SIEMENS

Efficiency: More value to your facility

Siemens steam turbine portfolio
Steam turbines from 10 kW to 1,900 MW

siemens.com/steamturbines

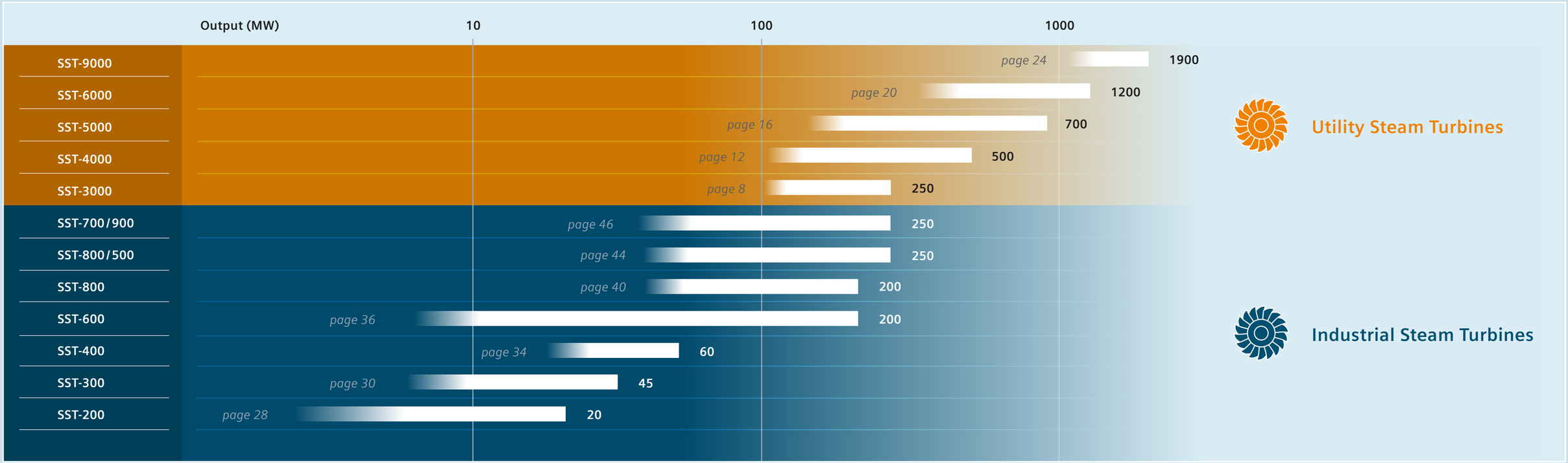
Steam turbines from 10 kW to 1,900 MW

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 world wide, Siemens is a reliable and experienced partner.

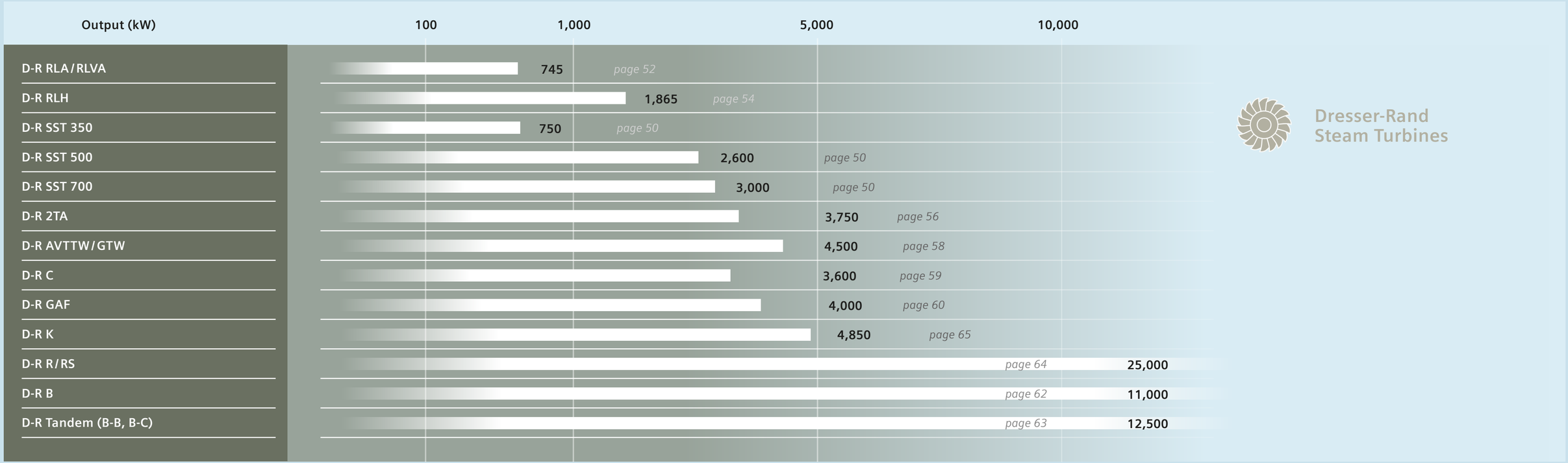
Siemens Steam Turbines are an essential piece of turbo-machinery to many power plants worldwide. They are applied either as a generator drive or a mechanical drive for pumps and compressors. The modular design concept of all steam turbines ensures high flexibility, availability and a reduction of time-to-market.

Content:

Steam turbines overview



Steam turbines overview



Utility steam turbines from 90 to 1,900 MW

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

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

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.

The SST-3000 series covers the power output range from 90 to 250 MW.

It features a separate high-pressure (HP) turbine and combined intermediate-pressure / low-pressure (IP / LP) turbine with single flow axial exhaust for 50 and 60 Hz applications.

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 × 390 MW

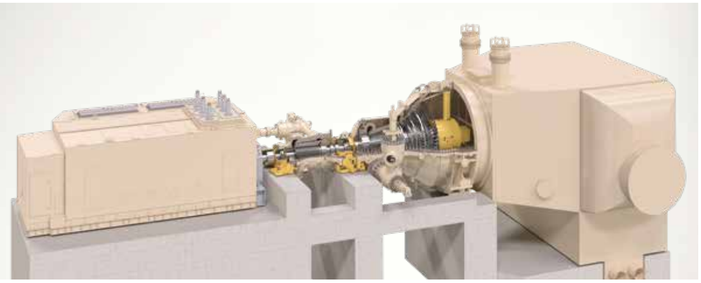
Steam turbine output:
3 × 142 MW

Scope of supply:
3 × SGT5-4000F, 3 × SST5-3000, 3 × SGen5-2000H

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

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

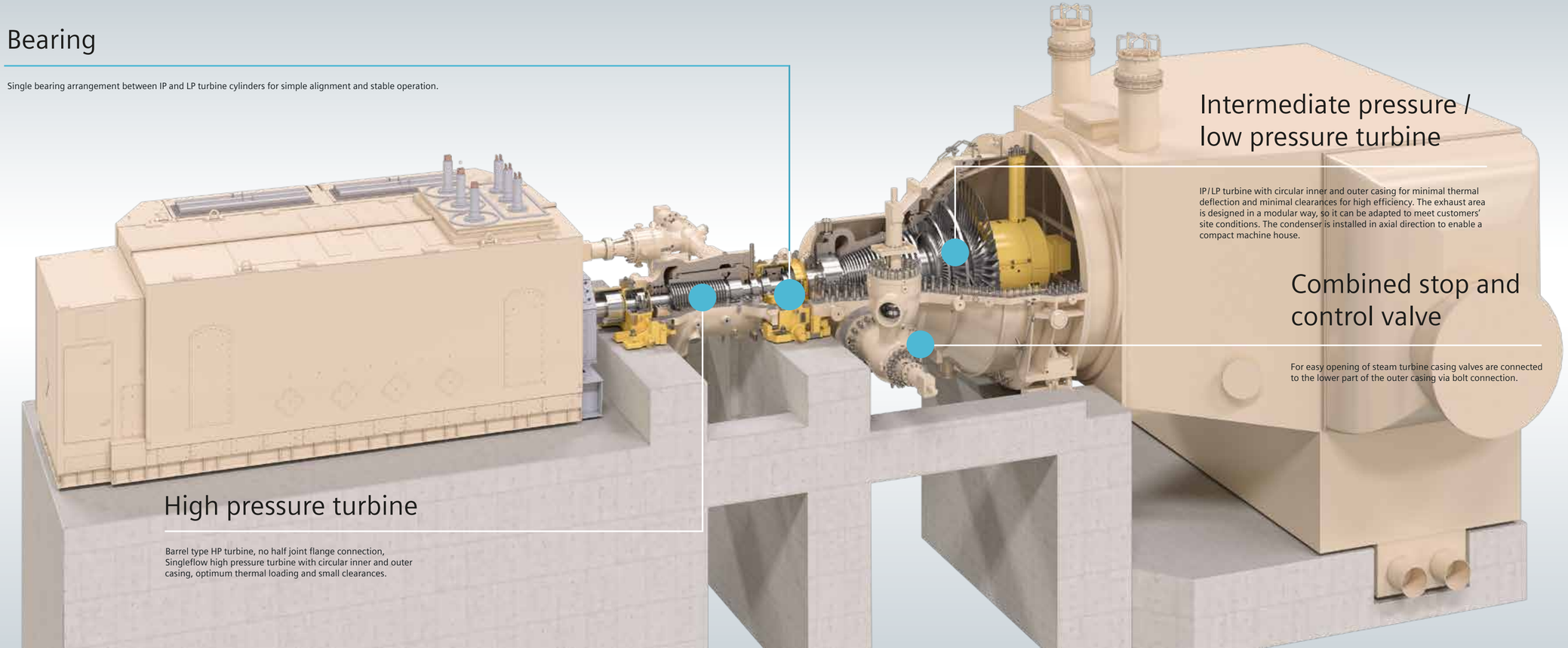
Ribatejo, Portugal



SST-3000	
Power output	**90 up to 250 MW**
Frequency	**50 or 60 Hz**
Main steam conditions	
Inlet pressure	up to 177 bar / 2,567 psi
Inlet temperature	up to 565 °C / 1,050 °F
Reheat steam conditions	
Temperature	up to 610 °C / 1,130 °F
Last stage blade length	
50 Hz	80 cm to 115 cm / 31 inches to 45 inches
60 Hz	76 cm to 95 cm / 30 inches to 38 inches

