Efficiency: More value to your facility

Siemens steam turbine portfolio
Steam turbines from 10 kW to 1,900 MW
With over a century of experience and continuous development in steam turbine technology, Siemens has stayed at the forefront of development and is a prime partner for your business. With a fleet of more than 60,000 steam turbines worldwide, Siemens is a reliable and experienced partner.

Siemens Steam Turbines are an essential piece of turbo-machinery to many power plants worldwide. They are applied either as a generator drive or a mechanical drive for pumps and compressors. The modular design concept of all steam turbines ensures high flexibility, availability and a reduction of time-to-market.

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Steam turbines
from 1 MW to 1,900 MW
# Steam Turbines Overview

<table>
<thead>
<tr>
<th>Output (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
</tr>
<tr>
<td>100</td>
</tr>
<tr>
<td>1000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>SST-9000</td>
<td>20</td>
</tr>
<tr>
<td>SST-6000</td>
<td>16</td>
</tr>
<tr>
<td>SST-5000</td>
<td>12</td>
</tr>
<tr>
<td>SST-4000</td>
<td>8</td>
</tr>
<tr>
<td>SST-3000</td>
<td>44</td>
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<tr>
<td>SST-800</td>
<td>40</td>
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<tr>
<td>SST-700/1900</td>
<td>36</td>
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<tr>
<td>SST-600</td>
<td>34</td>
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<tr>
<td>SST-500</td>
<td>32</td>
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<td>SST-400</td>
<td>28</td>
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<tr>
<td>SST-300</td>
<td>26</td>
</tr>
<tr>
<td>SST-200</td>
<td>24</td>
</tr>
<tr>
<td>SST-150</td>
<td></td>
</tr>
</tbody>
</table>

**Utility Steam Turbines**

**Industrial Steam Turbines**
Steam turbines overview

<table>
<thead>
<tr>
<th>Engine Type</th>
<th>Output (kW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-R RLA / RLVA</td>
<td>745</td>
</tr>
<tr>
<td>D-R RLH</td>
<td>750</td>
</tr>
<tr>
<td>D-R SST 350</td>
<td>1,865</td>
</tr>
<tr>
<td>D-R SST 500</td>
<td>2,600</td>
</tr>
<tr>
<td>D-R SST 700</td>
<td>3,000</td>
</tr>
<tr>
<td>D-R 2TA</td>
<td>3,750</td>
</tr>
<tr>
<td>D-R AVTTW/GTW</td>
<td>4,500</td>
</tr>
<tr>
<td>D-R C</td>
<td>3,600</td>
</tr>
<tr>
<td>D-R GAF</td>
<td>4,000</td>
</tr>
<tr>
<td>D-R U</td>
<td>6,000</td>
</tr>
<tr>
<td>D-R K</td>
<td>4,850</td>
</tr>
<tr>
<td>D-R R/RS</td>
<td>25,000</td>
</tr>
<tr>
<td>Engineered Mechanical Drive (EMD)</td>
<td>80,000</td>
</tr>
<tr>
<td>Engineered Turbo Generator (ETG)</td>
<td>100,000</td>
</tr>
<tr>
<td>D-R B</td>
<td>11,000</td>
</tr>
<tr>
<td>D-R Tandem (B-B, B-C)</td>
<td>12,500</td>
</tr>
</tbody>
</table>
Siemens offers a comprehensive range of steam turbine products in the power output range from 90 to 1,900 MW. These are used in conventional fossil-fired steam power plants as well as in nuclear and combined cycle power plants. With more than 8,000 steam turbines in service worldwide we provide proven technology, adapted to the specific local conditions.
**SST-3000**
Utility steam turbine package

Flexible steam turbine for applications in single-shaft and multi-shaft combined cycle configurations

In our Siemens Steam Turbine portfolio, we offer with the SST-3000 series steam turbine a compact arrangement, that features a two-cylinder design with an axial exhaust for use in combined cycle power plants. Steam turbines of SST-3000 series are exceptionally compact machines for use in combined cycle power plants.

<table>
<thead>
<tr>
<th>Plant output</th>
<th>90 up to 250 MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>50 or 60 Hz</td>
</tr>
<tr>
<td>Main steam conditions</td>
<td>up to 177 bar / 2,567 psi</td>
</tr>
<tr>
<td>Inlet temperature</td>
<td>up to 565 °C / 1,049 °F</td>
</tr>
<tr>
<td>Reheat steam conditions</td>
<td>up to 565 °C / 1,049 °F</td>
</tr>
<tr>
<td>Stage 1 blade length</td>
<td>80 cm to 115 cm / 31 inches to 45 inches</td>
</tr>
<tr>
<td>Stage 2 blade length</td>
<td>76 cm to 95 cm / 30 inches to 38 inches</td>
</tr>
</tbody>
</table>

*High turbine efficiency*
*Enhanced operational flexibility, high availability and long lifetime*
*Low complexity and low total plant costs*
*Short project schedule and installation time*

Ribatejo, Portugal

The Ribatejo power plant was one of the most technologically advanced combined cycle power plants at the time of construction. In operation: unit1: 02/2004, unit2: 10/2004, unit3: 03/2006

Net plant output: $3 \times 390$ MW

Steam turbine output: $3 \times 142$ MW

Scope of supply:
- $3 \times$ SGT-54000F
- $3 \times$ SST-3000
- $3 \times$ SGen-52000H

Main steam conditions:
- 125 bar / 1,813 psi
- 565 °C / 1,049 °F

Reheat steam conditions:
- 555 °C / 1,031 °F

"High turbine efficiency"
"Enhanced operational flexibility, high availability and long lifetime"
"Low complexity and low total plant costs"
"Short project schedule and installation time"
Utility steam turbine package

- Suitable for operations in condensation and back-pressure mode
- Proven designs for highly efficient, continuous operation
- Low space requirement due to compact design, low investment costs
- Short start-up times
- Blading of variable-reaction type
- Long service intervals lead to low maintenance costs and high availability

SST-4000

Powerful and reliable – thanks to proven design for high efficiency

The SST-4000 series is our specialised turbine for non-reheat, combined cycle applications. With the specialized design of the blade path, the entire power range from 100 to 380 MW can be covered with the highest reliability and availability. Almost 40 turbines of this type are already in operation or in the commissioning stage, with a total installed capacity of approximately 7,200 MW.

The SST-4000 series consists of an intermediate-pressure and a low-pressure turbine. The installation is either high or low level arrangement with down, double-side or single-side exhaust. The turbine is able to provide process steam e.g. for industries or sea water desalination and can provide industrial heating.

Thanks to its systematically modular design, the SST-4000 series can easily be adapted to the individual operating conditions and thermal cycle design of the plant. Its fast installation, thanks to prefabricated, tested modules delivered ready for connection, is of additional advantage.

Al Ezzel, Bahrain

The power plant makes an important contribution towards meeting the country's growing power demand in an economic and environmentally compatible manner.

Customer:
Al Ezzel Power Company
Plant type:
SCC5-2000E multi shaft 2 × 1
Power output:
2 × 475 MW (power plant)
Commercial operation:
unit 1: 04 / 2006
unit 2: 05 / 2007

Suitable for operations in condensation and back-pressure mode
Proven designs for highly efficient, continuous operation
Low space requirement due to compact design, low investment costs
Short start-up times
Blading of variable-reaction type
Long service intervals lead to low maintenance costs and high availability

Technical data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant output</td>
<td>100 up to 380 MW</td>
</tr>
<tr>
<td>Frequency</td>
<td>50 or 60 Hz</td>
</tr>
<tr>
<td>Steam conditions</td>
<td></td>
</tr>
<tr>
<td>Inlet pressure</td>
<td>up to 105 bar / 1,523 psi</td>
</tr>
<tr>
<td>Inlet temperature</td>
<td>up to 565° C / 1,049° F</td>
</tr>
<tr>
<td>Last stage blade length</td>
<td>50 Hz: 80 cm to 115 cm / 31 inches to 45 inches</td>
</tr>
<tr>
<td></td>
<td>60 Hz: 76 cm to 95 cm / 30 inches to 38 inches</td>
</tr>
</tbody>
</table>

Al Ezzel, Bahrain
**SST-5000**

Utility steam turbine package

A steam turbine with short start-up times and variable start-up modes to ensure grid stability

Siemens Steam Turbines of the SST-5000 series are operated in combined cycle power plants (CCPP) and in coal-fired steam power plants (SPP). The SST-5000 steam turbine combined with an SGT-8000H gas turbine, achieves a world record efficiency of 61.5 percent in combined cycle applications.

The SST-5000 is suitable for supercritical and ultra-supercritical steam power plants. Due to its higher pressure and temperature ratings, power plant efficiency increases to more than 46 percent and overall performance is improved. In steam power plants the SST-5000 consists of a combined high pressure/intermediate pressure turbine, and one or two low pressure turbines with down exhaust, single sided or double sided exhaust. It is installed in a low- or high-level arrangement. Various extractions (up to 9 stages) contribute to an optimized plant efficiency.

Lausward “Fortuna”, Germany

The combined cycle power plant set three world records: in the acceptance test a maximum electrical net output of 603.8 MW was achieved and the net energy conversion efficiency was around 61.5 percent.

