



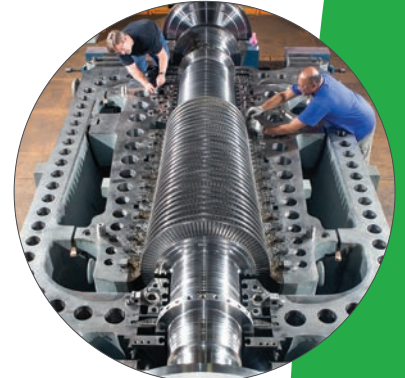
GE Power

COMBINED CYCLE

# STEAM TURBINES

POWER AND PERFORMANCE

Over the last 100 years, GE has delivered more than 1.2 TW of power production capability totaling over 41 percent of the world's installed steam turbine base. With unparalleled global experience in engineering, manufacturing, sourcing, and services, we are delivering advanced technology steam turbine products to ensure our customers are more profitable, successful and satisfied than ever before.



## Solutions to Meet Your Power Needs

GE's steam turbine portfolio has the breadth and depth to help ensure that your specific site, operational, steam cycle, and application needs are met. We work with you from the earliest stages of your project, through construction, commissioning, and operation to provide a highly efficient and cost effective turbine that integrates smoothly with the gas turbine and overall plant operations.

## Experience, Strength and Stability

A systematic and evolutionary platform approach incorporates best practices and technology improvements based on years of experience. Our best-in-class engineering and manufacturing centers around the world enable us to provide an industry-leading portfolio of steam turbine products.

## Advanced Technology Features

### High Efficiency Steam Paths

- High reaction 3-D blade and nozzle airfoils are designed for high pressure (HP), intermediate pressure (IP), and low pressure (LP) steam conditions to achieve industry-leading performance.

- Integral covered blades with continuous contacting surfaces provide excellent damping capability for superior mechanical integrity.
- Nozzle design provides precise control of radial clearances and throat areas to help ensure greater output and efficiency.

### Welded Rotors

- With more than eight decades of welded rotor experience, our designs are proven and reliable.
- Better access for ultrasonic testing equipment translates to higher reliability.

### Advanced Sealing Features

- Shaft and tip brush seals, developed in conjunction with our global research organization, improve leakage control when compared to more conventional sealing technology.
- Abradable coatings on stationary seals enable the reduction of radial clearances, decreasing long-term performance degradation.

### Shrink Ring Design

- GE's unique and proven shrink ring design reduces distortion, allowing critical clearances to be maintained and sustaining performance over the life of the machine.

- Compact design with smaller wall thickness provides flexible load cycling and faster startup times.

### Family of High Efficiency Last Stage Blades

- We offer a comprehensive family of last stage blades to meet your project's specific conditions.
  - Up to 50 inch (1270 mm) for 60 Hz
  - Up to 60 inch (1524 mm) for 50 Hz
- Robust mechanical design features enable high reliability.
- Features such as full tip shroud, enhanced tip section with low shock loss, aerodynamic part span connector, and increased root-reaction improve steam turbine performance.
- Advanced radial vortexing improves performance and hood integration over a range of loads.

### Self Synchronizing Clutch

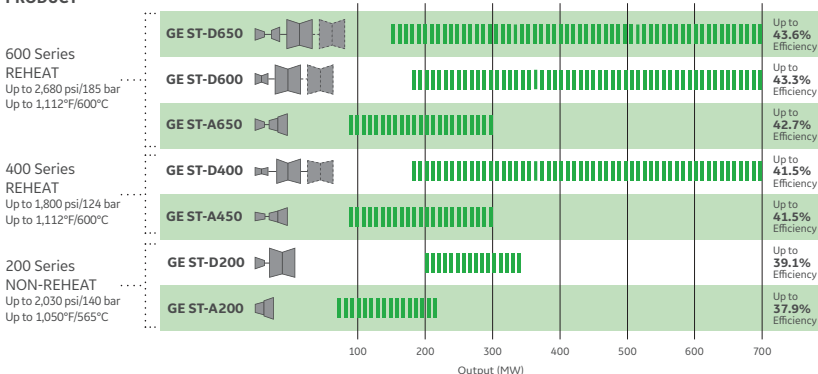
Reduces auxiliary startup steam demand and enables the gas turbine to reach 85 percent load in less than 20 minutes for hot start conditions.

### LP Side Exhaust

Available for all D-series machines and enables ground level condenser connections, reduced centerline height, BOP equipment to be located on one side and lower plant construction costs.

## Combined Cycle Steam Turbines

PRODUCT



## Proven Validation Methods

- GE thoroughly tests hardware to ensure every machine meets the reliability and performance standards our customers demand.
- The Low Pressure Development Turbine, located in Schenectady, NY, USA, is a key element out of our multiple test facilities. This test facility uses steam to test our LP designs for both mechanical robustness and aerodynamic efficiency.

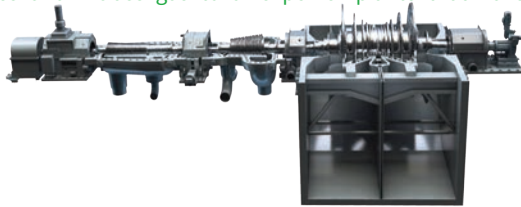


REHEAT

## D650 STEAM TURBINE

THREE CASING, DOUBLE-FLOW LP SECTION, COMBINED CYCLE STEAM TURBINE

The D650 is GE's highest-performing combined cycle steam turbine and delivers the reliability and availability needed in today's demanding energy environment. It is ideally suited for 50 Hz and 60 Hz H-class and F-class gas turbine power plants that have high fuel costs and high annual hours of operation. The single-shaft configuration incorporates a clutch for enhanced operational flexibility. The D650 turbine consists of separate HP, IP, and either one or two double-flow LP sections.



