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Flexible performance, convincing quality – economical and future-proof packages

SGT5-PAC 4000F / SCC5-PAC 4000F

Answers for energy.



Competitive energy efficiency: packages for gas turbine and combined cycle applications

With the SGT5-PAC 4000F and SCC5-PAC 4000F packages, you're investing in an entire range of benefits that can only be offered as a package from a single source: perfectly coordinated individual systems as basic packages that can be flexibly tailored with optional modules to meet your requirements.

As a supplier of turnkey power plants, Siemens perfectly masters the interfaces from the package to the entire power plant. This means that you benefit from a high level of performance and reliability, a broad range of applications, and the flexibility that you need to succeed in highly competitive energy markets – both today and in the future.

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Continuous innovations
As a technology leader, we're a trendsetter in many areas and are driving the development of power generation from fossil sources. Backed by our comprehensive knowledge of global energy markets, we continue to successfully combine the best technologies in our packages. As a whole, they offer even more benefits than their individual components, for everything from plant performance to adherence to strict emissions standards even in partial-load operation.

The gas turbine is an example of this kind of continuous innovation: Since its market introduction in 1996, we have continued to develop the machines and integrate improvements into the standard design. Thanks to rigorous implementation of the latest technology in the SGT5-4000F, the current models offer more performance and reliability than the initial model. And development efforts continue. How do you benefit? Existing turbines can be retrofitted with the majority of these improvements. In other words: The SGT5-PAC 4000F and SCC5-PAC 4000F packages safeguard your investments and your competitiveness – for years to come.

Minimized risk
Our SGT5-4000F-based packages help you plan and implement your plants as efficiently and flexibly as possible. Package components are optimally coordinated and tailored to meet your requirements, interfaces function smoothly – and performance is strong and delivered at clearly defined and transparent costs. What's more, a package from Siemens reduces your planning risk, since we are responsible for the heart of your plant, which is based on our comprehensive integration expertise as a supplier of turnkey power plants all over the world.



Efficiency that pays off

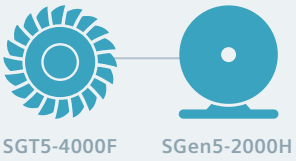
We have developed our three flexible packages based on our proven SGT5-4000F gas turbine and equipped them specifically for the 50 Hz market. All of the packages feature outstanding energy efficiency values, whether it's the SGT5-PAC 4000F for a gas turbine power plant or the SCC5-PAC 4000F version for combined cycle power plants. And the outstanding efficiency values can be attributed to more than just the use of the gas turbine: The other components in our packages combine the highest level of quality and outstanding performance data. Both the specified SGen5-1200A and SGen5-2000H generators as well as the SST5-3000 and SST5-5000 steam turbines are precisely tailored to fit the gas turbine's parameters to achieve optimal energy efficiency throughout the entire power generation process.

This allows you to leverage the full potential of your plant when operating at a full load as well as during flexible operation under a partial load. The result is lower emissions, reduced fuel consumption, and lower costs.

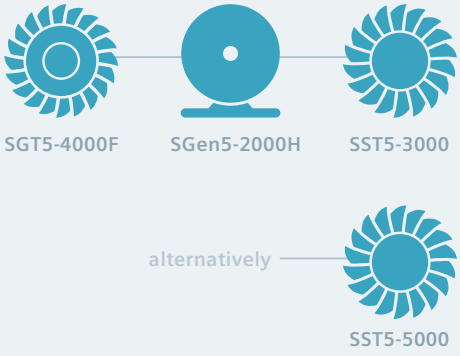
All interfaces under control

The key advantage of our SGT5-PAC 4000F and SCC5-PAC 4000F packages is that all the elements work together seamlessly. This holds true both within the packages and for the connection of other technologies. You can rest assured that our decades of experience will provide you with a long-term competitive edge through tailored technologies.

