

# The Market for Steam Turbines for Combined-Cycle Installation

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Product Code #F643

A Special Focused Market Segment Analysis by:





# Analysis 5

## The Market for Steam Turbines for Combined-Cycle Installation 2010-2019

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## PROGRAMS

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The following reports are included in this section: (**Note:** a single report may cover several programs.)

Alstom Steam Turbines  
Ansaldo Steam Turbines  
Fincantieri Steam Turbines  
Fuji Steam Turbines  
GE Oil & Gas Steam Turbines  
General Electric Steam Turbines  
Hitachi Steam Turbines  
Kawasaki Steam Turbines  
LMZ Steam Turbines  
MAN TURBO Steam Turbines  
Mitsubishi Steam Turbines  
Siemens Steam Turbines  
Skoda Steam Turbines  
Toshiba Steam Turbines



## Introduction

Due to their thermal efficiency, rotary motion, and power-to-weight ratio, steam turbines continue to be a major asset for electrical power generation.

Steam turbine technology has a long history. Heron of Alexandria in Roman Egypt is reputed to have demonstrated the first steam turbine, the classic aeolipile, or reaction boiler, 2,000 years ago. In the 1800s, Dr. de Laval of Stockholm, Sweden, demonstrated that steam, expanded through a trumpet-shaped jet, could be used to drive a paddle attached to a shaft. In 1884, Sir Charles Parsons developed a multi-stage steam turbine, and, in 1891, he fitted it with a condenser, thereby allowing the machine arrangement to be used for electrical generation. This arrangement, attached to a dynamo, generated 7.5 kW of electricity. In Parson's lifetime this generating capacity would expand by a factor of 10,000.

Steam turbine technology is not new, and major strides in development are unlikely. However, its use in modern power plants continues to be widespread, fired by coal, oil, gas, or nuclear power. The growth in combined-cycle electrical generation stations has given the workhorse steam turbine a new lease on life.

During the past several years, steam turbines have been designed with emphasis on improved efficiency and reliability, and reduced operating costs. These goals have been accomplished by decreasing the steam flow energy losses in each of a steam turbine's components; optimizing the steam inlet into high-pressure turbines; improving blade design, including the use of new high-reaction blades that provide up to 4 percent greater efficiency; and utilizing highly efficient welded rotors (as opposed to integral forged rotors) constructed of materials best suited for a steam turbine's particular temperature zone (e.g., use of 12 percent Cr steel in high-temperature zones and 5 percent NiCrMoV steel in low-temperature zones).

In addition, welded rotors improve efficiency and capacity when used in HP and IP turbines. Also, the delivery time for welded rotors is less than that for forged rotors. Since welded rotors are designed with larger bores, thermal stresses are reduced during the machine's startup, enabling faster machine startup in general.

It should be noted here that some developments have been outside the steam turbines themselves. Electronic control and governing systems are dramatically lowering turbine costs. Electronic diagnostic systems and vibration measurement, both of which can be monitored remotely, can alert operators to possible

problems and allow them to take remedial action and prevent unplanned downtime. In addition, the use of electronics has served to reduce the number of personnel needed to monitor a combined-cycle plant.

Of all heat engines and prime movers, the steam turbine machine is close to the ideal, and it is widely used in electrical generation plants and in industries where industrial processes require power and/or heat, including pulp mills, refineries, petrochemical plants, food processing plants, desalination plants, and refuse incinerating and district heating plants.

Advantages of steam turbine machines include:

- Ability to use high-pressure and high-temperature steam
- High efficiency
- High rotational speed
- High capacity/weight ratio
- Smooth, nearly vibration-free rotational operation
- No internal lubrication – external journal and thrust bearings only
- Oil-free exhaust steam
- Machines can be built in either small or very large units (up to 1,200 MW)
- Disadvantages of steam turbine machines are:
- For slow-speed applications, reduction gears are required
- The steam turbine cannot be made reversible (outside of some marine applications, where overheating by windage is a limiting factor)
- The efficiency of small steam turbines is poor
- Saturated or corrosive steam severely limits blade life

The impulse steam turbine consists of a casing containing stationary steam nozzles and a rotor with moving or rotating buckets. The steam passes through the stationary nozzles and is directed at high velocity against the rotor buckets, causing the rotor to rotate at high speed.

