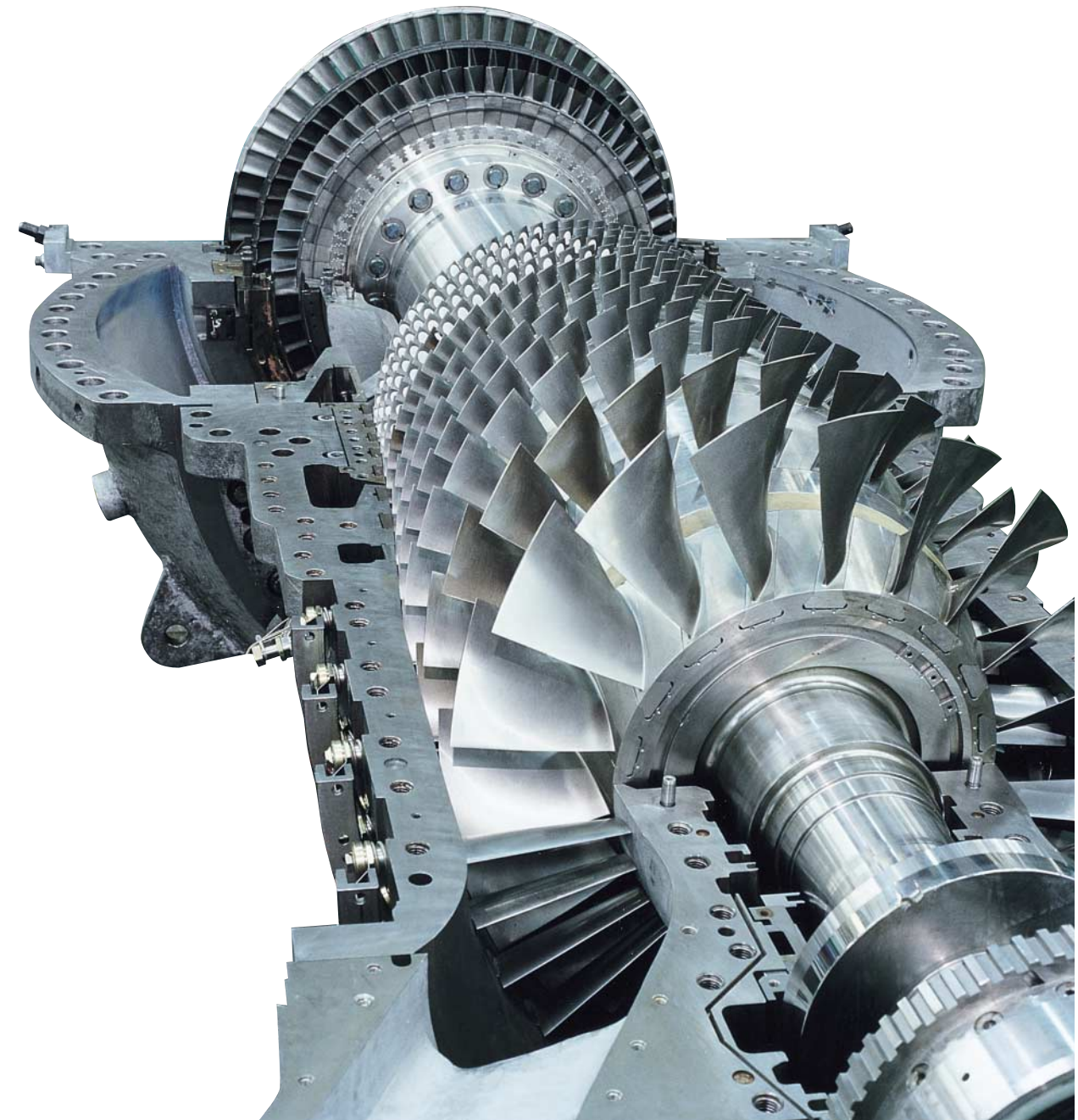


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GE
Oil & Gas

GE10-1

Gas Turbine

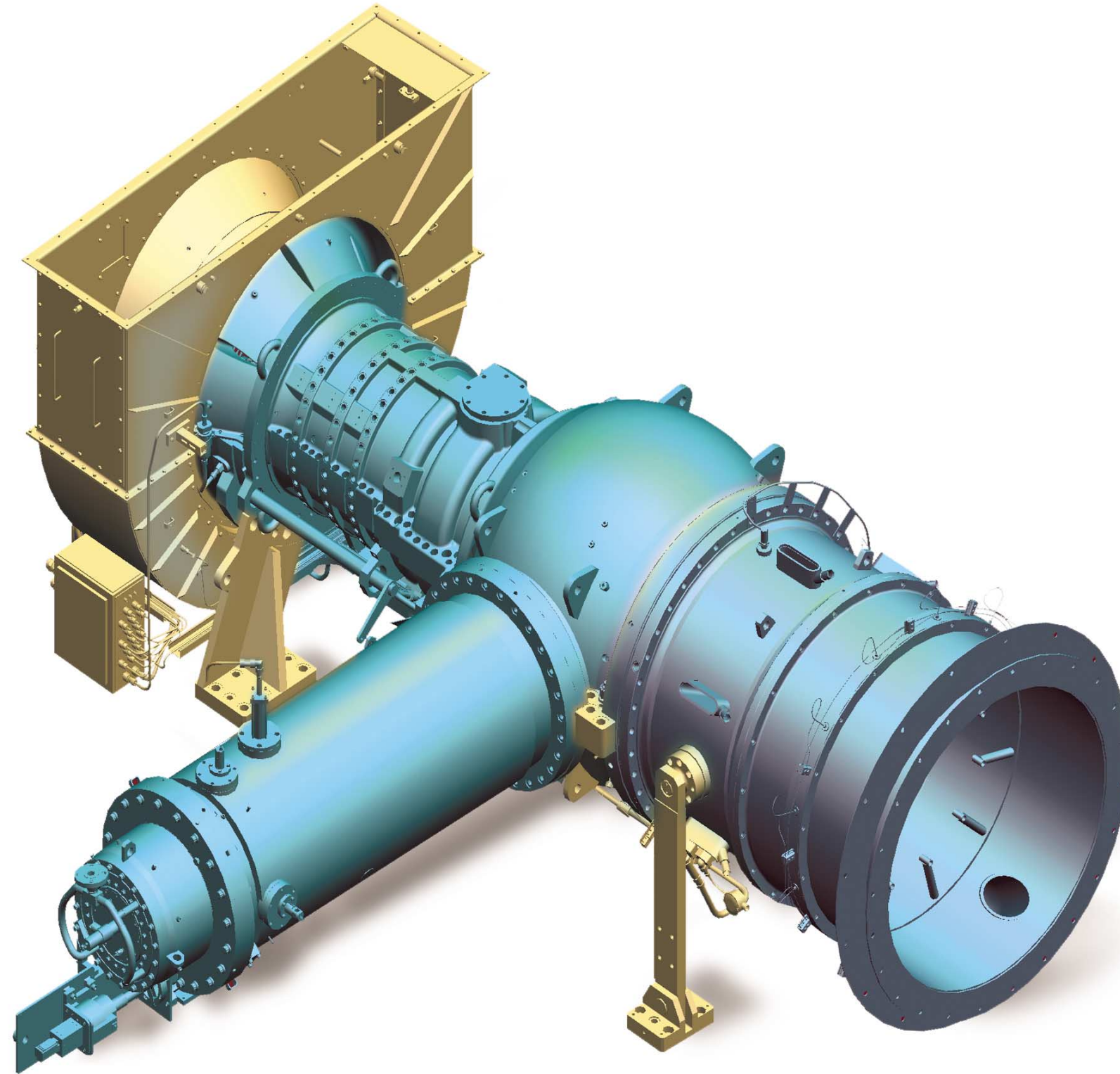


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The GE10 engine family is a 12 MW range heavy-duty gas turbine, available in either a single or a twin-shaft configuration. It is the evolution of the field proven PGT10 and incorporates the latest in aerodynamic design, and compact and versatile package arrangements. The GE10 engine design has been highly refined based on the extensive experience gained operating in all types of environments. There are many units running under conditions ranging from the cold of Alaska 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

GE10-1 Gas Turbine



Engine Characteristics

The gas turbine is the well proven GE10-1 Engine, a heavy duty single shaft engine that has accumulated a very large number of fired hours, and has leveraged the experience of the previous PGT10.

