SIEMENS

Siemens Gas Turbine

SGT-2000E Series

Reliable, robust, flexible

Answers for energy.

The SGT-2000E series – designed for reliable, robust, and flexible power generation

Ongoing fierce competition fueled by deregulation is dictating increasing flexibility and lower power generation costs. One approach to cost-cutting is economical plant operation based on low investment costs combined with high flexibility and reliability.

The SGT5-2000E Siemens Gas Turbine (SGT™) – our well-established workhorse – is created to meet these requirements. With its proven design, materials, and thermodynamic processes, the SGT5-2000E helps keep you strongly positioned in a highly competitive market. The SGT6-2000E is the corresponding 60 Hz model.

This machine is characterized by a long-established design concept:

- Two rotor bearings
- Cold-end generator drive
- Built-up rotor with Hirth serrations and central tie bolt

The combination of this proven design and innovative features means:

- Low investment costs per installed kilowatt
- Fuel flexibility
- Operational flexibility
- Low maintenance expenditure
- Long service life
- Fast payback on invested capital

Based on the standard design concepts of our modular reference power plants for multi-shaft application, we have identified several solution packages for the SGT5-2000E. These packages – from components to the SGT-PAC to full turnkey solutions – support all your requirements. The intelligent structuring of our power plants, offering a wide range of modules and options, provides you with many benefits.

This gas turbine concept draws on decades of experience with heavy-duty gas turbines at Siemens. This accumulated expertise is the solid technical foundation on which this proven technology is based, and ensures reliable, efficient, and flexible operation.

Performance SGT-2000E series*

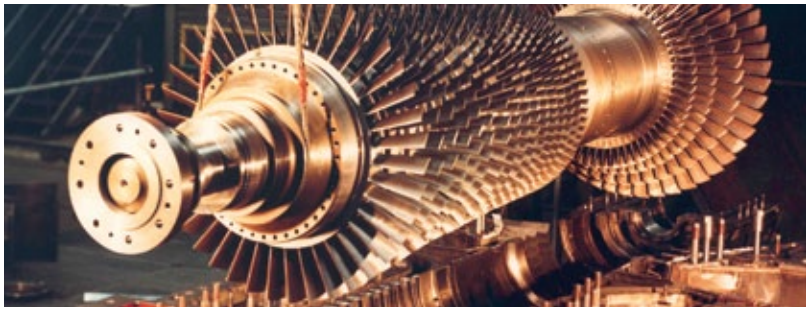
		SGT5-2000E	SGT6-2000E
Grid frequency	[Hz]	50	60
Power output	[MW]	166	112
Efficiency	[%]	34.7	33.9
Heat rate	[kJ/kWh]	10,375	10,619
Heat rate	[Btu/kWh]	9,834	10,066
Exhaust temperature	[°C/°F]	541/1,005.8	540/1,004
Exhaust mass flow	[kg/s]	525	365
Exhaust mass flow	[lb/s]	1,157	804
Pressure ratio		12	12.1
Length x width x height	[m]	10 x 12 x 7.5**	8.3 x 10 x 6.25**
Weight	[t]	234**	163**
Generator type			

* Gross values, standard design, ISO conditions, natural gas fuel ** Dimensions and weight incl. combustion chambers

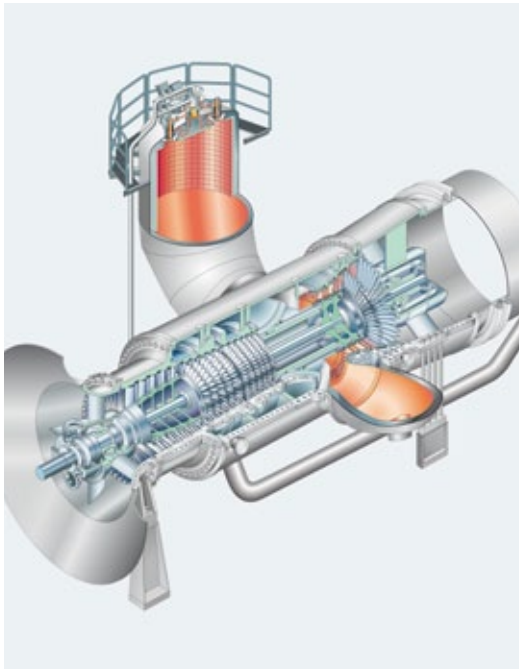
By July 2011, more than 400 SGT5-2000E and SGT6-2000E Siemens Gas Turbines were in operation worldwide.

