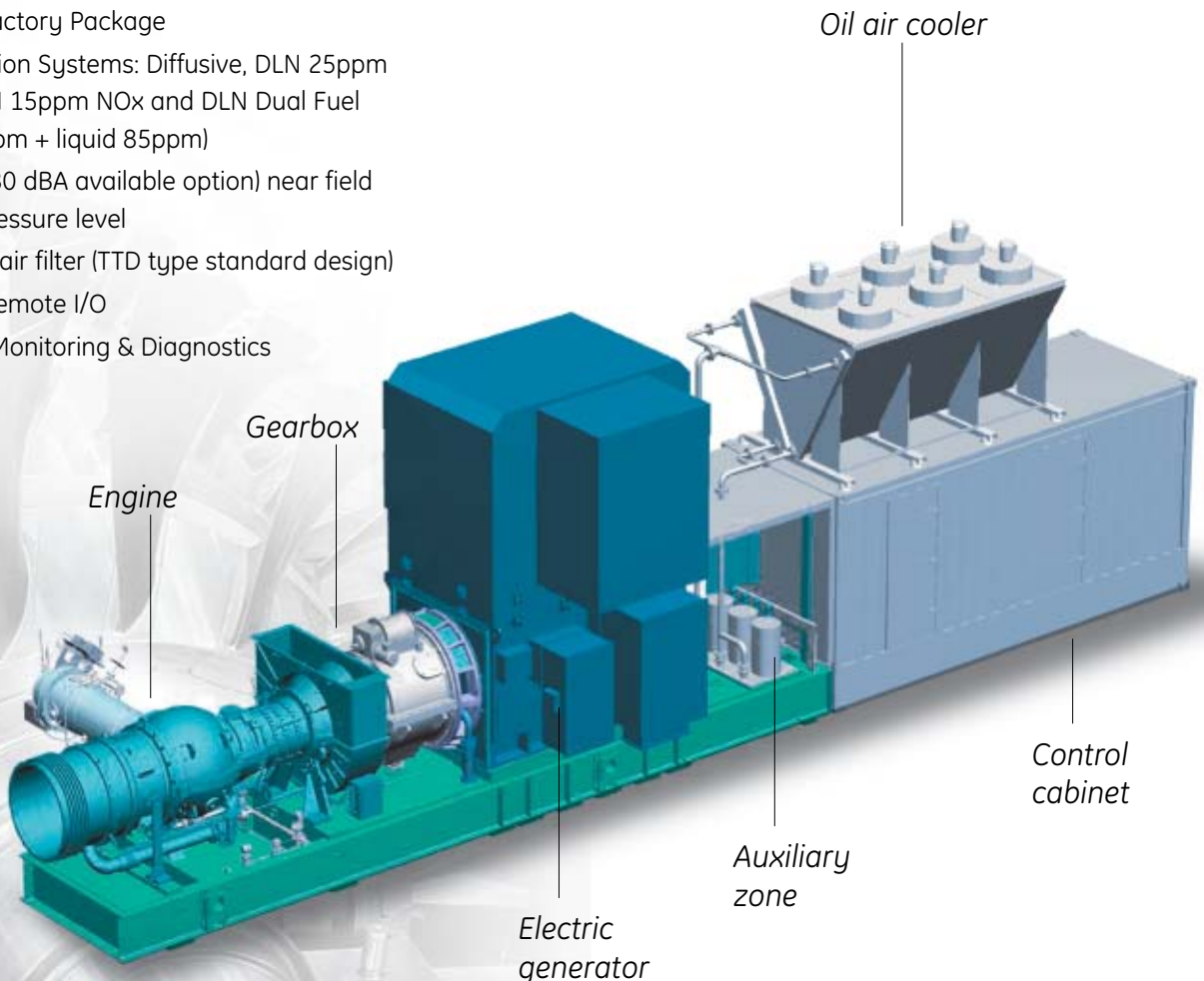
Package

- 50Hz CE Mark single base plate integrated package (11kV and 6.6kV)
- Tested Factory Package
- Combustion Systems: Diffusive, DLN 25ppm NOx, DLN 15ppm NOx and DLN Dual Fuel (gas 25ppm + liquid 85ppm)
- 85 dBA (80 dBA available option) near field sound pressure level
- Pulse-jet air filter (TTD type standard design)
- On skid remote I/O
- Remote Monitoring & Diagnostics