In the nozzles, the steam pressure decreases, the enthalpy of the steam decreases, the steam velocity increases, and the volume of the steam increases. Heat energy resulting from the decrease in steam enthalpy is converted into kinetic energy by the increased steam

**Continued...**

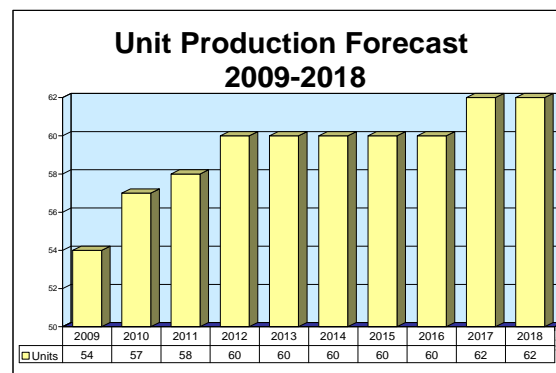




# General Electric Steam Turbines

## Outlook

- Production to increase as order pattern accelerates
- F-series technology gas turbine machines will be the strongest combined-cycle sales segment during forecast period; sales of steam turbines for F-series to be strong in the decade
- Use of large steam turbines by merchant power providers expected to rise
- Asia could become strong sales arena for GE steam turbine line



## Orientation

**Description.** The General Electric Company (USA) is a full-line supplier of steam turbines for use in nuclear or fossil utility power production, industrial processes, and power generation applications. It manufactures reheat, non-reheat, condensing, back-pressure, and single- and multiple-auto-extraction machines for 50/60-Hz duty.

**Note:** This report does not cover the steam turbines manufactured by GE Energy's GE Oil & Gas (and, in this regard, does not cover the former Nuovo Pignone and Thermodyn units).

**Sponsor.** The GE line of steam turbines for combined-cycle applications was privately developed by the prime manufacturer.

**Power Class.** In the electrical generation arena, GE Energy's steam turbines span the power output range up to 1,200 MW.

**Status.** In production.

**Total Produced.** At the start of the forecast period, GE had produced and installed over 5,728 steam turbines worldwide, including for combined-cycle applications. It has built more than 200 steam turbine-generator units totaling more than 15,000 MW of capacity for application in both reheat and non-reheat combined-cycle power plants.

**Application.** The focus of this report is large steam turbine machines (20 MW and larger) used with gas turbine generators in combined-cycle duty.

**Price Range.** Forecast International estimates a price range of \$6-\$50 million for steam turbines whose outputs are in the range of 3-200 MW when used in combined-cycle installations.

**Competition.** The steam turbine machines of several manufacturers worldwide compete with the GE Energy line of steam turbines.

## Contractors

### Prime

<b>General Electric Co</b>	<a href="http://www.ge.com">http://www.ge.com</a> , 3135 Easton Tpke, Fairfield, CT 06828-0001 United States, Tel: + 1 (203) 373-2211, Prime
<b>Hanjiang Machinery Plant</b>	PO Box 162, No 47 Hanjiang, Xi'angfan, 441002 China, Tel: + 86 710 224233, Fax: + 86 710 224613, Licensee

## General Electric Steam Turbines

<b>Toshiba Corp</b>	<a href="http://www.toshiba.co.jp">http://www.toshiba.co.jp</a> , 1-1, Shibaura, 1-chome, Minato-ku, Tokyo, 105-8001 Japan, Tel: + 81 3 3457 4511, Fax: + 81 3 34556 1631, Co-producer
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Comprehensive information on Contractors can be found in Forecast International's "International Contractors" series. For a detailed description, go to [www.forecastinternational.com](http://www.forecastinternational.com) (see Products & Samples/Governments & Industries) or call + 1 (203) 426-0800.

