



Introduction

The System 1® Predictive Emissions Monitoring System (PEMS) offered as part of GE's Bently Nevada product suite can predict the level of stack emissions generated by combustion equipment (typically gas turbines) based on ambient conditions, fuel composition and machine operating conditions while taking into account real time degradations. Emissions models are developed using GE's knowledge of aeroderivative and industrial gas turbines combining fundamental physics and real emissions test data. The resulting model can be tuned using periodic data from temporarily installed emissions monitoring system for continued or improved accuracy.

Emissions Regulations

Governments around the world have implemented or are planning more stringent legislation to measure and regulate the level of emissions by industrial processes both onshore and offshore. These regulations and others anticipated will require operators to monitor, self-certify and justify emissions of NO_x, CO, CO₂, SO₂ and unburned hydrocarbons (UHC) to their country's environmental agency. With the introduction of emissions trading and monitoring schemes with financial implications, the need for improved emissions monitoring has become an essential requirement.

Measuring Emissions

There are three methodologies currently being used to quantify stack emissions; factored based from fuel flows; Continuous Emissions Monitoring System (CEMS) and; PEMS. Estimates of emissions using an "emissions factor" are based on a periodic emissions test. The "emissions factor", applied to fuel consumption over a monthly or quarterly time period, is inaccurate because actual gas turbine emissions are dependent on variable



operating conditions such as ambient temperature, humidity, power output, machine degradation and fuel composition. While a CEMS is preferred, due to its ability for continuous direct in stack measurement, it can be very costly in terms of initial equipment, maintenance and calibration, which may not be required or justifiable for offshore platforms. A PEMS solution delivers the high accuracy required for emissions reporting at a significantly reduced cost (compared to CEMS).

The GE PEMS Solution

The System 1® PEMS software solution is based on a first principle, fundamental engine emissions model developed by GE that is known to correlate to emissions output. The PEMS model inputs can vary depending on the equipment manufacturer but are based upon ambient conditions, various turbine operating parameters and fuel properties. The model is valid for both gas and diesel fuels and computes emissions



estimates for NO_x, CO and unburned hydrocarbons, while providing calculated values for CO₂ and SO₂. Initially installed emissions models are calibrated using unit specific operational data and temporary emissions test data to tune the model output. This calibration feature enables improved accuracy and extends the time between calibrations. Model accuracy is further improved if additional seasonal calibration data sets are acquired (i.e. with varying ambient conditions). The calibration data can be collected without the need for GE site presence. To ensure model accuracy, the temporary emissions test equipment and personnel should comply with local environment agency or government standards.

PEMS Value

• Lower Cost of Regulatory Compliance.

