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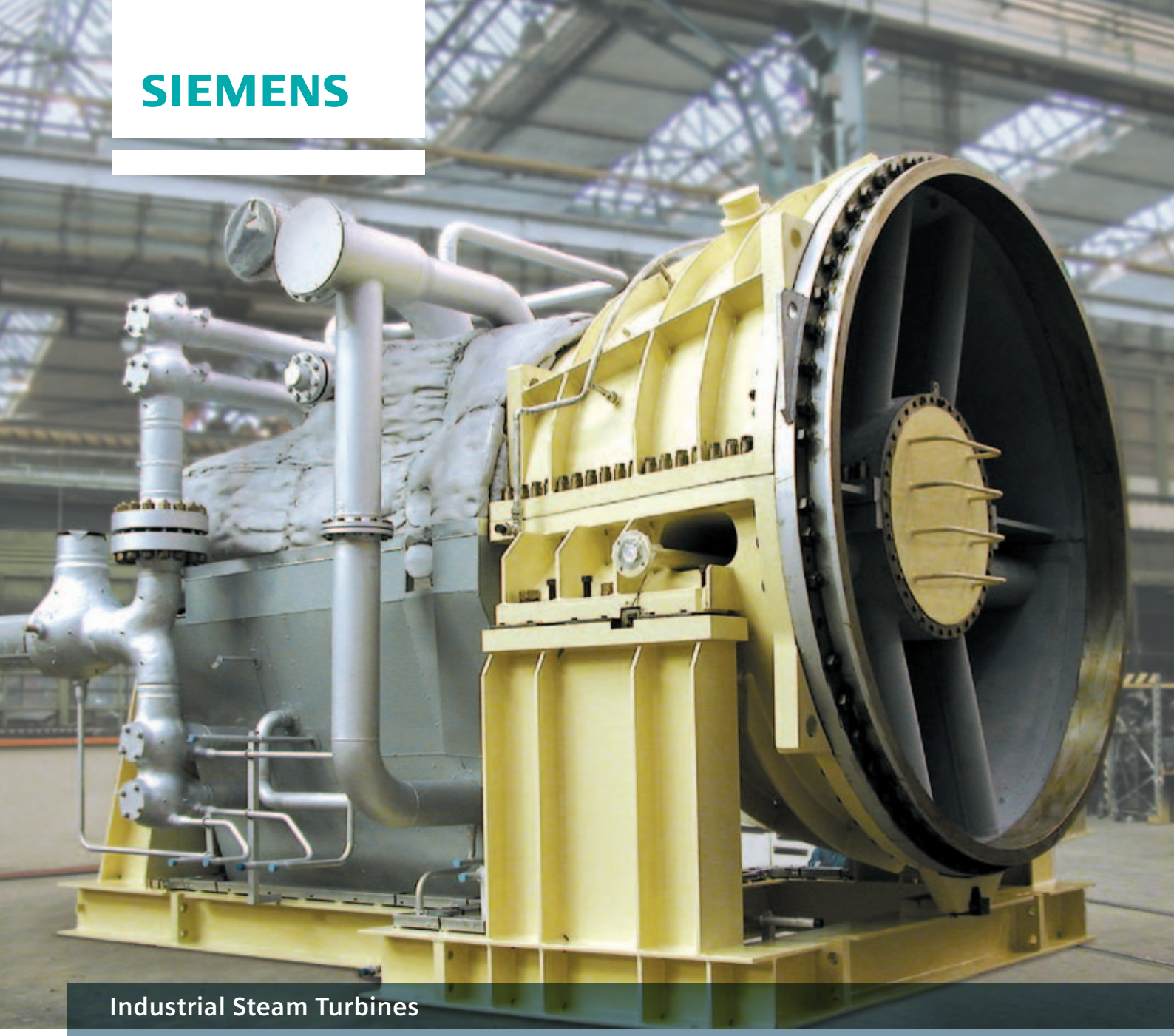