GE10-1 Nominal Steam Production Capability in Cogeneration and Combined Cycle



T ambient = 15 °C
P ambient = 1.013 bar abs.
Fuel = Natural Gas (LHV = 50,016 kJ/kg)



Steam Turbines

Overall Design Information:

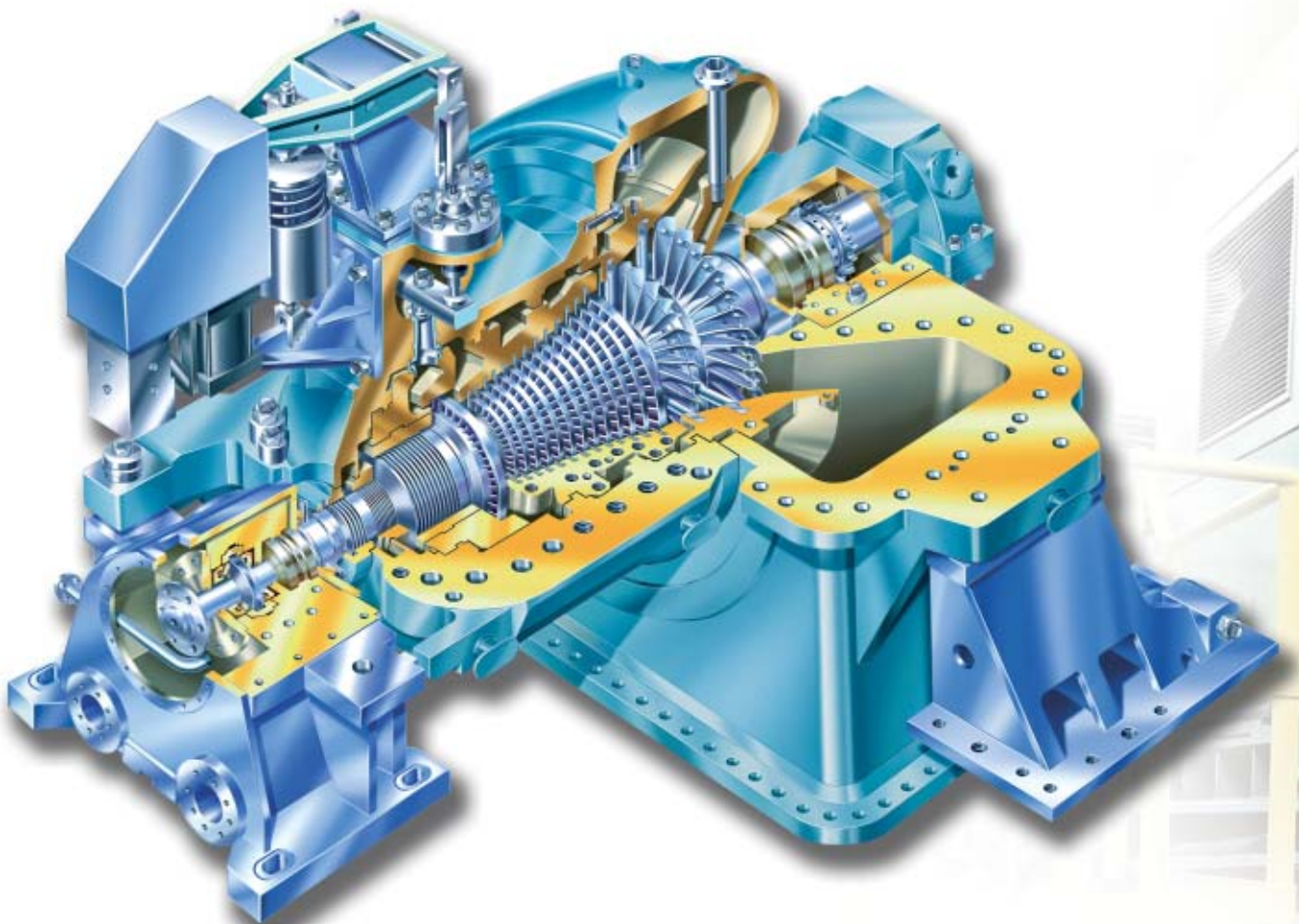
- 2,000 to 90,000 kW, 50/60 Hz, Up to 26" Last Stage Bucket (5 m²)
- Geared and Direct Drive
- Impulse and Reaction Designs
- Condensing/Non-Condensing
- Configurations
 - Complete packages for quick installation
 - Up, down and axial exhausts
 - Multiple extraction/admission

