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# Siemens Charlotte Energy Hub

## A fully integrated site for the manufacture and service of our advanced fossil power generation equipment portfolio

Siemens Charlotte Energy Hub is the company's worldwide hub for 60Hz fossil power generation equipment manufacturing and service, with additional capabilities for the 50Hz market. Opened in 1969, the facility has manufactured and serviced generators and steam turbines for the power generation market for decades.

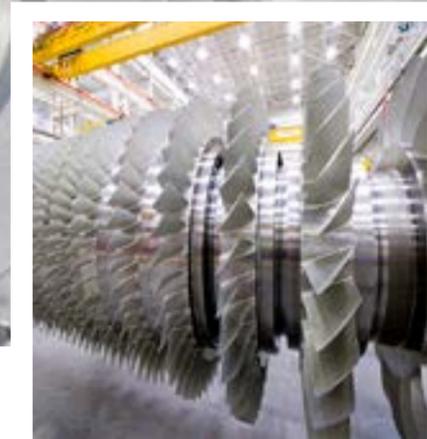
In November 2011 the facility was expanded, adding gas turbine production and service capabilities. The new gas turbine facility was designed based on LEAN manufacturing principles and U.S. LEED Gold building standards, making it the most advanced gas turbine production plant in the world.



The addition of the gas turbine facility, as well as other improvements and expansions on the site, represent a \$350 million total investment and nearly 1,000 additional jobs. With its current workforce of 1,500 and approximately 1.2 million square feet of space under roof, Siemens is the largest manufacturer in the city and the second largest in terms of employment among the 250+ energy companies based in Charlotte.

Since 2008 Siemens has exported more than \$800 million of power generation equipment. And our newly expanded gas turbine manufacturing capabilities will contribute more than \$200 million a year to our exports.

# SIEMENS



# World's most efficient and flexible power generation equipment facility

Fast service turnaround, quality parts and repairs, and state-of-the-art manufacturing are all hallmarks of the Siemens Charlotte Energy Hub. Charlotte's products range in size from 150 MW up to the largest steam turbines for nuclear units of more than 1,600 MW. A full-time, on-site engineering staff specializes in performing complete engineering evaluations, finite element and life extension analyses, and reverse component engineering. Engineering designs are kept current with the latest manufacturing capabilities, and the site is supported by the Siemens global engineering network, helping to provide the best solutions for customers.



## Manufacturing advanced technologies, using advanced technologies

- Advanced gas turbines**  
 Our advanced gas turbine operation has the following core competencies:
- Combustion Components
  - Compressor Components
  - Rotor Manufacturing
  - Engine Assembly

The operation features cellular manufacturing design with full machining capabilities from forged component to fully assembled products. Components up to 275 MW are machined to tolerances of less than a thousandth of an inch in some cases. Advanced technologies include diffusion bonding and effusion laser drilling. Nearly all machines, including those used in the manufacture of generators and steam turbines, have Siemens 840D controls on our large lathe and horizontals.

- Steam turbines**  
 Our steam turbine operation has the following core competencies:
- Turbine Rotors
  - Turbine Stationaries
  - Valve Components
  - Valves

The steam operation has the capability to address the needs for new unit, modernization and service of high-pressure, intermediate-pressure and low-pressure turbines for fossil and nuclear applications. The organization relies on features such as a vacuum high-speed balance bunker, vertical boring machines, horizontal lathes and world-class welding capabilities.

- Generators**  
 Our generator operation has the following core competencies:
- Rotor Machining
  - Rotor Winding
  - Stator/Assembly
  - Exciters

The full gamut including, machining, winding, assembly and balance, is performed at the Siemens Charlotte Energy Hub for units up to 1,200 MVA. Generators benefit not only from work-horse equipment, such as slotters, lathes, boring machines, pressure vessels and ovens, but also from an automated five-axis multi-tasking machine center, robotic stackers for core building and balance bunkers. The Siemens Charlotte Energy Hub has several balancing facilities with capacity up to 300 tons, length up to 67 feet and revolutions per minute (RPM) up to 4,680.



## Service is a differentiator

Comprising 40 percent of our workload, service work is an integral part of what we do at the Siemens Charlotte Energy Hub. Our mission is to serve as the primary service center for generator and steam and gas turbine equipment for the Americas. All functions necessary for a seamless service process—from initial bidding to transport for delivery—are located on-site. We also rely on colleagues at our Fort Payne, Alabama, facility to help with electrical component service work.

