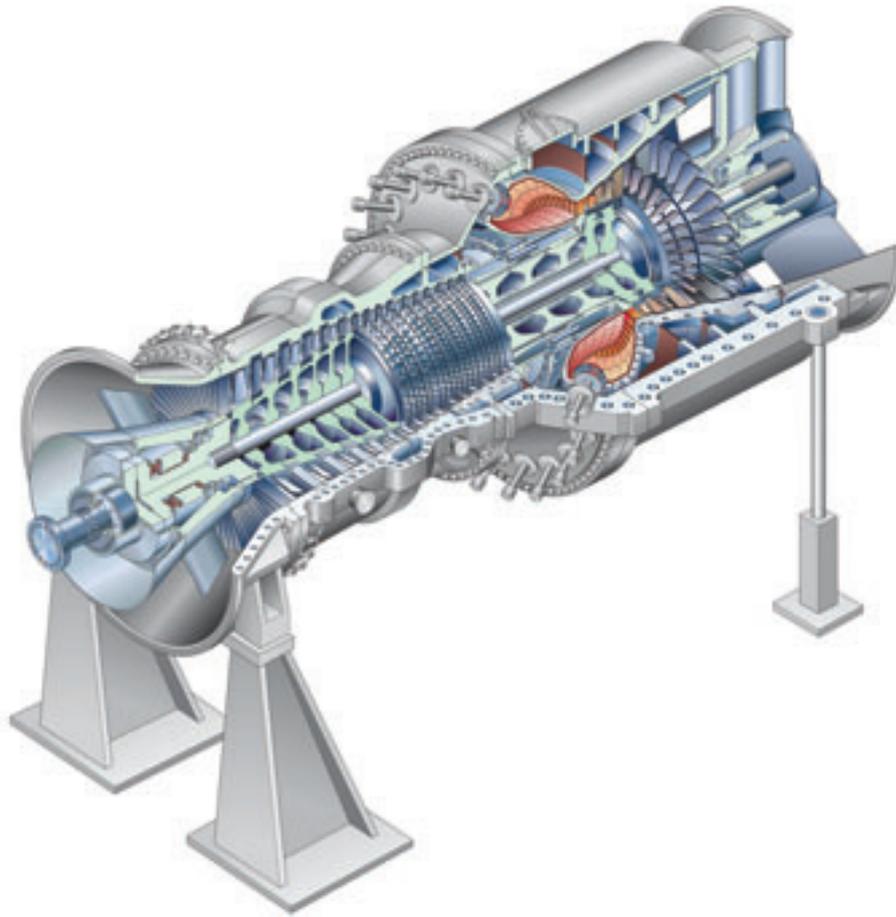


# Siemens Gas Turbine SGT5-4000F

Advanced performance

Answers for energy.

**SIEMENS**



## The SGT5-4000F – Designed for competitive power generation

Increasingly fierce competition fueled by deregulation and privatization is dictating ever lower power generation costs. One approach to cost-cutting is economical plant operation centering on low investment costs and in particular on lowest life-cycle costs.



The SGT5-4000F – Siemens Gas Turbine (SGT™) – our high-performance workhorse is tailored to meet these requirements. With its innovative design, materials and thermodynamic processes, the SGT5-4000F ensures you a strong position in a competitive market.

**The machine is characterized by the use of a proven 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 results in:**

- Low investment costs per installed kilowatt

- High efficiency
- Low maintenance expenditure
- Long service life
- Fast payback on invested capital

Based on the standard design concepts of our modular reference power plants for single-shaft and multi-shaft application we have defined several scope of supplies around the SGT5-4000F. These packages from component through SGT-PAC to the full Turnkey scope support all your needs. The intelligent with a range of modules and options brings you benefits in terms of deadlines and quality.

Siemens Gas Turbine*			
	SGT5-4000F	SGT5-3000E	SGT-1000F
Grid frequency (Hz)	50	50	50/60
Gross power output (MW)	292	191	68
Gross efficiency (%)	39.8	36.8	35.1
Gross heat rate (kJ/kWh)	9,038	9,794	10,265
Gross heat rate (Btu/kWh)	8,567	9,283	9,730
Exhaust temperature (°C/°F)	577/1,071	575/1,068	583/1,081
Exhaust mass flow (kg/s)	692	512	192
Exhaust mass flow (lb/s)	1,526	1,129	422
Pressure ratio	18.2	13.3	15.7
Length x width x height (m)*	13x6x8	13x6x8	11x4x4.8**
Weight (t)	308	308	53 + 20***

\* Standard design; ISO ambient conditions

\*\* Length incl. transmission

\*\*\* Weight main frame + transmission

The SGT5-4000F gas turbine concept builds on more than 40 years' experience with heavy-duty gas turbines at Siemens and Siemens Westinghouse. This is the solid technical foundation, on which innovative technology is based. Consistent application of the accumulated know-how on a wide range of disciplines was implemented. For instance, development and manufacture of this technology involved not only aeroengine manufacturers but also precision casting specialists, research institutes and technical universities.