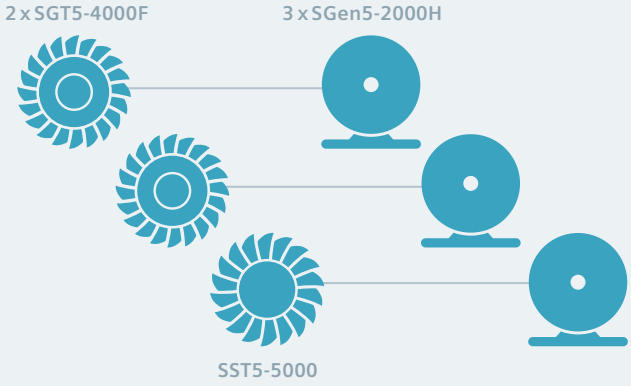
SGT5-PAC 4000F
for simple cycle operation



SCC5-PAC 4000F 1S
for combined cycle operation



SCC5-PAC 4000F MS 2 x 1
for combined cycle operation



SGT5-PAC 4000F and SCC5-PAC 4000F – your benefits at a glance

- **Investment security:** thanks to the long-term availability of spare parts, comprehensive service, and maintenance expertise, as well as gas turbine innovations suitable for retrofits
- **Shorter construction and commissioning times:** through the standardized design of packages with defined interfaces for the plant and the use of proven components
- **Easy adaptation to your power plant design:** minimized space requirements of components and predefined interfaces to the power plant
- **High energy efficiency values and flexibility:** faster startup and shutdown procedures, better performance, and optimal adaptation to individual plant conditions

Scopes of supply

SGT5-PAC 4000F

includes:

- SGT5-4000F gas turbine
- SGen5-2000H hydrogen-cooled generator
- Auxiliaries:
  - Fuel gas system
  - Fuel oil system (optional)
  - Water injection system (optional)
  - Hydraulic oil system
  - Pneumatic system
  - Compressor cleaning system
  - Lube oil system
- Air intake system
- Exhaust gas system
- Control system
- Electrical systems
- Power control centers
- Enclosures
- Fire protection

SCC5-PAC 4000F 1S

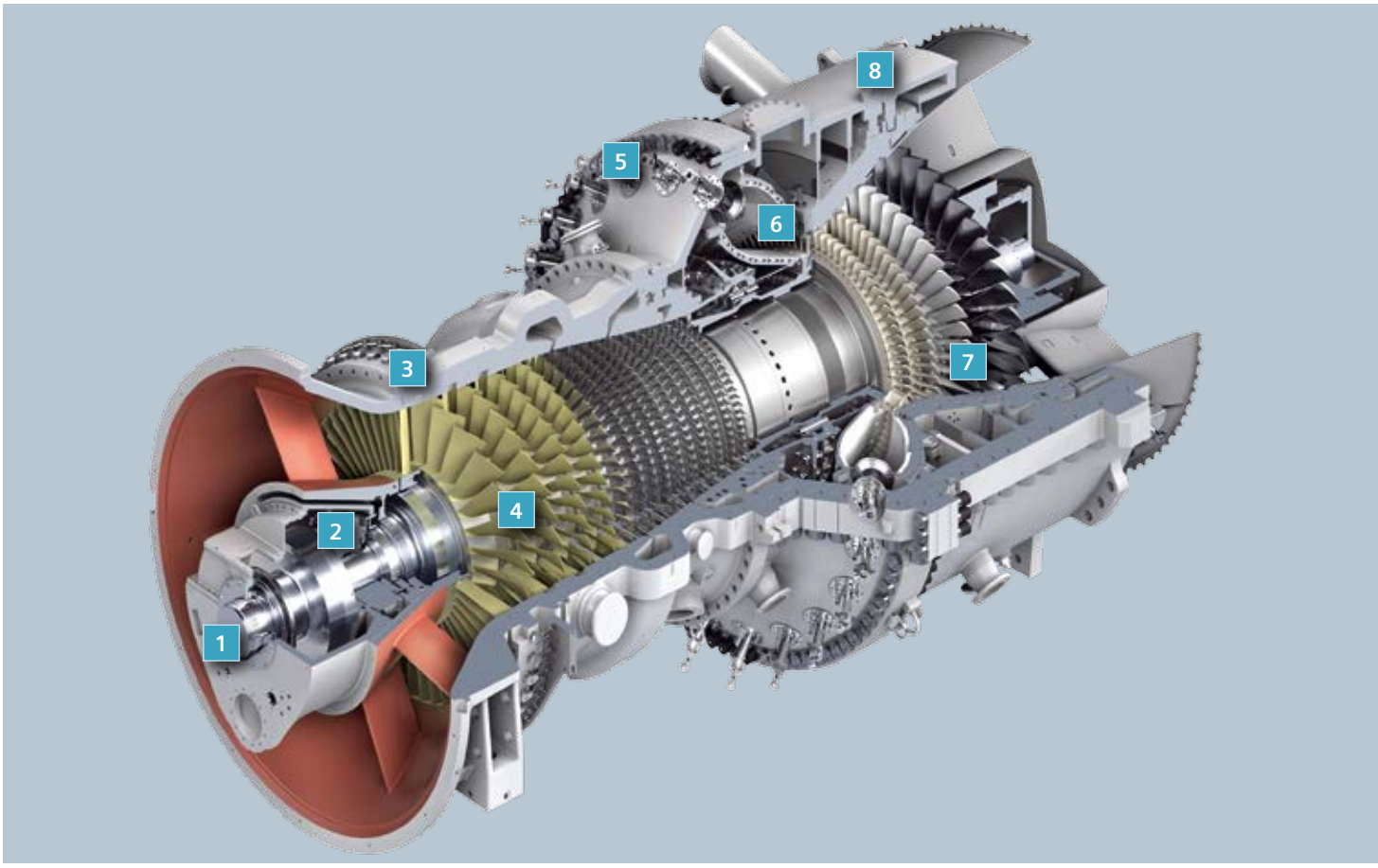
The package includes a gas turbine package and steam turbine package with the following single shaft-specific features:

- SST5-3000 or SST5-5000
- Condenser system
- SGen5-2000H hydrogen-cooled generator
- Auxiliaries for generator:
  - Hydrogen gas system
  - Seal oil system
- One lube oil system for gas turbine, steam turbine, generator, and clutch

SCC5-PAC 4000F MS 2 x 1

Two gas turbine packages and one steam turbine package are combined in a multishaft configuration:

- SST5-5000 steam turbine
- SGen5-2000H hydrogen-cooled generator
- Auxiliaries:
  - Control fluid system
  - Shaft sealing equipment
  - Steam bypass equipment
  - Drainage equipment
  - Lube oil system
- Condenser system
- Control system
- Electrical systems
- Enclosures



The SGT5-4000F: efficiency, performance, and flexibility

The best value for your investment: That is the SGT5-4000F. With its outstanding energy efficiency, its high performance, and its flexibility in operation, it has proven itself in many installations worldwide – including in the economical SGT5-PAC 4000F and SCC5-PAC 4000F packages. Featuring a rugged design and easy maintenance, the SGT5-4000F stands for the highest level of reliability and availability.

Key

1 Generator coupling
2 Rotor bearings
3 Compressor
4 Variable inlet guide vanes
5 Fuel nozzles
6 Combustion chamber
7 Turbine rotating blades
8 Turbine casing



Strong machine at the core
The centerpiece of our SGT5-PAC 4000F / SCC5-PAC 4000F packages is the gas turbine. Its performance profile has a single objective: your success in the competitive power markets. That is why our development consistently focuses on maximum efficiency, performance, and flexibility – while achieving outstanding low emission values during partial and full-load operation. Our turbine also offers these features in our reliable high-availability packages. The decisive benefit for you, however, is that we are never content to rest on our laurels: We continually work to further improve this proven machine – enhancements that can be implemented in retrofits.