- In the acceptance test a maximum electrical net output of 603.8 MW was achieved and the net energy conversion efficiency was around 61.5 percent.
- Overall plant efficiency considering thermal extraction was above 85%.
- 300 MW thermal power extraction through one steam turbine train.

**Plant type:** SCS-8000H 1S (single shaft)

**Power output:** 604 MW

**Efficiency:** 61.5%
Combined stop & control valve

Valve connection below the horizontal flange of the HP-IP turbine for easy maintenance.

High-pressure / intermediate-pressure turbine

Combined LP turbine with circular inner and outer casing for minimal thermal deflection and minimal clearances for high efficiency.

Single crossover pipe

Crossover pipe designed to minimize losses, reduces plant complexity and minimizes footprint.

Low-pressure turbine

Inner and outer casing of the double-flow turbine are mechanically decoupled. This allows minimal radial clearances resulting in maximum efficiency. The condenser is installed either below, on one side or on both sides of the low-pressure turbine.

Bearing

Single bearing arrangement between HP-IP and LP turbine cylinders for simple alignment and stable operation.

Combined HI turbine with circular inner and outer casing for minimal thermal deflection and minimal clearances for high efficiency.
Reduced lifecycle costs with the SST-6000 steam turbine

Siemens Steam Turbines of the SST-6000 series are widely operated in steam power plants with a power output up to 1,200 MW and an efficiency up to more than 46 percent. Turbine trains of the SST-6000 series consist of a high-pressure turbine, an intermediate-pressure turbine, and up to three low-pressure turbines for 50 and 60 Hz.

The SST-6000 is installed in a high-level arrangement with down exhaust. Various extractions (up to 10 stages) are available for feed water preheating, process steam, and district heating.

The globally installed capacity of the SST-6000 all over the world is more than 100,000 MW.

SST-6000
Reduced lifecycle costs

Highest quality manufactured in Germany
Long maintenance intervals to reduce lifecycle costs
Proven performance throughout the entire product lifetime
Short start-up times and flexible start-up modes
Highest reliability and availability
Remote performance control

Eemshaven, Netherlands

Thanks to a highly efficient power plant process the Eemshaven steam power plant consumes less hard coal compared to the average of coal-fired power plants. This leads to a reduction in CO₂ emissions of 2.5 million metric tons per year.

Power output: 2 × 800 MW
Efficiency: 46.2%
Main Steam: 275 bar/597 °C
Reheated Steam: 609 °C, 1,128 °F
Commissioning: 2014

<table>
<thead>
<tr>
<th>Feature</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power output</td>
<td>300 MW to 1,200 MW</td>
</tr>
<tr>
<td>Efficiency</td>
<td>46,5 % (Double reheat: 48 %)</td>
</tr>
<tr>
<td>Frequency</td>
<td>50 or 60 Hz</td>
</tr>
<tr>
<td>Steam conditions</td>
<td></td>
</tr>
<tr>
<td>Inlet pressure</td>
<td>up to 330 bar / 4,786 psi</td>
</tr>
<tr>
<td>Inlet temperature</td>
<td>up to 610 °C / 1,130 °F</td>
</tr>
<tr>
<td>Reheat temperature</td>
<td>up to 630 °C / 1,166 °F</td>
</tr>
<tr>
<td>Steam conditions</td>
<td></td>
</tr>
<tr>
<td>Temperature</td>
<td>600 °C / 1,112 °F</td>
</tr>
<tr>
<td>Last stage blade length</td>
<td>50 Hz: 66 cm to 142 cm / 26 inches to 56 inches</td>
</tr>
<tr>
<td></td>
<td>60 Hz: 66 cm to 95 cm / 26 inches to 36 inches</td>
</tr>
</tbody>
</table>

Eemshaven, Netherlands
### Intermediate-pressure turbine

- Double-flow intermediate-pressure turbine
- Circular inner and outer casing for minimum thermal deformation and minimum clearances for high efficiency
- Shipped to site fully assembled for smooth erection and start-up

### High-pressure turbine

- Barrel type HP turbine, no half joint flange connection
- Single-flow high-pressure turbine with circular inner and outer casing, optimum thermal loading and small clearances.

### Bearing

- Fixed bearing
- Single, fixed bearing arrangement between HP and IP turbine cylinders for simple alignment and stable operation. Fixed bearing pedestals on foundation crossbeams.

### Crossover pipe

- Single crossover pipe
- Large diameter pipe to minimize losses and to reduce plant complexity and steam turbine footprint.

### Low-pressure turbines

- Double-flow low-pressure turbines
- Inner and outer casing are mechanically decoupled preventing displacement and deformation of the inner casing. That allows minimal radial clearances resulting in maximum efficiency.
  - The outer casing is directly welded on the condenser underneath the low pressure turbine casing.

### Valve

- Combined stop & control valve
  - For easy opening of steam turbine casing valves are connected to the lower part of the outer casing via bolt connection.
SST-9000
Utility steam turbine package

Leading technology for efficient, flexible and reliable power generation

The SST-9000 is a highly reliable steam turbine for applications in the conventional islands of advanced pressurized water reactors in nuclear power plants, with a power output up to 1,900 MW. The half-speed SST-9000 features a double-flow saturated steam high-pressure (HP) turbine and up to three double-flow low-pressure (LP) turbines with shrunk-on disk rotors.

Shrink-on disk design features proven technology: eliminating stress-corrosion cracking and replacement of the low-pressure rotors or disks during the design life-time.

Yang Jiang, China (Unit 1–6)
Nuclear Power Plant

Customer:
China Nuclear Power
Scope of supply:
Unit 1: LP rotors and HP valves
Unit 1-6: Turbine Engineering and Instrumentation & Control Systems
Commercial operation:
Unit 1 since May 2014
Power output: 1,103 MW (as built)
Grid Frequency: 50 Hz
Turbine Frequency: 25 Hz

Maximimum reliability and availability
High operational flexibility
Low life cycle costs due to long inspection intervals
Extended lifetime of up to 60 years, thanks to state-of-the-art engineering and proven service concepts

Yang Jiang, China
As a market leader for industrial steam turbines, we offer a comprehensive range of reliable and versatile steam turbines for the power output range from 2 to 250 MW. Our industrial steam turbines are designed for easy constructability, fast start-up and economical operation.
Steam turbine with efficient and compact arrangement
The SST-150 is a single-casing steam turbine, providing geared drive to a 1,500 or 1,800 rpm generator. The turbine is packaged in a skid-mounted design (can also be with separate oil system). This is a very compact arrangement which provides high efficiency in power generation and mechanical drive applications. The pre-engineered turboset enables early planning of the turbine building layout, saving time for the customer.

The SST-150 is a steam turbine with impulse blading, developed to meet the most demanding customer requirements for cost-efficient power generation and mechanical drive applications. The turbine is used for both backpressure and condensing applications with internally controlled extraction and scope for several bleeds. Both back pressure and condensing turbines are available with upward or downward exhaust. The exhaust flange can be equipped with top or bottom exhaust.

Roi Et, Thailand: Turboset for the Bua Sommai Electricity biomass power plant.

Typical applications
- Mechanical drive
- Combined-cycle power plants
- Cogeneration/Combined Heat and Power and district heating
- Waste incineration plants and biomass power plants
- Waste heat recovery
- captive power plants for pulp and paper mills, steelworks, mines, and for the sugar, textile, chemical and petro-chemical industries

**SST-150**

**Industrial steam turbine**

- Back pressure or condensing steam turbine
- Customized steam path
- Single controlled extraction
- Highly predefined design
- Pre-engineered turbine
- Shop assembly

Roi Et, Bangkok, Thailand

The 9.9 MW electrical capacity power plant is based on mostly rice husk and a smaller fraction of wood chips (up to 10%) as fuel. The power plant was erected by Bioenergy Electricity Generating Co., Ltd. (Buasommai) located in Roi Et, Thailand. Out of the gross generation capacity of 9.9 MW, a total of 8 MW is fed into the national electricity grid.

Steam turbine: SST-150
Power output: 9.9 MW
Generator drive

**SST-150**

**Power output**

- up to 20 MW

**Speed**

- up to 13,000 rpm

**Inlet pressure**

- up to 103 bar / 1,495 psi

**Inlet temperature**

- up to 505 °C / 940 °F

**Exhaust steam parameters**

- Back-pressure up to 10 bar / 145 psi
- Condensing up to 0.25 bar / 3.6 psi

**Steam extraction**

- Controlled (up to 4) 16 bar / 230 psi / 350 °C / 560 °F
- Uncontrolled 25 bar / 365 psi

Roi Et, Thailand: Turboset for the Bua Sommai Electricity biomass power plant.
The Siemens SST-200 Siemens industrial steam turbine product line is based on the reaction blade technology. The turbine series follows a modular product philosophy, ensuring a high level of performance and reliability. The ability to combine standardized casing modules enable optimal design flexibility. This allows the turbine series to achieve high performance in combination with an optimal cost position.

Each steam path is customized for optimal fit to the specific thermal cycle requirements providing high efficiency over the entire operating range.

The inlet and exhaust sections are configured to cover different plant configuration needs and are used in condensing configurations as well as in back pressure applications. With this flexible approach the SST-200 covers the range of both industrial mechanical drive and industrial power generation applications.