The 168-MW 50 Hz model, the SGT5-2000E, is a heavy-duty gas turbine designed for reliable, efficient, and flexible operation. Over 6.4 million operating hours of experience with 300 SGT5-2000E gas turbines have been accumulated, demonstrating their outstanding reliability under a wide range of operating conditions.

The SGT5-2000E proves that it is possible to reconcile ambitious economic and environmental targets. Despite its high flexibility in terms of operation and fuels, the NO_x and CO_2 emissions of a SGT5-2000E are minimized.



		SGT5-2000E	SGT6-2000E
Siemens Combined Cycle power plant			
Multi-shaft 1 x 1			
Net power output	[MW]	250	171
Net efficiency	[%]	52.4	51.3
Net heat rate	[kJ/kWh]	6,869	6,990
Net heat rate	[Btu/kWh]	6,511	6,626
Multi-shaft 2 x 1			
Net power output	[MW]	505	345
Net efficiency	[%]	52.9	52.0
Net heat rate	[kJ/kWh]	6,805	6,920
Net heat rate	[Btu/kWh]	6,451	6,560



Proven design features – derived from decades of experience

Optimized flow, robust and versatile combustion and cooling systems add up to a gas turbine efficiency of nearly 35 percent.

- The machine features a single-shaft, single-casing design and two laterally flanged, large-volume, silo-type combustion chambers, a multi-stage compressor, and a four-stage turbine. An air-cooled generator is driven on the cold (compressor) end.

- Compressor stages:
  SGT5-2000E: 16
  SGT6-2000E: 17
- A modified version with 17 compressor stages is available for non- or partially air-integrated syngas/IGCC applications.
- Burners per combustion chamber:
  SGT5-2000E: eight
  SGT6-2000E: six
- A standard static-excitation and variable-frequency converter system ensures smooth acceleration of the gas turbine to full speed within four minutes.
- Easy access via manholes into the two combustion chambers permits direct inspection of the hot gas-path components, from the burners to the turbine blading.

1 Compressor blades

- Variable-pitch inlet guide vanes allow operation down to half load while maintaining a constant exhaust temperature.
- All stationary and moving blades in the compressor and turbine can be replaced individually without removing the rotor from the lower casing.

2 Turbine blades

- Convective air-cooling of the first three stationary and first two moving turbine blade rows protects the blade material against high inlet temperatures. The first three stages of the turbine are protected with a special coating.
- To allow ash-forming fuel firing, no film cooling is used.
- The free-standing moving blades of the compressor and turbine are tuned to permit continuous full-load operation over a wide off-frequency range.

3 Rotor

- The light, highly rigid rotor of disk design allows rapid startups.
- Internal air-circulation paths in the rotor minimize thermal stresses.
- Hirth facial serrations at the outer perimeter of the disks ensure self-centering of all the rotor components under steady- and non-steady-state operating conditions.

4 Combustion

- Two silo-type chambers with ceramic heat shields.
- Hybrid burners with dry low NO_x technology.
- Gaseous and liquid standard fuel firing.
- Special gaseous fuel firing, for example, low-Btu gas and syngas from IGCC.
- Special liquid fuel firing, for example, kerosene, naphtha, and ash-forming fuels (crude oil, heavy fuels).

Operational flexibility and service-friendliness – for challenging operating conditions

Large combustion chambers ensure low emissions, fuel flexibility, and ease in maintenance.

The SGT-2000E series can be fired with a wide variety of fuels, from low- to high-calorific gaseous and/or liquid fuels, including treated heavy oils.