Built to give you an edge
The SGT5-4000F is rightly considered to be a powerful workhorse among Siemens gas turbines. It was developed to provide its operators with competitive advantages in fiercely competitive markets – with its proven design, its robust structure, and a range of special features including its construction with:

- Two rotor bearings
- Generator drive on the cold end
- Disk-type rotor with Hirth serrations and a central tie bolt

The SGT5-4000F offers convincing performance, thanks to its very smooth operation, low thermal loads under all operating conditions, and superior mechanical stability. It features an outstanding cold start and warm start capability with absolute reliability – a fundamental requirement for flexible operation. The gas turbine is intrinsically optimized for use in a simple cycle power plant as well as in combined cycle operation. As an operator, you thus benefit from additional flexibility, because you can quickly commence operations with a simple gas turbine power plant and with the assurance that you can subsequently retrofit to combined cycle operation if your requirement profile changes. Of course, our service department is at your disposal from day one after delivery and commissioning of your turbine packages.





Peak values for energy efficiency
The SGT5-4000F was developed specifically for competitive markets in which every percentage point is crucial when it comes to energy efficiency. With this in mind, we have been able to significantly increase the energy efficiency of the gas turbine in a number of stages since its introduction in 1996. Over the years, the turbine capacity has increased from 240 MW to a current level of 329 MW. The majority of turbines can be retrofitted with the technical adaptations necessary to achieve the new capacity level.

Flexible for gas and oil operation
With its flashback-free hybrid burner, the SGT5-4000F can operate using natural gas as well as oil. This feature enables you to leverage fuel price differences to work more profitably without the need to invest in additional technology. What is special about our turbine is that you can seamlessly switch between gas and oil during operation (online switchover).

Low investment costs per kilowatt
The SGT5-4000F pays for itself quickly. This can be attributed to its relatively low investment costs and to the fact that the machine does more thanks to its high energy efficiency. Combined with the high-performance generators from Siemens, it produces more power that can be marketed at a profit. In addition, the turbine can flexibly cover peak loads as well as base load and partial-load operation – while achieving outstanding performance values and producing very low emissions.

Economical design
The low operating costs of the SGT5-4000F are a result of its high energy efficiency. In addition, it has a highly maintenance-friendly design and, thanks to intelligent features, helps to prolong maintenance intervals and minimize maintenance-related operation interruptions.

Features include the annular combustion chamber in which the heat shield tiles can be individually replaced as needed, and details such as the uniform temperature distribution with combustion that remains stable over the lifetime of the turbine, and the internal cool air extraction designed to cool the components exposed to high temperatures. They provide for low lifecycle costs and many years of reliable operation.



SGT5-4000F –
your benefits at a glance

Convincing performance for greater flexibility:
- Fast-start option in less than 30 minutes
- Fast power change in accordance with very strict grid requirements for optimal frequency stabilization
- Fast online fuel change from gas to oil and vice versa
- Various options available for increased performance

Best environmental compatibility
- Minimized NO_x and CO_2 emissions
- Compliance with emissions limits even in partial-load operation

High availability and reliability:
- Reliability in excess of 99 percent (average annual value)
- Over 320 units installed worldwide, including licensed engines, with more than 13.5 million equivalent operating hours and more than 205,000 equivalent operating hours of the leading unit
  (status March 2017)

Optimal efficiency
- High energy efficiency of more than 40 percent in simple cycle, thanks to optimal fuel utilization
- High performance (329 MW nominal output)



SST5-3000 and SST5-5000: high performance in a package

With almost 1,000 large steam turbines and approximately 380 GW capacity, technology from Siemens is responsible for almost 17 percent of the power plants installed worldwide. For the SCC5-PAC 4000F combined cycle power plant (CCPP) packages, the features and performance of the type SST5-5000 and SST5-3000 steam turbines are individually adapted to achieve an optimal focus on your goals as an operator.

