“Siemens Expands Footprint in the Middle East with SGT6-5000F Power Plant Solutions and New Gas Turbine Manufacturing Facility”

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Siemens AG Energy Sector
# Siemens Gas Turbine Portfolio

**Introduction**

<table>
<thead>
<tr>
<th>Model</th>
<th>Power Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>SGT6-5000F</td>
<td>232 MW</td>
</tr>
<tr>
<td>SGT6-8000H</td>
<td>274 MW</td>
</tr>
<tr>
<td>SGT6-2000E</td>
<td>115 MW</td>
</tr>
<tr>
<td>SGT5-8000H</td>
<td>375 MW</td>
</tr>
<tr>
<td>SGT5-4000F</td>
<td>293 MW</td>
</tr>
<tr>
<td>SGT5-2000E</td>
<td>172 MW</td>
</tr>
<tr>
<td>SGT-800</td>
<td>50 MW</td>
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<tr>
<td>SGT-750</td>
<td>36 MW</td>
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<tr>
<td>SGT-700</td>
<td>31 MW</td>
</tr>
<tr>
<td>SGT-600</td>
<td>25 MW</td>
</tr>
<tr>
<td>SGT-500</td>
<td>19 MW</td>
</tr>
<tr>
<td>SGT-400</td>
<td>14 MW</td>
</tr>
<tr>
<td>SGT-300</td>
<td>8 MW</td>
</tr>
<tr>
<td>SGT-200</td>
<td>7 MW</td>
</tr>
<tr>
<td>SGT-100</td>
<td>5 MW</td>
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</tbody>
</table>

- **Blue** 60 Hz heavy-duty gas turbines
- **Orange** 50 Hz heavy-duty gas turbines
- **Gray** Industrial gas turbines
SGT6-5000F Evolution
Successful Heritage of the 5000F Platform

SGT6-5000F Experience
245+ units in operation
9+ million operating hours

24 SGT6-5000F gas turbines are planned for commercial operation in the Kingdom of Saudi Arabia starting in 2013.

Consistent operational reliability @ 99%.
As reported by customers (199 units)

Low Risk Evolutionary Design Approach with Proven Reliability
The SGT6-5000F Package is Well-Suited for the Middle East Environment

**Rotor Air Cooler**
- Rotor air cooler guarantees a constant cooling air temperature for rotating components over the entire ambient temperature range.

**SGT6-5000F**
- 232 MW with the lowest firing temperature in the market
- 150 MW in 10 minutes
- Retrofittable combustion and turbine parts

**Inlet System**
- Pulse filter option
- Inlet cooling option(s)

**Air Cooled Generator**
- Simplified plant interfaces
- OAC or TEWAC
- Easy access and maintenance

**Starting System**
- SFC (air cooled)


SGT6-5000F
Gas Turbine Design Features

1. Combustion
   - Lowest F-class firing temperature
   - Wide wobble operation
   - Sub 9 ppm emissions

2. Turbine
   - 4-stage turbine
   - Conventionally cast parts

3. Rotor
   - Constant rotor cooling air temperature
   - Steel disks w/ Hirth serrations

1. **Lowest firing temperature in the market:**
   - Low NOx emissions
   - Longer part life
   - Conventionally cast turbine material (no need for single crystal material)

2. **4-stage turbine:**
   - Reliable part life due to lower aerodynamic loading when compared to a 3-stage turbine at the same power output

3. **Constant rotor cooling air temperature:**
   - Predictable rotor life regardless of ambient temperature
Predictable Rotor Life Regardless of Ambient Temperature

The Rotor Air Cooler guarantees a constant cooling air temperature for rotating components over the entire ambient temperature range!

Allows turbine discs to be fabricated from ductile steel material as opposed to relatively brittle nickel-based alloys. And isolates the turbine discs from damaging creep effects and cyclic effects providing a rotor design flexible to cycle changes with a predictable life.
Testing of SGT6-5000F with Compressor Upgrade Completed in 2006

Full Load Testing of New Designs

Off nominal testing…
- Compressor surge limits
- Transient operation
- Fuel transfers
- Load rejections
### Lowest Firing Temperature in the Market Enables Extended Service Intervals

- **Equivalent Starts**
  - Box Model CI
  - Box Model HGP

<table>
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<tr>
<th>Fired Hours</th>
<th>16.5K</th>
<th>33K</th>
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<tr>
<td>1,200</td>
<td></td>
<td></td>
</tr>
<tr>
<td>900</td>
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<tr>
<td>600</td>
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<td>25</td>
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</table>

- **Increased Availability**
- **Reduced Maintenance Costs**

**A duty cycle of 200 starts and 5,500 fired hours per year doesn’t require a rotor inspection until year 25!**

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Lowest F-class Firing Temperature Equals Low Risk Service Intervals
SGen6-1000A
Air Cooled Generator Overview

Air cooled for simplicity, operational flexibility, and high availability

- Proven operation up to 232 MW of power output with world class reliability and efficiency
- OAC and TEWAC configurations to meet the environmental conditions in the region
- 30 year design life @ IEEE Class F temperature rise

Simple, Reliable and Efficient Air Cooled Generator
SST-5000 Series
Steam Turbine Overview

- First installed in the early 1990’s
  - More than 100 units in operation [17 in the Middle East]
- Applied to >180 MW multi-shaft (1x1, 2x1, 3x1, 4x1, etc.) applications.
- Major inspection interval @ 100,000 hours.
- Designed for FACY (fast cycling) power plants. Steam valves wide open in <30 minutes.
- Adaptable to match any plant thermal cycle needs.
  - Water or air cooled condenser
  - Extraction for process steam
**SCC6-5000F**
Combined Cycle Configuration Flexibility

**Energy Solutions to Meet Customer Needs**

Configuration flexibility to reduce life cycle costs and capital expenses.

- **1x1**
  - 345 MW

- **2x1**
  - 701 MW

- **3x1**
  - 1,040 MW

- **4x1**
  - 1,390 MW

Power shown without inlet cooling, duct firing or other power augmentation methods!

Most Powerful and Proven Gas Turbine Technology in the 60 Hz F-Class Market
Continuous Improvement
Efficient Energy Production

Commensurate with the Kingdom of Saudi Arabia objective of efficient energy production...Siemens Energy is continuously developing retrofittable enhancements for the SGT6-5000F.

The recent SGT6-5000F delivers 232 MW of net power at a gas turbine efficiency of >38.8% resulting in a combined cycle net efficiency of >57.5%.

232 MW of Net Power @ a Gas Turbine Net Efficiency of >38.8%
Thank You!
Questions?

Thank You For Your Attention!

Siemens Energy
Fossil Power
Orlando, FL, USA