Industrial Steam Turbines

SST-400 Steam Turbine

Up to 65 MW

SST-400 Steam Turbine

Overview

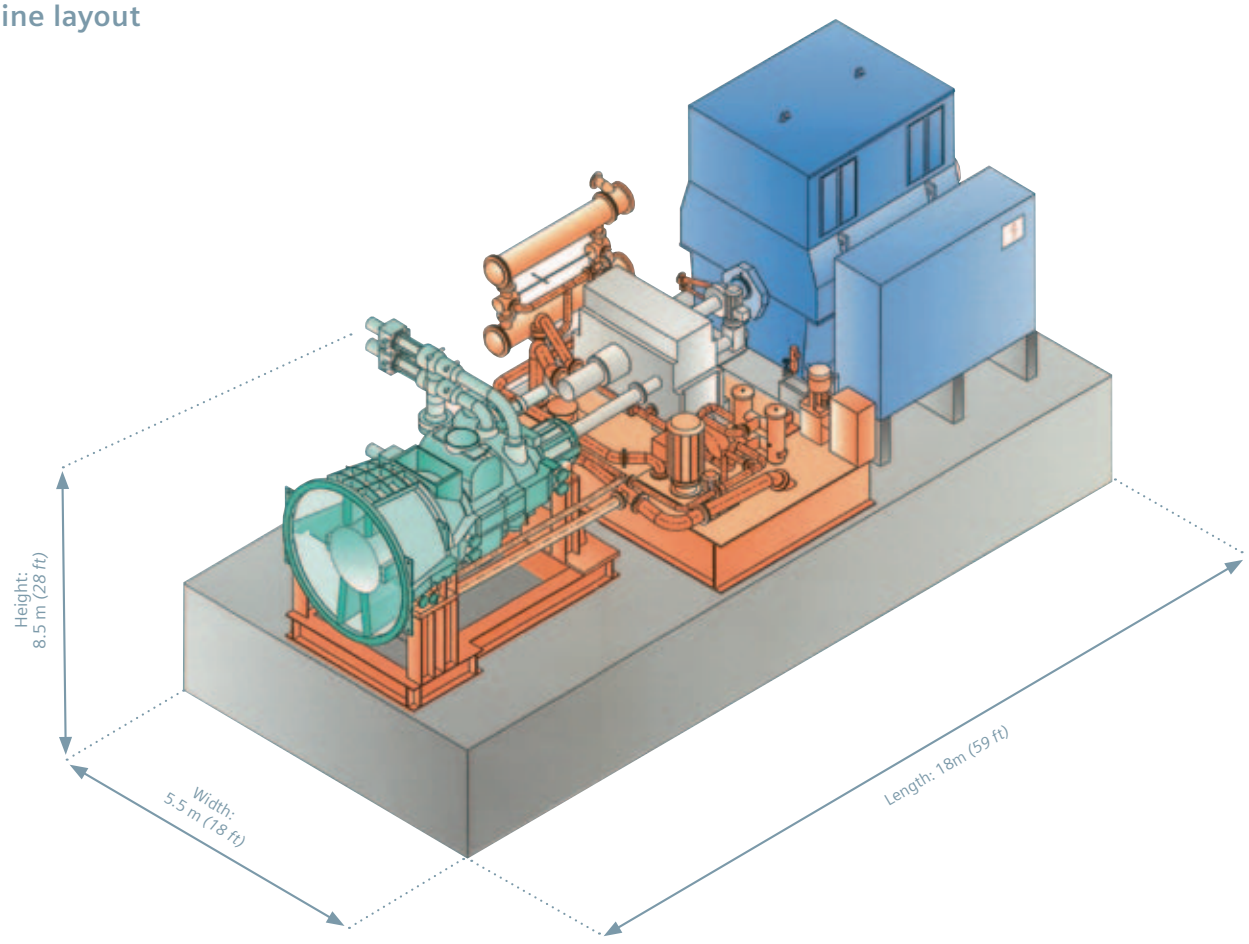
The SST-400 is a single casing steam turbine, providing geared or direct drive to 50 and 60 Hz generators, or to compressors and pumps. The symmetrical casing with horizontal joint flange enable the SST-400 to accept short start-up times and rapid load changes.

The modular package design allows a wide variety of configurations to satisfy the customer's individual needs in the most economical way. The utilization of selected proven components assures high reliability and easy maintenance.