The product design closely follows API 612 requirements.

**SST-200 Industrial steam turbine**

- Customized steam path
- Modular design for short delivery time
- Thermoflexible design
- Fast and early layout planning
- Compact design minimizes space requirements of installation

Tamoil, Switzerland

2 turbines producing on average 5 MW each in mechanical drive application

Steam turbine: 2× SST-200

Power output: 5 MW each

Mechanical drive

**Live steam parameters**

- Inlet pressure: up to 120 bar(a) / 1,740 psi
- Inlet temperature: up to 540 °C / 1,004 °F

**Exhaust steam parameters**

- Water-Cooled Condenser: 0.05–0.15 bar(a)
- Air-Cooled Condenser: 0.15–0.50 bar(a)
- Backpressure Turbine: 2–20 bara

**Steam extraction**

- Controlled: (up to 4) up to 16 bar / 230 psi up to 350 °C / 560 °F
- Uncontrolled: 60 bar / 870 psi

**Plant output**

- up to 35 MW

**Speed**

- up to 14,600 rpm

**Typical applications**

- Generator and mechanical drive
- Chemical and petrochemical industry, such as Ethylene plants, Ammonia and fertilizer plants, Methanol plants
- Sugar mills
- Biomass plants
- Metals & mining
- Energy from waste plants

26 27
The SST-300 is an optimal solution for a wide range of applications due to the implementation of the best technology combined with over 20 years of experience. In the last decade alone, this turbine has been installed in over 500 industrial and power applications by customers all over the world.

The flexible configuration of the SST-300 enables it to be used in diverse applications such as waste to energy, chemical processing, pulp and paper, cement and many more.

All components and auxiliaries including the lube oil system are mounted on a common base frame. The turbine can be configured with either an upward, downward or axial exhaust orientation depending on the layout of the plant. The turbine can also accommodate multiple steam extraction/steam induction points as well. The compact design and simple layout of the turbine significantly reduce the cost and time associated with its construction, inspection and maintenance.

### Typical applications

- Biomass plants
- Chemical and petrochemical industry
- Cement industry
- Combined cycle power plants and combined heat and power plants
- Concentrated solar power plants
- District heating
- Waste-to-energy plants (waste incineration)
- Pulp and paper mills
- Sugar industry
- Steel works and mines

### Power output

- Adjustable output up to 45 MW
- Speed up to 12,000 rpm

### Live steam parameters

- Inlet pressure: 140 bar / 2,030 psi
- Inlet temperature: 540 °C / 1,004 °F

### Exhaust steam parameters

- Back pressure up to 16 bar / 232 psi
- Condensing up to 0.3 bar / 4.4 psi
- District heating up to 3.0 bar / 43 psi

### Control extractions (up to 2)

- Single or double, adaptive stage, nozzle control, throttle control
- Pressure up to 25 bar / 362 psi
- Temperature 400 °C / 752 °F

### Uncontrolled extractions (up to 6)

- Pressure up to 60 bar / 870 psi

### Waste-to-energy plant, Lincoln / UK

- In operation since 2014, the Lincolnshire Waste-to-energy facility provides a safe, sustainable and affordable waste treatment solution to dispose of household waste, with a useful and profitable by-product: electricity. It burns 150,000 t of waste a year.
- Power output: 25.15 MW
- Speed: 5,300 rpm
- Live steam pressure: 58 bar / 841 psi
- Live steam temperature: 397 °C / 746 °F
- Exhaust steam pressure: 0.07 bar / 1 psi

### Waste-to-energy plant, Lincoln / UK

- Power output: 25.15 MW
- Speed: 5,300 rpm
- Live steam pressure: 58 bar / 841 psi
- Live steam temperature: 397 °C / 746 °F
- Exhaust steam pressure: 0.07 bar / 1 psi

### All components and auxiliaries can be mounted on a common base frame or skid

- Short erection time at site due to a "plug and play" system

- Fast, easy and flexible layout planning

### SST-300 Industrial steam turbine
Valve arrangement

Internal valve arrangements (or adaptive stages) control the steam flow and maintain constant process steam extraction pressures over a wide flow range.

Base frame

SST-300 turbines are delivered as packaged units with simple or integrated base frame. The oil tank is inside the base frame. Only a minimal number of external connections, which are clearly defined according to standards, ensure fast and easy installation.

Exhaust

Equipped with upward, downward or axial exhaust orientation

Turbine Casing

The nearly symmetrical casing allows short start-up times and quick load changes.

Reaction Blading

The rotor is fitted with resonance-proof fully shrouded blading. The last stage is free standing with a damping wire (condensing steam turbine)
**SST-400**

*Industrial steam turbine*

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 enables 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.

- **Power output** up to 60 MW
- **Speed** up to 8,000 rpm
- **Inlet pressure** up to 140 bar / 2,030 psi
- **Inlet temperature** up to 540 °C / 1,004 °F
- **Exhaust steam parameters**
  - **Back pressure** up to 25 bar / 363 psi
  - **Condensing** up to 0.3 bar / 4.4 psi
  - **Steam extraction**
    - **Controlled** (up to 4): up to 45 bar / 510 psi
    - **Uncontrolled** up to 60 bar / 870 psi

**Waste-to-energy plant, Mallorca / Spain**

Tourism drives the local development and welfare of the Mediterranean island. The significant increase in island guests causes the population to vary between about 1 million in winter and 6 million in summer. This poses a challenging task for the proper disposal of daily waste. The EfW plant in Palma de Mallorca has a capacity of about 430,000 t per year. Mallorca reached zero landfill waste.

**Power output:** 38 MW (steam turbine)

- **Speed:** 4,500 rpm
- **Inlet temperature:** 397 °C / 746 °F
- **Inlet pressure:** 50 bar / 725 psi

**Typical applications**

- Power generation industrial power plants
- Biomass & waste
- District heating
- Combined cycle power plants
- Mechanical drive
- Waste heat recovery

**Waste-to-energy plant, Mallorca / Spain**
The SST-500 is a single casing, double exhaust flow steam turbine, which can be used as an entire drive or as the low-pressure module of a multiple-casing turbinset; directly driven or geared. This turbine, with its capacity to operate over a wide range of speed and power, is ideal for large steam volume flows. Steam flows into the turbine via two tangential inlets to equalize thermal loading and blade stress. Emergency stop valves and control valves are installed in the steam inlet pipes. The steam flows tangentially into the inner casing and then axially to both exhausts. The customized design of the steam path allows exact adjustment to surpass general physical limitations of the last stage blades. Double-end drive is available, if required, e.g. for booster pump drive.

Booster pump drive, Shanghai/China

Customer: Shanghai Municipal Electric Power Co
Project: The coal-fired #6 Gao Qiao power station consists of eight generating units, including four 300 MW sub-critical, two 900 MW supercritical and two 1,000 MW ultra supercritical units.
Application: Booster pump drive
Power output: 19.4 MW (steam turbine)
Speed: 5,912 rpm
Inlet temperature: 343 °C / 649 °F
Inlet pressure: 11.1 bar / 160.9 psi

Typical applications:
- Pump drive (e.g. feedwater pump for large boilers)
- Generator drive
- Compressor drive
- Chemical industry
- Steel works
- Waste to energy, e.g. waste incinerators
- Waste heat from chemical processes
**SST-600**

Flexible condensing or back-pressure steam turbine

**Generator drive in various packages**
We deliver a standard steam turbine generator set including the SST-600 (with or without gearbox), a generator, oil system, piping and instrumentation and the control system.

The standard package can be extended to include a condenser, condensing plant or pre-heating system.

The SST-600 with its reliable and flexible design is available with axial or radial exhaust.

**Mechanical drive**
The SST-600 is also an efficient and economic mechanical drive. Since the 1970s, hundreds of projects have been successfully implemented all over the world using the SST-600 to directly drive everything from the smallest boiler feedwater pump just as reliably as the largest compressor ever in the most complex processes. The SST-600 complies with regulations including the API standard.

**Biomass district heating plant, Västergötland / Sweden**

The district heating plant operated by Mölndal Energie supplies 91 MWth thermal power and 23 MWe electricity. It has been in operation since 2009 and uses wood as fuel. Siemens delivered the complete turboset (SST-600 and generator).