Contractors are invited to submit updated information to Editor, International Contractors, Forecast International, 22 Commerce Road, Newtown, CT 06470, USA; [rich.pettibone@forecast1.com](mailto:rich.pettibone@forecast1.com)

## Technical Data

General Electric's steam turbines for power generation applications are manufactured in an impulse design or a reaction design, or a combination of the two. Condensing and non-condensing sets are available, with their exhaust oriented upward, downward, to either side, or axially. Steam extraction and admission can be through single or multiple points as needed. Shafts can either be directly connected to a gas turbine or be gear-driven. Geared turbines are in the output range of 3-35 MW, while directly connected steam turbines are in the output range of 20-130 MW.

**Design Features.** The combined-cycle steam turbine line offered by GE is made up of modular components in order to achieve the cost and reliability benefits offered by standardization without compromising performance. Modules include the supports (or bearing standards), inlet sections, inlet and extraction valve gear, and exhaust modules.

Modules are selected to optimize performance as dictated by a user's specific operating conditions. The pre-engineered modules are assembled around a custom barrel section, and selected for the flow path desired for a given installation.

**Rotors.** The stage rotors are forged from single, solid pieces of treated steel alloy. This eliminates susceptibility to fretting and loosening of shrunk-on components. Once the blades/buckets are attached, the

rotor is dynamically high-speed balanced for smooth operation.

**Blades/Buckets.** The steam path has been substantially refined based on experience drawn from GE's development work with aviation gas turbines. For example, bucket profiles have been refined to eliminate flow separation and reduce pressure losses. The refinement of buckets, nozzles, and exhaust hoods has brought about efficiency improvements of 1-2 percent.

Buckets are designed with either tangential-entry or finger-type dovetails; covers are added to attenuate vibration.

**Bearings.** Either tilting-pad or fixed-bore journal bearings are used, depending on performance requirements. Both types are designed to handle heavy loads with stability and provide smooth operation. Either fixed-geometry or tilting-pad thrust bearings are used.

**Turbine Shells.** The IP and HP turbine shells are of alloy steel, with metal-to-metal joints. Each casing is machined to match its diaphragms, then X-rayed, and hydrostatically and ultrasonically tested.

**Turbine Controls.** Steam turbine controls are digital and triple redundant and auto-synchronizing, and include selectable monitoring features.

## Variants/Upgrades

**Non-Reheat Steam Turbines.** GE's non-reheat steam turbines are available in single-casing/single-flow or double-casing/double-flow configurations. GE's flexible and reliable non-reheat line is well proven in combined-cycle, cogeneration, district heating, industrial, and small power generation applications around the globe. These turbines are optimized for combined-cycle applications in plants using GE's small to midsize heavy-duty gas turbines, including the 6F, 6C, 6B, 7E, and 9E, and for use with GE's LM6000 aeroderivative gas turbine.

Single-casing turbines feature a compact design, using an HP casing bolted to a single-flow, low-pressure

section, available in either an axial or down exhaust configuration. For larger non-reheat condensing applications, GE offers a two-casing design featuring a separate HP and a double-flow LP. For non-condensing applications, the HP and exhaust casing sections make up a single casing.

Combined-cycle applications utilize designs employing sliding pressure control with off-shell-mounted combined stop and control valves. Cogeneration

designs utilize fixed-pressure control with shell-mounted inlet and extraction control valves, enabling constant inlet pressure and precise process-extraction steam pressure control.

#### Features & Benefits

- Compact design, which maximizes power density.
- Single- or double-flow LP.
- Condensing and non-condensing designs.
- Up to two controlled extractions available (back-pressure dependent).
- Sliding-pressure and fixed-pressure control available.
- Suitable for base mounting; maximum factory assembly.
- Axial and down exhausts provide flexibility in plant arrangement.

#### Product Characteristics

- Power rating: up to 250 MW.
- Steam conditions: up to 1,800 psig/1,000°F.
- Arrangement: HP/LP - front or rear drive.

#### **Reheat Steam Turbines**

A Series Reheat Steam Turbines. According to the manufacturer, GE's A series reheat steam turbines deliver exceptional reliability and availability in today's demanding energy environment. The A series is optimized for maximum output and efficiency in GE steam and gas (STAG) combined-cycle systems.