Combined Cycle

GE Oil & Gas steam turbo-generators have a modular design to match typical gas turbo-generator heat recovery applications in combined cycles and have high reliability and top thermodynamic/mechanical performance. GE Oil & Gas steam turbo-generators are designed for cyclic operation with frequent starting and loading without compromising the base load capability. The low-pressure stage blades are designed for optimized 50 Hz and 60 Hz application as well as for geared coupling to generators.

Typical Combined Cycle Steam Turbine Performance

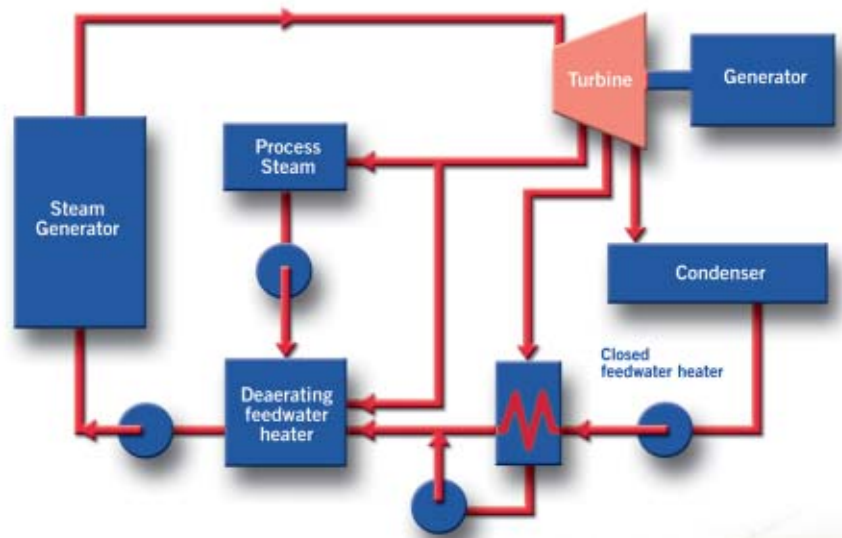
	Condensing Steam Turbine for GE10-1	Backpressure Steam Turbine for GE10-1	
INLET	Press. (bar abs.)	40 - 45	40 - 45
	Temp. (°C)	300 - 350	300 - 350
	Mass Flow (kg/s)	5.83	5.83
EXHAUST	Press. (bar abs.)	0.08	1.25
OUTPUT	Power (MW)	4	3



Cogeneration

Paper mills, steel mills, landfills, refineries and food processing plants are significant examples of applications where cogeneration enhances process profitability. The experience of GE Oil & Gas offers maximum energy recovery and cost savings with highly customized steam turbo-generators and ensures:

- flexibility to fit the plant arrangement and customer requirements
- ability to optimize turbine operating parameters in accordance with the customer's thermal cycle
- multiple steam extraction/injection at intermediate pressures with limited impact on part load efficiency



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GE imagination at work