- **Power output**: 23 MW
- **Live steam temperature**: 519 °C / 966 °F
- **Live steam pressure**: 122 bar / 1,769.5 psi
- **Exhaust steam pressure**: 0.5 bar / 7.3 psi
- **Speed**: 5,000 rpm

**Technical data**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power output</td>
<td>up to 200 MW</td>
</tr>
<tr>
<td>Speed</td>
<td>1,500 to 18,000 rpm</td>
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<tr>
<td>Exhaust steam</td>
<td>up to 165 bar / up to 2,393 psi</td>
</tr>
<tr>
<td>Inlet temperature</td>
<td>up to 565 °C / 1,050 °F</td>
</tr>
<tr>
<td>Back pressure</td>
<td>up to 80 bar / 1,160 psi</td>
</tr>
<tr>
<td>Condensing</td>
<td>up to 1.0 bar / 15 psi</td>
</tr>
<tr>
<td>District heating</td>
<td>up to 3.0 bar / 43 psi</td>
</tr>
<tr>
<td>Exhaust steam parameters (up to 6)</td>
<td>up to 85 bar / 1,233 psi</td>
</tr>
<tr>
<td>Pressure, ext. valve</td>
<td>up to 72 bar / 1,044 psi</td>
</tr>
<tr>
<td>Pressure, int. valve</td>
<td>up to 45 bar / 660 psi</td>
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<tr>
<td>Temperature</td>
<td>up to 480 °C / 895 °F</td>
</tr>
<tr>
<td>Uncontrolled extractions (up to 6)</td>
<td>up to 85 bar / 1,233 psi</td>
</tr>
</tbody>
</table>

**Outstanding efficiency**
- Fast start-up times
- Highest reliability
- Economic installation and operation
- Flexibility for complex, industrial processes

**Typical applications**
- Chemical and petrochemical industry
- Pulp and paper mills
- Steel works
- Mines
- Power plants
- Sewage desalination plants
- Biomass and Waste-to-energy plants (waste incineration)
The possibility of applying up to 3 balancing pistons minimizes thrust and allows smaller axial bearings. Thanks to improved journal bearings less oil and a smaller oil tank are needed.

The symmetrical design of the upper and lower halves avoids material concentrations and ensures improved thermal behavior and an improved start-up time.

Can be designed for straight flow, or equipped with uncontrolled and/or controlled extractions.

Intermediate section

Sealing

The improved sealing system allows more sealing strips per blade row at both moving and stationary blades.

Exhaust section

A wide range of exhaust sizes and types is available for back-pressure and condensing applications.

The improved cylindrical high pressure blades and tapered intermediate pressure blades allow longer airfoils and contribute to the overall high efficiency.

Blades

Casing

Bearing

The possibility of applying up to 3 balancing pistons minimizes thrust and allows smaller axial bearings. Thanks to improved journal bearings less oil and a smaller oil tank are needed.
Steam Turbine with center steam admission

Generator drive in various packages

The SST-800 is a single casing steam turbine with center steam admission and reverse steam flow inner casing, designed for a direct coupled generator or mechanical drive. The power output with double casing solution is up to 250 MW.

The highly customized turbine provides for an outstanding efficiency, fast start-up times and high reliability and availability. It supports all requirements for economical installation and operation in combination with highest flexibility for complex industrial processes. A double or even multicausing solution can also be provided.

The SST-800 steam turbine can be used for both condensing and back-pressure applications. It is built up from pre-designed modules combined into a single unit for optimum matching of the required parameters. Turbine auxiliary systems are also designed as pre-engineered modules covering the complete range of turbine sizes.

The SST-800 turbine is equipped with impulse control stage and reaction blading fixed in blade carriers. Furthermore the turbine is offered with throttle controlled inlets. The turbine can be arranged on a foundation or as a package (including oil system and a base frame). The SST-800 steam turbine design is in accordance with DIN or API standards.

SST-800 Steam turbine for the pulp plant Klabin, Brazil

Two Siemens SST-800 steam turbines are supplying electricity and process steam to a pulp factory in Brazil. The SST-800 has a capacity of 190 megawatts (MW), making it among the largest steam turbines in use in the pulp and paper industry worldwide.

Power output: 190 MW
Speed: 3,600 rpm
Inlet steam pressure: 100 bar (1,450 psi)
Inlet steam temperature: 498 °C (928 °F)

Typical applications

- Combined cycle power plants (CCPP)
- Combined heat and power plants (CHP)
- Oil & Gas industries
- Industrial power plants (e.g. captive power plants in chemical and petro-chemical industries, manufacturing industries, paper mills, mines, metal and cement plants, waste heat recovery)
- District heating plants
- Biomass plants and waste-to-energy plants (WtE)
- Concentrated solar power plants (CSP)
Center steam admission
The reverse flow adjusts the thrust and relieves the bearings of large steam turbines.

Bearings
Simplified maintenance due to horizontal casing split or independently accessible bearings.

Steam path
Highly customized section with up to 2 internally or externally controlled extractions and up to 7 uncontrolled extractions.

Exhaust section
Axial or downward connection for condensing, upward or downward connection for back pressure is provided.

Casing
The steam turbine casing is based on a combined housing concept featuring a cast steel and welded design. The material mix ensures high availability and reduced delivery times.
SST-700 / 900

Industrial steam turbine

Economical dual casing steam turbine for reheat applications

The SST-700 / 900 is a standard turbine solution with short delivery time due to its fixed pre-engineered design. Prefabricated modules enable a short manufacturing period, cost-efficient material supply and a fast ex-works delivery. The straight flow turbine solution with power output of up to 250 MW consists of a geared high-pressure steam turbine (backpressure), an intermediate/low-pressure steam turbine (condensing), both driving a generator installed in between. The dual casing reheat turbine configuration with inner casing is a competitive and optimized product for combined cycle power plants and concentrated solar power plants.

Parabolic trough technology in Morocco

On February 4, 2016, the King of Morocco Mohammed VI inaugurated the Noor I unit of Ouarzazate Solar Power Station. This is the first of four phased solar projects at Ouarzazate site which are expected to provide a total electrical generating capacity of 580 megawatts, making it the largest complex of its kind in the world. Siemens is supplying three turbine-generator sets for the power station.

Steam turbine: SST-700/900

Power output: 160 MW

Inlet steam temperature: 380°C / 716°F

Inlet steam pressure: 168 bar (a) / 2,437 psi

Exhaust pressure: 0.06 bar (a) / 0.87 psi

"Fast load changes"

"Short start-up times"

"Increased efficiency"

"Increased life cycle"

"Low level arrangement"

"Reheat application"

Typical applications

• Combined cycle power plants
• Concentrated solar thermal power plants
• Biomass-fired power plants
With the D-R steam turbine portfolio Siemens has the most comprehensive range of API turbines available on the market, including:

- Standard single stage turbines for pump, fan & small compressor drives according to API 611 General Purpose (GP) standard
- Standard and engineered single stage turbines as generator drives for waste heat recovery applications
- Engineered single stage turbines for applications according to API 611 (General Purpose — GP) or API 612 (Special Purpose — SP) standards
- Standard multistage turbines for larger pumps, fans & compressors to API 611 or API 612 standards, or for power generation
- Engineered Multi-Stage Turbines according to API 612 for main compressor drives or power generation
- Turbines for geothermal plants
- Turbines for expansion of ORC and process fluids

As required either bare ST drivers to OEMs, or complete packages including gears, lube oil systems and controls are supplied

Benefits:

- Highest levels of quality & reliability for the most critical services in the business
- All units factory tested in accordance with API and customer requirements
- Units with modular designs, but engineered to order, according to customer project specifications & standards and local environmental requirements
D-R SST 350 / 500 / 700

Standard single stage steam turbine

- Rugged, versatile design
- Woodward TG Oil Relay NEMA Class A constant speed governor or electronic governor
- Horizontally split casing with centerline support
- Overspeed mechanical trip valve, separated from governor valve
- Carbon ring or labyrinth sealing glands
- Built-in, removable steam strainer
- API style blanket lagging/insulation (API applications)
- Oil ring lubricated with forced pressure lubrication or circulating oil cooling options
- Rolling element or Tiltpad thrust bearings
- Broad range of controls and accessories available
- WORTHINGTON heritage (D-R SST 350 / 500)

Typical applications:
- Refineries
- Petrochemical plants
- Food processing
- Smelting industry
- Pulp & Paper
- Institutional
- Process waste heat recovery
- Replacement of steam pressure reduction valve
- Feed water pumps
- Process pump drives
- Cooling water pumps
- Fans
- Compressors
- Generators

Technical Data

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Power output</td>
<td>2,460 kW / 3,500 HP</td>
</tr>
<tr>
<td>Turbine speed</td>
<td>≤ 12,000 rpm</td>
</tr>
<tr>
<td>Inlet steam temperature</td>
<td>≤ 482°C / 900°F</td>
</tr>
<tr>
<td>Inlet steam pressure</td>
<td>≤ 63 bar(a) / 914 psi</td>
</tr>
<tr>
<td>Back pressure</td>
<td>21 bar(a) / 315 psi</td>
</tr>
<tr>
<td>Type of wheel / blades</td>
<td>Curtis / impulse</td>
</tr>
<tr>
<td>API compliant</td>
<td>API 611 and API 612</td>
</tr>
<tr>
<td>Bearings</td>
<td>Sleeve</td>
</tr>
</tbody>
</table>
D-R RLA / D-R RLVA

Standard single stage steam turbine

**Technical Data**

- **Power (peak):** 745 kW / 1,000 HP
- **Turbine speed:** ≤ 4,300 to 6,000 rpm
- **Inlet steam temperature:** ≤ 440 °C / 824 °F
- **Inlet steam pressure:** ≤ 47 bars (a) / 682 psi
- **Back-pressure:** ≤ 12 bars (a) / 174 psi

**Type of wheel / blades:** Curtis / Impulse

**API 611 compliant:** Yes

**Bearings:** Ball bearing journal & thrust

**Typical applications**

- **Refineries**
- **Petrochemical and chemical plants**
- **Food processing**
- **Institutional**
- **Process pump drives**
- **Lube oil pump drives**