Typical applications of the SST-400 include:

- Industrial power plants, e.g. captive power plants in the chemical industry, sugar industry, textile industry, in pulp and paper mills, steel works, mines
- Cogeneration and district heating plants
- Concentrated Solar Power (CSP) plants
- Geothermal power plants (SST-400 GEO)
- Biomass plants, waste to energy, e.g. waste incinerators, waste heat from chemical processes
- Combined cycle power plant

Turbine layout



SST-400 – design features

The SST-400 is available as a back pressure or condensing turbine with internally controlled extraction and possibility of several bleeds. The blading design provides for high efficiency over the whole operation range, giving the customer highly flexible plant operation. The design of the exhaust blades allows large exhaust areas with high thermodynamic efficiency and reliability. With a separate internal casing, the steam turbine can also be used as a single casing reheat turbine.

Operational flexibility

The turbine has a symmetrical casing with horizontal joint flange, which allows short start-up times and rapid load changes. The design of all supports for labyrinths and blade carriers ensures flexibility for the whole turbine. Internal valve arrangements, controlling the steam flow to the back end of the turbine, are used to maintain constant process steam extraction pressures over a wide flow range.

The rotor of the SST-400 range is made of solid forging and is fitted with resonance-resistant blading. The reduction gears are taken from the existing range of world class gear manufacturers and have proven high reliability and performance.

Reliability and efficiency from proven technology

The SST-400 single casing turbine can be equipped with upward, downward or axial exhaust to fit with the selected installation. The turbine skid can be combined with standardized gearbox-oil units and generators to a turboset, according to the customer's needs. The turbine skid and gearbox / oil unit are fully assembled in the workshop before being shipped to the site.

Easy maintenance

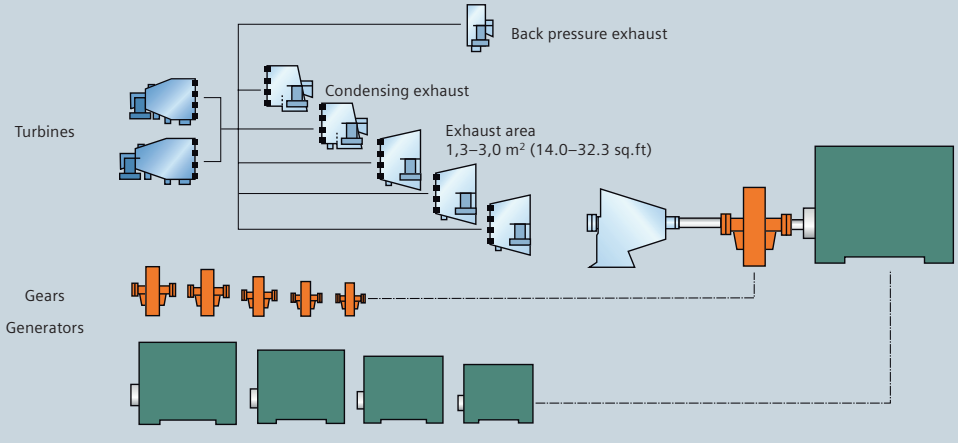
Our proven installation and maintenance concept lowers maintenance cost by enabling easy access to the installed components, the turbine, gearbox, and generator. Several maintenance concepts are available for different modes of operation.

Design features

- Customized steam path
- Proven
- Modular
- Thermoflexible design

Customer benefits

- Fast and early layout planning
- Short delivery time
- Compact design minimizes space requirements of installation
- Easy access to mechanical components facilitates maintenance
- Remote control for simple operation
- High reliability/availability
- High efficiency

