System 1 PEMS Package for Aeroderivative Gas Turbines

Introduction

The System 1* Predictive Emissions Monitoring System (PEMS) offered as part of Bently Nevada's product suite is specifically designed for Gas Turbines. It can predict with high accuracy the level of emissions generated by gas turbines based on ambient conditions, fuel composition and machine operating conditions while considering real- time degradations. This unique solution leverages an internal aeroderivative gas turbine emissions model developed from fundamental physics and real data collected over many years during testing of these gas turbines. The resulting generalized model is then tuned using periodic data from a transportable Continuous Emissions Monitoring System (T-CEMS) for improved accuracy.

Emissions regulation and issues

Governments around the world have been planning more stringent legislation to measure and regulate the level of emissions by industrial processes. In Europe, there are various legislations coming into enforcement with respect to gas turbine emissions monitoring. The most important of these, for the offshore industry, is the Offshore Combustion Installations (Pollution Prevention and Control) Regulations. This regulation, and others anticipated, will require offshore operators to monitor, self-certify and justify emissions of NOx, CO, CO_2, SO_2, and unburned hydrocarbons to their country's trade and industry authorities.

Traditional estimates of emissions use an "emissions factor" based on a CEMS audit or default value. The emissions factor applied to fuel consumption 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. Today, two solutions are applicable to meet regulations requiring higher accuracy—permanently mounted continuous emissions monitoring systems (CEMS) and predictive emissions

monitoring systems (PEMS). While a CEMS is traditionally preferred—due to its ability for continuous direct measurement and regulation preferences, it can however be very costly and may not be required or justifiable for offshore platforms.

The System 1 PEMS solution delivers the high accuracy and affordability demanded by offshore platforms with lower costs of ownership and greater reliability.
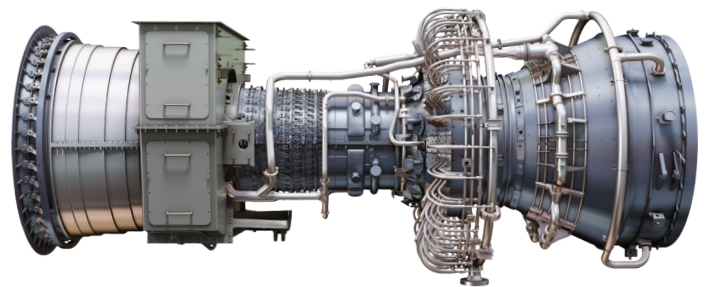
Consequences of current practices

Without factoring in power output, real-time machine degradation, ambient conditions and fuel composition, the traditional emissions factor method lacks accuracy for computing emissions at actual operating conditions. Whereas accuracy may be improved via additional T-CEMS testing, this approach would require more testing compared to a PEMS solution. A PEMS solution can achieve overall greater accuracy with minimal T-CEMS testing.

Depending on the specific regulation that is in force, inaccurate emissions reporting may result in fines for the gas turbine operators. Although the offshore emissions regulation is still in its infancy, the accuracy of our solution may enable emissions trading in the future.

The Bently Nevada PEMS solution

Today, most offshore platforms perform an emissions test using temporarily placed equipment on an as-needed basis. The lack of any type of models prevents the extension of these tests to other operating regimes (e.g., different ambient conditions) resulting in poor emission estimates.

The System 1 PEMS software solution for gas turbines is based on physics-based modeling methods. Ambient conditions, various turbine operating parameters, and fuel properties are model inputs. The model is valid for both gas and diesel fuels and computes emissions estimates for NOx, CO and unburned hydrocarbons, while providing calculated mass balance values for CO_2 and SO_2.

 In addition, Bently Nevada's PEMS solution also includes a calibration feature— which is used to adjust the general model output for increased accuracy--based on tuning adjustments derived from T-CEMS data sets.

Bently PERFORMANCE, the System 1 software extension for gas turbine performance monitoring, provides fundamental model data validation and replacement capability and/or calculated or derived PEMS input parameters that may not be available online (i.e., unavailable measurements). These sensor models are available for all the critical PEMS inputs with replacement recorded as part of the PEMS sensor status process.
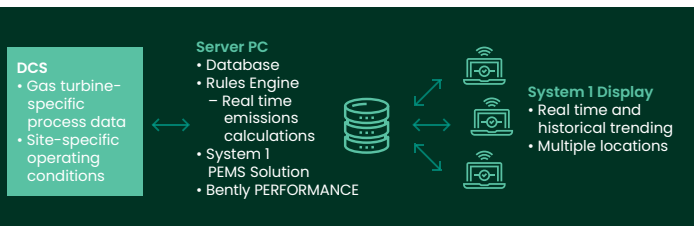
Value

- **Lower Cost of Regulatory Compliance.** A PEMS solution reduces the installation and operating costs compared with a CEMS-only solution. The installed capital costs for CEMS on a remote platform can be as much as three times higher than PEMS, while operating costs are also lower for PEMS.

- **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 visits to the platform which helps to keep PEMS annual costs low.

PEMS configuration and options

The System 1 PEMS solution requires the following:

- System 1 software
- Bently PERFORMANCE with PEMS
- PEMS installation and tuning services

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

Supporting services

Bently Nevada can provide additional supporting services to ensure the System 1, Bently PERFORMANCE, and the PEMS solution meets your needs. In addition, we can provide a long-term supporting services agreement to ensure our customers derive the most value out of their systems.

For additional information on Bently Nevada's Predictive Emissions Monitoring System (PEMS), please consult with your local Bently Nevada Sales Representative, or visit bently.com.

Service and expertise ... delivered

For more than 60 years, Bently Nevada has provided trusted solutions and expertise in protection and condition monitoring for customers in Oil & Gas, Power Generation, and other industrial markets. This depth of application-specific experience allows us to tailor solutions that fully deliver your business objectives.

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