Each service project is assigned a project engineer who becomes the customer's single source of information, offering direct status updates. The Siemens Charlotte Energy Hub also has dedicated service areas for providing service for both planned and unplanned outages.

Our extraordinary depth of skill and experience enable us to service not only the Siemens fleet, but components originally designed and manufactured by all large original equipment manufacturers.

### Rotor restoration

One specialty service in Charlotte is advanced welding for steam and gas turbines, and generators. This expertise applies to shaft restoration, reconditioning of rotor journals and restoration of blade attachment areas on turbine rotors.

### Comprehensive valve and actuator services

Our full scope of services for long-term valve maintenance features the resources to inspect, repair, reconstruct, modify and upgrade both fossil and nuclear turbine valves. Specific services include stroking/mechanical testing, actuator functional testing, geometry restoration, deep bore weld repair, dimensional and material analyses, and sizing interfaces for interchangeability. In addition, we maintain an inventory of replacement valve and actuator parts to help respond quickly to your needs.

### Comprehensive generator exciter services

We maintain a comprehensive inventory of replacement exciter components, which can include, for example, rectifier components and permanent magnet generators. Specific services offered range from inspection and cleaning to rotor, stator and exciter rewinds. An accelerated exciter rewind can be accomplished in as little as five weeks compared to the industry average of approximately 12 weeks. Also, refurbished exciter spares are available for purchase or rent for some applications.

### Service on nuclear components

As a single-source solution, Siemens Charlotte Energy Hub is the premier U.S. facility to receive, decontaminate, inspect, repair, test and transport many radioactive nuclear components. One key capability includes the ability to service nuclear valves.

## People are our most important asset

### Unique partnerships for hiring and training employees

Through our partnership with Central Piedmont Community College (CPCC), we have been able to customize the training provided to our workforce, which has been a critical factor in our ability to quickly staff the new gas turbine facility. Members of the CPCC faculty have been trained to our specialized skills and knowledge requirements. During the construction of the gas turbine facility, we took faculty members to visit our 50Hz gas turbine manufacturing facility in Berlin so they could see firsthand our operations. We also worked closely with them to develop the training curriculum and materials. They are now involved in on-site training for our employees, many of whom are new to the gas turbine product line. CPCC also provided screening for our hiring process by testing applicants prior to interviews of potential new hires.

### Apprenticeship programs provide education and on-the-job training

We also have started an apprenticeship program modelled after the successful established programs in Germany.

Six first-year and six second-year apprentices are currently in the program. They attend classes at CPCC for their associate degree in mechatronics, and also work at the Siemens Charlotte Energy Hub as an apprentice to apply the skills they are learning in the classroom. Siemens pays both their tuition for school as well as the wages they earn while working as apprentices. This is one of many increasingly important streams of knowledgeable, capable employees for our Siemens Charlotte Energy Hub.

### It takes a community

In addition, Siemens is a strategic partner in the University of North Carolina at Charlotte's (UNCC's) Energy Production and Infrastructure Center. The goal of the Center is to supply highly trained engineers who are qualified to meet the demands of the energy industry. This is accomplished through traditional and continuing education. Siemens has been involved since the formation of the concept for the program and has helped in the development of courses and of student and university projects. Siemens invested \$4.3 million in the effort.



## Efficiency and flexibility drives continuous improvement

### Flexible for any project

- Balanced manufacturing/service mix
- 50Hz and 60Hz capabilities
- Capacity to handle large and complex projects

### Efficient for fast, reliable service

- The new facility in Charlotte was designed based on LEAN manufacturing practices, which means it was built nearly 100,000-square-feet smaller than would have been needed a generation ago. We have optimized the flow of work, thereby reducing the footprint we need to efficiently manufacture gas turbines. It was also designed according to the U.S. LEED Gold building standards.

- The workspaces of the steam and generator facilities were also reorganized to provide optimal efficiency. Saving on moving material and personnel translates to cost savings in areas such as the generator core building area and balancing facility area. In addition, all departments in generator manufacturing are designed to accommodate a Siemens Production Systems single piece flow concept, which is an ideal state of efficient operations where batch sizes and lot production are replaced by working on one product at a time.