SST5-3000 and SST5-5000 – the versatile steam turbines

While the SST5-3000 features a separate high-pressure cylinder and a combined intermediate-pressure / low-pressure cylinder with a single-flow axial exhaust, the SST5-5000 features a combined high-pressure / medium-pressure cylinder and a double-flow low-pressure cylinder. Both steam turbines are highly compact and perfect for use in combined cycle power plants with the state-of-the-art gas turbine technology offered by the SGT5-4000F. The SST5-3000 covers a power range of 90 to 250 MW, while the SST5-5000 operates in a power range between 120 and 650 MW. To meet your specific requirements, the turbine sections are assembled individually and the blade path is optimized. During this process, the adaptation of prefabricated modules helps to accelerate the assembly work and commissioning on-site while minimizing the technical risks. The success can be seen in a failure rate that is 50 percent less than the average value reported by the North American Electric Reliability Council (NERC). In addition, the overhaul intervals are synchronized for the gas turbine, generator, and steam turbine to minimize scheduled plant downtimes and achieve optimal plant availability.

SST5-3000 and SST5-5000 steam turbines – your benefits at a glance

- Compact and cost-effective design
- Proven designs for single- and multishaft combined cycle power plant concepts
- High efficiency through advanced 3DV™ blade profile design and variable reaction type
- High reliability and availability (10-year interval for general inspections)
- High operational flexibility through short startup times and a wide application range
- Short delivery and installation times
- Reduced maintenance costs through maintenance-friendly design
- Up to three-stage extraction for district heating (optional)



SGen5-1200A and SGen5-2000H: the reliable powerhouses

The selection of a generator is essentially based on the performance of the power plant – in gas turbine operation or in highly efficient combined cycle operation. Over a century of experience in building generators of all kinds has gone into the development of our highly specialized generators for package applications in combination with the SGT5-4000F.

Reliable performance: SGen5-1200A
Depending on the requirement profile, the air-cooled generators of this series are available with either TEWAC (Totally Enclosed Water-to-Air Cooling) or OAC (Open Air Cooling) cooling systems.

With a capacity of up to 370 MVA, they can be used in areas until now reserved for hydrogen-cooled units. Their high energy efficiency of 98.8 percent and their high reliability and availability values make them the first choice for all operating modes, from base loads to peak load coverage, for use in gas turbine power plants and in combined cycle power plants. These generators feature a highly maintenance-friendly design and the maintenance intervals can easily be coordinated to coincide with turbine maintenance. They offer optimal performance while minimizing lifecycle costs.

For maximum performance: SGen5-2000H
With an output range from 350 MVA to 600 MVA and efficiency levels as high as 99 percent, the hydrogen-cooled SGen5-2000H seamlessly connects to the air-cooled SGen5-1200A. Similarly, thanks to global vacuum pressure impregnation, the SGen5-2000H offers high availability combined with low technical risk. Its flexible use in all performance classes is made possible through a variety of features, including Omega™ coolers which ensure an even temperature distribution in the generator, while the carbon seals combine minimal oil use with outstanding emergency running properties. The generator design has proven itself worldwide in numerous reference applications.





Auxiliary components – the ideal way to round out your package

In our packages, every detail has to be just right, because we not only supply perfectly coordinated core components, but the auxiliary components also need to ensure reliable and economical operation. That includes customized, maintenance-friendly design and piping that is adapted to the use and easy to install.





Air intake system
The air intake system comprises filter housing, filter system, and inlet duct work. The filter housing offers weather protection and prevents large debris from entering the filter system. The filter system removes both large particles and fine particulates from the air stream. The inlet air duct directs the air flow into the gas turbine compressor inlet manifold.

Exhaust gas system
After expanding through the combustion turbine, the gases pass through the exhaust gas diffuser, which provides connection to a stack, a heat-recovery steam generator, or a diverter and bypass stack.

Condenser system
The condenser collects and condenses exhaust steam from the low-pressure turbine and steam from the turbine startup bypass stations. It also accepts condensate from locations such as drains, vents, and steam seals. It further produces and maintains a high vacuum at the low-pressure turbine exhaust.

Control system
The control system is based on Siemens Power Plant Automation SPPA-T3000 and contains control, monitoring, and protection equipment necessary for the turbine and generator. This includes the operation and monitoring system, the automation system, and the interface to the plant control system.