The task in hand was to ensure maximum operating economy. The first crucial questions we had to answer were:

Does an appropriate technical platform for this development already exist?

Where do new solutions have to be found?

The key technical starting points:

Compression and combustion. We had to push forward into new thermodynamic ranges and higher combustion temperatures, while still fulfilling the requirements for an easy-to-service design and long intervals between major overhauls.

Today, the SGT5-4000F is proof that it is possible to reconcile ambitious economic and environmental targets – through:

- Effective use of resources
- Low NOx content of exhaust gas
- Lowest CO<sub>2</sub> emissions





### The compressor

The compressor with optimized flow path and controlled diffusion airfoils for more efficient operation. Ruggedized compressor design to withstand underspeed and overspeed conditions, ensuring reliable operation of the SGT5-4000F in grids with major frequency fluctuations.



### The turbine blades

The blades of the first and second turbine stages have to withstand thermal stresses and are therefore fabricated from a heat-resistant alloy which is allowed to solidify as a single-crystal structure. They also have an additional ceramic coating. They are cooled internally through a complex array of air channels and externally by film cooling. These measures combine to ensure a long blade service life.

## The SGT5-4000F – Innovative design on a proven basis

Optimized flow, combustion and cooling systems as well as new materials add up to a gas turbine efficiency of nearly 40%. To highlight a few features:

- Very compact casing
- 15-stage high-efficiency compressor
- Optimized design point for compressor pressure ratio and boundary-zone-corrected compressor blades (controlled diffusion airfoils)
- Annular combustion chamber with 24 hybrid burners for uniform flow and temperature distribution
- Compact design and fully ceramic heat shields to minimize cooling air requirements
- Single-crystal blades made of high-grade alloys with additional ceramic coating
- High-efficiency vortex and convection cooling in the blade interior with film cooling of the blade surface
- The latest vintage SGT5-4000F also features fail-safe hydraulic turbine blade tip clearance control for optimized radial clearances and hence maximum performance
- Easy-to-service design thanks to an annular walk-in combustion chamber, which enables inspection of hot-gas-path parts without cover lift





### The rotor

The rotor is designed as a disk-type rotor with Hirth serrations and central tie bolt. This proven design principle combines low weight with high stiffness and ensures smooth running and low thermal stresses under all operating conditions, resulting in the familiar short run-up times of Siemens gas turbines.



### The annular combustion chamber

The enhanced hybrid burner (HR3) with its cylindrical burner extensions and modified flow path results in stable, low noise combustion.

## Proven design features at a glance

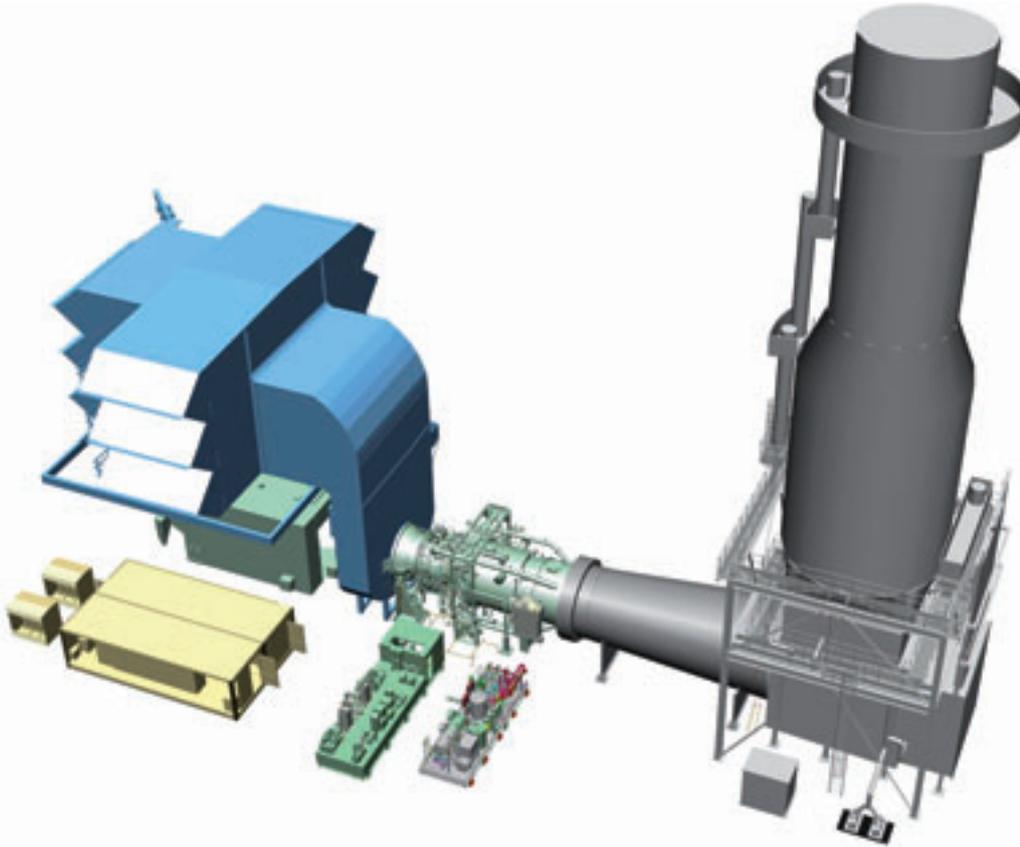
The SGT5-4000F is based on the SGT5-2000E/SGT6-2000E, our reliable runners. These gas turbines are of proven ruggedness, as attested by more than 380 machines sold and more than 8.8 million cumulative operating hours. Main features include:

- Horizontally split casing
- Two rotor bearings
- Disk-type rotor with Hirth serrations and a central tie bolt
- All blades removable with rotor in place
- Multi-stage axial-flow compressor with variable-pitch inlet guide vanes, four-stage axial-flow turbine, all moving blades free-standing
- Hybrid burners for premix and diffusion mode operation with natural gas and fuel oil
- Combustion chambers lined with individually replaceable ceramic heat shields
- Generator coupled to compressor (cold-end drive)
- Axial exhaust gas flow



### The enhanced hybrid burner

The dual-fuel hybrid burner for premix and diffusion combustion of gas and oil consists of a system of rugged individual burners. This configuration permits flexible, stable, clean – and therefore economical – operation.



## The SGT5-PAC 4000F

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 extend. The auxiliary systems are combined in groups and installed as prefabricated packages. This reduces installation and commissioning expenditures and durations.

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 4000F

Base scope	Options (selection)
Gas turbine	Liquid fuel system
Electrical generator	Dual-fuel operation
Fuel gas system	NOx water injection system for liquid fuels
Hydraulic oil system	Inlet air evaporative cooling
Instrument air system	Inlet air anti-icing system
Lube oil system	Inlet air self-cleaning pulse filter
Compressor cleaning system	Gas turbine stack for simple cycle
Air intake system	Diverter damper and bypass stack for combined cycle
Exhaust gas diffuser	Further noise abatement
Instrumentation & Control	Fin-fan cooling systems for generator and lube oil
Electrical equipment	
Power Control Centers	
Noise enclosures	
Fire protection	
Starting frequency converter	



Performance*			
	SGT5-4000F	SGT5-3000E	SGT-1000F
Siemens Gas Turbine Packages	50 Hz	50 Hz	50/60 Hz
Net power output (MW)	288	188	66
Net efficiency (%)	39.5	36.3	34.6
Net heat rate (kJ/kWh)	9,114	9,908	10,396
Net heat rate (Btu/kWh)	8,638	9,391	9,854
Exhaust temperature (°C/°F)	580/1,075	579/1,073	586/1,087
Exhaust mass flow (kg/s)	688	512	190
Exhaust mass flow (lb/s)	1,516	1,128	418
Generator type	Air-cooled	Air-cooled	Air-cooled
<b>Siemens Combined Cycle Power Plant</b>			
<b>Single-Shaft</b>			
Net power output (MW)	423	290	101
Net efficiency (%)	58.4	56.5	52.6
Net heat rate (kJ/kWh)	6,164	6,368	6,844
Net heat rate (Btu/kWh)	5,842	6,036	6,487
<b>Multi-Shaft 2x1</b>			
Net power output (MW)	848	576	201
Net efficiency (%)	58.5	56.3	52.5
Net heat rate (kJ/kWh)	6,158	6,389	6,858
Net heat rate (Btu/kWh)	5,836	6,056	6,501

\* ISO conditions, natural gas fuel

### Didcot B, England

National Power plc. operates the combined cycle power plant with two multi-shaft 2x1 units that has a total capacity of 1390 MW and nearly 220,000\*\* operating hours for V94.3A (new: SGT5-4000F).