**Rugged, versatile design**

- Radially split casing with centerline support
- Woodward TG Oil Relay NEMA Class A constant speed governor
- API 611 compliant, positive seating, mechanical overspeed trip valve
- Separate double seated governor valve
- Built-in removable steam strainer
- Removable carbon ring sealing glands
- API style blanket lagging/insulation
- Grease lubricated with circulating oil options
- Broad range of controls and accessories available
- COPPUS heritage

**D-R RLA**

**D-R RLVA**

**D-R RLVA**

**Typical applications**

- **Refineries**
- **Petrochemical and chemical plants**
- **Institutional**
- **Process pump drives**
- **Lube oil pump drives**

- **Separate double seated governor valve**
- **Built-in removable steam strainer**
- **Removable carbon ring sealing glands**
- **API style blanket lagging/insulation**
- **Grease lubricated with circulating oil options**
- **Broad range of controls and accessories available**
- **COPPUS heritage**
D-R RLH
Standard single stage steam turbine

**D-R RLH-15**
- Rugged, versatile design
- Woodward TG Oil Relay NEMA Class A constant speed governor or electronic governor
- Horizontally split casing with centerline support
- API 611 compliant, positive seating, mechanical overspeed trip valve
- Separate double seated governor valve

**D-R RLH-15/24**
- Horizontally split casing with centerline support
- Woodward TG Oil Relay NEMA Class A constant speed governor or electronic governor
- API 611 compliant, positive seating, mechanical overspeed trip valve
- Separate double seated governor valve
- Built-in removable steam strainer

**Technical Data**
- Power output: 1,865 kW / 2,500 HP
- Turbine speed: ≤ 6,000 rpm
- Inlet steam temperature: ≤ 482°C / 900°F
- Inlet steam pressure: ≤ 63 bar(a) / 914 psi
- Back pressure: ≤ 21 bar(a) / 300 psi
- Type of wheel / blades: Curtis / Impulse
- API 611 compliant: Yes
- Bearings: Ball and sleeve bearing designs

**Typical applications**
- Refineries
- Petrochemical plants
- Food processing
- Institutional
- Process waste heat recovery
- Replacement of steam pressure reduction valve
- Process pump drives
- Feed water pumps
- Lube oil pumps

**Typical applications**
- Refineries
- Petrochemical plants
- Sugar mills
- Food processing
- Institutional
- Paper & Paper
- Process pump drives
- Cooling water pumps
- Fans
- Compressors
- Generators
D-R 2TA

Single stage steam turbine

- Horizontally split casings
- Between bearing design
- Multi-Valve or Single Valve Inlet
- Solid or built-up rotor
- Carbon ring or labyrinth glands
- API 611 & 612 compliance
- Electronic governor
- Electronic overspeed trip
- Trip and throttle valves (option w/o exerciser)

Typical applications
- Pumps and fans
- Compressors

Technical Data

<table>
<thead>
<tr>
<th>D-R 2TA</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Power output</td>
<td>3,640 kW / 4,880 HP</td>
</tr>
<tr>
<td>Turbine speed</td>
<td>≤ 12,500 rpm</td>
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<tr>
<td>Inlet steam temperature</td>
<td>≤ 530 °C / ≤ 986 °F</td>
</tr>
<tr>
<td>Inlet steam pressure</td>
<td>≤ 104 bar(a) / ≤ 1,515 psi</td>
</tr>
<tr>
<td>Back pressure (abs)</td>
<td>≤ 33 bar(a) / ≤ 480 psi</td>
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<tr>
<td>Type of wheel blades</td>
<td>Curtis/Rateau impulse</td>
</tr>
<tr>
<td>API 611 compliant</td>
<td>Yes</td>
</tr>
<tr>
<td>Bearings</td>
<td>Tilting pad/sleeve</td>
</tr>
</tbody>
</table>
**D-R AVTTW / GTW**

*Single stage steam turbine*

- Integradly geared or direct drive overhung turbine design
- Available in horizontal or vertical configuration (AVTTW)
- Axially split casing
- Multiple or single valve inlet
- Derivative GTW frame used for compressor drives
- GTW overhung turbine design, direct drive
- Electronic governor
- Electronic overspeed trip

**Technical Data**

<table>
<thead>
<tr>
<th>D-R AVTTW/GTW</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Power output</td>
<td>4,500 kW / 6,000 HP</td>
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<td>Turbine speed</td>
<td>= 14,500 rpm</td>
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<tr>
<td>Inlet steam temperature</td>
<td>= 520°C / 986°F</td>
</tr>
<tr>
<td>Inlet steam pressure</td>
<td>≤ 125 bar(a) / 1,813 psi</td>
</tr>
<tr>
<td>Back pressure (bed)</td>
<td>≤ 40 bar(a) / 588 psi</td>
</tr>
<tr>
<td>Type of wheel (blades)</td>
<td>Curtis // Rateau Impulse</td>
</tr>
<tr>
<td>API 611 compliant</td>
<td>Yes (with comments)</td>
</tr>
<tr>
<td>Bearings</td>
<td>Tiltpad / Sleeve</td>
</tr>
</tbody>
</table>

**D-R C**

*Single stage steam turbine*

- Direct drive or integral Gear operation
- Overhung design
- Multi-Valve or Single Valve Inlet
- Marine Classification approval
- Auto/Quick start ability

**Typical applications**

- Waste Energy
- Biomass Plants
- Marine Applications
- Chemical Industries
- Paper / Sugar Mills

**Technical Data**

<table>
<thead>
<tr>
<th>D-R C</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Power output</td>
<td>2,500 kW / 3,250 HP</td>
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<tr>
<td>Turbine speed</td>
<td>≤ 14,500 rpm</td>
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<tr>
<td>Inlet steam temperature</td>
<td>≤ 550°C / 1,022°F</td>
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<tr>
<td>Inlet steam pressure</td>
<td>≤ 125 bar(a) / 1,813 psi</td>
</tr>
<tr>
<td>Back pressure</td>
<td>≤ 40 bar(a) / 588 psi</td>
</tr>
<tr>
<td>Condensing pressure</td>
<td>vacuum</td>
</tr>
</tbody>
</table>

**Type of wheel (blades)**

- Curtis / Rateau Impulse

**API 611 & 612 compliance**

- with exception

**Bearings**

- Tiltpad / Sleeve
D-R GAF / U

Standard multi-stage steam turbine

D-R GAF
- Condensing or back pressure steam turbine
- Horizontal casing split
- Between bearings
- Max. 6 stages
- Single valve inlet
- API 611 or 612 design

D-R U
- Unique above-centerline casing split allows removing the cover without disturbing the steam sealing areas, coupling and steam connections
- Condensing or back pressure
- Low cost applications
- Single valve inlet
- Up to 10 stages

Typical applications
- API mechanical drive (e.g. pump fans)
- Turbogenerator sets

Technical Data

<table>
<thead>
<tr>
<th></th>
<th>D-R GAF</th>
<th>D-R U</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power output</td>
<td>3,500 kW / 4,690 HP</td>
<td>6,340 kW / 8,500 HP</td>
</tr>
<tr>
<td>Turbine speed</td>
<td>≤ 6,000 rpm</td>
<td>≤ 10,000 rpm</td>
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<tr>
<td>Inlet steam pressure</td>
<td>≤ 440°C / 825°F</td>
<td>≤ 455°C / 850°F</td>
</tr>
<tr>
<td>Back pressure</td>
<td>≤ 15 bar (217 psi)</td>
<td>≤ 15 bar (217 psi)</td>
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<tr>
<td>Condensing pressure</td>
<td>vac.</td>
<td>vac.</td>
</tr>
<tr>
<td>Type of Blading</td>
<td>Impulse</td>
<td>Impulse</td>
</tr>
<tr>
<td>API 611 &amp; 612 compliance</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Bearings</td>
<td>Tiltpad / Sleeve</td>
<td>Tiltpad, Sleeve</td>
</tr>
</tbody>
</table>
D-R R/RS

Standard multi-stage steam turbines

- Single valve or multivalve inlets
- Multiple uncontrolled bleeds
- Dual-acting, hydrodynamic, Tiltpad thrust bearing
- Spherically seated or Tiltpad-type journal bearings
- Interchangeable parts
- Standard assemblies and components
- API and non-API options
- Condensing or back pressure
- Up to 15 stages

Typical applications
- API 611/612 compressor, fan and pump drives
- Turbogenerator sets, oil & gas and industrial

<table>
<thead>
<tr>
<th>Technical Data</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Model</strong></td>
</tr>
<tr>
<td><strong>Power output</strong></td>
</tr>
<tr>
<td><strong>Turbine speed</strong></td>
</tr>
<tr>
<td><strong>Inlet steam temperature</strong></td>
</tr>
<tr>
<td><strong>Inlet steam pressure</strong></td>
</tr>
<tr>
<td><strong>Back pressure</strong></td>
</tr>
<tr>
<td><strong>Condensing pressure vacuum</strong></td>
</tr>
<tr>
<td><strong>Type of Blading</strong></td>
</tr>
<tr>
<td><strong>API 611 &amp; 612 compliance</strong></td>
</tr>
<tr>
<td><strong>Bearings</strong></td>
</tr>
<tr>
<td><strong>Bleedings/extractions</strong></td>
</tr>
<tr>
<td>Pressure capability increases above 950 psig at reduced temperature.</td>
</tr>
</tbody>
</table>