#### Features & Benefits

- Designed for robust operation and rapid startup.
- Compact design maximizes power density.
- Separate HP casing.
- Combined IP/LP casing.
- Single-flow LP.
- Axial exhausts.
- Wide range of last-stage buckets accommodate site-specific back-pressure conditions.
- High-efficiency LP hood and diffuser.
- Robust low-pressure-drop combined stop and control valves.

#### Product Characteristics

- Power rating: 85-150 MW.
- Maximum steam conditions: 2,400 psig/1,050°F.

## General Electric Steam Turbines

- Arrangement: HP + combined IP/LP.
- LP designs:
  - 60 Hz: 1x20"/1x26"/1x33.5"/1x40"
  - 50 Hz: 1x33.5"/1x42"/1x48"

D Series Reheat Steam Turbines. GE's D series reheat steam turbines deliver high thermal efficiency in GE STAG combined-cycle systems. Available in 50- or 60-Hz single-shaft and multi-shaft configurations, the D series is designed for a wide range of inlet steam conditions and heat recovery steam generator (HRSG) firing capabilities. Structured designs provide customer benefits by standardizing many of the major components while maintaining the flexibility to adapt the D series to specific conditions.

#### Features & Benefits

- Structured steam path design minimizes design and delivery cycles.
- Pre-assembled single-shell HP/IP section reduces site installation time required: diaphragms pre-installed, rotor pre-installed and aligned.
- Standardized instrumentation package for enhanced operation and monitoring.
- Wide range of last-stage buckets accommodate site-specific back-pressure conditions.
- High-efficiency LP hood.
- Standardized parts platform allows for reduced spare parts inventories.
- Dense Pack-design HP/IP increases efficiency and lowers cost of electricity.
- Equipped with robust low-pressure-drop combined stop and control valves.

#### Product Characteristics

- Power rating: 120-425 MW.
- Maximum steam conditions: 1,920 psig/1,050°F.
- Arrangement: combined HP/IP 2 flow LP.
- Double-flow LP designs:
  - 60 Hz: 2x20"/2x26"/2x33.5"/2x40"
  - 50 Hz: 2x26"/2x33.5"/2x42"/2x48"

## General Electric Steam Turbines

### Program Review

**Background.** The General Electric Company (USA) started producing steam turbines for use by electric utilities around 1900, one of the first companies to do so. Today, General Electric is a full-line supplier of steam turbines for use in nuclear or fossil utility power production, and industrial process and power generation applications.

Steam turbine machines are produced in reheat, non-reheat, condensing, back-pressure, and single or multiple auto-extraction configurations for 50- and 60-Hz applications.

GE's industrial steam turbines range from 3-130 MW in power output. They are manufactured in an impulse design or a reaction design, or a combination of the two, depending on the most efficient and cost-effective solution for a given plant.

GE has produced and installed over 5,600 steam turbines worldwide. The company has more than 650 boiler-fed steam turbines in operation, and, since 1950, GE has placed more than 500 combined intermediate-pressure/low-pressure and high-pressure/intermediate-pressure steam turbines into service worldwide, including supercritical units.

The company reports that it can provide extended-scope, on-site maintenance and repair service for any GE plant/machinery, scheduled or unscheduled. GE has built more than 200 steam turbine-generator units totaling more than 15,000 MW of capacity for use in both reheat and non-reheat combined-cycle power plants.

GE states that it can provide a customer with a single turbine or build an entire turnkey facility, and can provide technical direction, site supervision, and management during all phases of construction if so contracted. It will also provide for receipt of material; coordination of special tooling, cranes and rigging; and supervision and monitoring of special contractors, and can aid in obtaining and directing craft labor.

The company reports that it is fully capable of preparing a customer for operation of its equipment. GE will provide training either on-site or at a GE facility to those who wish to operate and maintain their own plants. Each program is specifically drawn up to suit

the individual plant, and includes theoretical and practical applications regarding plant operations, installed equipment, daily operations, and routine maintenance.

**Advanced Design Steam Path.** In 1995, GE introduced its Advanced Design Steam Path (ADSP) uprate package that boosts turbine efficiency by up to 3 percent.