Electrical systems
The electrical systems supply low-voltage power to the package loads and include battery and battery charger for uninterruptible direct current power supply. The electrical equipment also includes static excitation equipment with transformer, starting frequency converter with transformer for static startup of the gas turbine via the generator, and generator protection and synchronization equipment.

Power Control Centers (PCC)
Prefabricated and functional precommissioned PCC containers provide compact and weather-protected accommodation of electrical and I&C equipment. Redundant HVAC units also offer a controlled environment for sensitive equipment.

Enclosures
Enclosures provide noise abatement for personnel. They also provide the means for delineation of hazardous areas and containment of fire suppression agents.

Fire protection
Fire protection includes fire detection and fire fighting and is provided for gas turbine, fuel gas system, and PCCs.



Antalya



Jebel Ali M-Station

Best references worldwide

SGT5-PAC 4000F packages have earned an excellent reputation worldwide, as confirmed by numerous references in all 50 Hz markets around the world. We can show you only a small selection here, but please do not hesitate to request additional references that may better reflect your requirements.





Nhon Trach 2

Hamm-Uentrop, Germany
Trianel Power Kraftwerk Hamm-Uentrop GmbH & Co. KG operates a combined cycle power plant with a total capacity of 850 MW. The technologies used in the power plant include two type SGT5-PAC 4000F gas turbine packages.

Antalya, Turkey
The Ali Metin Kazanci power plant in Antalya, Turkey, operates using two type SGT5-PAC 4000F gas turbine packages. The power plant was constructed by Turkish operator AKSA and covers the majority of the high electricity requirements in Antalya – one of the main tourist regions in Turkey. The 520 MW gas turbine power plant was constructed by AKSA in record time. It is currently being retrofitted with an SST5-5000 steam turbine package to become a combined cycle power plant with a total capacity of 780 MW.

Jebel Ali M-Station, United Arab Emirates
With an electrical capacity of 2,000 MW, the Jebel Ali M-Station combined cycle power plant operated by Dubai Electricity and Water Authority (DEWA) in Dubai supplies clean power to approximately one million households. The electricity is generated by six high-efficiency SGT5-4000F gas turbine packages.

In addition, the hot exhaust gases generate process steam for a connected seawater desalination plant that has a daily capacity of more than 630,000 m^3 of drinking water.

Nhon Trach 2, Vietnam
The Nhon Trach 2 combined cycle power plant operated by Petro Vietnam Nhon Trach 2 Joint Stock Company is equipped with two SGT5-4000F gas turbines, one SST5-5000 steam turbine, and matching generators. Thanks to the packages used, it was possible to construct and commission the power plant in just 28.5 months. With an installed capacity of approximately 760 MW and an efficiency level of over 57 percent, Nhon Trach 2 supplies clean power to help meet the increasing demand for electricity in Vietnam. Thanks to state-of-the-art Siemens burner technology, the power plant also features very low nitrogen oxide emissions.

Persuasive figures

SGT5-4000F	
Compressor	
Type	Axial flow
Number of stages	15
Rotor speed	3,000 rpm
Inlet guide vanes	Variable
Combustors	
Type	Dry low NO_x
Configuration	Annular
Number	24
Fuel	Natural gas, fuel oil, natural gas and fuel oil (dual-fuel option)
Turbine	
Number of stages	4
Drive	Cold end, direct coupled

SST5-3000	
Turbine series	High-pressure (H) modules and combined intermediate-pressure / low-pressure (IL) modules for 50 Hz
Plant type	Combined cycle
Output range	90 MW to 250 MW for combined cycle applications
Main steam (Typical parameters)	Temperature: up to 565 °C / 1,049 °F Pressure: up to 177 bar / 2,567 psi
Reheat steam (Typical parameters)	Temperature: up to 565 °C / 1,049 °F
Exhaust areas	50 Hz: 5.0 m² to 12.5 m²; 26.2 inches to 45.1 inches*