D-R K

Standard multi-stage steam turbine

- Condensing or back pressure
- Low cost applications
- Single valve inlet
- For wide range of speeds throughout continuous operation

Typical applications – K
- Non-API mechanical drive (e.g. pump fans)
- Air conditioning chiller / compressor drives
- Small, low pressure turbogenerator sets

<table>
<thead>
<tr>
<th>Technical Data</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Model</strong></td>
</tr>
<tr>
<td><strong>Power output</strong></td>
</tr>
<tr>
<td><strong>Turbine speed</strong></td>
</tr>
<tr>
<td><strong>Inlet steam temperature</strong></td>
</tr>
<tr>
<td><strong>Inlet steam pressure</strong></td>
</tr>
<tr>
<td><strong>Back pressure</strong></td>
</tr>
<tr>
<td><strong>Condensing pressure vacuum</strong></td>
</tr>
<tr>
<td><strong>Type of Blading</strong></td>
</tr>
<tr>
<td><strong>API 611 &amp; 612 compliance</strong></td>
</tr>
<tr>
<td><strong>Bearings</strong></td>
</tr>
</tbody>
</table>

Pressure capability increases above 950 psig at reduced temperature.
Engineered Mechanical Drive (EMD)
• Controlled/uncontrolled extractions
• Double end drive

Technical Data

<table>
<thead>
<tr>
<th>EMD</th>
<th></th>
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<tbody>
<tr>
<td>Power output</td>
<td>80 MW</td>
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<td>Turbine speed</td>
<td>≤ 17,000</td>
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<tr>
<td>Inlet steam temperature</td>
<td>≤ 565°C / 1,049°F</td>
</tr>
<tr>
<td>Inlet steam pressure</td>
<td>≤ 139 bar(a) / 2,016 psi</td>
</tr>
<tr>
<td>Exhaust back pressure</td>
<td>vacuum</td>
</tr>
<tr>
<td>Type of blading</td>
<td>Impulse/Reaction</td>
</tr>
<tr>
<td>API 611/612 compliance</td>
<td>Yes</td>
</tr>
<tr>
<td>Bearing constellation</td>
<td>Tiltpad</td>
</tr>
<tr>
<td>Bleedings/Extractions</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Engineered Turbine Generator (ETG)
• Single/double uncontrolled extraction
• Multiple uncontrolled extractions/bleeds
• Induction

Technical Data

<table>
<thead>
<tr>
<th>ETG</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Power output</td>
<td>100 MW</td>
</tr>
<tr>
<td>Turbine speed</td>
<td>≤ 17,000</td>
</tr>
<tr>
<td>Inlet steam temperature</td>
<td>≤ 565°C / 1,049°F</td>
</tr>
<tr>
<td>Inlet steam pressure</td>
<td>≤ 139 bar(a) / 2,016 psi</td>
</tr>
<tr>
<td>Exhaust back pressure</td>
<td>vacuum</td>
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<tr>
<td>Type of blading</td>
<td>Impulse/Reaction</td>
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<tr>
<td>API 612 compliance</td>
<td>Yes</td>
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<td>Bearing constellation</td>
<td>Tiltpad</td>
</tr>
<tr>
<td>Bleedings/Extractions</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Typical applications
• Refinery
• Petrochemical
• fertilizer
• Feed pump drives

Typical applications
• Power generation
• Combined cycle
• Petrochemical
• Fertilizer
D-R B

Standard multi-stage steam turbine

- Low cost design for high efficiency
- Multivalve inlets
- Multiple uncontrolled bleeds
- External controlled induction
- Double shaft end
- Suitable for Tandem

D-R B Tandem

- Multivalve inlets
- Multiple uncontrolled bleeds
- Single automatic controlled extraction/induction
- Max. extraction pressure 40 bar

Typical applications

- Turbogenerator sets
- Mechanical drives

Technical Data

<table>
<thead>
<tr>
<th>Type</th>
<th>In-B</th>
<th>In-B Tandem</th>
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<tbody>
<tr>
<td>Max. Power output</td>
<td>11 MW</td>
<td>12.5 MW</td>
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<tr>
<td>Turbine speed</td>
<td>≤6,500 rpm</td>
<td>8,000 rpm</td>
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<tr>
<td>Inlet steam pressure</td>
<td>≤65 bar(a) / 942 psi</td>
<td>≤121 bar(a) / 1,750 psi</td>
</tr>
<tr>
<td>Back pressure</td>
<td>≤13 bar(a) / 189 psi</td>
<td>≤13 bar(a) / 189 psi</td>
</tr>
<tr>
<td>Condensing pressure</td>
<td>vacuum</td>
<td>vacuum</td>
</tr>
</tbody>
</table>

- Type of wheel / blades: Impulse
- API 611 compliant: with exemption
- Bearings: Tilting or Sleeve
Our steam turbines meet customer requirements for economic installation and operation as well as providing excellent flexibility for complex processes.

Worldwide, hundreds of successfully installed generator drives for power generation or a mechanical drives for compressors, blowers and pumps are in operation and reliably provide power.
Lünen is the cleanest and most efficient hard-coal-fired power plant in Europe. It supplies electricity for around 1.5 million households. It also supplies the city of Lünen with district heating. Using leading-edge Siemens technology makes it possible to save up to a million tons of CO2 every year.

Power output: 812 MW
Efficiency: 46%
Commercial operation: 2013

Ultra-supercritical steam power plant
Lünen, Germany

Since startup in 2008, Waigaoqiao III has compared to an average Chinese coal-fired power plant saved 900,000 million metric tons of raw coal. The plant reaches an efficiency of up to 45% making it a highly efficient coal plant.

Power output: 2 × 1,000 MW
Efficiency: 45%
Commercial operation: 2008

Ultra-supercritical steam power plant
Waigaoqiao III, China

At the time, Siemens was the first company to supply a machine for this temperature range.

Power output: 600 MW
Steam conditions: 600 °C / 610 °C
Commercial operation: 2002

Ultra-supercritical steam power plant
Isogo, Japan

In 2008, Yuhuan was China’s most advanced coal-fired power plant and got the “Asian Power Award”.

Power output: 4 × 1,000 MW
Efficiency: 45%
Commercial operation: 2007

Ultra-supercritical steam power plant
Yuhuan, China

Reference examples  Steam Power Plants
Reference examples  Combined Cycle Power Plants

Combined cycle power plant Dangjin III
South Korea
Siemens turbines are making Dangjin III the most efficient combined cycle power plant currently operating in Asia.

Power output: 400 MW
Efficiency: 60%
Commercial operation: 2013

Combined cycle power plant for the mining industry
Diamantina, Australia
Two Power Islands each performing at well in excess of 51% efficiency. The plant provides a total capacity of 242 MW to supply environmentally friendly electricity to local mines and to people living in the region. The power-generation solution for silent off-grid operation matching the variable power demand of the adjacent copper mine.

Power output: 242 MW
Commerical operation: 2014

Combined cycle power plant
Panda Sherman Power Project, Texas, USA
The Panda Sherman Power Project utilizes the latest, most advanced emissions control technology, making it one of the cleanest, natural gas-fueled power plants in the United States. The 758 MW combined cycle generating facility can supply the energy needs of up to 750,000 homes.

Plant type: SC56-5000F 2 × 1 Flex-Plant™
Power Output: 758 MW

Power block for combined cycle power plant
Nhon Trach 2, Vietnam
The power plant reaches an efficiency of over 57 percent and has very low nitrogen oxide emissions. It entered commercial operation after just 28.5 months.

Power output: 760 MW
Efficiency: 57%
Commercial operation: 2011
Reference examples  Biomass and Waste-to-energy

Igelsta
Södertalje, Sweden

SST-800: Biomass District Heating Plant

Sweden’s largest biomass plant

Inaugurated in March 2010, the plant uses a biomass fuel mix consisting of about 90% renewable fuels like forest refuse, wood chips, tree bark, and 10% non-recyclable waste paper and plastic.

It produces 200 MW heat and 85 MW electricity; the equivalent of heating 50,000 households and generating electricity for 100,000 residences.

Steam turbine: SST-800
Power output: 90 MW
Inlet pressure: 83 bar / 1,205 psi
Inlet temperature: 540 °C / 1,004 °F

Afval Energie Bedrijf
Amsterdam / Netherlands

Afval Energie Bedrijf (AEB, Waste and Energy Company Amsterdam) burns 1.7 million tonnes of waste per year and has recently increased its energy generation efficiency from 22% to 30%. The 8% increase resulted from installing a new SST-700 with a steam reheat system.

AEB not only generates power from Amsterdam’s municipal waste, but also recovers and sells material from the waste stream such as metals and gypsum.

Steam turbine: SST-700, Reheat
Power output: 74 MW
Inlet pressure: 125 bar / 1,813 psi
Inlet temperature: 440 °C / 824 °F
Fuel: Municipal solid waste

Biomass Power Plant Simmering
Vienna, Austria

The Simmering biomass power plant, owned by the Viennese utility Wien Energie, is exclusively fed with fresh wood from the forest. Producing 23.4 MW electricity in summer and 15.06 MW plus 37 MWth for district heating in winter, the plant reduces Vienna’s CO2 emissions by 144,000 tons per annum. In operation with heat extraction, total efficiency is 83%.

