SGT5-2000E – Latest Service Improvements for Optimized Operations, Maintenance and LNG Fuel Conversion Upgrade

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Siemens Gas Turbines
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Siemens Gas Turbines Portfolio
Performance at ISO Condition

Heavy-duty gas turbines

50Hz

SGT5-8000H 400 MW
SGT5-4000F 307 MW
SGT5-2000E 187 MW

60Hz

SGT6-8000H 296 MW
SGT6-5000F 242 MW
SGT6-2000E 117 MW

Ind. Trent 60 53 to 66 / 54 to 62 MW

Power Generation / Mechanical Drive

Performance at ISO conditions

Ind. RB211 27 to 32 / 28 to 34 MW
SGT-600 24/25 MW
SGT-500 19/19 MW
SGT-400 13 to 14 / 13 to 15 MW
SGT-300 8/8 MW
SGT-200 7/8 MW
SGT-100 5/6 MW
Ind. 501 4 to 6 MW
Three world records in one CHP CCPP:
Net Efficiency 61.5%, Power Output 600MW and District Heating 300MWth
SGT5-4000F Gas Turbine Series:
Advanced technologies added to proven features

20th anniversary and a worldwide growing fleet

Optimized operational flexibility and performance

<table>
<thead>
<tr>
<th>307 MW / 40.0% (today)</th>
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<tbody>
<tr>
<td>• Fast Start up</td>
</tr>
<tr>
<td>SC ~10 minutes</td>
</tr>
<tr>
<td>CC &lt;30 minutes</td>
</tr>
<tr>
<td>• 50 MW/min load following</td>
</tr>
<tr>
<td>• Wobbe range +/-15%</td>
</tr>
<tr>
<td>• H₂S up to 4000ppm</td>
</tr>
<tr>
<td>• Operation at T_{amb}</td>
</tr>
<tr>
<td>-50 °C to +55 °C</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>233 MW / 37.0% (1996)</th>
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<tbody>
<tr>
<td>• Adjusted pressure ratio</td>
</tr>
<tr>
<td>• Cooling air reduction</td>
</tr>
<tr>
<td>• Fuel preheating</td>
</tr>
<tr>
<td>• Hydraulic clearance optimization</td>
</tr>
<tr>
<td>• Mass flow increase</td>
</tr>
<tr>
<td>• TIT increase</td>
</tr>
<tr>
<td>• Turbine aero re-design</td>
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</tbody>
</table>

Market intro | 339 units sold | Today

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SGT5-2000E Gas Turbine
Recent developments to serve customer needs in Africa

Siemens introduced the brand new upgraded version

- Power Output 187 MW
- Efficiency 36.2 %
- Fully retrofit able design
- The Big SGT5-2000E principles continue

Strong Robust Mature Reliable Flexible

Total number of 525 E-class Gas Turbines incl. 256 license units – still growing!

Siemens will continue new unit developments based on customer needs because Siemens supports and believes in future E-Class market in Africa
Siemens Gas Turbine SGT5-2000E
High reliability in accordance with proven design features

SGT5-2000E
Availability: 95,0 %
Reliability: 99,4 %
Starting Reliability: 96,8 %

Excellent values on our OEM engines
Siemens Gas Turbine SGT5-2000E
Service Package 9 - Upgrade Scope Overview

- **Mixing casing:**
  - Hard facing
  - Alignment

- **Flame tube:**
  - Spoiler CHS (at F-ring)
  - HR3 burner design (A1/A2 <> F-row)
  - New support ring
  - Re-activation of dilution air openings

- **Burner:**
  - HR3 Burner
  - Fuel oil burner tip (material change)

- **OTC+:** Outlet temperature control

- **Burner insert ring (IN939):**

- **Inner casing (SP8):**
  - Improved coating
  - New hub design
  - Hard facing

- **Compressor Mass Flow Increase (CMF++):**

- **Hydromotor:**

- **Compressor bearing:**
  - Improved wider SP8 bearing
  - Hydraulic Clearance Optimization (HCO)

- **Legend:**
  - Recommended
  - Optional

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Siemens Gas Turbine SGT5-2000E
Power Limit Increase with Si3D Blades and Vanes

Si3D1-4 is mandatory for Power Limit Increase: Ready for future fleet upgrades
First Example: Significant reduction of GT load level switch-over time

Fuel Change Over Phases and GT Load for F- and E-class

(2010 vs 2015)

- Fuel change over at 75% GT load*
- Significantly faster switch-over time
- Fast reaction on gas pressure loss
- Successfully tested in the field
- Available also as an upgrade

* Subject to project specific conditions. Optional scope needed

Focus of latest product enhancement
Siemens Gas Turbine SGT5-2000E
Next Generation

SP9: CMF++
  Power & Efficiency,
  Lifecycle Cost Reduction, Fuel Flexibility,
  Operational Flexibility

SP8: Fast Load Gradients*,
  Wobbe Range Extension*,
  extended PLI*
  41MAC/1500 starts/10 MIC
  Part Load Upgrade*
  Power Limit Increase (PLI) to 186 MW
  Hydraulic Clearance Optimization (HCO)
  Si3D 3+4 and FTI+ to 173 MW, 35.8%

SP7: Si3D 1+2

SP6: Wet Compression
  41MAC/FTI and CMF+

SP5: Compressor Mass Flow Increase (CMF+)

SP4: Fire Temperature Increase (FTI)/41MAC

SP3: HR3 Burner
  33MAC
  Turbine Section Upgrade

SP2: Rotor Light Upgrade

SP1: 25MAC to 118 MW, 32.4%

* part of FlexPower
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Siemens Gas Turbine SGT5-2000E
Fuel Flexibility – Combinations

| Gaseous Fuels                          | Liquid Fuels
|----------------------------------------|-----------------
| High caloric NG                        | Fuel Oil No. 2/Diesel |
| LNG                                    | Naphtha/Condensates |
| Synthetic NG                           | Kerosene         |
| Low caloric NG                         | Light Crude Oils (e.g. ASL, AXL,...) |
| H2 enriched NG (<10 vol%)              | Crude Oils       |
| Ethane enriched NG (<25 vol%)          | Heavy Fuel Oil   |
| LPG enriched NG (<15 vol%)             | Biodiesel enriched Fuel Oils (<B20) |
| Biogas                                 | Methanol         |
| Wellhead gas w/ high inert content    | Ethanol          |
| Sour Gas (4% H2S)                      |                  |
| Synthesis Gases                        |                  |

SGT5-2000E class engines are capable of **online fuel switch-overs** between listed gases and liquid fuels.