* Last blade profile length

SST5-5000	
Turbine series	Combined high-pressure / intermediate-pressure (HI) modules and low-pressure (L) modules for 50 Hz
Plant type	Combined cycle
Output range	120 MW to 600 MW for combined cycle applications
Main steam (Typical parameters)	Temperature: up to 600 °C / 1,112 °F Pressure: up to 190 bar / 2,756 psi
Reheat steam (Typical parameters)	Temperature: up to 600 °C / 1,112 °F
Exhaust areas	50 Hz: 5.0 m² to 12.5 m²; 26.2 inches to 45.1 inches*

* Last blade profile length

SGen5-1200A	
Frequency	50 Hz
Standard power factor	0.80
Speed	3,000 rpm
Terminal voltage	20 kV
Efficiency	up to 98.8%
Apparent power	250 MVA to 370 MVA
Coolant	Air, OAC (Open Air Cooling) or TEWAC (Totally Enclosed Water-to-Air Cooling)
Design	In accordance with IEC and ANSI standards
Thermal classification	Class F insulation system
Type of enclosure	Suitable enclosures for indoor and outdoor application per IP 54 available
Excitation	Static
Transport dimensions	Suitable for rail transport in most countries

SGen5-2000H	
Frequency	50 Hz
Standard power factor	0.80
Speed	3,000 rpm
Terminal voltage	16.5 kV to 22 kV
Efficiency	up to 99.0%
Apparent power	350 MVA to 600 MVA
Coolant	Hydrogen at 4 to 5 bar
Design	In accordance with IEC and ANSI standards
Thermal classification	Class F insulation system
Type of enclosure	IP64 (60034-5); suitable for outdoor installation
Excitation	Static
Transport dimensions	Suitable for rail transport in most countries

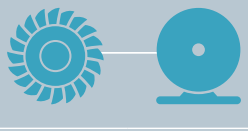
Recommended inspection intervals

NOTE: Flexible service intervals are available with an LTSA

Inspection type	Equivalent operating hours
Minor inspection	8,333
HGPI (hot gas path inspection)	25,000*
eHGPI (extended hot gas path inspection)	50,000*
HGPI (hot gas path inspection)	75,000*
Major inspection	100,000*

* Maximum 750 starts per interval

SGT5-PAC 4000F



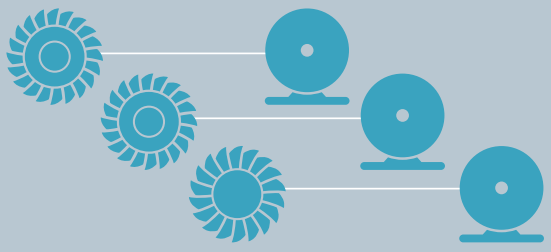
ISO conditions, gross values		
Configuration flexibility to meet power plant-specific needs		
Power output	[MW]	329
Efficiency	[%]	40.7
Heat rate	[kJ/kWh]	8,846
Heat rate	[Btu/kWh]	8,385
Pressure ratio		20.0
Exhaust temperature	[°C]	600
Exhaust temperature	[°F]	1,112
Exhaust mass flow	[kg/s]	725
Exhaust mass flow	[lb/s]	1,598

SCC5-PAC 4000F 1S



ISO conditions, net values		
Configuration flexibility to meet power plant-specific needs		
Power output	[MW]	475
Efficiency	[%]	59.7
Heat rate	[kJ/kWh]	6,030
Heat rate	[Btu/kWh]	5,716

SCC5-PAC 4000F MS 2 x 1



ISO conditions, net values		
Configuration flexibility to meet power plant-specific needs		
Power output	[MW]	950
Efficiency	[%]	59.7
Heat rate	[kJ/kWh]	6,030
Heat rate	[Btu/kWh]	5,716

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Power Generation Division
Order No. E50001-G210-A130-V1-4A00 |
Printed in Germany | Dispo 34802 |
TH 214-130626 | WS | 07141.0

Printed on elementary chlorine-free bleached paper.

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