The ADSP includes new components, improved leakage control, and contouring. The thrust of this program has been to increase steam turbine efficiency by reducing aerodynamic and steam leakage losses in the steam path. This is accomplished by designing specific features that maximize overall turbine efficiency while maintaining high reliability. The focus has been on reducing secondary flow losses, improving the aerodynamic design of nozzles and blades, and providing new improved last-stage blades and new high-efficiency exhaust hood designs. Parallel programs have focused on improving sustained efficiency. This is being accomplished by developing improved steam leakage control devices, new nozzles, and coatings that greatly improve resistance to solid particle erosion.

The HP/IP section hardware includes a diffusion-coated new-design steam path for the first-stage nozzle box; advanced-design blades and diaphragms from the second-stage HP through the last stage of the IP; contoured sidewalls for the first and second stage of the HP and the first stage of the IP; GE's Diamond Tuff coating for the first-stage HP blades and the first-stage IP blades and nozzles; and advanced sealing for the blade tips, spill strips, and interstage packing. For the LP turbine, the hardware includes a first-stage inlet tub with contoured sidewall nozzles, one to three stages of advanced-design blades and diaphragms, and improved-design last-stage blades.

GE uses advanced materials and coatings to produce more-aerodynamic nozzles in order to enable more efficient operation in higher operating temperatures. For the same purpose, the company uses advanced materials and coatings to produce longer blades.

The ADSP package has been incorporated into all GE steam turbines currently in production and is retrofittable to most turbines.

## General Electric Steam Turbines

## GE Steam &amp; Gas Turbine (STAG) Power Plants

STAG Configuration	Frequency (Hz)	CC Output (unfired) (a)	Steam Turbine Code	Steam Turbine Generator Code
<b>I. Reheat Machinery</b>				
109H	50	520.0 MW	Toshiba	Toshiba
107H	60	400.0 MW	Toshiba	Toshiba
109FB SS	50	412.9 MW	GE A Series	450H
109FB MS	50	412.9 MW	GE A Series	9A5
209FB	50	825.8 MW	GE D Series	390H
107FB	60	280.3 MW	GE A Series	9A4
207FB	60	560.6 MW	GE D Series	7FH2/324
307FB	60	840.9 MW	GE D Series	390H/324
109FA SS	50	390.8 MW	GE D Series	390H
109FA MS	50	390.8 MW	GE A Series	9A4/9A5
209FA	50	781.6 MW	GE D Series	324/390H
107FA	60	262.6 MW	GE A Series	9A4
207FA	60	525.2 MW	GE D Series	7FH2/324
307FA	60	787.8 MW	GE D Series	390H/324
<b>II. Non-Reheat Machinery</b>				
109E	50	193.2 MW	SC (b)	7A6/9A4
209E	50	386.4 MW	SC	9A5
107E	60	130.2 MW	SC	6A8
207E	60	260.4 MW	SC	7A6
106F	50/60	117.7/118.1 MW	SC	6A8
206F	50/60	237.9/237.5 MW	SC	7A6
106B	50/60	64.3 MW	SC/MC	4-pole
206B	50/60	130.7 MW	SC	6A8
106C	50/60	62.8 MW	SC/MC	4-pole
206C	50/60	126.7 MW	SC	6A8
160 (c)	50/60	64.5/65.3 MW	SC/MC	4-pole
260 (c)	50/60	129.0/130.5 MW	SC	6A8
360 (c)	50/60	193.5/195.8 MW	SC	6A8
460 (c)	50/60	258.0/261.9 MW	SC	7A6

(a) Output is at ISO conditions for straight power generation application with no cogen or steam extraction.

(b) SC and MC are referred to by GE as "small steam turbines."

(c) Based on LM6000PC; other LM6000 configurations are available.

## Funding

It is unknown whether the GE line of steam turbines was developed wholly with internal resources or whether outside resources were used as well. GE has worked with Toshiba and other firms – through the GE Power Funding Corp – to provide funding to customers in acquiring GE and GE Oil & Gas (here Nuovo Pignone-design and Thermodyn-design) steam turbines.