Bearing

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



High pressure turbine

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

Intermediate pressure / low pressure turbine

IP/LP turbine with circular inner and outer casing for minimal thermal deflection and minimal clearances for high efficiency. The exhaust area is designed in a modular way, so it can be adapted to meet customers' site conditions. The condenser is installed in axial direction to enable a compact machine house.

Combined stop and control valve

For easy opening of steam turbine casing valves are connected to the lower part of the outer casing via bolt connection.

SST-4000

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

Powerful and reliable – thanks to proven design for high efficiency

The SST-4000 series is our specialized turbine for non-reheat, combined cycle applications. With the specialized design of the blade path, the entire power range from 100 to 500 MW can be covered with the highest reliability and availability. More than 40 turbines of this type are already in operation or in the commissioning stage, with a total installed capacity of approximately 8,200 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

Al Ezzel, Bahrain

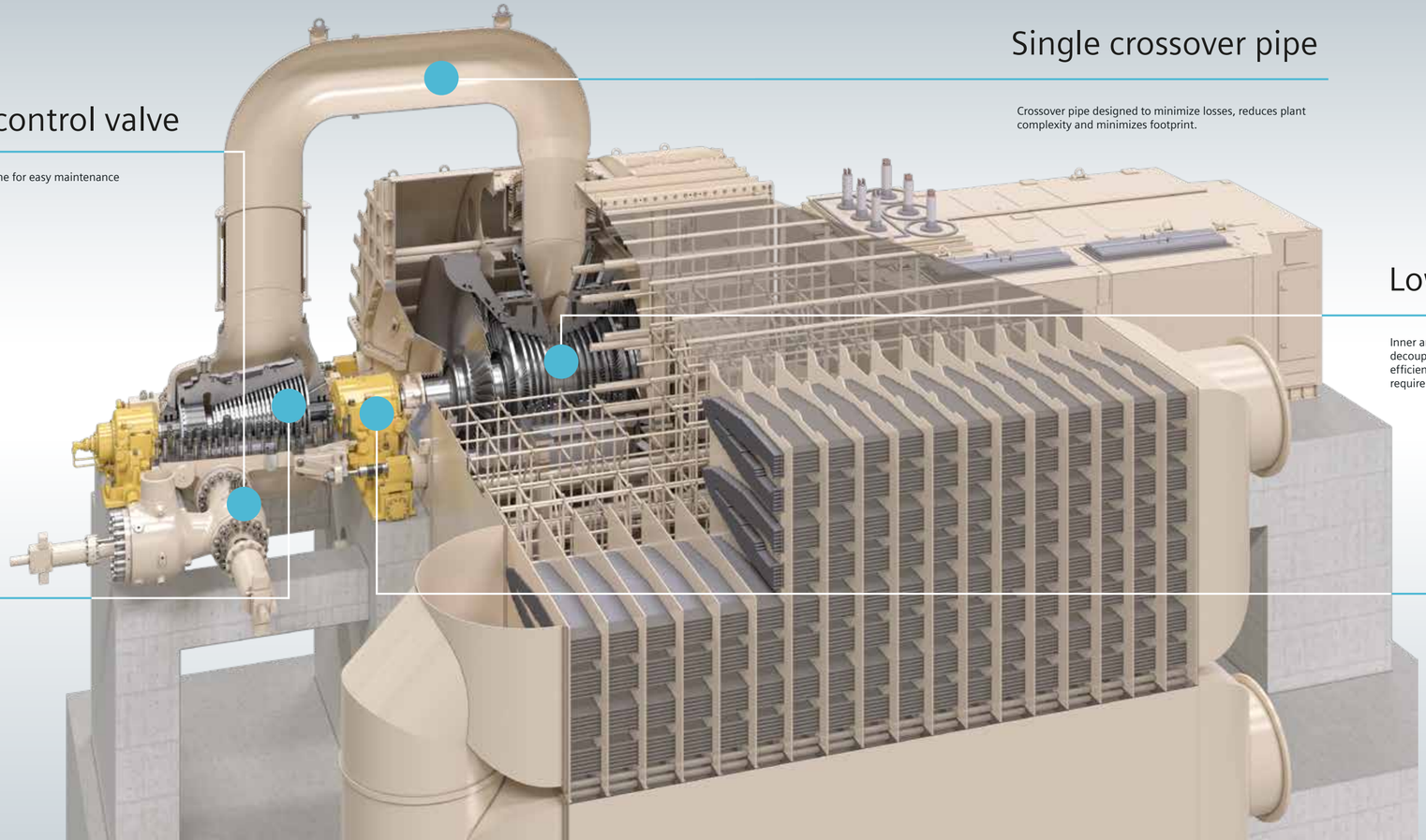
SST-4000	
Power output	**100 up to 500 MW**
Frequency	**50 or 60 Hz**
Main steam conditions	
Inlet pressure	up to 105 bar / 1,523 psi
Inlet temperature	up to 565° C / 1,049° F
Last stage blade length	
50 Hz	80 cm to 115 cm / 31 inches to 45 inches
60 Hz	76 cm to 95 cm / 30 inches to 38 inches

Combined stop and control valve

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

Single crossover pipe

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



Low pressure turbine

Inner and outer casing of the doubleflow turbine are mechanically decoupled. That allows minimal radial clearances resulting in maximum efficiency. The condenser is installed on one side and as special requirement below, or on both sides of the low pressure turbine.

Intermediate pressure turbine

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

Bearing

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

SST-5000

Utility steam turbine package

- Class record efficiency in combined cycle applications
- Option for combined heat and power
- Long maintenance intervals to reduce lifecycle costs
- Flexible steam extractions
- Short start-up times and flexible start-up modes
- Highest reliability and availability
- Remote performance control

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 class record net plant efficiency of more than 63 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

