

# Efficiency Extra Edition

T2E3 Newsletter  
4th Quarter 2007

## Compressors - Revisited

I will be traveling to New Orleans next week to **PowerGen 2007** to give a talk about Compressor Efficiency. If you happen to be in the area, please stop by: **Tuesday (12/11/07) Plant Performance I; Room 254 - between 1330 and 1530.** I hope to see you there. Below is a preview of the topic I'll be discussing.

### Monitoring Compressor Efficiency for Maximum Performance

Gas turbine compressors consume more than half of the power generated in the turbine. It is therefore imperative to monitor compressor health in order to maximize unit performance – maximizing generator output while keeping fuel usage and emissions to a minimum.

**A 1% loss in compressor efficiency can lead to more than 2% in lost output, with a corresponding 2% increase in heat rate.** When compressors become fouled, not only do they take more energy to reach the same discharge pressure, the compressor discharge temperature will also be elevated. For units with limits on compressor discharge temperature (such as the LM6000), this performance loss can be compounded as the unit must back down in load to maintain the compressor discharge temperature within control system limits.

There are many options for calculating a compressor efficiency (Isentropic, Adiabatic and Polytropic efficiencies, to name a few). All of these methods can be used to track changes in compressor performance over time. **The version of efficiency used is not important: picking one method and using it to monitor changes in efficiency on a regular basis is.**

When tracking compressor performance, the following parameters need to be recorded for the compressor:

- Inlet temperature and pressure
- Discharge temperature and pressure
- Operating mode of unit (base, part load, T3, T48, etc.)
- Auxiliary systems in use (inlet cooling, wet compression, SPRINT, bleed heat, etc.)

Note: if you have a dual shaft unit, you might want to trend performance of each compressor section (HP and LP) separately, as well as trending the overall compressor performance.

Compressor efficiency will vary naturally with load and air density entering the compressor. The use of wet compression or SPRINT systems will also have a significant impact on the measured compressor efficiency.

Curves can be built to determine the expected compressor discharge temperature which will result from changes in compressor inlet temperature and pressure ratio at constant compressor efficiency. These curves can be used to determine the expected compressor discharge temperature under actual operating conditions. The efficiency calculated using this expected discharge temperature can then be compared with the measured compressor efficiency. The result of this comparison can be used as a **compressor performance ratio, which can be trended over time** to determine the fouling rate of the compressor.

Once the compressor fouling rate is identified, an economic impact analysis can be completed to **determine the break-even time to perform a water wash**; maximizing compressor performance - and the profitability of your site.

If you have any questions on applying these methods to your units, please contact me via phone (425-821-6036) or email ([tinat@t2e3.com](mailto:tinat@t2e3.com)).

### Upcoming Events

- **PowerGen 2007**  
December 11-13  
New Orleans, LA
- **LM6000 Seminar**  
April 3rd & 4th 2008  
San Diego, CA  
(see page 2 for more)

### Products & Services

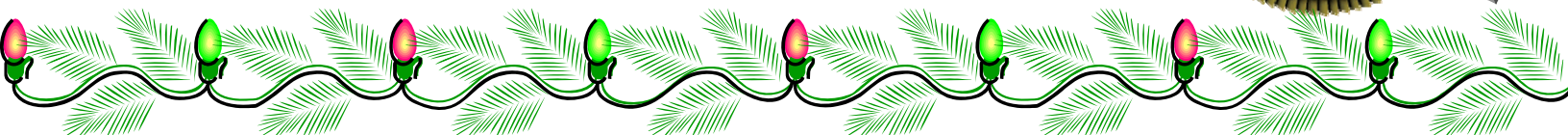
#### Analysis Tools

- Excel Workbooks, Macros and Add-Ins:**
- \* Corrected Performance
  - \* Compressor Efficiency
  - \* Steam & Water Flow
  - \* Moist Air Properties

#### Training Seminars

#### Performance Test Support

#### Performance Monitoring Program Design, Support and Evaluation



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## LM6000 Performance Seminar to be held in San Diego next April 3 & 4

Learn about the thermodynamic relationships behind Gas Turbine **performance**, and how to apply this to your units and your site.

Delve into the economics and application of correction curves - including an understanding of **Throttle Push**.

Get an overview of **ASME PTC-22**, the standard on gas turbine performance testing.

Learn about performance **monitoring** programs for gas turbines, what you need to look out for, and what to do if you think you may have a problem.

**Walk away with information and ideas that you can apply to your operation immediately.**

Seminar to be held in San Diego April 3 & 4, 2008.

Scheduled to compliment attendance at the 2008 WTUI conference.

See the T2E3 website for more information:

[www.t2e3.com/LM6000.php](http://www.t2e3.com/LM6000.php)



## T2E3 Services for Power Generators

**Analysis Tools & Software** – from customized spreadsheets to add-ins for Excel or complete compiled programs, T2E3 can develop software tools and analyses to support all your performance monitoring needs, including integrating your existing tools with available site data systems, to create online systems providing data and results in real-time.

**Training** – both public seminars and customized options are available. Highly interactive sessions increase attendees' knowledge and understanding of the thermodynamic cycles, instrumentation and analyses needed to improve equipment performance and reliability.

**Performance Test Support** – if your site is required to perform annual capacity or PPA performance tests, having Tina Toburen from T2E3 on site to direct the testing can lead to a smoother test execution with more consistent performance results. Professional reports can also be produced to communicate the results to all required parties.

**Commercial Program Design and Evaluation** – For sites interested in a more complete enterprise solution for performance monitoring, T2E3 can support your program planning and design, including evaluation of the various commercial products available within the industry for performance monitoring. Choosing the

correct solution will depend on the specific goals and objectives of your performance monitoring program.

Unlock the potential of your operation. Call for more information on how we can work together, today!