## Contracts/Orders & Options

GE Energy and its partners have been very active in garnering combined-cycle power plant orders. In most instances, GE Energy does not reveal the steam turbine machine designation and its power output in announcements of new orders. Notably, cancellation of eight large power plants due to the KKR/TXU buyout deal in 2007 did not lead to any layoffs in Schenectady, as GE's order book was sufficiently full to absorb this change.

## General Electric Steam Turbines

The following is representative of orders for which GE Energy steam turbines are part of the equipment package.

<u>Contractor</u>	<u>Award (in millions)</u>	<u>Date/Development</u>
GE Energy	Not Available	May 2010 – GE has received a contract of nearly \$300 million to supply five steam turbines for a major expansion of the Saudi Electricity Company's (SEC) Qurayyah Open Cycle Power Plant in Saudi Arabia's Eastern Province. The five steam turbines will join 15 GE F-technology gas turbines already operating at the site, converting the plant to combined-cycle operation to help Saudi Arabia meet its goals for greater power generation capacity and efficiency.

## Timetable

<u>Month</u>	<u>Year</u>	<u>Major Development</u>
	1950	GE introduces first high-power-density steam turbine (opposed-flow HP and IP sections in a single casing)
	1983	SPEEDTRONIC Mark VI turbine control introduced
Jan	1995	Advanced Design Steam Path uprate package announced
	1998	Introduction of D11S "structured" turbine; DX2 launched late in year
	1999	DX2 Dense Pack turbine design unveiled at PowerGen International
Mid-	2005	A14HEAT turbine begins operation
Thru	2019	Continued production of GE steam turbines

## Worldwide Distribution/Inventories

At the start of the forecast period, GE had produced and installed more than 5,728 steam turbines worldwide, including those for combined-cycle applications. It has built more than 200 steam turbine-generator units totaling over 15,000 MW of capacity for application in both reheat and non-reheat combined-cycle power plants.

## Forecast Rationale

In 1997, General Electric recognized a requirement to standardize its steam turbine designs for combined-cycle applications. Pending deregulation brought about the need to shorten delivery cycles as the demand for new combined-cycle power generation grew.

GE's first move was to standardize its D11 steam turbine design to shorten delivery time to 12 months. This was done by standardizing as many parts and assembling as much of the turbine (basically the HP/IP sections) as possible prior to delivery. GE has also sharpened up its business by forecasting production volume to reliable suppliers. It also provides fairly standardized turbine dimension information so that site designers can organize and assemble installation equipment and ancillary systems in a timely manner.

GE then introduced the DX2 steam turbines to offer the same "structured" benefits and yet with greater operating efficiency. GE is also structuring the already established A-10 turbine and is working the approach into new designs being developed.

This structuring philosophy and the increased efficiency of GE's steam turbine offerings have no doubt helped secure large contracts from a number of independent power companies such as Duke and Calpine.

GE Energy's steam turbines are projected to sell well in the U.S. but will continue to face stiff competition from other steam turbine majors such as Alstom, LMZ, Siemens, and Mitsubishi.

The GE steam turbines that will be the most actively ordered for the next several years are those that are best matched to the most popular gas turbines GE offers for combined-cycle installations. The D11 series are selling along with Frame 7F and Frame 9F machines, resulting in strong production in the 125-199 MW range where two gas turbines are paired to one steam turbine, as in the S207FA 60-Hz or S209FA 50-Hz systems. Production is also strong for the pairing of steam turbines with individual Frame machines, S107FA packages in particular. When matched one-on-one (separate shafts, two generators), steam turbine production is greatest in the 50-124 MW power band.

## General Electric Steam Turbines

The popular S206FA 60-Hz package falls into the 50-124 MW power band as well.

The forecast for the 200+ MW steam turbine power band largely represents turbines coupled with pairs of Frame 7H and Frame 9H machines. We continue to foresee slow but steady growth in production of the very large Frame 9H for 50-Hz applications.

Frame 6, 7, and 9 F series machines will continue to be widely sold worldwide as the decade progresses. GE's new DX2 steam turbines should be the type most frequently matched with FA and FB series technology, including with some competing producers' gas turbines.

Overall, in the decade forecast, we project that GE Energy will manufacture 603 steam turbines for combined-cycle installation.