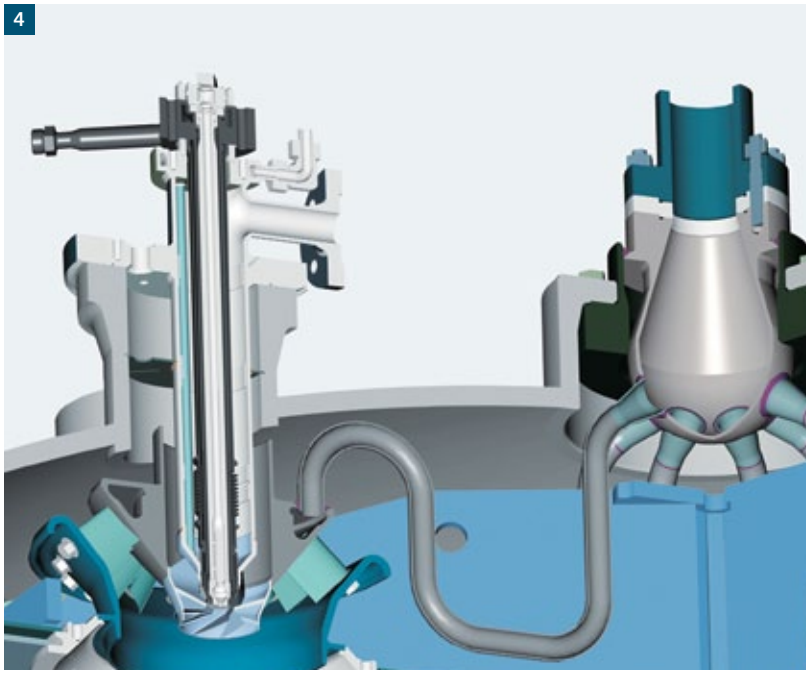
Off-board combustion eliminates any direct flame radiation on the turbine blading, and the long dilution path allows for long service intervals and high availability of the hot gas casings.

3

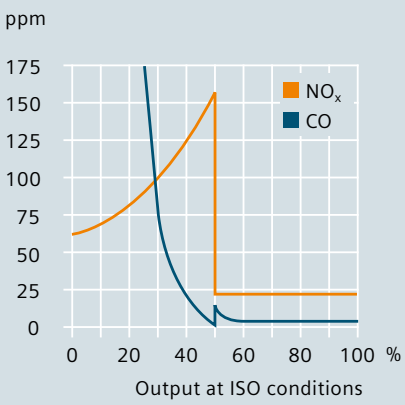
The basic robust design guarantees the best in E-class flexibility:

- A wide range of fuel quality
- Low emissions even at lower partial loads
- Fast startup
- Flexible grid support
- Low-maintenance, extended maintenance intervals according to customer needs
- Excellent accessibility eases manual turbine washing and inspection when firing ash-forming fuel oil

4



Emissions
(in dry exhaust gas with 15% O_2)

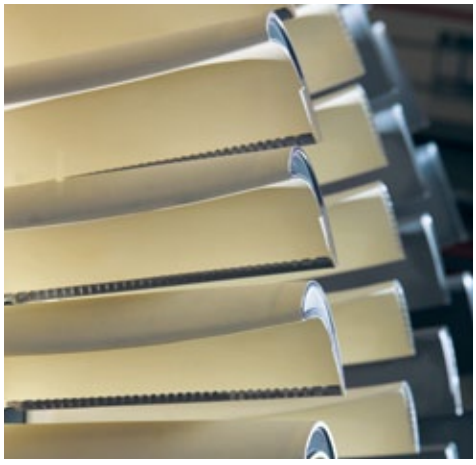


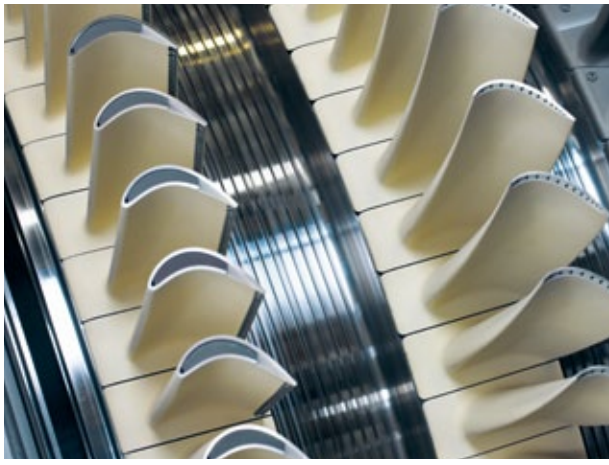
Fuel flexibility – a broad range to meet different needs

