



**POWER** MADE™  
**EFFICIENT.**

- **Integrated Modular Skids**
- **Fuel Solutions**
- **Control Systems**
- **Compressor Water Wash**

For over 50 years, Gas Turbine Efficiency (GTE) has been providing solutions involving the application of mechanical, electrical and process related equipment and components to optimize our client's performance. Our experienced team of engineers and designers have solid industrial process backgrounds with expertise in fluid systems, instrumentation and system controls.

This experience allows the team to design, modify, upgrade, and enhance existing systems to provide 'Value Maximized', fully integrated solutions to our customers.

Working from conceptual ideas and functional specifications, GTE provides a complete design to meet the application-specific operational requirements. Our expertise can address a customer's design to be incorporated within an existing equipment footprint while providing lower cost alternatives. Employing the latest 3D modeling and analysis software allows easy resolution of interface issues, control of design changes and optimization of the fabrication process.

Document control complies with the most demanding requirements for revision control and the support of process and equipment installation. GTE's offerings range from stand-alone proprietary systems supplied with OEM equipment to fully integrated, remote-monitored, hardwired and web-based systems. These systems provide operator and supervisory control, alarming, and monitoring as well as administrative performance summary analyses.

The Service Excellence process for GTE is to ensure all customer needs are met according to their requirements and standards, and to protect our customers' interests by applying robust industry quality standards. GTE has developed and maintains a quality management system that encompasses all personnel in all areas of its business, and are certified to ISO 9001, ASME, AWS, and / or ATEX standards.

## Integrated Modular Skids

An integrated modular skid, often referred to as an auxiliary system, is a self-contained system designed and engineered to meet functional specifications by incorporating the required mechanical equipment, valves, controls, piping, wiring and other components onto a single structural base. This significantly reduces field assembly time and effort as only minimal piping and electrical connections are required once the skid is delivered to the site. A true added value to our customers resides in our engineer's expertise in component selection and knowing which components interface effectively with one another.

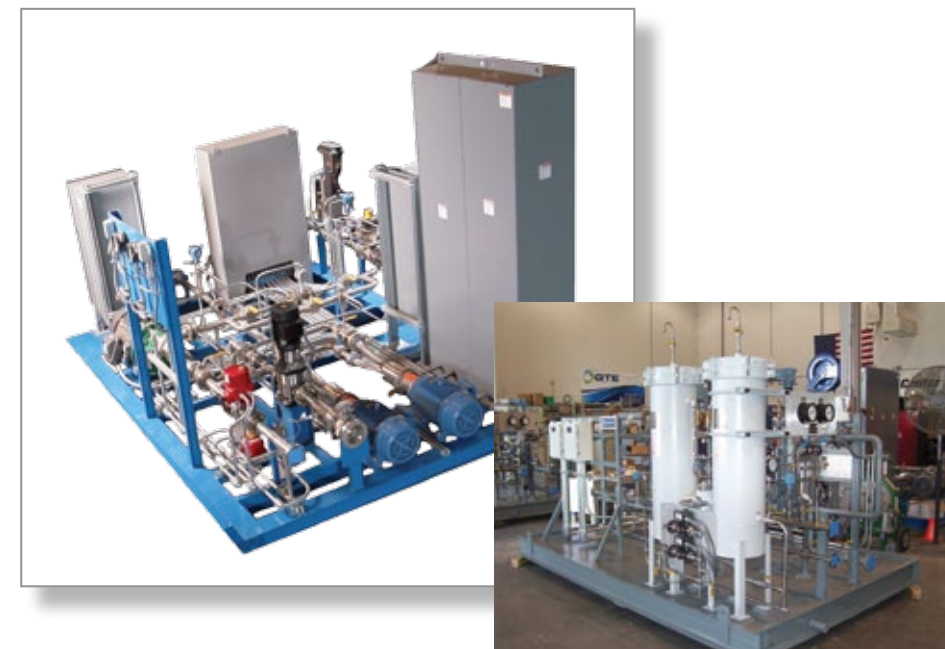
Structural steel and pipe welding, assembly, electrical wiring, panel installation, testing, inspection and final shipment of each integrated skid is accomplished in one of our three production facilities. GTE's internal process integration results in expertly maintained material and quality control through each step of the manufacturing cycle.

While all skids manufactured by GTE are fully inspected by the quality team, Factory Acceptance Testing (FAT) of the completed product follows the requirements of the customized FAT document. Testing can range from simple continuity and leak checks, to full scale flow and performance testing.

GTE also provides prefabricated pipe assemblies, spools and materials that are used for interface connections during installation.

### Integrated Modular Skids Include:

- Water Injection
- Low NOx
- Fuel Blending
- Lube Oil
- Atomizing Air
- Steam Injection
- Fogging
- Fuel Forwarding
- Filtration



## Fuel Solutions

Fuel consumption can use up to 75 percent of a power plant's budget. The cost and quality of fuel changes frequently and must be monitored, managed and accounted for. Quality and composition variations seriously impact combustor emissions, dynamics and equipment operation and reliability.

GTE has supplied over 1,000 fluid flow measurement systems worldwide. These installations include the measurement of oil, natural gas, water, and steam used for custody transfer, environmental reporting, turbine performance tuning, check meters, and fuel blending applications. GTE is a fuel solutions company with experience in applying flow measurement technologies for industrial needs.