## Ten-Year Outlook

ESTIMATED CALENDAR YEAR UNIT PRODUCTION												
Designation or Program		High Confidence				Good Confidence			Speculative			
	Thru 2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total
<b>General Electric Co</b>												
<b>GE Steam Turbine Series &lt;= MW 50.0 to &lt;125.0 &lt;= Combined-cycle Generation, Steam</b>												
	3,042	16	18	18	20	20	21	22	22	24	24	205
<b>GE Steam Turbine Series &lt;= MW 125.0 to &lt;200.0 &lt;= Combined-cycle Generation, Steam</b>												
	1,950	18	19	20	20	20	20	19	19	19	19	193
<b>GE Steam Turbine Series &lt;= MW &gt;=200.0 &lt;= Combined-cycle Generation, Steam</b>												
	736	20	20	20	20	20	19	19	19	19	19	195
<b>Subtotal</b>	5,728	54	57	58	60	60	60	60	60	62	62	593
<b>Total</b>	5,728	54	57	58	60	60	60	60	60	62	62	593





# FORECAST INTERNATIONAL

## ORDER FORM FOR PROPER SHIPPING, PLEASE PROVIDE ALL OF THE FOLLOWING INFORMATION.

Name \_\_\_\_\_ Title \_\_\_\_\_

Company \_\_\_\_\_

Street Address \_\_\_\_\_

City \_\_\_\_\_ State/Prov. \_\_\_\_\_ Country \_\_\_\_\_ Zip \_\_\_\_\_




Phone \_\_\_\_\_ Fax \_\_\_\_\_


E-Mail \_\_\_\_\_

Cardholder Name \_\_\_\_\_

Card# \_\_\_\_\_ Exp. \_\_\_\_\_ csc# \_\_\_\_\_

Billing Address (if different from above) \_\_\_\_\_

- ☐ Check Enclosed  
☐ Bill Company  
(Purchase Order # and Signature Required)  
☐ Quotation Requested  
☐ VISA  ☐ MasterCard   
☐ American Express 

Name of Product/Service	Code	E-Mail Address	Qty.	Price
<b>Please include your e-mail address to receive twice-weekly E-Market Alert Newsletters.</b> 			Subtotal _____ Shipping _____ In Connecticut add 6% sales tax _____ Grand Total _____	

### SHIPPING AND HANDLING RATES

	U.S.	World		U.S.	World		U.S.	World
<b>Market Intelligence Services</b>			<b>Market Intelligence Libraries</b>			<b>Governments &amp; Industries</b>		
Binder	\$45	\$85	<b>Complete Library</b>			Binder	\$540	\$1,020
DVD	\$50	\$95	<b>(Civil/Commercial &amp; Military)</b>			DVD	\$50	\$95
Binder & DVD	\$95	\$180	Binder	\$1,575	\$2,975	<b>International Military Markets</b>		
Binder & RT	\$45	\$85	DVD	\$50	\$95	<b>(A Subset of G&amp;I above)</b>		
<b>Worldwide Inventories</b>			<b>Military Market Library</b>			Binder	\$270	\$510
<b>Aerospace Systems</b>			Binder	\$1,440	\$2,720	DVD	\$50	\$95
CD	\$50	\$95	DVD	\$50	\$95	<b>Naval</b>		
<b>Weapons Systems</b>			<b>Civil/Commercial Library</b>			Binder	\$90	\$170
Hard Copy	\$45	\$85	Binder	\$360	\$680	DVD	\$50	\$95
CD	\$50	\$95	DVD	\$50	\$95	<b>Power</b>		
<b>Power Systems</b>			<b>Market Intelligence</b>			Binder	\$90	\$170
Hard Copy	\$45	\$85	<b>Group Libraries</b>			DVD	\$50	\$95
<b>Focused Market</b>			<b>Aerospace</b>			<b>Weapons</b>		
<b>Segment Analyses</b>			Binder	\$360	\$680	Binder	\$180	\$340
Hard Copy	\$25	\$45	DVD	\$50	\$95	DVD	\$50	\$95
			<b>Electronics</b>			<small>NOTE: No charge for Real-Time format.</small>		
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