	D650
Main Steam	Up to 2,680 psi (185 bar) Up to 1,112°F (600°C)
Reheat Temperature	Up to 1,112°F (600°C)
Frequency	50 Hz and 60 Hz
Output	150 MW-700 MW
Steam Turbine Efficiency	Up to 43.6%

### Built for Efficiency and Reliability

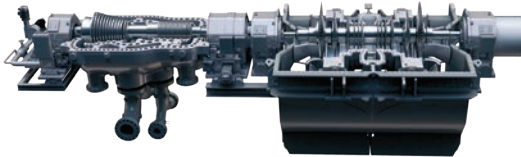
- Shared bearing design between sections reduces construction time, increases power density and enhances reliability by avoiding load shifts.
- HP, IP and valve units are shipped fully assembled.

REHEAT

## D600/D400 STEAM TURBINES

TWO CASING, DOUBLE-FLOW LP SECTION, COMBINED CYCLE STEAM TURBINE

GE's D600 and D400 steam turbines primarily support H-class and F-class gas turbine combined cycle plants. They were developed for highly efficient power generation in large, single-shaft or multi-shaft plants and for sites with low condenser pressure. GE's D600 and D400 steam turbines feature a combined HP and IP section and either one or two double-flow LP sections.



	D600	D400
Main Steam	Up to 2,400 psi (166 bar) Up to 1,112°F (600°C)	Up to 1,800 psi (124 bar) Up to 1,112°F (600°C)
Reheat Temperature	Up to 1,112°F (600°C)	Up to 1,112°F (600°C)
Frequency	50 Hz and 60 Hz	50 Hz and 60 Hz
Output	180 MW-700 MW	180 MW-700 MW
Steam Turbine Efficiency	Up to 43.3%	Up to 41.5%

### Architecture for Reliable Performance

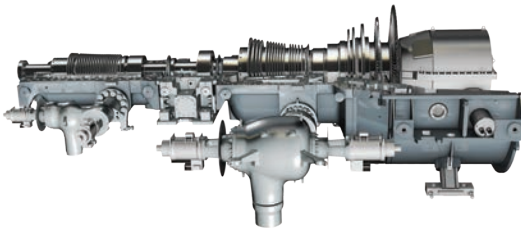
- Combined HP/IP section provides high power density, and side- or down-flow LP exhaust provides layout flexibility.
- One or two, double-flow LP modules enable enhanced performance at sites with low condenser pressure.

REHEAT

## A650/A450 STEAM TURBINES

AXIAL EXHAUST, HIGH EFFICIENCY, COMBINED CYCLE STEAM TURBINES

GE's A650 and A450 combined cycle steam turbines deliver performance, reliability, and high shaft efficiency for today's 50 Hz and 60 Hz applications. They can be applied in both single-shaft and multi-shaft combined cycle plants, with the single-shaft configuration incorporating a clutch for enhanced operational flexibility. These turbines have a separate HP section and combined IP and LP sections.



	A650	A450
Main Steam	Up to 2,680 psi (185 bar) Up to 1,112°F (600°C)	Up to 1,800 psi (124 bar) Up to 1,112°F (600°C)
Reheat Temperature	Up to 1,112°F (600°C)	Up to 1,112°F (600°C)
Frequency	50 Hz and 60 Hz	50 Hz and 60 Hz
Output	85 MW-300 MW	85 MW-300 MW
Steam Turbine Efficiency	Up to 42.7%	Up to 41.5%

### High Performance in a Compact Footprint

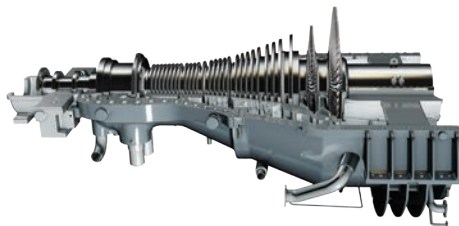
- Fully assembled HP and IP/LP sections reduce installation times by up to three months.
- Compact, cost-effective configurations for both single-shaft and multi-shaft combined cycle plants.
- Available with down or straight axial exhaust to meet specific plant needs.

NON-REHEAT

## D200/A200 STEAM TURBINES

DOUBLE-FLOW AND AXIAL FLOW, NON-REHEAT COMBINED CYCLE STEAM TURBINES

GE's D200 and A200 steam turbines are ideal for non-reheat applications. The D200 is a two casing, double-flow LP machine, and the A200 is a compact axial exhaust design available in either a single or double casing. Both models are available with internally and externally controlled extractions to remove steam at any point along the steam path at the desired flow and pressure conditions. They are ideal for combined cycle conversion projects, when a bottoming cycle is added to an existing simple cycle plant to increase power output and efficiency upwards of 50 percent.



	D200	A200
Main Steam	Up to 2,030 psi (140 bar) Up to 1,050°F (565°C)	Up to 2,030 psi (140 bar) Up to 1,050°F (565°C)
Reheat Temperature	N/A	N/A
Frequency	50 Hz and 60 Hz	50 Hz and 60 Hz
Output	200 MW-340 MW	70 MW-220 MW
Steam Turbine Efficiency	Up to 39.1%	Up to 37.9%

### D200: Delivering Cost and Performance

- HP ships fully assembled, enabling a five-month installation.

### A200: Compact and Robust

- Single casing design ships fully assembled, enabling a four-month installation.
- Depending on machine size, factory tested pre-packaged units are available to minimize installation and startup times.