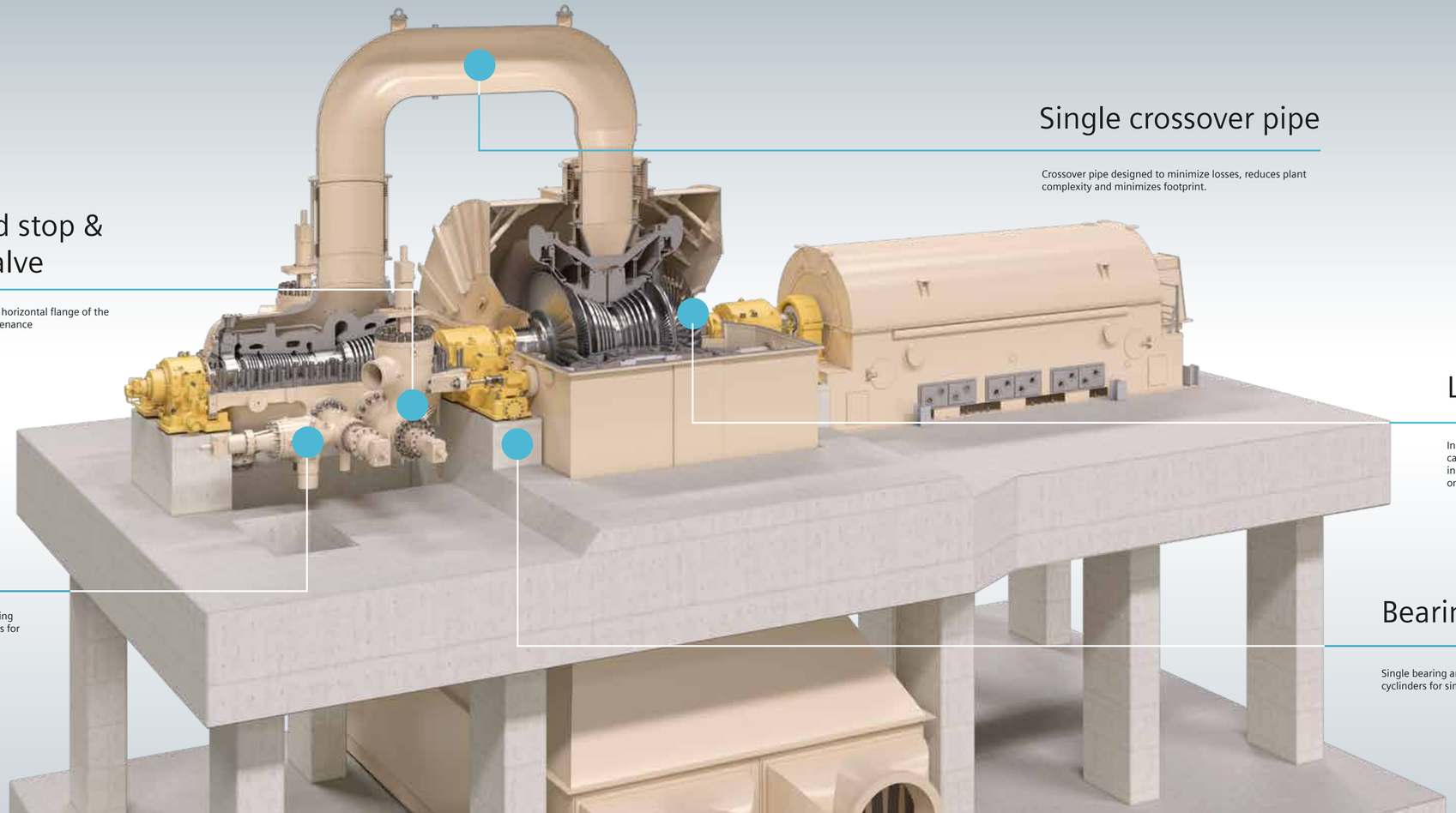
The combined cycle power plant set three world records: in the acceptance test a maximum electrical net output of 603.8 MW was achieved and the net energy conversion efficiency was around 61.5 percent.

- overall plant efficiency considering thermal extraction was above 85%
- 300 MW thermal power extraction through one steam turbine train

Plant type: SCC5-8000H 1S (single shaft)
Power output: 604 MW
Efficiency: 61.5 %

Lausward "Fortuna", Germany

SST-5000	CCPP	SPP
Power output	120 MW to 650 MW	200 MW to 500 MW
Efficiency	61.5 % in combined cycle	43 % for subcritical 46,4 % for supercritical
Frequency	50 or 60 Hz	50 or 60 Hz
Main steam conditions		
Inlet pressure	up to 177 bar / 2,567 psi	up to 260 bar / 3,770 psi
Inlet temperature	up to 600 °C / 1,112 °F	up to 600 °C / 1,112 °F
Reheat steam conditions		
Temperature	up to 610 °C / 1,130 °F	up to 610 °C / 1,130 °F
Last stage blade length		
50 Hz	66 cm to 142 cm / 26 inches to 56 inches	
60 Hz	66 cm to 95 cm / 26 inches to 38 inches	



Single crossover pipe

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

Combined stop & control valve

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

Low-pressure turbine

Inner and outer casing of the double-flow turbine are mechanically decoupled. That 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.

High-pressure / intermediate-pressure turbine

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

Bearing

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

SST-6000

Utility steam turbine package

- 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

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 net plant efficiencies of 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 fleet is more than 100,000 MW.

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 CO_2 emissions of 2.5 million metric tons per year.

Power output: 2 × 800 MW

Efficiency: 46.2 %

Main Steam: 275 bar / 597 °C
3,989 psi / 1,107 °F

Reheat Steam: 609 °C / 1,128 °F

Commissioning: 2014

Eemshaven, Netherlands

SST-6000	
Power output	300 MW to 1,200 MW
Efficiency	46,5 % (Double reheat: 48 %)
Frequency	50 or 60 Hz
Main steam conditions	
Inlet pressure	up to 330 bar / 4,786 psi
Inlet temperature	up to 610 °C / 1,130 °F
Reheat steam conditions for single and double reheat	
Temperature	630 °C / 1,166 °F
Last stage blade length	
50 Hz	66 cm to 142 cm / 26 inches to 56 inches
60 Hz	66 cm to 95 cm / 26 inches to 36 inches

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

Crossover pipe

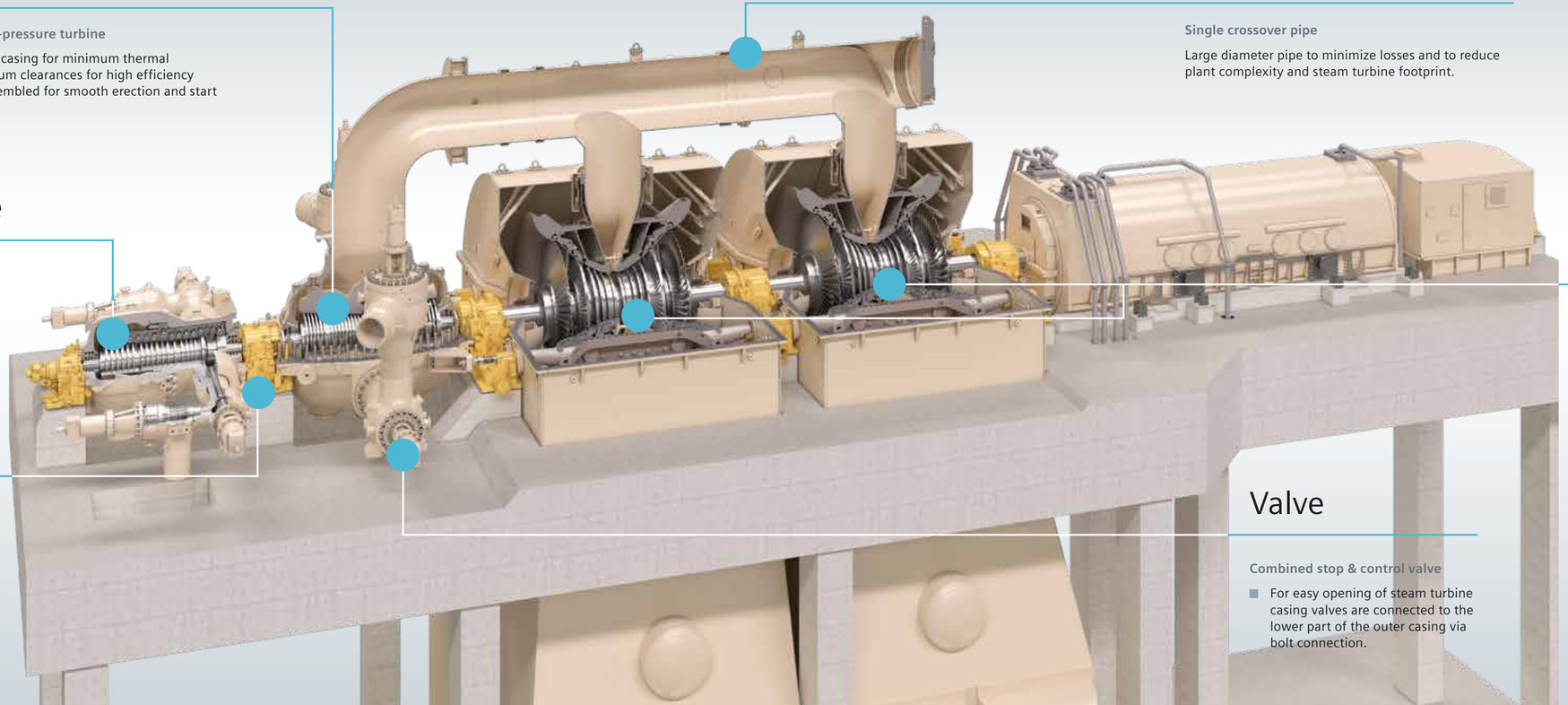
Single crossover pipe

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

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.



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 under-neath the low pressure turbine casing.

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.

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

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

Leading technology for efficient, flexible and reliable power generation

The SST5-9000 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 SST5-9000 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.

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

Olkiluoto 3, Finland

Nuclear Power Plant

Customer:
Teollisuuden Voima Oyj (TVO)

Scope of supply:
Conventional Island

Commercial Operation:
Jan 2020 (planned)

Power Output:
Approx. 1.600 MW (net)

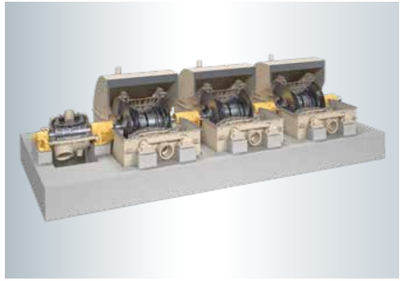
Grid Frequency:
50 Hz

Turbine Frequency:

25 Hz

Photo: ©TVO

Olkiluoto, Finland



SST-9000	
Power output	
Power output	1,000 to 1,900 MW
Frequency	50 or 60 Hz
Main steam conditions	
Inlet pressure	up to 80 bar / 1,160 psi
Inlet temperature	up to 310 °C / 590 °F
Last stage blade length	
50 Hz	117 cm to 183 cm / 46 inches to 72 inches
60 Hz	107 cm to 142 cm / 42 inches to 56 inches

Industrial steam turbines from 2 to 250 MW

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.