Steam turbine: SST-400, Reheat
Power output: 23.4 MW
Inlet pressure: 120 bar / 1,740 psi
Inlet temperature: 520 °C / 968 °F
Fuel: Fresh wood

SST-300 North Hykeham
Lincoln, UK

“We would definitely recommend Siemens. First because we would work again with them, they have provided a machine that is hard to make and hard to integrate into such a kind of plant, and they have been successful with this project.”

Project manager at CNIM

Power output: 25.15 MW
Speed: 5,300 rpm
Live steam pressure: 100 bars
Live steam temperature: 317°C

Customer: CNIM
Operator: FCC Environment
### Concentrated solar plants

#### ANDASOL 1 + 2, Granada, Spain
The two CSP plants are located in the Granada area, each covering a field of 1.95 km² of which the mirror field size is about 510,000 m². Both Andasol plants have a thermal storage system using molten salt to absorb part of the heat produced in the solar field during the day. This process almost doubles the number of operational hours per year at the solar thermal power plant. Andasol I went online in 2008 and Andasol II in 2009.

#### IVANPAH SOLAR POWER COMPLEX, California, USA
BrightSource Energy, a privately-owned energy company, developed the Ivanpah Solar Energy Generating System in California’s Mojave Desert. It consists of three separate plants using tower technology and provides approximately 400 MW (e) electricity to the US grid. The Ivanpah complex generates enough electricity to power more than 140,000 homes.

#### PUERTO ERRADO 1 (PE1), Calasparra, Spain
The PE1 Linear Fresnel demonstration plant, developed by Novatec Biosol AG, commenced selling power to the Spanish grid in March 2009. The 1.4 MW plant, located in Calasparra in the region of Murcia, Spain, has two rows of receivers, each with a length of 860 m, providing direct steam to the steam turbine. Each receiver uses 16 parallel lines of mirrors with a total surface of 18,662 m². A Ruth heat storage system, which utilizes hot water and saturated steam, is used for steam buffering.

#### IVANPAH SOLAR POWER COMPLEX, California, USA

<table>
<thead>
<tr>
<th>Parabolic trough (DH)</th>
<th>500 MW(e) each</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steam turbine:</td>
<td>2 × Siemens SST-700</td>
</tr>
<tr>
<td>Power output:</td>
<td>2 × 50 MW(e)</td>
</tr>
<tr>
<td>Inlet steam pressure:</td>
<td>100 bar / 1,450 psi</td>
</tr>
<tr>
<td>Inlet steam temperature:</td>
<td>377 °C / 711 °F</td>
</tr>
</tbody>
</table>

#### IVANPAH SOLAR POWER COMPLEX, California, USA

<table>
<thead>
<tr>
<th>Solar Power Tower (Water/Direct Steam)</th>
<th>3 plants, 392 MW(e) in total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steam turbine:</td>
<td>3 × Siemens SST-900</td>
</tr>
<tr>
<td>Power output:</td>
<td>123 MW(e)</td>
</tr>
<tr>
<td>Inlet steam pressure:</td>
<td>160 bar / 2,321 psi</td>
</tr>
<tr>
<td>Inlet steam temperature:</td>
<td>540 °C / 1,004 °F</td>
</tr>
</tbody>
</table>

#### IVANPAH SOLAR POWER COMPLEX, California, USA

<table>
<thead>
<tr>
<th>Turbine data for the first plant:</th>
<th>Power output: 123 MW(e)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steam turbine: Siemens SST-900</td>
<td></td>
</tr>
<tr>
<td>Inlet steam pressure: 160 bar / 2,321 psi</td>
<td></td>
</tr>
<tr>
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</tbody>
</table>

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<td>Steam turbine: Siemens SST-900</td>
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<td>Inlet steam pressure: 160 bar / 2,321 psi</td>
<td></td>
</tr>
<tr>
<td>Inlet steam temperature: 540 °C / 1,004 °F</td>
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</tbody>
</table>

#### NOOR/Ouarzazate, Morocco
On February 4, 2016, the King of Morocco, Mohammed VI, dedicated the Noor I unit of Ouarzazate Solar Power Station. This is the first of four phased Noor projects at Ouarzazate site which are expected to provide a total electrical generating capacity of 580 MW, making it the largest complex of its kind in the world. Siemens is supplying three turbine-generator sets for the power station.

<table>
<thead>
<tr>
<th>Linear Fresnel (Water/Direct Steam)</th>
<th>1.4 MW(e)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steam turbine: Siemens SST-120</td>
<td></td>
</tr>
<tr>
<td>Power output: 1.4 MW(e)</td>
<td></td>
</tr>
<tr>
<td>Inlet steam pressure: 55 bar / 798 psi</td>
<td></td>
</tr>
<tr>
<td>Inlet steam temperature: 270 °C / 518 °F (saturated steam)</td>
<td></td>
</tr>
<tr>
<td>Exhaust pressure: 0.06 bar / 0.87 psi</td>
<td></td>
</tr>
</tbody>
</table>
Reference examples  Sugar Mills

Khanh Hoa (Cam Ranh), Sugar Plant, Vietnam
The Khanh Hoa Sugar Plant is located in the Cam Lam District in central coastal Khanh Hoa Province. It handles roughly 3,000 tons of sugarcane per day.
Technology  SST-300
Complete 1999
Power output: 25 MW
Speed: 7,161 rpm
Inlet steam pressure: ≤46 bar(a) / 667 psi
Inlet steam temperature: ≤450 °C / 842 °F
Exhaust pressure: 2.5 bar(a) / 36.3 psi

Mitr Phol, Sugar Plant, Thailand
In 1946 Mitr Phol sugar business was initially established in Ratchaburi province as a small family business producing and trading condensed syrup to sugar mills. Meanwhile, it has expanded its operations to an internationally integrated enterprise acting in China, Laos, Australia and other countries.
Technology SST-300
Complete 2010
Power output: 26 MW
Switchable bleed for deaerator

Grupo Delta Sucroenergia / Brazil
The efficiency of the SST 600 steam turbine convinced the customer Grupo Delta Sucroenergia. Siemens installed the biggest steam turbine in the sugar-ethanol sector with an power output of 73.5 MW. It is also the first turbine in Brazil to waive the use of gears with direct drive for the generator.
Technology SST-600
Complete 2013
Power output: 73.5 MW
Inlet steam temperature: 520°C
Inlet steam pressure: 67 bar(a)
Exhaust: radial downward
Length: 8.5 m
Weight: 130 t

Simbhaoli Sugar, Sugar Plant, India
Simbhaoli Sugars is a technology company with a business mix that spans specialty sugars, quality liquor, technology consultancy, co-generated power, extra neutral alcohol (ENA), ethanol and bio-mass. As India’s largest integrated sugar refinery, the Company has pioneered path-breaking innovations in sugar refining (Defeco Remelt Phosphotation and Ion Exchange technology), high value, niche products (specialty sugars) and clean energy (ethanol).
Technology SST-300
Complete 2013
Power output: 18 MW
Speed: 6,900 rpm
Inlet steam pressure: 86 ata
Inlet steam temperature: 510 °C / 950 °F
Exhaust steam pressure: 0.1 ata
Steam Turbines for Pulp & Paper Industry SST-800, Hainan Island / China

Siemens Industrial Technologies was appointed as general contractor for the entire electrical engineering, while Siemens Energy won the order for the Hainan Pulp & Paper's power plant.

Technology: SST-800

- Complete: 2004
- Power output: 120 MW (each)
- Inlet steam temperature: 475 °C / 887 °F
- Inlet steam pressure: 80.5 bar / 1,167.5 psi
- Speed: 3,000 rpm
- Extraction steam pressure: 6.5 bar / 94.3 psi
- Exhaust steam pressure: 0.13 bar / 1.88 psi

Steam Turbines for Pulp & Paper Industry SST-800, Klabin / Brazil

Two Siemens SST-800 steam turbines are supplying electricity and process steam to a pulp factory in Brazil. The SST-800 has a capacity of 190 megawatts (MW), making it among the largest steam turbines in use in the pulp and paper industry worldwide.

The plant has a total capacity of 270 MW. The customer is Klabin, a leading manufacturer and exporter of paper and packaging.

Technology: SST-800

- Power output: 190 MW
- Speed: 3,600 rpm
- Inlet steam pressure: 100 bar / 1,450 psi
- Inlet steam temperature: 498 °C / 928 °F
- Extraction pressure: 10 bar / 145 psi
- Exhaust pressure: 5.4 bar / 78.3 psi

SST-300 for UPM Caledonian, Scotland / United Kingdom

UPM's mill is responsible for a third of all industrial and commercial electricity consumed across Ayrshire. With huge amounts of electricity and heat required to drive processes in the pulp and paper industry, UPM was keen to explore ways of reducing its energy costs while improving site competitiveness.

Siemens custom designed its SST-300 steam turbine to meet UPM's specific requirements at the plant and also provided the control systems. The plant incorporating Siemens technologies has enabled the mill to meet all its steam requirements involved in the production of coated papers – and in particular, drying of the paper.