The cases are horizontally split and the rotor has a disk architecture.

The combustion system consists of a horizontally positioned single can; the GE10-1 is available in both Diffusion Combustion System and DLN (Dry Low NOx) versions and is able to burn a wide range of liquid and gas fuels, including Low BTU gas and hydrogen.

Fuel Gas System

A typical gas fuel configuration employs shutoff valves for safety reasons and metering valves to control the machine load and CO/NO_x emissions. Depending on the level of DLN performance requested, two or three metering valves are needed in order to control gas injection in the various parts of the combustion chamber.

Unit Control Panel

The GE10 control system is standardized to assure a high degree of integration between the turbine and the generator. The system is based on the GE Fanuc RX3i PAC System platform with remote I/O modules. The Bently Nevada 1701 is installed for the acquisition of data from seismic probes and for humming detection. The control, monitoring and tuning of unit parameters can be performed remotely. Remote data acquisition does not interfere with normal site operations.

Control CAB

An integrated control cab containing all electrical panels for control and

operation of the unit is supplied, including:

- Unit control panel
- Motor control center
- VFD for gas turbine starting
- Generator control and protection panel
- DC panel & battery charger
- Batteries
- On site monitoring system

The cab is provided with an air conditioning system, normal and emergency lighting, a smoke detection system and manual fire suppression bottles.

Air Filter

The air filtration system consists of a "pulse jet type" filter house, an inlet duct and a silencer.

The Pulse Jet system also provides an anti-icing function without any additional hardware. Filter inspection and replacement of filter cartridges are facilitated by gangways and ladders that are included as part of the scope of supply.

Package Arrangement

The gas turbine enclosure consists of a separate structure and panels mounted on a base plate. Access doors are included for normal maintenance operations and inspections. The ventilation system for internal cooling of the package consists of two 100% axial fans.

The enclosure includes fire & gas detection systems and an automatic CO₂ type fire fighting system.

The enclosure guarantees a sound pressure level lower than 85 dBA at 1m. For indoor applications, an 80 dBA version is available upon request.

The GE10-1 package is designed specifically for power generation applications and is optimized to minimize plant dimensions and to reduce maintenance cost and time.

The single lift architecture minimizes the site installation and commissioning lead time. The integrated control cab eliminates civil works for the control room and site wiring activities.

Available Options

- Dual Fuel DLN version (liquid + gas fuel)
- 6.6 kV IP55 CACA Electric Generator
- 80 dBA sound pressure level package
- Indoor version
- H₂O oil cooler
- STD exhaust duct (12 m)
- Lubrication stand-by pump
- Control cabinet located alongside the unit
- Additional Pre-Engineered BN1701 for complete vibrational monitoring

Axial Compressor

The compressor is a high Performance, eleven-stage axial flow design with a 15.5:1 pressure ratio derived from GE Aircraft Engine transonic flow aero design technology. The rotational speed is 11000 rpm with a mass flow of 47 kg/s. The antisurge margin exceeds 25%. Advanced 3D airfoils are used for vanes and blades, and the first three rows of stator blades are adjustable to optimize operability. The compressor rotor cold side (the fixed point of the gas turbine) accommodates the load flange.

This configuration guarantees reduced flange movement during gas turbine thermal transients.

A patented GECC-1 aluminum ceramic coating is provided for application in marine environments.

Combustion System and Emissions

The combustion system consists of a single, slot-cooled combustion chamber assembly that permits easy maintenance of the hot gas path.

This combustion chamber is able to burn a wide range of fuels, from liquid distillates to residuals, to all gaseous fuels, including low BTU gas. The broad fuel capability of this combustor is due to the variable geometry design patented by GE. A NO_x level of 25 ppmvd @ 15% O₂ is guaranteed over a wide load range.

DLN Dual Fuel version (liquid + gas fuel) is also available.

Turbine

The single-shaft version is optimized for power generation applications. The turbine consists of three reaction stages.

In the first two-stages, the hot gas parts are cooled by air extracted from the axial compressor.

The second and third stages have interlocked shrouds to limit tip leakage and blade vibration.