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**

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.

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

SST-200	
Power output	up to 20 MW
Speed	up to 14,600 rpm
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 Turbines	2–20 bar(a)
Uncontrolled extraction	up to 3
Controlled extraction	1
Steam extraction	
Controlled (up to 4)	up to 16 bar / 230 psi up to 350 °C / 560° F
Uncontrolled	60 bar / 870 psi

Typical applications

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

SST-300

Industrial steam turbine

- **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, early and flexible layout planning**

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.

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

SST-300	
Power 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
Controlled 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

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

SST-300

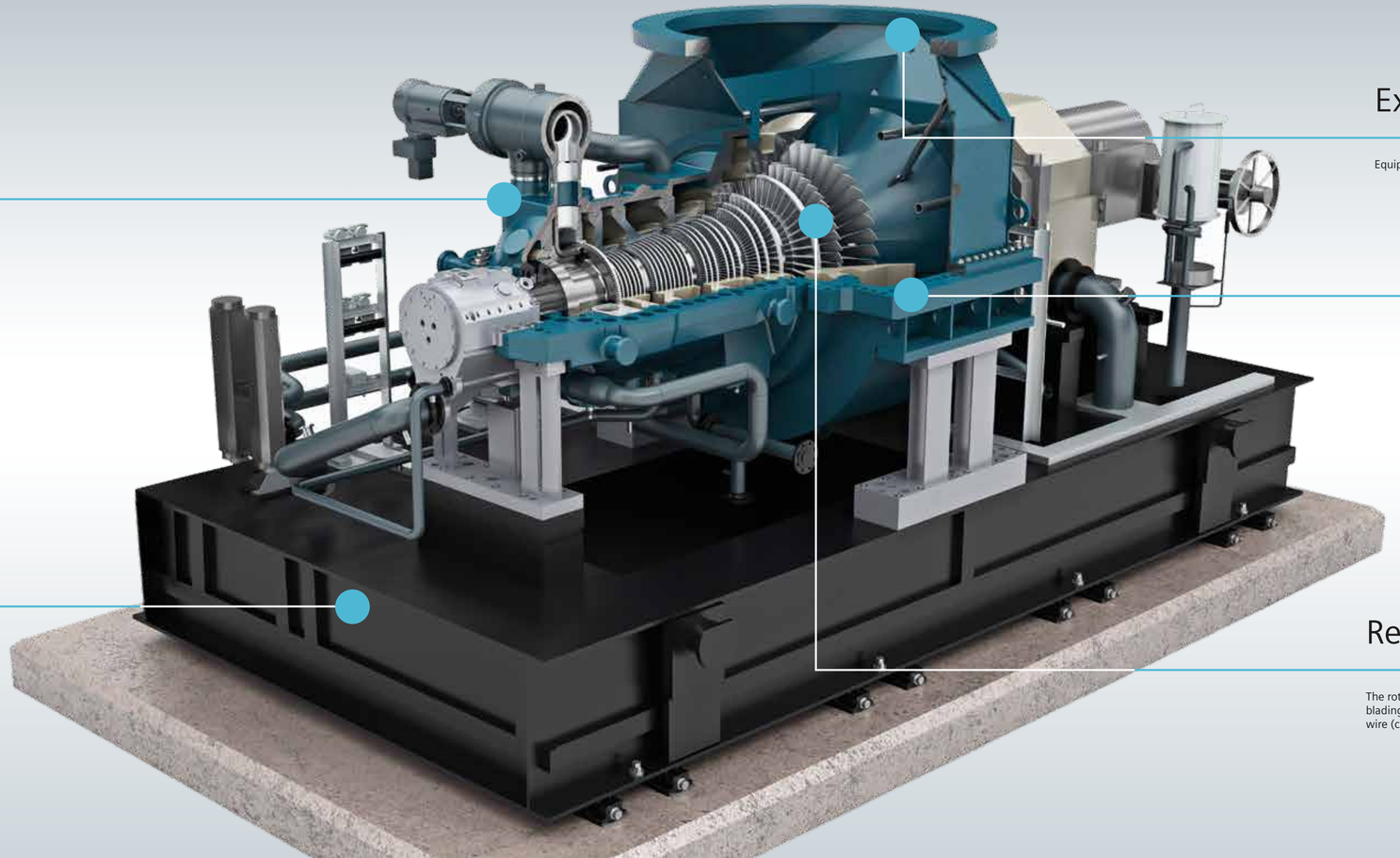
Valve arrangement

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

- **Fast and early layout planning**
- **Short delivery time**
- **Compact design minimizes space requirements of installation**
- **Easy access to mechanical components facilitates maintenance**

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 achieve 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.

The SST-400 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. Our proven installation and maintenance concept lowers maintenance cost by enabling easy access to the installed components, the turbine, gearbox, and generator.

Waste-to-energy plant, Mallorca / Spain

Tourism drives the local development and welfare of the Mediterranean island. The significant number of 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 430,000t 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

Waste-to-energy plant, Mallorca / Spain

SST-400	
Power output	up to 60 MW
Speed	up to 8,000 rpm
Live steam parameters	
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 / 653 psi
Uncontrolled	up to 60 bar / 870 psi

Typical applications

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

SST-600

Flexible condensing or back-pressure steam turbine

- Soft reheat up to 400°C
- Outstanding efficiency
- Fast start-up times
- Highest reliability
- Economic installation and operation
- Flexibility for complex, industrial processes

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 even 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 91MWth 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: 25 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

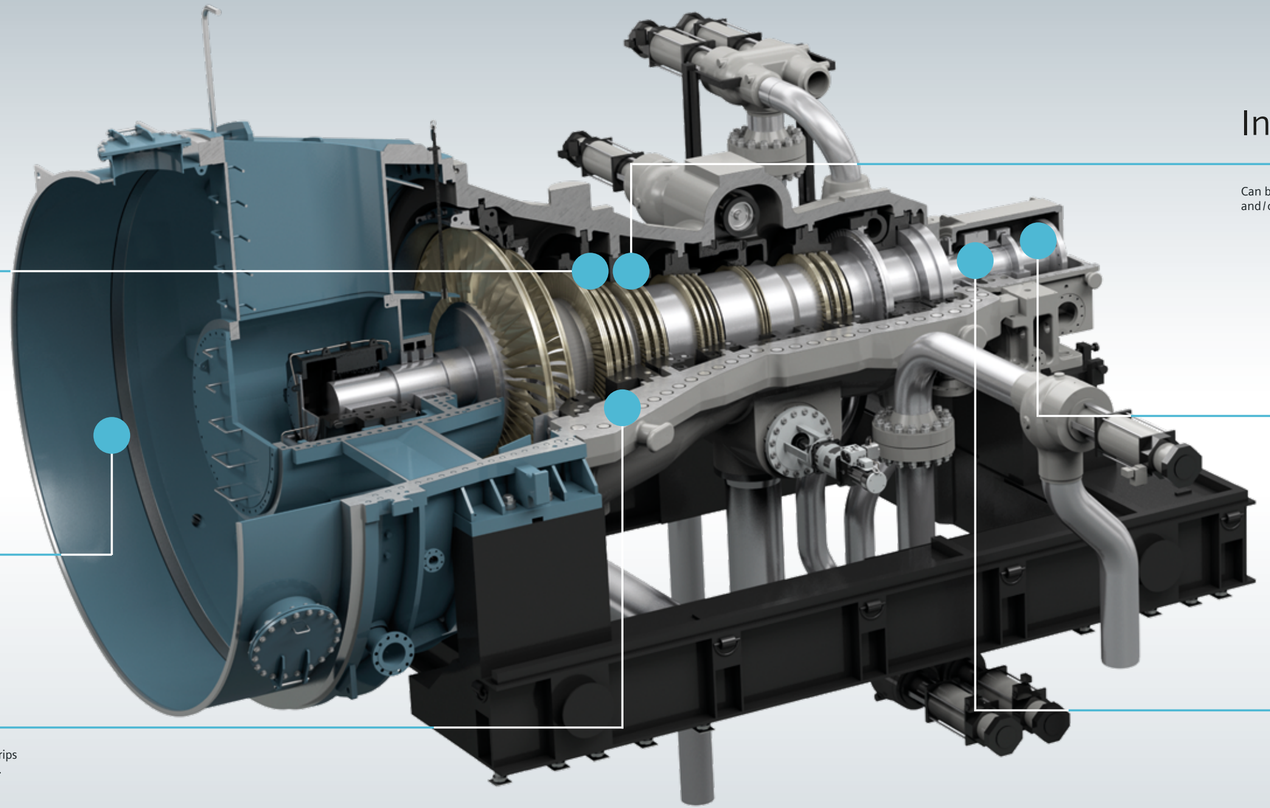
Biomass district heating plant, Västergötland / Sweden

SST-600	
Power output	**up to 200 MW**
Speed	**3,000 to 18,000 rpm**
Live steam parameters	
Inlet pressure	up to 165 bar / up to 2,393
Inlet temperature	up to 565 °C / 1,050 °F
Exhaust steam parameters	
Back pressure	up to 80 bar / 1,160 psi
Condensing	up to 1.0 bar / 15 psi
District heating	up to 3.0 bar / 43 psi
Controlled extractions (up to 2)	
Pressure, ext. valve	up to 72 bar / 1,044 psi
Pressure, int. valve	up to 45 bar / 798 psi
Temperature	up to 480 °C / 895° F
Uncontrolled extractions (up to 6)	
	up to 85 bar / 1,233 psi

Typical applications

- Chemical and petrochemical industry
- Pulp and paper mills
- Steel works
- Mines
- Power plants
- Seawater desalination plants
- Biomass and Waste-to-energy plants (waste incineration)

SST-600



Blades

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

Intermediate section

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

Casing

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

Exhaust section

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

Sealing

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

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.