Technology: SST-300

- Power output: 27 MW
- Speed: 6,800 rpm
- Inlet steam pressure: 90 bar / 1,305 psi

Reference examples Pulp and Paper
Kuwait is forging ahead with a new refinery project costing 4 billion Kuwaiti dinars (Dh49.7bn) despite the oil price slump, Kuwaiti officials said.

The construction of Al Zour refinery is part of plans to boost refining capacity to 1.4 million barrels per day (bpd) by 2019 from 940,000 bpd at present.

Scope of Supply: 57 SSTs for process and water pump drives
Model: Variety of models to meet power and steam conditions
Const. year: 2018 expected completion

Morning Star Packing, 24 Single Stage Steam Turbines
California, USA

Application: Mechanical drive for feed water pumps, boiler fans, hydraulics, pumps, etc.

The tomato processing window in the US is May through October. Six months of non-stop production requires rugged, reliable equipment which is the reputation the KL124 has earned over the years.

Scope of Supply: 24 Single Stage Turbines
Model: KL124
Shipped: 2014

Steam Turbine Applied as a Gas Expander Emergency Shut Down Drive
Approximately 95 world wide

Dresser Rand supplied special expander turbines which operate only when a power outage or other mechanical fault causes tripping of the process compressor and/or the main motor drive. When a "kill cycle" is initiated polyethylene or polypropylene reactor gases are routed from the compressor discharge to the turbine inlet (the turbine exhausts to a flare) which starts the turbine and drives the compressor train through an SSS clutch at reduced speed and load for 10 minutes or less. This is adequate time for the process to be poisoned by a "kill gas" which is injected into the reactor vessel thus preventing "solidification", which would require personnel with jackhammers to enter and clean the reactor vessel at a cost of millions in lost production.

KNPC New Refinery Single Stage, Mechanical Drive steam turbines
Kuwait

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## Performance data overview

<table>
<thead>
<tr>
<th>Steam turbine type</th>
<th>Output SPP</th>
<th>CCPP</th>
<th>Net efficiency SPP</th>
<th>CCPP</th>
<th>Net efficiency</th>
<th>Frequency</th>
<th>Inlet pressure</th>
<th>Inlet temperature</th>
<th>Reheat temperature</th>
<th>Rotational Speed</th>
<th>Controlled extraction barriers</th>
<th>Uncontrolled extraction barriers</th>
<th>Exhaust Pressure (back)</th>
<th>Exhaust Pressure (cond.)</th>
<th>Exhaust Pressure (distr)</th>
<th>Last stage blade length 50 Hz</th>
<th>Last stage blade length 60 Hz</th>
</tr>
</thead>
<tbody>
<tr>
<td>SST-9000 1,000–1,900</td>
<td>50 / 60</td>
<td>77 / 120</td>
<td>310 / 590</td>
<td>3,000–3,600</td>
<td>117 to 183</td>
<td>0.3 / 4.4</td>
<td>79.8 to 114.6</td>
<td>76.2 to 95.4</td>
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<tr>
<td>SST-6000 300–1,200</td>
<td>50 / 60</td>
<td>330 / 4,786</td>
<td>600 / 1,112</td>
<td>3,000–3,600</td>
<td>66 to 142</td>
<td>3 / 43</td>
<td>79.8 to 114.6</td>
<td>76.2 to 95.4</td>
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<tr>
<td>SST-5000 200–500</td>
<td>50 / 60</td>
<td>260 / 3,771</td>
<td>600 / 1,112</td>
<td>3,000–3,600</td>
<td>66 to 142</td>
<td>3 / 43</td>
<td>79.8 to 114.6</td>
<td>76.2 to 95.4</td>
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<tr>
<td>SST-4000 100–380</td>
<td>50 / 60</td>
<td>105 / 1,523</td>
<td>565 / 1,049</td>
<td>3,000–3,600</td>
<td>80 to 115</td>
<td>3 / 43</td>
<td>79.8 to 114.6</td>
<td>76.2 to 95.4</td>
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<tr>
<td>SST-3000 90–250</td>
<td>50 / 60</td>
<td>177 / 2,567</td>
<td>565 / 1,049</td>
<td>3,000–3,600</td>
<td>80 to 115</td>
<td>3 / 43</td>
<td>79.8 to 114.6</td>
<td>76.2 to 95.4</td>
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<tr>
<td>SST-700 / 900</td>
<td>≤ 250</td>
<td>180 / 2,611</td>
<td>565 / 1,049</td>
<td>3,000–3,600</td>
<td>72 / 1,044</td>
<td>0.3 / 4.4</td>
<td>79.8 to 114.6</td>
<td>76.2 to 95.4</td>
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<tr>
<td>SST-800</td>
<td>≤ 250</td>
<td>165 / 2,393</td>
<td>565 / 1,049</td>
<td>3,000–3,600</td>
<td>65 / 942</td>
<td>0.3 / 4.4</td>
<td>79.8 to 114.6</td>
<td>76.2 to 95.4</td>
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<tr>
<td>SST-600</td>
<td>≤ 200</td>
<td>165 / 2,393</td>
<td>565 / 1,049</td>
<td>3,000–3,600</td>
<td>72 / 1,044</td>
<td>0.3 / 4.4</td>
<td>79.8 to 114.6</td>
<td>76.2 to 95.4</td>
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<tr>
<td>SST-500</td>
<td>≤ 100</td>
<td>30 / 435</td>
<td>400 / 750</td>
<td>15,000</td>
<td>none</td>
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<tr>
<td>SST-400</td>
<td>≤ 60</td>
<td>140 / 2,030</td>
<td>540 / 1,004</td>
<td>3,000–8,000</td>
<td>45 / 510</td>
<td>0.3 / 4.4</td>
<td>79.8 to 114.6</td>
<td>76.2 to 95.4</td>
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<tr>
<td>SST-300</td>
<td>≤ 45</td>
<td>140 / 2,030</td>
<td>540 / 1,004</td>
<td>12,000</td>
<td>25 / 363</td>
<td>0.3 / 4.4</td>
<td>79.8 to 114.6</td>
<td>76.2 to 95.4</td>
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<tr>
<td>SST-200</td>
<td>≤ 20</td>
<td>120 / 1,781</td>
<td>540 / 1,004</td>
<td>14,400</td>
<td>1</td>
<td>20 / 286</td>
<td>0.3 / 4.4</td>
<td>79.8 to 114.6</td>
<td>76.2 to 95.4</td>
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<tr>
<td>SST-150</td>
<td>≤ 20</td>
<td>100 / 1,495</td>
<td>505 / 940</td>
<td>12,000</td>
<td>19 / 272</td>
<td>0.3 / 4.4</td>
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<td>76.2 to 95.4</td>
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<tr>
<td>Steam Turbine Type</td>
<td>Power Output (kW)</td>
<td>inlet Pressure (bar / psi)</td>
<td>inlet Temperature (°C / °F)</td>
<td>Rotational Speed (rpm)</td>
<td>Uncontrolled Extraction Pressure (bar / psi)</td>
<td>Exhaust Pressure (cond.) (bar / psi)</td>
<td>Bearings Type</td>
<td>wheel / blades</td>
<td>API 611 Compliant</td>
<td>Type of wheel / blades</td>
<td>APG 611 compliant</td>
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<tr>
<td>D-W BLACK/NOX</td>
<td>1,000 (HP)</td>
<td>47 / 692</td>
<td>870 / 1,580</td>
<td>4,300–6,000</td>
<td>12 / 174</td>
<td>Ball-bearing</td>
<td>journal &amp; thrust</td>
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<td>1,866 (HP)</td>
<td>63 / 913</td>
<td>862 / 1,550</td>
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<td>21 / 308</td>
<td>Ball and sleeve bearings</td>
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<td>69 / 994</td>
<td>862 / 1,550</td>
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<td>21 / 315</td>
<td>Ball and sleeve bearings</td>
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<td>D-W SST (ISO 1567) / TJS</td>
<td>6,000 (HP)</td>
<td>120 / 1,717</td>
<td>518 / 952</td>
<td>14,300</td>
<td>46 / 692</td>
<td>Tilting sleeve</td>
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<td>6,000 (HP)</td>
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<td>520 / 966</td>
<td>15,000</td>
<td>21 / 315</td>
<td>Tilting sleeve</td>
<td>Impulse yes</td>
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<td>D-W C</td>
<td>2,200 (HP)</td>
<td>89 / 1,315</td>
<td>495 / 892</td>
<td>6,000</td>
<td>6 / 97</td>
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<td>4,500 (HP)</td>
<td>96 / 1,404</td>
<td>495 / 893</td>
<td>10,000</td>
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<td>4,500 (HP)</td>
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<td>862 / 1,550</td>
<td>15,000</td>
<td>29 / 421</td>
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<td>750 (HP)</td>
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<td>495 / 893</td>
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<td>3,640 (HP)</td>
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<td>565 / 1,024</td>
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Subject to changes and errors. The information given in this document only contains general descriptions and/or performance features which may not always specifically reflect those described, or which may undergo modification in the course of further development of the products. The requested performance features are binding only when they are expressly agreed upon in the concluded contract.

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