Flexibility Solutions and Upgrades for CCPP

Anja Berghoff I Marketing and Sales Exp. M&U
Thomas Stoll I Regional Sales Head
Flexible Solutions
Market Development for Combined Cycle Power Plants

What can make your Power Plant more successful?

Service factor: Operating hours/period hours – Load factor: actual power / installed power
Data source: Siemens WinTS Data from Power plants in AT; HU; SK; CZ
Clean Spark Spread - Identify Potential for optimization

- Scheduled Maintenance
- Minimum Load/Fast Start
- Power Augmentation
- Maximum Power Output

Example of CSS Overview based on own calculations sourced on ENTSO-E & EEX data
Power Generation Service – Your Partner for Flex Solutions

Our Target:
Be your Partner for innovative solutions and attractive service programs.

Maintenance
- Optimize maintenance intervals: Minor & Major inspections
- Increase outage flexibility
- Fast outage: Innovative Field Service methods & tools
- Turbine exchange (BEX)

Performance
- Service Packages / Upgrades & Modernization
- Plant Assessment / Plant Optimization

Environment
- Further increase engine efficiency – New Turbine Generation
- Hydrogen Application
- Low NOx-Emission Solutions

Flexible Operation
- Increased Load Gradients, Fast Start, Turn Up
- Optimize part load capabilities

Digital Solutions towards Intelligent Gas Turbine & Smarter Service
Upgrades for Flexible operation
Flexibility in modernized power plants: What is it worth and can we afford to ignore it?

1. Advanced Turbine Efficiency Package
2. Turn Down – Part Load Options
3. Hot Start on the Fly – Shut Down on the Fly
4. H2
Advanced Turbine Efficiency Package (ATEP)
Are you ready for the future?

- Up to 31,7 MW add. Power Output
- Up to 1,3%pts Efficiency Increase

Combined Cycle Performance Gain*
- Combined cycle Power: +31 MW
- Combined Cycle Efficiency: +1,3 %pts.

Utilized effects:
- Turbine Outlet Temperature Increase
- Operation Point and Pressure Ratio Increase
- Turbine Exit Diffuser Optimization
- Turbine Blades and Vanes Aero Design Optimization
Advanced Turbine Efficiency Package (ATEP)
Are you ready for the future?

New Designed Parts
Turbine Blades and Vanes 1-4

Modification of parts in place
Turbine Exhaust Casing
Turbine Vane Carrier
Rear Hollow Shaft
Combustor Cooling Air Adaptions
Shaft Cover Modification

Exchange parts with existing designs (depending on site specific configuration)
Burner Upgrade
Torque Discs 1-3
Compressor Discs 14 & 15

Typical Upgrade Scope for SGT5 – 400F version 4
Final scope depending on site specific configuration and project needs
**Turn Down – Part Load Options**

**Hardware Modification**
- New linearization unit for Inlet Guide Vane
- New Inlet Guide Vane position sensor with extended operating range
- Modification of Inlet Guide Vane ring (including new scale and new bolts for bearing blocks)

**Further Scope**
- I&C modifications (icing controller & Cooling air monitoring)
- TVC/TEC liner sealing & CVC groove 7-9 grinding recommended
- Detailed engineering and implementation of instrumentation and controls modifications related to the gas turbine
Turn Down – Part Load Options

Schematic illustration for explanation of principles, actual values have to be calculated plant specific with individual emission parameter.
Improving startup and shut down
Cycling operation with/without startup & shutdown improvements

Start
60%
Up to 46 min reduced start up time

Stop
56%
Up to 17 min reduced plant shut down time

Gas
57%
Up to 50 kNm³ reduced gas consumption

* depend on the specific plant configuration

Source: Site data from 2016
Hot Start On The Fly

**Benefit**
- Hot start-up time reduction
- Efficient operation due to less fuel consumption
- Reduced gas turbine CO emissions during start-up

**Scope**
- Mechanical evaluation of steam turbine
- Revised start-up logics of UMC/BoP/ST
- I&C implementation & testing on site
- Operator training and documentation

**Applicability**
- Siemens reheat steam turbines

---

**The perfect extension for the GT Start Gradient Optimization!**
Fast Plant Shutdown

**Benefit**
- Shutdown time reduction
- Efficient operation due to less fuel consumption
- Reduced gas turbine CO emissions during shutdown

**Scope**
- Revised shutdown logics of UMC/BoP/ST
- I&C implementation & testing on site
- Operator training and documentation

**Applicability**
- Siemens CCPP with UMC
Siemens Hydrogen Gas Turbines for our sustainable future – The mission is to burn 100% hydrogen

Gas turbine model

- SGT5-9000HL
- SGT5-8000H
- SGT5-4000F
- SGT5-2000E
- SGT6-9000HL
- SGT6-8000H
- SGT6-5000F
- SGT6-2000E
- SGT-A65
- SGT-800
- SGT-A45
- SGT-750
- SGT-700
- SGT-A35
- SGT-600
- SGT-400
- SGT-300
- SGT-100
- SGT-A05

Power Output

- 593 MW
- 450 MW
- 329 MW
- 187 MW
- 405 MW
- 310 MW
- 215 to 260 MW
- 117 MW
- 60 to 71/58 to 62 MW
- 48 to 57 MW
- 41 to 44 MW
- 40/34 to 41 MW
- 33/34 MW
- 27 to 37/28 to 38 MW
- 24/25 MW
- 10 to 14/11 to 15 MW
- 8/8 to 9 MW
- 5/6 MW
- 4 to 6 MW

H₂ capabilities in vol. %

- 5
- 10
- 15
- 27
- 5
- 10
- 25
- 27
- 15
- 50
- 100
- 40
- 55
- 100
- 60
- 65
- 30
- 65
- 2
- 15

Values shown are indicative for new unit applications and depend on local conditions and requirements. Some operating restrictions/special hardware and package modifications may apply. Any project >25% requires dedicated engineering for package certification.

Higher H₂ contents to be discussed on a project specific basis

1. ISO, Base Load, Natural Gas Version 2.0, March 2019

Unrestricted © Siemens 2019.
Hydrogen Combustion in Siemens Large Gas Turbines

H₂DeCarb¹) SGT5-2000E & SGT5-4000F Status

SGT5-2000E

- **Burner modified** based on latest fleet improvements and optimized for H₂ combustion
- **Successfully tested** in High Pressure Combustion Test Rig
- Operational influence (emission & combustion behavior) revealed and related **control measures** defined

**Capability: 27 vol% H₂**

SGT5-4000F

- SGT5-2000E **design derived for SGT5-4000F**
- Functional changes & control measures defined

**Capability: 15 vol% H₂**

and with further potential as soon as requested

¹) Upgrade working title

Unrestricted © Siemens 2019.
Thomas Stoll
Regional Sales
Head for Eastern Europe & Turkey

Department
Number
GP SPG REU S EE&TR
Phone
+49 (9131) 17-35703
Mobile
+49 (174) 1560446
E-mail
Thomas.ts.Stoll@Siemens.com

Anja Berghoff
Marketing Expert
Modernization and Upgrades

Department
Number
GP SPG MK&SOP SM GTM&U
Phone
+49 30 386-56707
Mobile
+49 173 8946971
E-mail
anja.berghoff@siemens.com

siemens.at/future-of-energy