SST-800

Steam turbine with center steam admission

- Singel casing with or withouth reheat
- Outstanding efficiency
- Fast start-up times
- Highest reliability
- Economic installation and operation
- Flexibility for complex, industrial processes

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 dual 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 multicasing 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 (includung oil system and on a base frame). The SST-800 steam turbine design is in accordance with DIN or API standards.

Steam Turbines for Pulp & Paper IndustrySST-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.

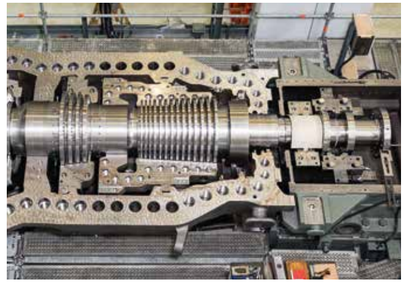
Power output: 190 MW

Speed: 3,600 rpm

Inlet steam pressure: 100 bar / 1,450 psi

Inlet steam temperatue: 498 °C / 928 °F

Steam turbine for the pulp plant Klabin, Brazil



SST-800	
Power output	**up to 200 MW**
Speed	**3,000 to 3,600 rpm**
Live steam parameter	
Inlet pressure	up to 165 bar / up to 2,393 psi
Inlet temperature	up to 565 °C / up to 1,050 ° F
Exhaust conditions	
Back pressure	up to 72 bar / 1,044 psi
Controlled extractions (up to 2)	
Pressure, ext. valve	up to 72 bar / 1,044 psi
Uncontrolled extractions (up to 7)	
	various pressure levels

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)

SST-800

Center steam admission

The reverse flow adjusts the thrust and relieves the bearings of large steam turbines

Exhaust section

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

Bearings

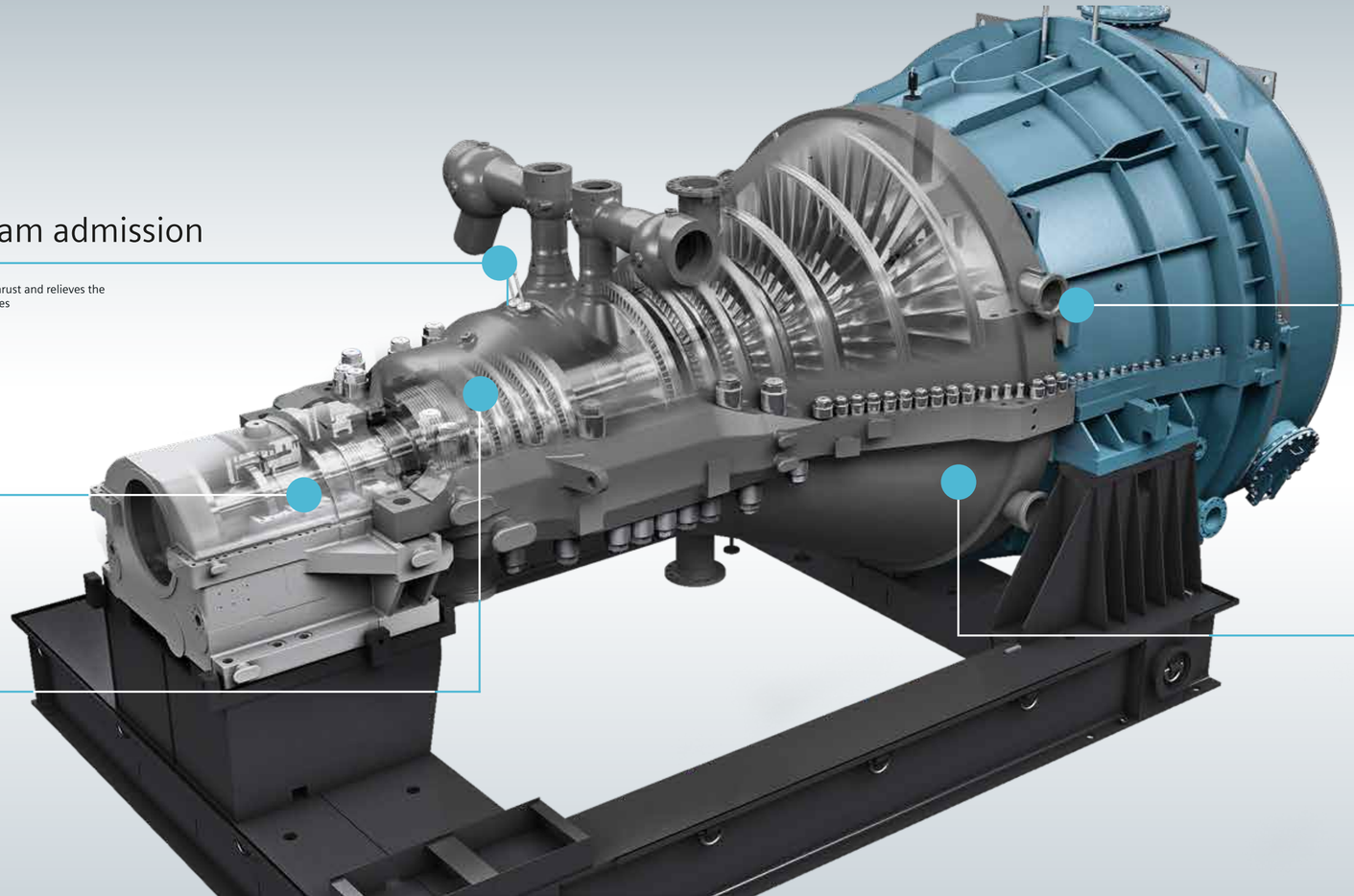
Simplified maintenance due to horizontal casing split and / or independently accessible bearings

Steam path

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

Casing

The steam turbine casing is based on a combined housing concept featuring a cast steel and welded design. The material mix ensures high availabilty and reduced delivery times.



SST-800/500

Double exhaust flow steam turbine in a single or multi-casing solution

- **Double-casing reheat or non-reheat solution**
- **Customized steam path**
- **Short delivery time due to extensive pre-design**
- **Easy access to mechanical components facilitates maintenance**

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 turboset, 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.

BSolarthermal power plant, Morocco

Customer: Masen, Ouarzazate Solar Power Station

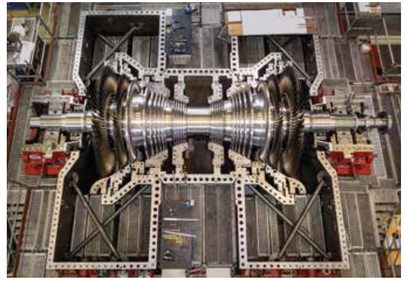
Project: Three dual-casing steam turbines put into service at the Noor project site – the most ambitious solar power project in the world. The steam turbine generator set employed in Noor II (a solar tower plant) is a SST- 500/800

Power output: 200 MW

Inlet temperature: 380°C / 716°F

Inlet pressure: 105 bar(a) / 1,522 psi

SST-800/500 Double-casing reheat solution



	SST-500	SST-800/500
Power output	up to 100 MW	up to 250 MW
Speed	up to 15,000 rpm	3,000 to 3,600 rpm
Live steam parameters		
Inlet pressure	up to 30 bar/435 psi	up to 165 bar/2,393 psi
Inlet temperature	up to 400°C/750°F	up to 565°C/1,050°F
Exhaust steam parameters		
District Heating	up to 1.5 bar/21.75 psi	
Condensing	up to 0.5 bar/7.25 psi	
Steam extraction		
Uncontrolled (up to 2)	various pressure levels	various pressure levels

Typical applications

- Solarthermal power plants
- Combined cycle plants
- 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-700/900

Industrial steam turbine

- Fast load changes
- Short start up times
- Highest with reheat efficiency
- Increased life cycle
- Low level arrangement
- Reheat application

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. Predefined 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, inaugarated 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 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