### Integrated for continuous improvement

- The Siemens Charlotte Energy Hub fosters a culture of working across the three product lines to continue to improve products, processes and efficiencies. Procurement management representatives for generators, gas turbines and steam turbines recently completed a project to identify and develop a cost-effective supply chain solution provider for small machined and hardware components for all three Charlotte product lines. Two suppliers were each awarded a three-year agreement, which is projected to save millions for both Siemens and our customers.

- In a collaborative effort, the steam and gas engineering groups have jointly qualified a weld repair process to restore critical features on gas turbine rotor components, saving customers both cost and time to get their plants restarted and producing power.
- The Siemens Charlotte Energy Hub also actively participates as part of the global Siemens manufacturing network, which facilitates load leveling and utilization of unique capabilities.



## Expertise and experience benefit our customers

In Charlotte, customers are valued members of our team. With 24/7 access to plant and staff, customers can participate throughout the manufacturing or service process. The following are some examples of recent and upcoming projects:

### New apparatus

- The first gas turbine assembled at the Siemens Charlotte Energy Hub was shipped to Mexico in November 2011.
- After having focused on repair and modernization of existing units since the early 2000s, we recently added capabilities in our steam turbine facility and in March 2012 shipped our first new steam turbine in more than 10 years.
- Siemens Charlotte Energy Hub is producing 10 gas turbines and 18 generators for the Qurayyah combined-cycle power plant in Saudi Arabia.
- Siemens has been awarded an order for the turnkey supply of two SGT6-5000F gas turbines, one SST6-5000 steam

turbine, two SGen6-1000A generators, and one SGen6-2000H generator for a combined-cycle power plant project in Texas. This plant will be among the cleanest fossil-fueled plants in the U.S., with carbon monoxide (CO) emissions less than 10 parts-per-million (ppm), and nitrogen oxide (NO<sub>x</sub>) emissions less than 2.0 ppm. Once completed, the generating station will be able to supply up to 758 megawatts (MW), or the power needs of approximately 750,000 homes in the Central and North Texas regions.

- Siemens has been awarded an order for the supply of two SGT6-5000F gas turbines, one SST6-5000 steam turbine, three SGen6-1000A generators, and the SPPA-T3000 instrumentation and control system for a combined-cycle power plant being built in Manaus, Brazil. The natural gas-fired plant will have an installed capacity of approximately 580 MW, making it the largest natural gas plant in the Amazon region.



### Service

- High-pressure / intermediate-pressure (HP/IP) and low-pressure (LP) steam rotors and an inner casing from a power plant in Houston, Texas, were brought to the factory after a major vibration incident caused severe rubbing between the rotors and stationary casings, which resulted in significant distortion and damage. The repair scope involved replacing the majority of the rotating and stationary blading, weld repair of the HP/IP rotor and re-rounding of the HP/IP inner casing. The repair scope was the most extensive Siemens ever performed for a turbine of this type and relied on both the local expertise in welding and case rounding as well as Siemens global experience in developing the overall approach.
- An advanced F-class gas turbine rotor was recently brought to Charlotte for extensive repair, which required a full-scope inspection and replacement of several components, both new and refurbished. The repair was completed with close cooperation between experts in service engineering, design engineering and factory operations.

The work was performed under a very aggressive schedule requirement, which would not have been possible without a dedicated gas turbine rotor repair line.

- A complete new replacement generator rotor was built for a customer in Slovenia. The new rotor needed to be built to the old vintage (1970s) drawing to allow the stator and all other mating components to be readily interchanged. The challenge for the manufacturing team resided in the procurement of special tooling and the development of new manufacturing processes to meet the critical customer schedule. The forging was procured from a foundry in Europe, and the entire machining, winding assembly and balance process was executed within the schedule. Our component manufacturing plant in Fort Payne, Alabama, manufactured all new copper and glass components for this order. The shrink components were manufactured at the Siemens Charlotte Energy Hub, using state-of-the-art machining equipment and manufacturing processes. The unit was shipped to the customer site ahead of schedule.

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91058 Erlangen, Germany

Siemens Energy, Inc.  
5101 Westinghouse Blvd.  
Charlotte, NC 28273-9640

Order No. E50001-F500-A138-X-76US  
Printed in USA  
TD 3535T BR 12121