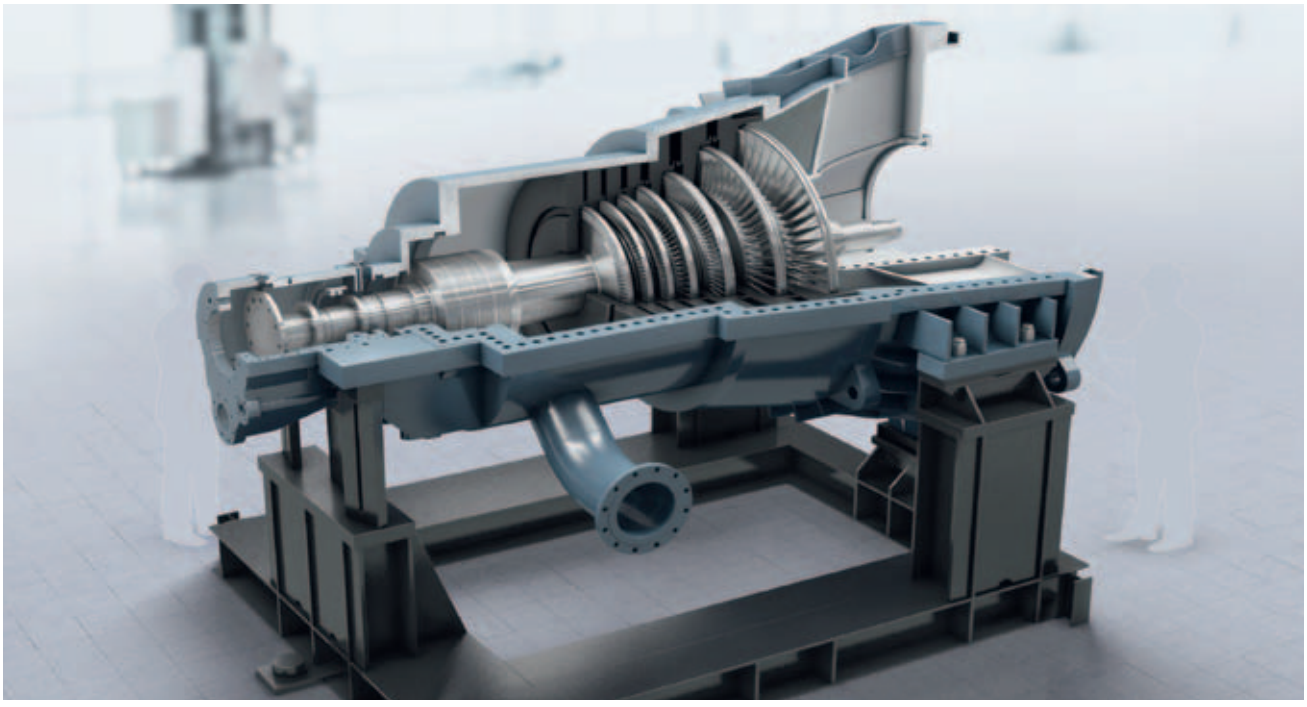


Modular concept for SST-400 turboset

SST-400 GEO for Geothermal Plants

The SST-400 GEO is a derivative of the SST-400 turbine, optimized for the harsh conditions of geothermal steam cycles. The SST-400 GEO is used in geothermal applications with superheated direct steam, flash or combined cycle, offering an outstanding reliability, flexibility and economy of operation.

High performance butterfly control and trip valves are designed for demanding geothermal steam environment. These components are an integral part of the control, monitoring and safety system that utilize the operator friendly SIMATIC S7 that easily interfaces with plant DCS. These systems have been designed to meet the demanding EC and international safety standards and leverage the strength of Siemens and TurboCare.