Steam turbine SST-900 for the CSP-plant NOOR III, Morocco

SST-700/900	
Power output	**up to 250 MW (CCPP: 230 MW)**
Speed	**3,000 to 3,600 rpm**
Live steam parameters	
Inlet pressure	up to 180 bar/up to 2,611 psi
Inlet temperature	up to 585 °C/up to 1,085° F
Exhaust steam parameters	
Back pressure	0.3 bar/4.4 psi
Steam extraction	
Controlled	72 bar/1,044 psi
Uncontrolled	up to 7 uncontrolled extractions possible

Typical applications

- Combined cycle power plants
- Concentrated solarthermal power plants
- Biomass-fired power plants

Dresser-Rand — A Siemens Business

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
- 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

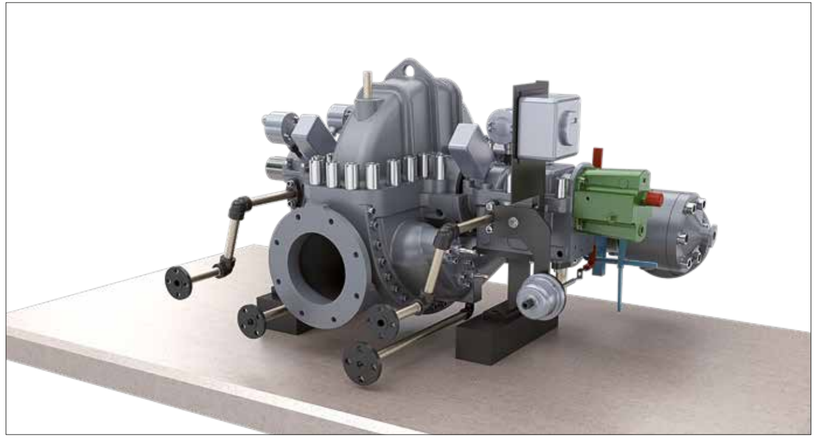
D-R SST 350 / 500 / 700

Standard single stage steam turbine

Typical applications

- Refineries
- Petrochemical plants
- Palm oil plants
- Food processing
- Steel 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

- 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 accesories available
- WORTHINGTON heritage



Technical Data

D-R SST 350 / 500 / 700	
Power output	2,460 kW / 3,500 HP
Turbine speed	≤ 12,000 rpm
Inlet steam temperature	≤ 482°C / 900°F
Inlet Steam pressure	≤ 63 bar(a) / 914 psi
Back-pressure	21 bar(a) / 315 psi
Type of wheel / blades	Curtis / Impulse
API 611 and API 612	Yes
Bearings	Sleeve, Ball or Tiltpad

D-R RLA / D-R RLVA

Standard single stage steam turbine

Typical applications

- Refineries
- Petrochemical and chemical plants
- Food processing
- Institutional
- Process pump drives
- Process waste heat recovery
- Replacement of steam pressure reduction valve
- Lube oil pumps

RLA

- 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 (API applications)
- Oil ring lubricated
- Broad range of controls and accessories available
- COPPUS heritage

D-R RLA

D-R RLVA

RLVA

- Rugged, versatile design
- Radially split casing
- Vertical shaft design with NEMA motor mounting flange & various ball thrust bearing configurations
- 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 (API applications)
- Grease lubricated with circulating oil options
- Broad range of controls and accesories available
- COPPUS heritage

D-R RLVA

Technical Data

D-R RLA / RLVA	
Power output	745 kW / 1,000 HP
Turbine speed	up to 6,000 rpm
Inlet steam temperature	≤ 440 °C / 825 °F
Inlet steam pressure	≤ 47 bar(a) / 682 psi
Back-pressure	≤ 12 bar(a) / 179 psi

Type of wheel / blades	Curtis / Impulse
API 611 compliant	Yes
Bearings	Ball bearing journal & thrust

Typical applications

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

D-R RLH

Standard single stage steam turbine

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

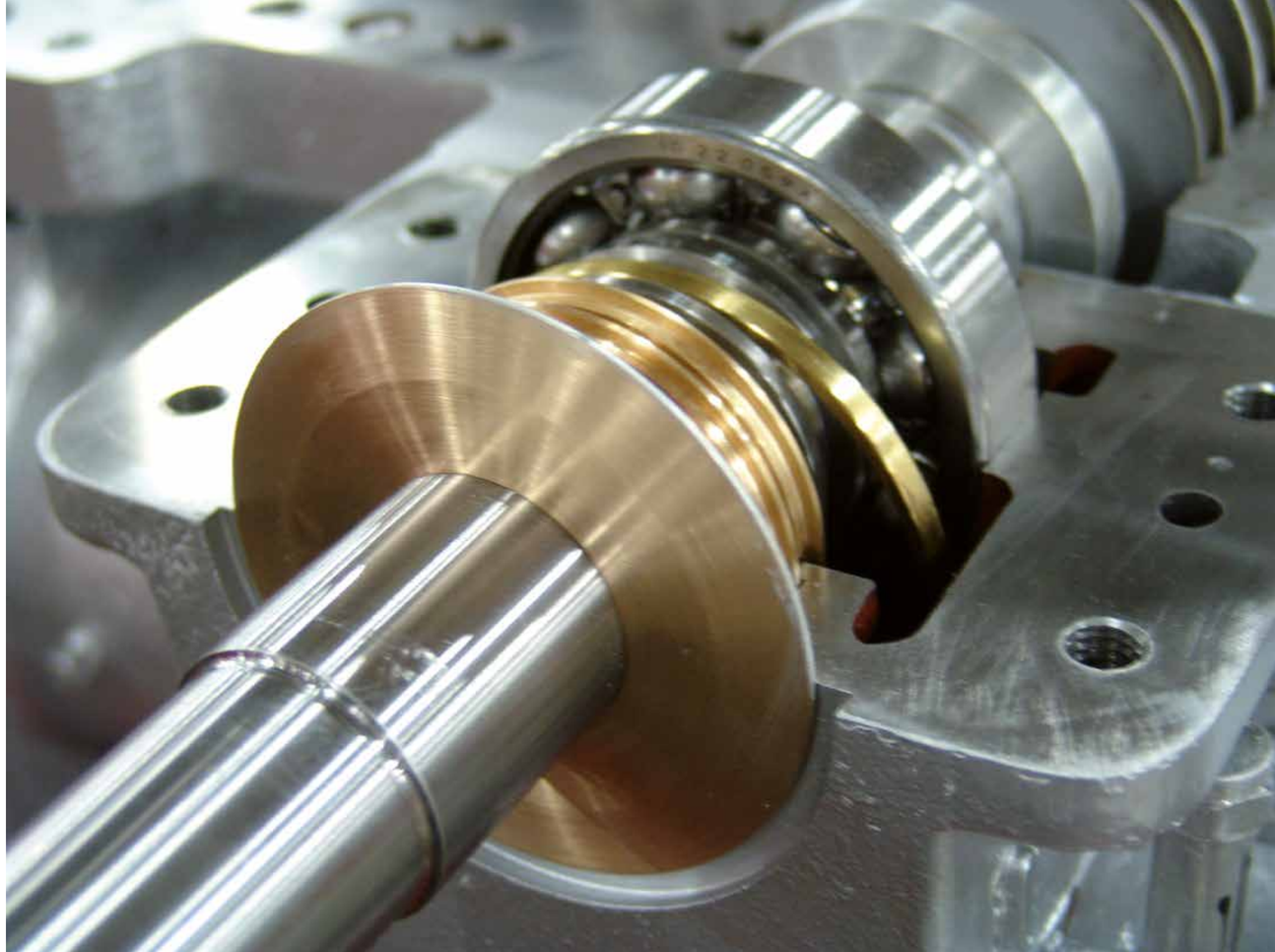
D-R RLH

- 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
- Built-in removable steam strainer
- Carbon ring sealing glands
- API style blanket lagging / insulation (API applications)
- Carbon ring sealing glands
- Oil ring lubricated with forced pressure lubrication or circulating oil cooling options
- Broad range of controls and accesories available
- COPPUS heritage

Technical Data

D-R RLH	
Power output	1,865 kW / 2,500 HP
Turbine speed	6,000 rpm
Inlet steam temperature	≤ 482°C / 900°F
Inlet steam pressure	≤ 97 bar(a) / 1.414 psi
Back-pressure	≤ 22 bar(a) / 314 psi

Type of wheel / blades	Curtis / Impulse
API 611 compliant	Yes
Bearings	Ball and sleeve bearing designs



D-R 2TA

Single stage steam turbine

Typical applications

- Pumps and fans drives
- Compressors drives

- Horizontally split casings
- Between bearing design
- Multi-Valve or Single Valve Inlet
- Solid or built-up rotor
- Carbon ring or labyrinth glands
- Electronic governor
- Electronic overspeed trip
- Separate mechanical or hydraulic trip and throttle valves (option w / o exerciser)
- Auto / quick start capability
- Terry heritage