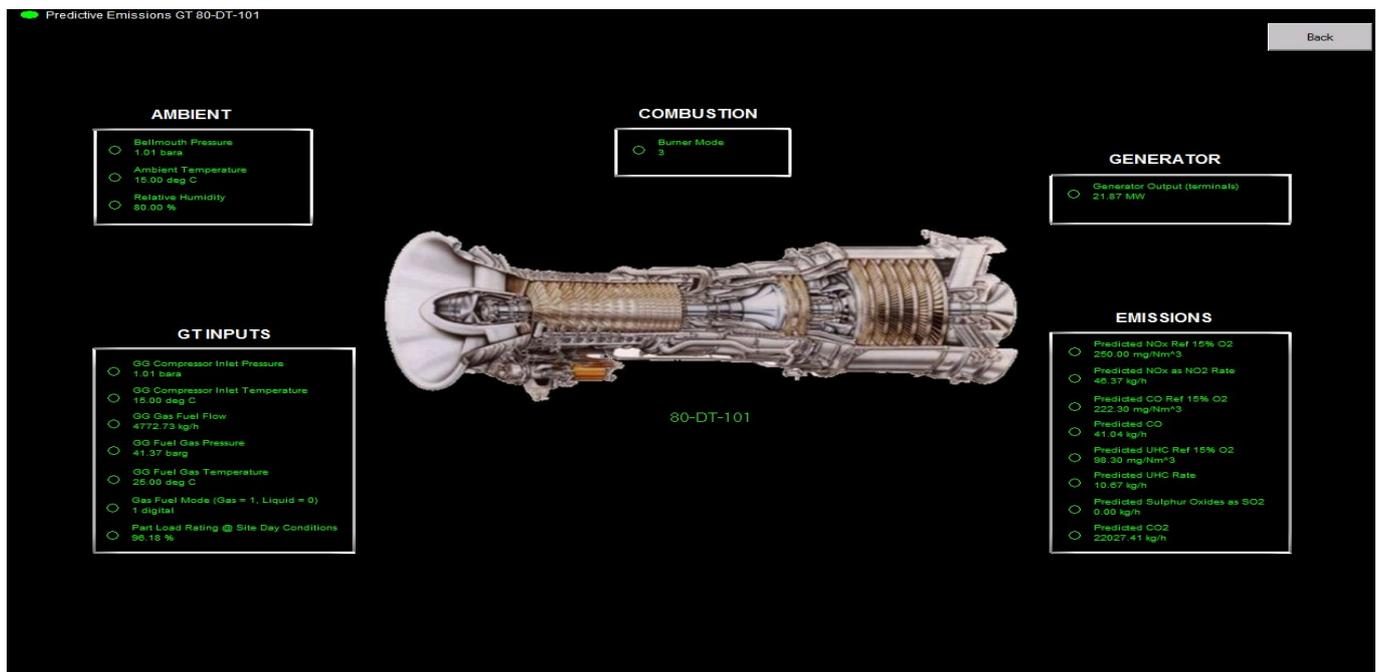
PEMS reduces initial installation and operating costs compared to a CEMS solution. The installed cost of PEMS can be one third the cost of a permanently mounted CEMS emissions monitoring solution that achieves similar accuracy.

• Local and Remote Access.

The PEMS and System 1® Display client server can be installed anywhere (i.e. on or off platform) that has access to the required data. System maintenance, configuration and calibration updates do not require GE visits to site and help to keep PEMS annual costs low.

• Emissions Credits Trading.

Emissions' trading is an administrative approach used to control pollution by providing economic incentives for achieving reductions in the emissions of pollutants. Companies are issued allocations for a specific amount of emissions per year. They are required to purchase additional allocation if their emissions exceed their limits. Likewise they can sell allocation if their emissions are lower than their allotment. Meaningful emission reductions within a trading system can only occur if they can be measured with sufficient accuracy based on live plant operational data. Therefore, emissions' trading is predicted on accurate estimation of past and future emissions.





PEMS Requirements

The System 1® PEMS solution requires the following:

- System 1® software, version 5.x or later
- Bently PERFORMANCE™
- PEMS configuration, tuning and installation services

For customers with an existing System 1 and Bently PERFORMANCE installation, the PEMS option is a simple add-on module and in most cases, can be installed remotely.

System 1® and Bently PERFORMANCE™ software provide the foundation for the PEMS calculation, display and reporting system. Bently PERFORMANCE™ is the calculation platform for PEMS and includes calculated or derived input parameters, which may not be available online such as exhaust flow or firing temperature, as well as accumulators for total mass emitted calculations. All calculated PEMS data can then be viewed using the System 1® platform including mimic displays, historical trending and reports. The resulting reports can be formatted specifically to support and comply with environment agency regulations.

Supporting Services

GE's Measurement and Control Solutions group can provide additional supporting services to ensure the System 1®, Bently PERFORMANCE™ and PEMS solutions have the required inputs of sufficient quality. As the quality of the calculated results is dependent highly upon the quality of the inputs, any changes to measurement and/or sensor quality may affect the calculated results. In addition, we can provide a long-term supporting services agreement to ensure our customers derive the most value out of their systems. For details on specific applications for your needs, please contact your local sales representative.

GE Energy welcomes all questions and comments from our customers.

Visit us at www.ge-energy.com/bently

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