Generator and Gearbox

The unit is equipped with:

- an open, air cooled four-pole 11kV generator (6.6kV CACA also available).
- Jacking oil system
- Anti-condensation heater
- Brushless excitation system
- Seismic probes
- Thermocouple for each bearing and each phase
- Ventilation silencers

The gearbox is directly connected to the generator and the entire gear is supported by the generator casing without an external coupling.

Lubrication and Bearings

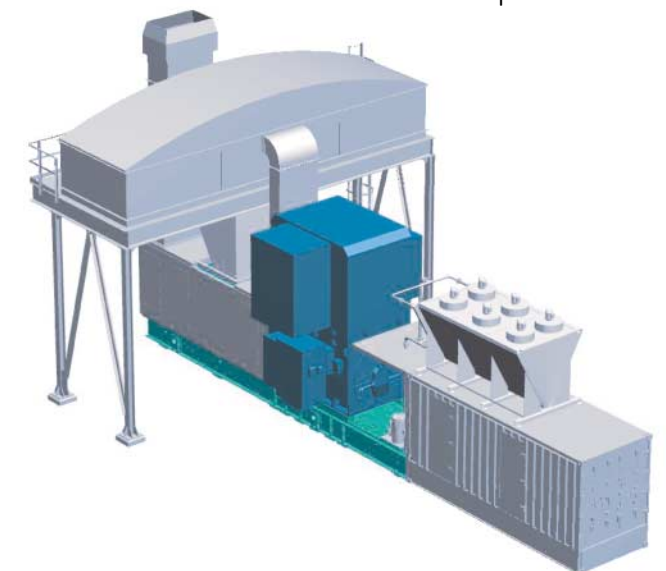
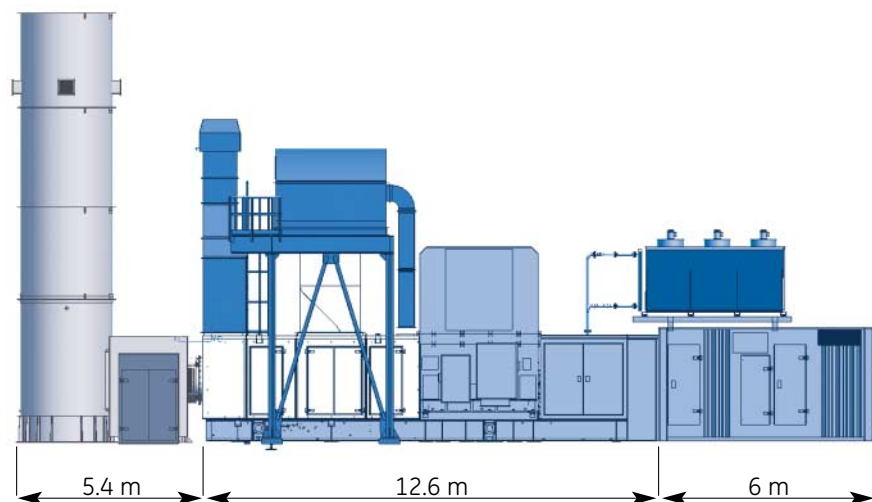
The on-base integrated lubrication system feeds the gas turbine, the speed reduction gear and the driven generator.

The lube oil tank is integral with the gas turbine base plate. The main lube oil pump is a VFD Type and a DC electric motor driven pump is provided for emergency backup.

A stand-by pump identical to the main pump is available as an option in order to allow continuous operation in the event of a main pump failure. In the standard package configuration, the oil is cooled with an air cooler; a water cooler can be provided upon customer request. The thrust and journal bearings are of the tilting pad type.

Starting System

In this package, the Electric Generator is provided with an LCI VFD starting panel that allows it to be used as the gas turbine starter. The panel allows the generator to act as a motor until the machine reaches the self-sustaining speed. At that point, the generator function is switched to generation mode to achieve synchronization as soon as a suitable rpm is reached.