### Mainz-Wiesbaden, Germany

Kraftwerke Mainz-Wiesbaden AG operates the combined cycle cogeneration power plant with one multi-shaft 1x1 unit that has a total capacity of 410 MW, featuring the latest vintage V94.3A (new: SGT5-4000F) design already with over 52,000\*\* operating hours.

### Seabank 1&2, England

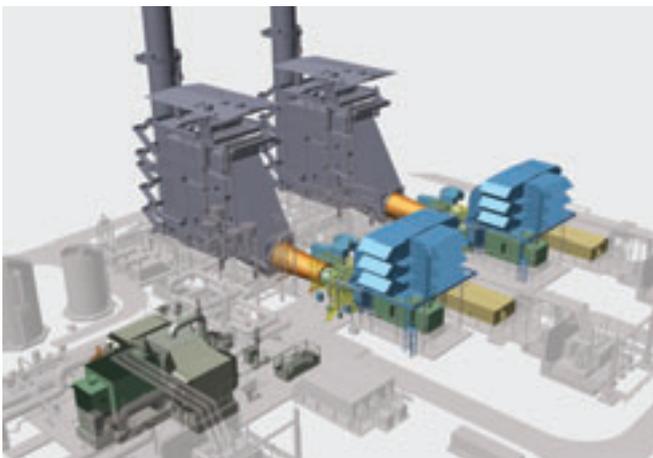
Seabank Power Ltd./Scottish & Southern Energy operate one multi-shaft 2x1 and one single-shaft combined cycle power plant with a total capacity of 1,140 MW and nearly 150,000\*\* operating hours.

### Genelba, Argentina

PECOM ENERGIA S.A. operates the combined cycle power plant with a multi-shaft 2x1 unit that has a total capacity of 660 MW and over 133,000\*\* operating hours.