SST-400 GEO turbine

Proven technology

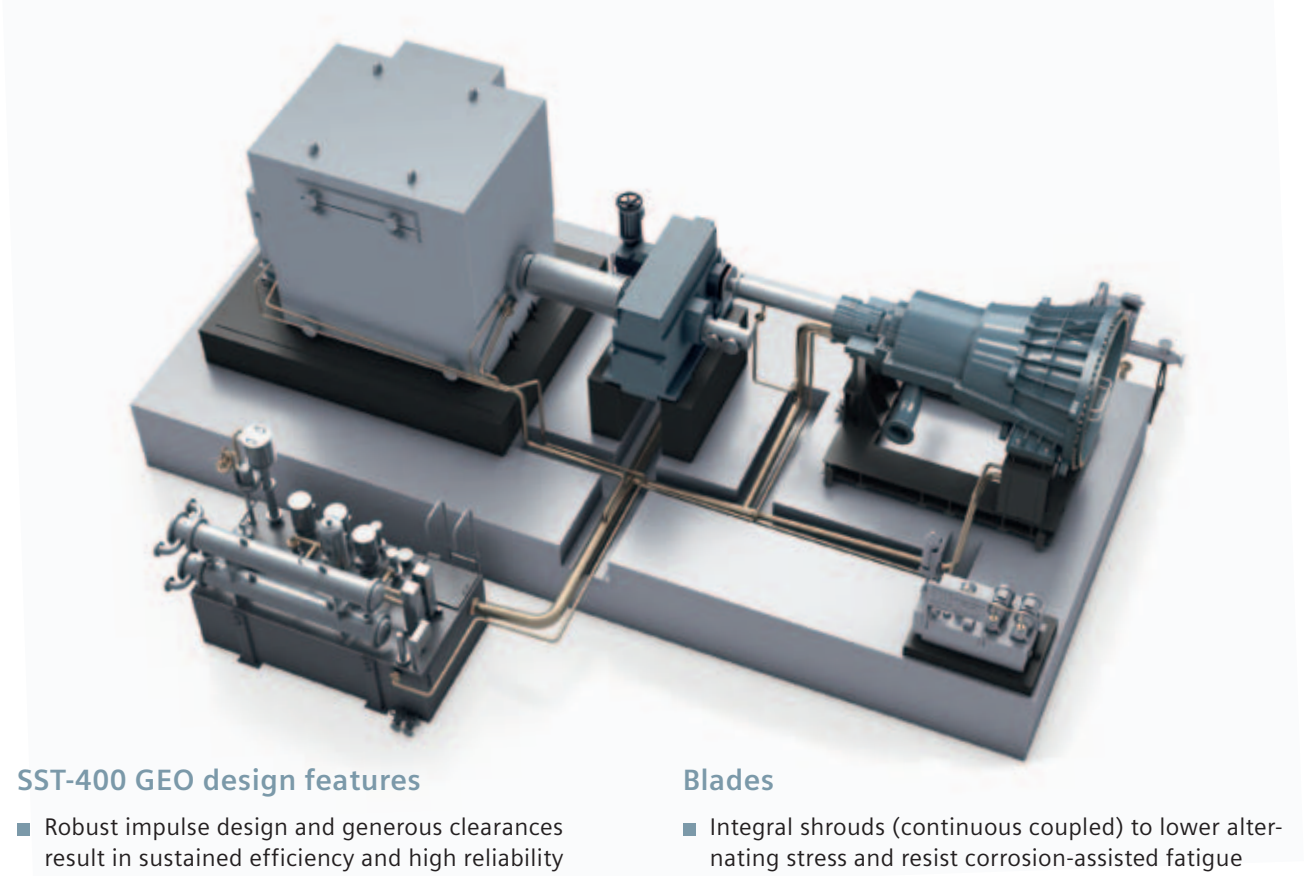
The SST-400 GEO is a joint development between Siemens and the geothermal steam turbine service provider TurboCare. The turbine combines the proven turbine casing of the Siemens SST-400 as well as the steam turboset accessories (gears, generator, base frame) with the geothermal steam path and moisture removal features of the TurboCare Magma turbine family.

SIEMENS

is a world leader in steam turbine technology, offering versatile, reliable and proven industrial steam turbines which meet all customer requirements for economic installation and operation.

TurboCare®

through long experience in the after-market, is well known in the industry for turbomachinery services and improving reliability, efficiency and output of Geothermal power plants.



SST-400 GEO design features

- Robust impulse design and generous clearances result in sustained efficiency and high reliability
- Proven steam path for optimized reliability with low steam parameters
- Ground floor installation
- Package solution for faster installation and commissioning
- Advanced highly effective moisture removal techniques
- Ease of maintenance due to inlets in casing lower half