GE10 Gas Turbine SPECIFICATIONS

Axial Compressor

- 11-Stage Axial Flow
- 15.5:1 Pressure Ratio

Combustion Chamber

- Single Can Combustor
- Pollution prevention: DLN Gas Available
DLN Dual Fuel Available

Turbine GE10-1

- 3-Stage HP Turbine 11000 rpm

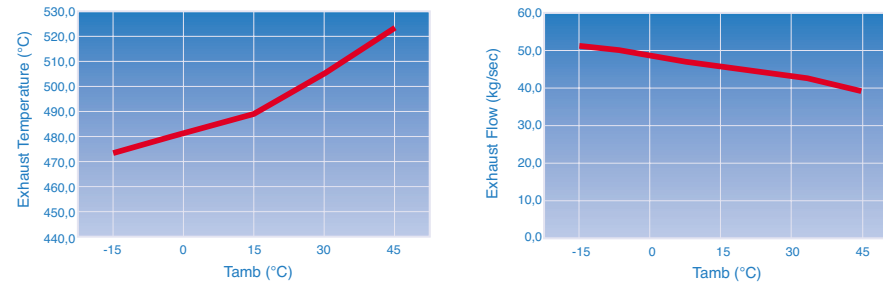
Nominal Rating - ISO

At 15 °C, Sea Level, No External Pressure Losses, Relative Humidity 60%, Natural Gas Fuel with LHV = 32 to 44 MJ/Nm³

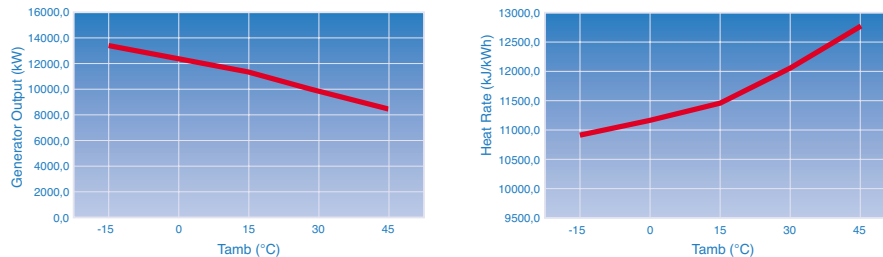
	GE10-1
ELECTRICAL OUTPUT (kW)	11250
ELECTRICAL EFFICIENCY (%)	31.4
EXHAUST FLOW (kg/sec)	47.5
EXHAUST TEMPERATURE (°C)	482

GE10 Gas Turbine Performance Curves

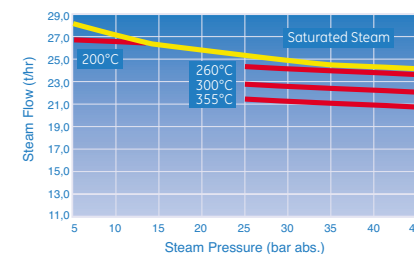
Effect of Compressor Inlet Temperature on Exhaust Temperature and Exhaust Flow
Base Load with zero inlet and zero exhaust pressure drops at Sea Level, 60% RH - Natural Gas



Effect of Compressor Inlet Temperature on Output and Heat Rate
Base Load with zero inlet and zero exhaust pressure drops at Sea Level, 60% RH - Natural Gas



Nominal Steam Production Capability in Cogeneration and Combined Cycle



Maintainability

GE10 maintenance can be carried out either "on-site" or at an authorized shop.

An engine exchange maintenance approach can be adopted to maximize the unit availability.

Enclosure doors, and flexible piping and electrical connectors permit the engine to be easily removed, and a back-up engine quickly installed to minimize the plant down time.

The engine is provided with borescope holes for periodic inspection of the internals, and the combustion chamber can be disassembled without removal of any of the engine casings. GE gives the highest priority to engineering and field assistance and offers continuous technological improvements, tailored solutions and support for each machine.

The Global Services Portfolio includes:

- Comprehensive training by highly qualified experts using a combination of traditional and modern interactive training materials and tools supplemented by our manufacturing, testing and repair facilities.

- Remote Monitoring and Diagnostics (RM&D) for accurate and continuous assessment of your equipment condition and for maintenance planning to maximize your plant output. It is equivalent to having a team of experts in your plant 24 hours a day 7 days a week.

- A Customer Care Center for a direct link to GE's Oil & Gas experts. Call any time to get technical support or information about products, offerings and orders.

- An Inventory of GE Oil & Gas capital parts available to satisfy emergency needs, including complete modules.

- Qualified GE regional service shops guaranteeing quality repairs and reducing turnaround time.

- Contractual Service Agreements to provide maintenance services at a predetermined cost and on a priority basis.