## World experience

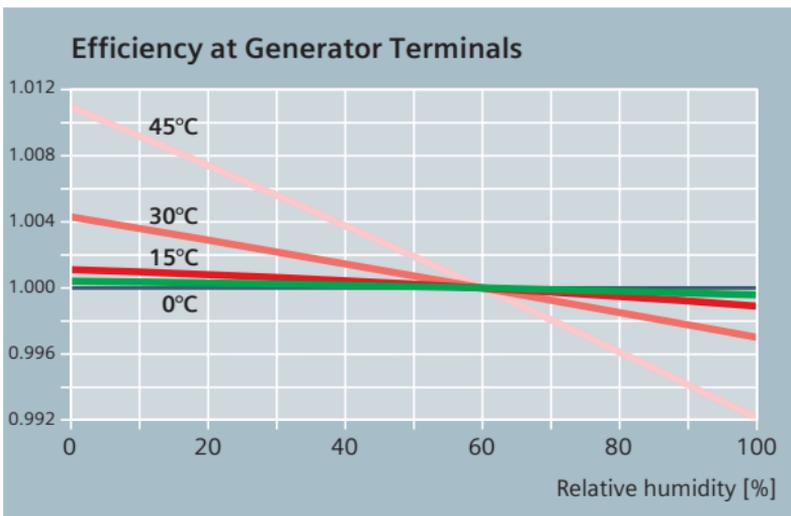
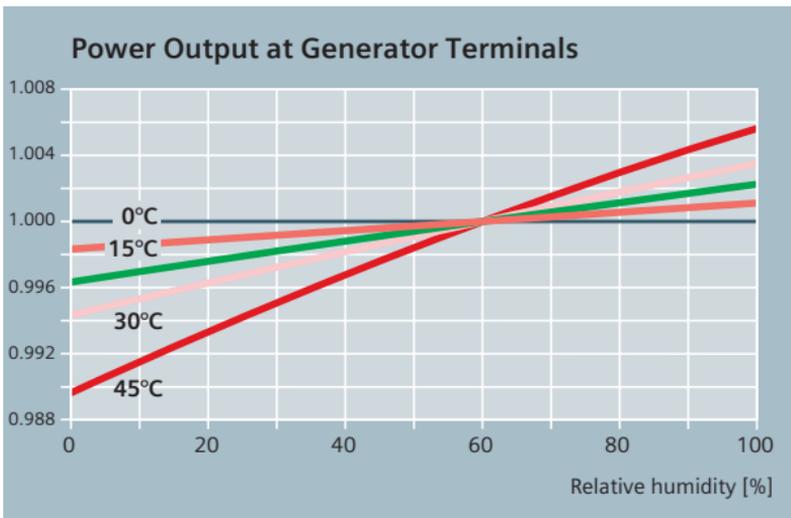
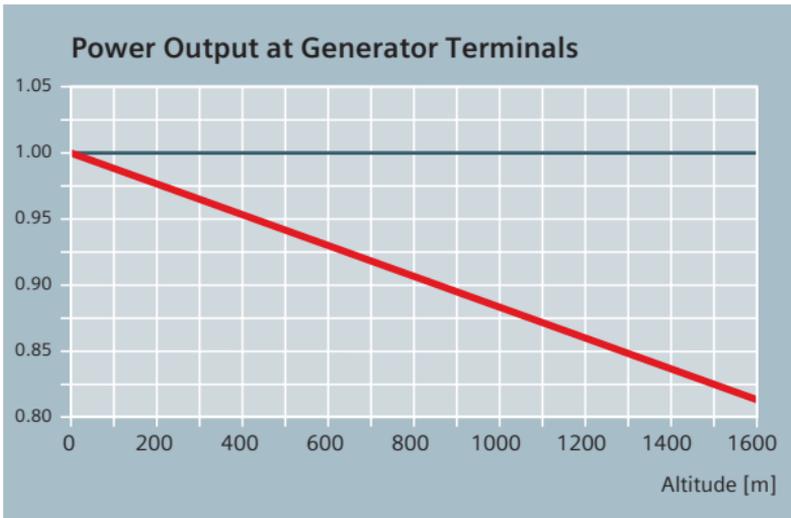
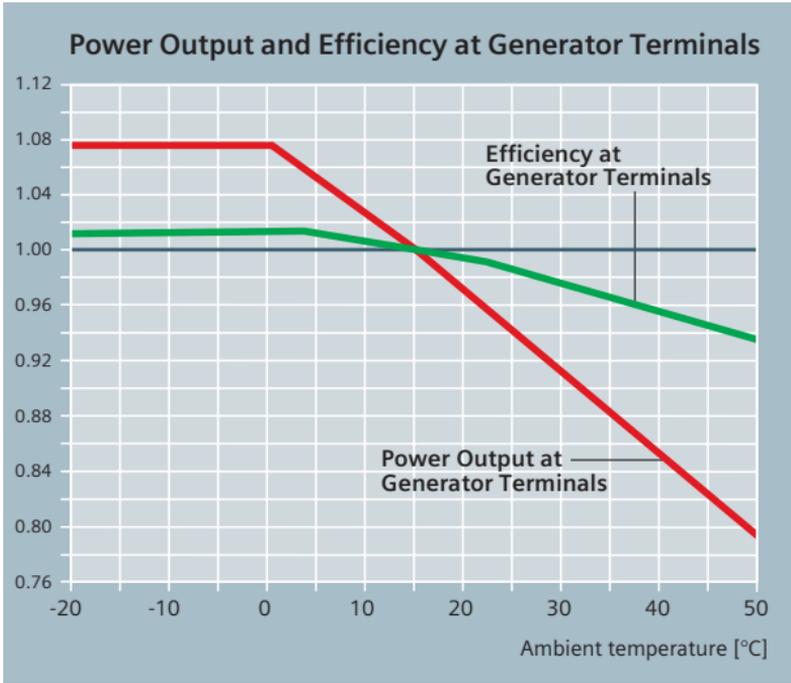
The SGT5-4000F has been in service since 1997. We have sold nearly 290 gas turbines of the SGT-1000F series, SGT5-4000F and SGT6-4000F with more than 3.6 million cumulative operating hours and a fleet reliability exceeding 99%.\*\*



\*\* Status December 2007



# SGT5-4000F adjustment to site conditions



Published by and copyright © 2008:  
Siemens AG  
Energy Sector  
Freyeslebenstrasse 1  
91058 Erlangen, Germany

Siemens Power Generation, Inc.  
4400 Alafaya Trail  
Orlando, FL 32826-2399, USA

For more information, contact our  
Customer Support Center.  
Phone: +49 180/524 70 00  
Fax: +49 180/524 24 71  
(Charges depending on provider)  
e-mail: support.energy@siemens.com

Fossil Power Generation Division  
Order No. A96001-S90-B323-X-4A00  
Printed in Germany  
Dispo 05400, c4bs No. 1359, 805  
108411M WS 05083.

Printed on elementary chlorine-free bleached paper.

All rights reserved.  
Trademarks mentioned in this document are  
the property of Siemens AG, its affiliates, or their  
respective owners.

Subject to change without prior notice.  
The information in this document contains general  
descriptions of the technical options available, which  
may not apply in all cases. The required technical  
options should therefore be specified in the contract.