Blades

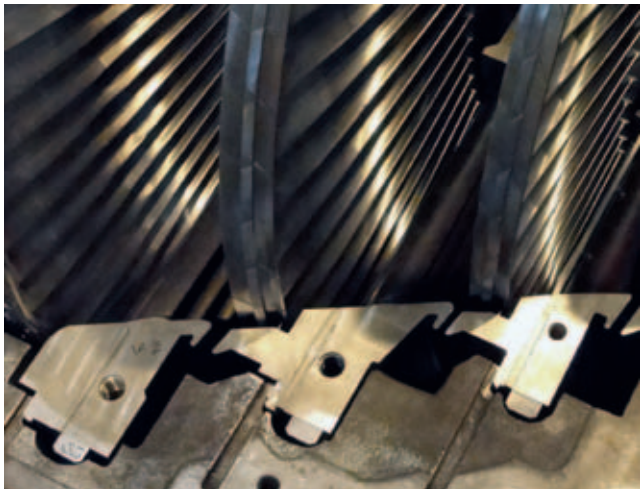
- Integral shrouds (continuous coupled) to lower alternating stress and resist corrosion-assisted fatigue
- Laser applied Stellite alloy on last stage
- Modern airfoil shapes to improve turbine efficiency
- Widely spaced nozzles to resist fouling from deposits
- Modern dovetails that reduce peak stress and resist stress corrosion cracking

Materials

Special material selection to meet geothermal specific steam chemistry and to resist corrosion attacks and corrosion-assisted fatigue cracking:

- 12 Cr diaphragms
- 2% Cr integral forged rotor; 12% Cr optional
- X-15 & 17-4 blades standard, Titanium and Inconel optional

Moisture separators of the SST-400 GEO



Moisture separators pull moisture from the steam at the tip of the blade. The condensate must be removed from the casing at each stage to minimize erosion and improve performance due to the "Reheat Effect".

When humidity is removed before the steam enters the next turbine stage, the steam proceeding through the turbine shifts to a higher quality (less moisture), as a result from a higher enthalpy. When the enthalpy of the steam going through the turbine increases, the steam turbine efficiency improves as well. That is referred to as the "Reheat effect."

Installation and maintenance

Our proven installation and maintenance concept lowers maintenance cost by enabling easy access to the installed components - the turbine, gearbox, generator and auxiliaries. Our service solutions are based on long experience of taking care of a substantial global fleet. This experience is incorporated systematically into our design and manufacturing as well as our service and maintenance practice, making Siemens a reliable partner now and in the future.

We are able to provide comprehensive spare-part service, repairs and maintenance solutions designed to increase the reliability and availability of the plant. Our retrofit solutions return turbines to the state of the art even after a normal operating life. Long-term maintenance contracts assure prolonged plant operation at predefined costs.

Remote monitoring

As all SST-400 and SST-400 GEO turbines are prepared for remote monitoring, Siemens offers service contracts for condition-based maintenance, customized for the specific operating status of each machine to reduce outage and overhaul costs. Using the remote monitoring technology, customers are able to get fast telephone advice and secure remote support, online help, advanced trouble-shooting and intervention, provided by specialist personnel who know the plant's design and understand its operation.

Reference examples

SST-400, Burnaby, BC, Canada; 25 MW.
The condensing extraction turbine powers an incineration plant.

SST-400, Haldia, India; 35 MW.
Manufacturing of the condensing turbine at the workshop.

SST-400, Kayseri, Turkey; 35.5 MW.
Condensing turbine for a combined cycle plant.

The Blundell Geothermal Plant in Milford, Utah (USA), uses a 26 MW TurboCare condensing turbine with SST-400 GEO steam path.

SST-400 technical data

- Power output 50 or 60 Hz, up to 65 MW
- Speed range 3000–8000 rpm
- Live steam conditions
  Pressure up to 140 bara / 2030 psia
  Temperature up to 540°C / 1004°F
- Hot reheat conditions
  Pressure up to 30 bara / 435 psia
  Temperature up to 450°C / 842°F
- Bleed up to 60 bara / 870 psia
- Controlled extraction (single or double)
  Pressure up to 45 bara / 653 psia
  Temperature up to 450°C / 842°F
- Exhaust steam conditions
  Back pressure up to 25 bara / 363 psia
  District heating up to 3 bara / 43 psia
  Condensing up to 0.6 bara / 8.7 psia

SST-400 GEO technical data

- Power output
  50 or 60 Hz, 5–55 MW (condensing)
  50 or 60 Hz, 5–60 MW (non-condensing)
- Speed range 3000–6000 rpm
- Live steam conditions
  Pressure up to 12 bara / 175 psia
  Temperature up to 250°C / 482°F
- Exhaust steam conditions
  Condensing up to 0.4 bara / 5.8 psia
  Non-condensing up to 1.4 bara / 20 psia

All data are approximate and project-related.

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