The company provides flow metering, conditioning and analysis systems that exceed applicable codes and industry standards. These skid-based systems include appropriate components to measure fuel mass flow, quality constituencies, composition and BTU or caloric content. Manufacturing, welding, honing, hydrostatic and NDE testing, inspection and assembly of each flow metering system are performed in GTE's global manufacturing locations.

Flow measurement experts work closely with our customers to understand the requirements of the application and the most important elements. Parameters including accuracy, maintenance and calibration, pressure loss, flow conditions, straight length considerations and cost expectations are closely reviewed.

GTE supplies flow metering systems that meet strict accuracy standards such as AGA, ASME and API. The combination of resources provide complete, independent and accurate characterization of flow nozzles, orifice meters, turbine meters, annubars, vortex, coriolis and magmeters over a wide range of Reynolds numbers.

GTE designs systems for fuel conversions that provide the operator the flexibility to select gas, oil, dual, blended or alternative fuels. Expertise extends to process systems that work to condition fuel by removing undesirable liquids and particulates from the gas and heating it as required by the application. These fuel solution systems are usually skid-based and prepare the fuel for a cleaner burn in the turbine, extending the life of the hardware and reducing emissions.

### Typical Fuel Solution Systems:

- Fuel Conditioning / Treatment
- Fuel Flexibility
- Fuel Metering
- Fuel Blending
- Fuel Forwarding
- Fuel Selection

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## Control Systems

GTE designs and manufactures a wide variety of mechanical, instrument and electrical control panels for almost any application. Panels have been certified by major international independent agencies including UL, CSA International and CE. GTE panels can be qualified to meet hazardous area classifications up to Class 1, Div 1, Groups B, C, & D.

Our engineering staff has a wide range of instrumentation and component expertise, and has completed extensive factory training from leading manufacturers. In-depth knowledge and experience includes calibration, check-out and characterizing performance.

Our panel shop provides a clean, climate controlled area for panel construction and assembly.

### Programmable Logic Controllers (PLCs):

GTE's control system engineers and technicians provide a full range of support for PLC-based industrial system applications. This includes logic design, programming, modifications, upgrades, troubleshooting and repair. Our engineers and programmers are extremely knowledgeable of several leading brands of PLC's and user interface software and have completed factory trainings for all Allen-Bradley, Siemens and other major providers. Their expertise includes knowledge in Control Logix, Compact Logix, SLC500, Micro Logix, HMI and all associated softwares.

### Typical Control Systems:

- PLC / HMI
- Generator Protection
- Performance Monitoring
- Flow Metering
- Relay Protection
- Process
- Gas Chromatograph



## Compressor Water Wash Systems

Gas turbine compressors consume approximately 60 percent of the overall required energy during operation. The combustion turbine process consumes large quantities of air, and although the air is filtered, small quantities of dust, aerosols and water pass through the filters and deposit on the blades, decreasing the air flow and overall performance of the turbine. Compressor cleanliness can be maintained using a program of water washing.

There are two water wash processes performed on gas turbines: offline and online. An offline process is conducted with the gas turbine in a cooled state using cranking speed. Offline processes clean the entire core and recover lost performance. An online process is conducted with the machine at full operating speeds using only deionized or demineralized water. The online system cleans the early stages (which fouls most easily) and maximizes the time period between needed offline washing to provide peak availability. Both operations use highly atomized water spray patterns targeted directly at the compressor core.

GTE's water wash technology uses a smart and proven water delivery system to create a controlled distribution of water droplets. Droplet size can effectively enter the compressor inlet stream without evaporating prior to wetting the blade. The droplet mass and momentum are adequate to penetrate the pressure wave surrounding each compressor blade, yet the droplet distribution has an impact force that is benign to erosion. At the same time, the droplet impact produces a very significant lateral stress, or jet, to locally scrub the blade surface of fouling materials.

Other considerations in the water wash process are the location of the injection nozzle within the bellmouth, the solubility, volume and temperature of the water. The throat of the compressor is identified by varying the location of the nozzle position and optimizing distribution of the atomized water wash. The water volume is set to a specific air-to-water ratio and does not overly saturate the machine. The water is heated to a specific temperature to further increase the efficiency of the wash process.

The patented GTE highly atomized compressor wash system offers the operator the following improvements:

### Demonstrated Improvement:

- Availability: ~ 2 %
- Performance / output: ~ 3 %
- Heat rate: ~ 1 %
- Economic payback can be achieved in months

### Benefits:

- High efficiency wash cycle
- Multi-turbine operation is available
- Remote / local operation
- Automated operation via PLC based program logic

GTE's compressor wash technology is proven on more than 800 stationary gas turbines, including both heavy frames and aeroderivatives. Many of these systems have been supplied and approved directly through the OEM. The experience totals more than 20 million operating hours of gas turbine running time.

## Locations



### Western Hemisphere

Gas Turbine Efficiency, LLC  
300 Sunport Lane  
Orlando, FL 32809  
USA  
Tel: +1 407 304 5200  
Fax: +1 407 304 5201

### Eastern Hemisphere

Gas Turbine Efficiency Sweden, AB  
Svetsarvägen 15, 2 tr  
171 41 Solna  
Sweden  
Tel: +46 8 546 10 500  
Fax: +46 8 546 10 501

[www.gtefficiency.com](http://www.gtefficiency.com)





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171 41 Solna  
Sweden  
Tel: +46 8 546 10 500  
Fax: +46 8 546 10 501