Technical Data

D-R 2TA	
Power output	3,640 kW / 4,880 HP
Turbine speed	≤ 12,500 rpm
Inlet steam temperature	≤ 530 °C / ≤ 986 °F
Inlet Steam pressure	≤ 104 bar(a) / ≤ 1,515 psi
Back-pressure [bar(a)]	≤ 33 bar(a) / ≤ 480 psi
Type of wheel / blades	Curtis / Rateau impulse
API 611 & 612 compliant	Yes
Bearings	Tiltpad / Sleeve

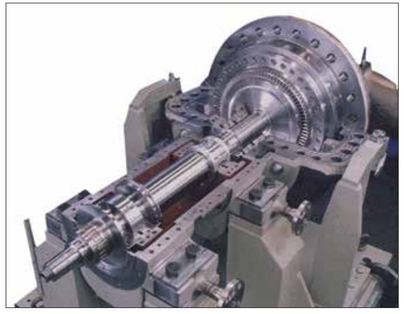
D-R AVTTW / GTW

Single stage steam turbine

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

Typical applications

- Pump and fan drives
- Compressor drives



Technical Data

D-R AVTTW / GTW	
Power output	4,500 kW / 6,000 HP
Turbine speed	≤ 14,500 rpm
Inlet steam temperature	≤ 550 °C / ≤ 1,022 °F
Inlet Steam pressure	≤ 125 bar(a) / ≤ 1,813 psi
Back-pressure [bar(a)]	≤ 40 bar(a) / ≤ 508 psi
Type of wheel / blades	Curtis / Rateau Impulse
API 611 compliant	Yes (with comments)
Bearings	Tiltpad / Sleeve

D-R C

Single stage steam turbine

- Radially split casings
- Direct drive or Integral Gear operation
- Overhung rotor design
- Multi-Valve or Single Valve Inlet
- Marine Classification approval
- Auto / Quick start ability
- Carbon ring or labyrinth glands
- Nadrowski heritage

Typical applications

- Waste to Energy
- Biomass Plants
- Marine Applications
- Chemical Industries
- Paper / Suger Mills
- ORC
- Waste heat recovery

Technical Data

D-R C	
Power output	2,500 kW / 3,250 HP
Turbine speed	≤ 8,500 rpm
Inlet steam temperature	≤ 520°C / 986 °F
Inlet steam pressure	≤ 120 bar(a) / 1,740 psi
Back-pressure	21 bar(a) / 315 psi
Condensing pressure	vacuum
Type of wheel / blades	Curtis / Rateau Impulse
API 611 & 612 compliance	with exception
Bearings	Tiltpad / Sleeve

D-R GAF

Standard multi-stage steam turbine

Typical applications

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

D-R GAF

- Condensing or back pressure steam turbine
- Horizontal casing split
- Between bearings rotor design
- Max. 6 stages
- Single valve inlet
- API 611 or 612 design
- Terry heritage

Technical Data

	D-R GAF
Power output	3,500 kW / 4,690 HP
Turbine speed	≤ 6,000 rpm
Inlet steam temperature	≤ 440 °C / 825 °F
Inlet steam pressure	≤ 49 bar(a) / 715 psi
Back-pressure	≤ 6 bar(a) / ≤ 87 psi
Condensing pressure	vacuum

Type of Blading	Impulse
API 611 & 612 compliance	Yes
Bearings	Tiltpad / Sleeve

D-R B

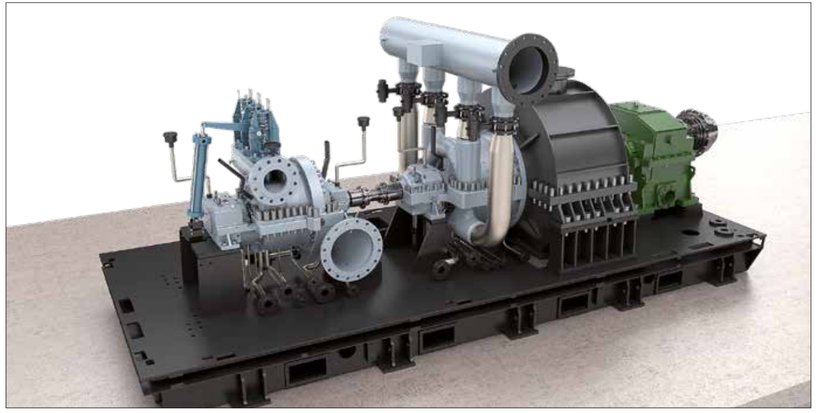
Standard multi-stage steam turbine

Typical applications

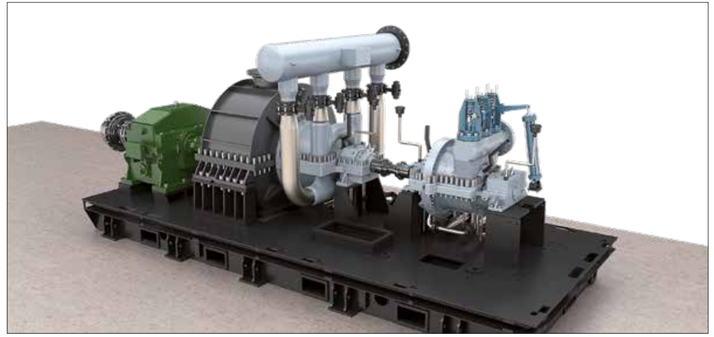
- Turbogenerator sets
- Mechanical drives
- Sugar mills
- Pulp and paper mills
- Metall & Steel
- Waste to energy plants
- Marine applications
- Waste heat recovery

D-R B

- Low cost design for high efficiency
- Multivalve inlets
- Multiple uncontrolled bleeds
- External controlled induction
- Double shaft end
- Available as single casing or multiple (tandem) casing machine
- Compact integral package designs
- Multiple externally controlled bleeds



B5-B7 Tandem



D-R B Tandem

- Multivalve inlets
- Multiple uncontrolled bleeds
- Single automatic controlled extraction / induction
- Extraction pressure up to 40 bar
- Nadrowski heritage

Technical Data

	D-R B	D-R Tandem
max. Power output	11 MW	12,5 MW
Turbine speed	≤ 9,500 rpm	8,500
Inlet steam temperature	≤ 500°C / 932°F	≤ 530°C / 986°F
Inlet Steam pressure	≤ 65 bar(a) / 942 psi	≤ 121 bar(a) / 1,750 psi
Back-pressure	13 bar(a) / 189 psi	≤ 13 bar(a) / 188 psi
Condensing pressure	vacuum	vacuum
Type of wheel / blades	Impulse	Impulse
API 611 & 612 compliant	No	No
Bleedings / Extractions	Multiple / one	Multiple / 1
Bearings	Tiltpad or Sleeve	Tiltpad or Sleeve

D-R R/RS

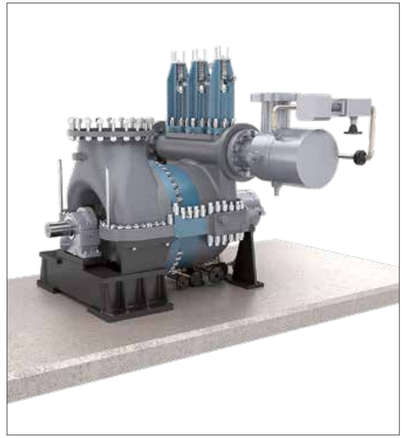
Standard multi-stage steam turbines

Typical applications

- API 611/612 compressor, fan and pump drives
- Turbogenerator sets, oil & gas and industrial
- Oil & gas, refineries
- Chemical plants
- Food and beverage
- Sugar mills
- Pulp & paper mills
- Waste to energy plants
- Biomass/palm oil plants
- Waste heat recovery

- Single valve or multivalve inlets
- Multiple uncontrolled bleeds
- Single automatic controlled extraction/induction
- 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
- Murray heritage



Technical Data

D-R R/RS	
Power output	25,000 kW / 33,500 HP
Turbine speed	≤ 15,000 rpm
Inlet steam temperature	≤ 510 °C / ≤ 950 °F
Inlet steam pressure	≤ 67 bar(a) / ≤ 972 psi
Back-pressure	≤ 19 bar(a) / ≤ 415 psi
Condensing pressure	vacuum
Type of Blading	Impulse
API 611 & 612 compliance	Yes
Bearings	Tiltpad or sleeve
Bleeds	Multiple/one

Pressure capability increases above 950 psig at reduced temperature.

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
- Up to 12 stages
- Murray heritage

Technical Data

D-R K	
Power output	4,850 kW / 6,500 HP
Turbine speed	≤ 10,000 rpm
Inlet steam temperature	≤ 389 °C / ≤ 750 °F
Inlet steam pressure	≤ 28,5 bar(a) / ≤ 415 psi
Back-pressure	≤ 6 bar(a) / ≤ 90 psi
Condensing pressure	vacuum
Type of Blading	Impulse
API 611 & 612 compliance	No
Bearings	Tiltpad, Sleeve

Typical applications – K

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

Reference examples

Our steam turbines meet customer requirements for economic installation and operation as well as providing excellent flexibility for complexl 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.