With a fuel range from heavy fuel oils to low calorific gases, the SGT-2000E series delivers high application flexibility

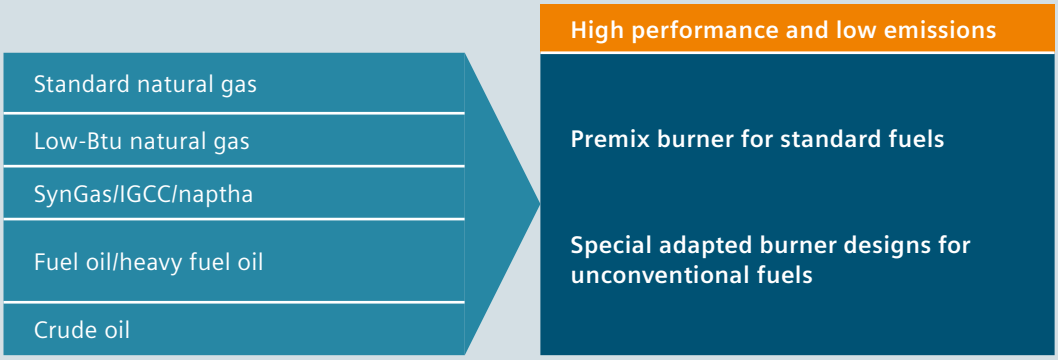
Siemens has broad experience with different types of fuels, including non-standard fuels like crude oil and low calorific gases.
Depending on the fuel composition, Siemens provides standard combustors or project-specific solutions.

Thanks to the robust design, the SGT-2000E series operates at high levels of reliability – even under challenging fuel conditions.





Gas turbines in the SGT-2000E series are capable of firing the following fuels:

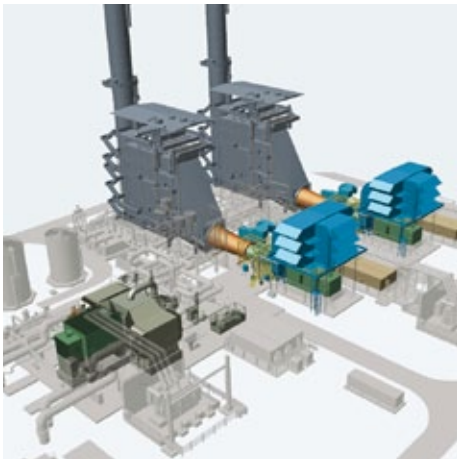


The SGT5-PAC 2000E and SGT6-PAC 2000E – Pre-engineered modules for faster commissioning

The Siemens Gas Turbine Package (SGT-PAC) comprises the gas turbine and generator, and all major mechanical, control, and electrical equipment required for safe and reliable operation of these components.

We deliver our Siemens Gas Turbine Packages largely pre-assembled, including piping and wiring to a major extent. The auxiliary systems are combined in groups and installed as pre-fabricated packages. This reduces installation and commissioning time and expenditures.

Pre-engineered options are available to meet project- and site-specific requirements or to increase operating flexibility and performance of the power generating system.



Scope of SGT5-PAC 2000E and SGT6-PAC 2000E

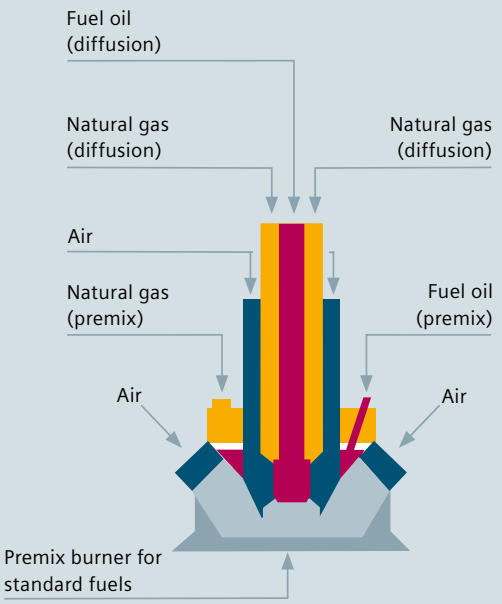
Base scope	Options (partial list)
■ Gas turbine ■ Electrical generator ■ Fuel gas system ■ Hydraulic oil system ■ Instrument air system ■ Lube oil system ■ Compressor cleaning system ■ Air intake system ■ Exhaust gas diffuser ■ Instrumentation and control ■ Electrical equipment ■ Power control centers ■ Noise enclosures ■ Fire protection ■ Starting frequency converter	■ Liquid fuel system ■ Dual-fuel operation ■ NO_X water injection system for liquid fuels ■ Inlet air evaporative cooling ■ Inlet air anti-icing system ■ Inlet air self-cleaning pulse filter ■ Gas turbine stack for simple cycle ■ Diverter damper and bypass stack for combined cycle ■ Enhanced noise abatement ■ Fin-fan cooling systems for generator and lube oil ■ Operation with heavy fuel oils ■ Operation with syngas