Reference examples Steam Power Plants

Ultra-supercritical steam power plant Lünen, Germany

Lünen is the cleanest and most efficient hard-coal-fired power plant in Europe. It provides 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 CO_2 every year.

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

Ultra-supercritical steam power plant Waigaoqiao III, China

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.
In 2009, Waigaoqiao III was "Asian Power Plant of the Year" and got an "Asian Power Award".

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

Ultra-supercritical steam power plant Isogo, Japan

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 Yuhuan, China

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

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 ecofriendly electricity to local mines and to people living in the region.

The power generation solution for island off-grid operation matching the variable power demand of the adjacent copper mine.

Two power islands consisting each of:
- 2 × SGT-800 gas turbines and 1 × SST-400 steam turbine
- 2 × heat-recovery steam generators

Power output:	242 MW
Commercial 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:	SCC6-5000F 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:	85 bar / 1,305 psi
Inlet temperature:	540 °C / 1,004 °F

Afval Energie Bedrijf
Amsterdam / Netherland

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 %. This 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 materials 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 MWe electricity in summer and 15.06 MWe plus 37 MWth for district heating in winter, the plant reduces Vienna's CO_2 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" *Tangay Carrabin, Project manager at CNIM*

Power output:	25.15 MW
Speed:	5,300 rpm
Live steam pressure	58 bar(a)
Live steam temperature:	397 °C
Customer:	CNIM
Operator:	FCC Environment

Reference examples 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.

Parabolic trough (Oil)
50 MW(e) each

Steam turbine:	2 × Siemens SST-700
Power output:	2 × 50 MW(e)
Inlet steam pressure:	100 bar / 1,450 psi
Inlet steam temperature:	377 °C / 711 °F

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 electricity to the US utilities PG & E and Southern California Edison. The whole complex generates enough electricity to power more than 140,000 homes.

Solar Power Tower (Water / Direct Steam)
3 plants, 392 MW(e) in total

Steam turbine: 3 × Siemens SST-900
Turbine data for the first plant:

Power output:	123 MW(e)
Inlet steam pressure:	160 bar / 2,321 psi
Inlet steam temperature:	540 °C / 1,004 °F

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.

Linear Fresnel (Water / Direct Steam)
1.4 MW(e)

Steam turbine: Siemens SST-120

Power output:	1.4 MW(e)
Inlet steam pressure:	55 bar / 798 psi
Inlet steam temperature:	270 °C / 518 °F (saturated steam)

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 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

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
Inlett 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 expanded to an internationally engaged enterprise acting in China, Lao, Australia and other countries.

With a transparent management system that is accountable to the public and takes good care of natural environment for more than 55 years, Mitr Phol Group has been honored with a number of prestigious awards both at the national and international levels, e. g. ASEAN Energy Awards 2011.

Technology	SST-300
Complete	2010
Power output:	26 MW
Switchable bleed for deaerator	

Grupo Delta Sucroenergia / Brazil

Biggest turbine in the sugar-ethanol sector

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

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-manure. 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:	6,800 rpm
Inlet steam pressure:	86 ata
Inlet steam temperature:	510 °C / 950 °F
Exhaust steam pressure:	0.1 ata

Reference examples Pulp and Paper

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 Mill's power plant.

Technology	2 × 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

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

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.

Power output:	190 MW
Speed:	3,600 rpm
Inlet steam pressure:	100 bar / 1,450 psi
Inlet steam temperatue:	498 °C / 928 °F
Extraction pressure:	10 bar / 145 psi
Exhaust pressure:	5.4 bar / 78,3 psi

Reference examples Dresser Rand

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

Application: Mechanical drive for feed water pumps, boiler fans, hydraulics, generators, slurry pumps, fire systems.

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 RLH24 has earned over the years.

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

KNPC New Refinery Single Stage, Mechanical Drive steam turbines Kuwait

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
Models:	Variety of models to meet power and steam condition
Const. year:	2018 expected completion

Steam Turbine Applied as a Gas Expander Emergency Shut Down Drive Approximately 85 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 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.

Performance data overview

Steam turbine type	Output SPP MW	Output CCPP MW	Net efficiency SPP %	Net efficiency CCPP %	Frequency Hz	Inlet pressure bar/psi	Inlet temperature °C/°F	Reheat temperature °C/°F	Rotational Speed rpm		Controlled extraction bar/psi	Controlled extraction temperature °C/°F	Uncontrolled extraction bar/psi	Exhaust Pressure (back) bar/psi	Exhaust Pressure (cond.) bar/psi	Exhaust Pressure (distr) bar/psi	Last stage blade length 50 Hz cm/inches	Last stage blade length 60 Hz cm/inches
SST-9000	1,000–1,900				50/60	80/1,160	310/590		3,000–3,600								117 to 183/46 to 72	107 to 142/42 to 56
SST-6000	300–1,200		46,5 (Double reheat 48)		50/60	330/4,786	600/1,112	600/1,112	3,000–3,600								66 to 142/26 to 56	66 to 95/26 to 38
SST-5000	200–500	120–700	43 (subcritical) 46,4 (supercritical)	61.5	50/60	260/3,771 (SPP) 177/2,567 (CCPP)	600/1,112 (SPP) 600/1,112 (CCPP)	610/1,130 (SPP) 610/1,130 (CCPP)	3,000–3,600								66 to 142/26 to 56	66 to 95/26 to 38
SST-4000		100–500			50/60	105/1,523	565/1,049		3,000–3,600								80 to 115/31 to 45	76 to 95/30 to 38
SST-3000		90–250			50/60	177/2,567	565/1,049	610/1,130	3,000–3,600								80 to 115/31 to 45	76 to 95/30 to 38
SST-700/900	≤250	≤230			50/60	180/2,611	585/1,085	565/1,049	3,000–3,600		72/1,044		Up to 7		0.3/4.4		79.8 to 114.6/31.4 to 45.1	76.2 to 95.4/30 to 37.6
SST-800	≤200	≤200			50/60	165/2,393	565/1,049		3,000–3,600		72/1,044		Up to 7	72/1,044	0.3/4.4	3/43	79.8 to 114.6/31.4 to 45.1	76.2 to 95.4/30 to 37.6
SST-600	≤200	≤200			50/60	165/2,393	565/1,049		3,000–18,000		72/1,044 (up to 2)	480/895	85/1,233 (up to 6)	80/1,160	1.0/15	3/43	79.8 to 114.6/31.4 to 45.1	76.2 to 95.4/30 to 37.6
SST-500	≤100				50/60	30/435	400/750		15,000		none		up to 2		0.5/7.25	1.5/21.75		
SST-400	≤60				50/60	140/2,030	540/1,004		3,000–8,000		45/653 (up to 4)	450/842	60/870	25/365	0.3/4.4			
SST-300	≤45				50/60	140/2,030	540/1,004		12,000		25/363 (up to 2)	400/752	60/870	16/232	0.3/4.4	3.0/43.0		
SST-200	≤20				50/60	120/1,740	540/1,004		14,600		1	350/562	Up to 3	20/290	≥0.50/7.3			

Performance data overview

Steam turbine type	Power output kW	Inlet Pressure bar/psi	Inlet Temperature °C/°F	Rotational Speed rpm	Uncontrolled extraction bar/psi	Exhaust Pressure (back) bar/psi	Exhaust Pressure (cond.) bar/psi	Bearings	Tpye of wheel/blades	API compliant
D-R RLA/RLVA	745 1,000 (HP)	47/682	440/824	4,300–6,000		22/300		Ball bearing journal & thrust	Impulse	611
D-R RLH	1,865 2,500 (HP)	97/1,414	482/900	6,000		21/300		Ball and sleeve bearing designs	Impulse	611
D-R SST 350/500/700	750 1,000 (HP)	63/914	482/900	12,000		21/315		Tiltpad/Ball/Sleeve	Impulse	611/612
D-R 2TA	3,640 4,880 (HP)	104/1,515	530/986	12,500		33/480		Tiltpad/Sleeve	Impulse	611/612
D-R AVTTW/GTW	4,500 6,000 (HP)	125/1,813	550/1,022	14,500		40/508		Tiltpad/Sleeve	Impulse	611/612
D-R C	2,500 3,250 (HP)	121/1,785	520/986	8,500		21/315	vacuum	Tiltpad/Sleeve	Impulse	611 with exceptions
D-R GAF	3,500 4,690 (HP)	49/715	440/825	6,000		6/87	vacuum	Tiltpad/Sleeve	Impulse	611/612
D-R R/RS	25,000 33,500 (HP)	67/972	510/950	15,000	1 or multiple	19/415	vacuum	Tiltpad/Sleeve	Impulse	611/612
D-R K	4,850 6,500 (HP)	28.5/415	389/750	10,000		6/90	vacuum	Tiltpad/Sleeve	Impulse	no
D-R B	11,000 14,750 (HP)	65/942	500/932	9,500	1 or multiple	13/189	vacuum	Tiltpad/Sleeve	Impulse	no
D-R B Tandem	12,500 16,750 (HP)	121/1,750	530/986	8,500	1 or multiple	13/188	vacuum	Tiltpad/Sleeve	Impulse	no

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