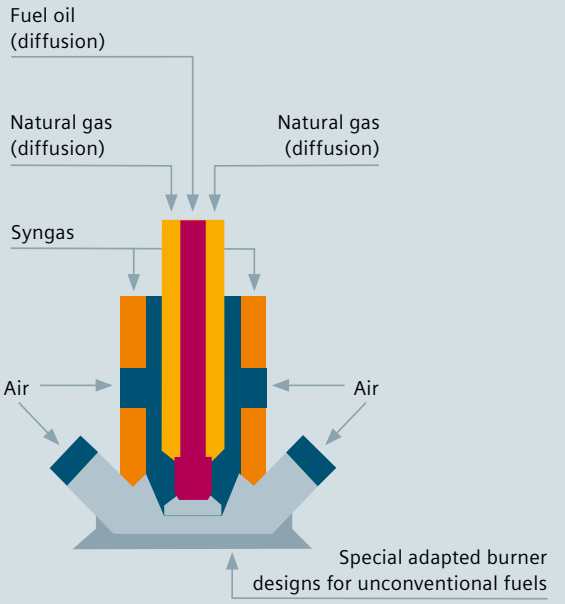
Oil and gas business applications: one engine – many possibilities

In addition to applications in power plants, the SGT-2000E series can also be used for diverse applications in the oil and gas industry.

The compressor drive design, derived from proven standards, can be used, for example, in the production of liquified natural gas – either as a direct mechanical drive compressor or as an all-electric generator version.

Due to the robust engine design, the SGT-2000E series is capable of operating with low calorific gases and syngas. Typical applications are gas-to-liquid plants and IGCC power plants.





More than 350 engines working hard – worldwide

The SGT5-2000E has been in service since 1981, and the SGT6-2000E since 1989. We have sold more than 400 SGT5-2000E and SGT6-2000E gas turbines and accumulated about nine million operating hours, with fleet reliability exceeding 99 percent.

1 Buggenum, Netherlands

Nuon Power Buggenum operates its power station as an integral part of a fully integrated, coal-based IGCC plant with a net output of 290 MW. The Buggenum power station consists of one single-shaft combined cycle unit with one SGT5-2000E gas turbine with approximately 80,000 operating hours. The gas turbine is equipped with Siemens syngas burners that permit operation using both syngas and natural gas, which is used as backup fuel.

2 Townsville, Australia

Transfield Pty Ltd's 150-MW simple cycle gas-turbine power plant has been in operation for more than 35,000 hours. The power plant is equipped with one SGT5-2000E of the latest generation, and burns natural gas.

3 Az Zour, Kuwait

The Ministry of Electricity and Water operates the 960-MWe Az Zour power plant, which consists of eight SGT5-2000E Siemens Gas Turbines in simple cycle operation with more than 170,000 operating hours. The gas turbines are equipped with Siemens hybrid burners, which permit the use of both gas and oil.

4 Hsinta, Taiwan

Taiwan Power Company operates Hsinta, the world's largest 60 Hz/2,200-MW combined cycle power plant. The plant comprises five 442 MW combined cycle units, each with three natural gas-fired Siemens Gas Turbines SGT6-8000H, three HRSGs, and one single bottoming non-reheat condensing steam turbine. To date, the gas turbines have already accumulated more than 900,000 operating hours.

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