

ABB MEASUREMENT & ANALYTICS

Predictive Emission Monitoring Systems

The new approach for monitoring emissions from industry



Measurement made easy

ABB delivers an extensive range of solutions for managing any requirement in emission monitoring.

We couple Predictive Emissions Monitoring Systems (PEMS) to traditional Continuous Emissions Monitoring Systems (CEMS) to bring you the broadest portfolio of analytical solutions for all environmental applications.

ABB's Predictive Emission Monitoring Systems (PEMS)

Experts in emission monitoring

PEMS are software-based systems for estimating pollutant concentrations through advanced mathematical models. They are innovative and effective solutions able to complement traditional hardware-based analyzers for emission monitoring purposes.

PEMS exploit the most sophisticated mathematical and statistical techniques and the latest generation IT infrastructure in order to enhance and maximize effectiveness of emission monitoring.

According to major environmental authorities, they are one of the recognized technologies able to comply with the legally-enforced requirements in terms of continuous emissions analysis and recording and deliver substantial benefits to plant owners and operators. PEM is an extremely versatile technology that is able to:

- back-up existing CEMS to increase the service factor of the whole emission monitoring system
- act as the primary monitoring source where allowed by legislation
- extend monitoring from a campaign-based approach to continuous approach

ABB field-proven applications have been demonstrated to be as accurate as conventional CEMS, and have obtained the certification of compliance to US EPA standards concerning performance and data availability.



Source: EPA Handbook - Continuous Emission Monitoring Systems for Non-criteria Pollutants, 1997

ABB capabilities Technology, expertise and local presence

ABB best-of-breed software Inferential Modeling Platform (IMP) is the core of our PEMS solutions.

IMP includes first-class mathematical and statistical procedures designed to deliver efficient, easy-to-use and field-proven PEMS. ABB systems structure is fully compliant with environmental regulations.

Model development

The heart of PEMS is represented by powerful and efficient mathematical models. Over the years, ABB identified empirical (also known as 'data-driven') models as the most reliable.

Empirical model development is based on historical process and emission data gathered from plant control systems and from the existing emission monitoring system (or from a temporary analyzer if PEMS is designed as the primary monitoring source).

In order to ensure best performance of the system, the main requirement is that process conditions during data collection are representative of the typical operating range of the units.



Model creation and validation are performed exploiting the outstanding features of ABB proprietary software IMP: the unmatched data processing routines and the sophisticated mathematical algorithms are crucial during the development phase.

Embedded neural networks and other modeling techniques, like Partial Least Square (PLS) and Multi-Linear Regressions (MLR) provide a wide range of tools to build the most versatile and performing predictive system.



A dedicated team of experts is always ready to support you in every phase of a project or for consultancy.



IMP also includes testing and off-line validation modules, aimed at analyzing and checking model robustness and reliability, together with a unique 'What-if' section, that enables each input value to be varied in order to investigate its impact on the final emissions output.

PEMS are implemented by an interdisciplinary team of engineers with relevant competences in data-processing, environmental regulation, process and instrumentation & control.

On-line deployment

The development of sophisticated models is not the only requirement of the industrial environment; their integration with existing IT infrastructure is even more important. IMP software is supplied with all the features needed to enable it to easily interface with control and monitoring systems.

After the building phase, models are installed on site and supplied with real-time values gathered from plant DCS through a standard OPC connection.

Predictions generated by IMP are made available as standard DCS tags that are easily managed by the plant historian and by the emission Data Acquisition System.

The online environment presents an HMI-devoted module for local visualization of the relevant input and output information, giving the operator an overview of the process behavior and emission values over time.



A dedicated feature that identifies abnormal input variable values from field instrumentation is also provided with IMP. This feature enables the software to detect potential field device faults and continue to manage emission values according to predefined strategies.

Additional features

- Statistical Process Control (SPC)
- Multi-Variable Statistical Process Control (MVSPC)

Deliverables and services

ABB provides complete solutions from data collection to final commissioning of the system. Next-to-you ABB service units will co-operate side-by-side with you for commissioning, site activities, service and maintenance. Our network of experts is at your disposal during the different phases of the project or for consultancy activities, supporting you for every environmental-related topic.

Most typical applications:

ABB has a proven track-record in successfully applying empirical models to many different process units, ranging from oil refinery hydrocracking to power and Pulp & Paper sectors. PEMS are able to deal with emissions from many different applications; in particular they are tailored for: • Gas turbines

- Boilers
 - Furnaces
 - Combustion engines.

However, ABB has also successfully implemented PEMS in very complex process units, such as Fluid Catalytic Cracking and Sulfur Recovery Units.



PEMS benefits Much more than a replacement

ABB PEMS solutions optimize the effectiveness of emission monitoring systems and minimize investments.

High performances with low investments

PEMS are a valuable alternative to traditional hardware instrumentation and are able to provide the same accuracy with around half the initial and lifecycle costs. PEMS guarantee higher service factors, with data availability easily above 99 %.

Independent from the automation system supplier

Through IMP tool functionalities, PEMS are able to interface with any control system and other automation levels independently from the supplier. The embedded features provide the possibility to import data from the most common sources.

Compact footprint

PEMS are installed in a standard Server workstation and interface with the process control system without any additional field devices or cabinets. This is particularly relevant in units where space availability is an issue as in the offshore Oil & Gas production.

Insight on process

As it is based on process values, PEMS provides an overview of process behavior, highlighting potential abnormal conditions and providing a pre-evaluation of the root causes for emissions upsets.

What-if analysis

PEMS have a unique advantage over HW-based CEMS – the availability of a robust model which can be used off-line to simulate emissions behavior under variable input conditions in order to evaluate the influence of each parameter on pollutant emissions.

Fully compliant to environmental regulation

PEMS structure follows legislation requirements, including model recalibration and abnormal input values detection and management.

Delivery times

PEMS project can be completed in a few weeks. The commissioning usually follows the model building phase, avoiding possible delays introduced by supply chain issues.

Maintenance trigger and validation

When acting as back-up to traditional analyzers, PEMS can identify drift or HW device malfunction, provide values during off-service periods and validate emission values after maintenance.

Minimal maintenance needed

With almost no hardware involved, PEMS do not require specific maintenance. Only a periodic recalibration may be useful to extend the covered operating region and increase model robustness and overall performances.

No need for warehouse – predictive systems do not need consumables and spare parts, negating the need for warehouse storage.



A success story Emission monitoring of gas turbines

ABB has been the first to complete a PEMS installation in the UAE, certified as compliant to US EPA standards.

This application was included in a larger scope of supply, demonstrating PEMS and CEMS complementarity.

In 2008 ABB installed a PEMS in a turbo-compressor station for gas injection at a major plant in the Gulf Region. The customer required PEMS as the emission monitoring method and requested certification of the system to US EPA standards (40CFR 60 Subpart GG – Performance Specification 2 and related regulations).

The injection plant consists of two parallel trains, each comprising a dual-stage, gas-turbine driven compression. The PEM system was designed to predict the emissions from each of the four gas-turbines.

Being the sole monitoring system, a temporary analyzer was installed at the stack in order to collect emission data and to perform final validation of the system.

Once developed, the empirical models were implemented on-site and the predictive system was integrated with the plant emission data acquisition system.

Real-time values of the process parameters were then collected via OPC and made available to the IMP calculation engine that generates predictions.

For this project, a devoted model recalibration procedure was introduced in order to adjust output values on the basis of the date available from the Laboratory Information Management System (LIMS).

A third-party company performed a RATA (Relative Accuracy Test Audit) on the system, certifying its compliance with EPA requirements.

The system ensured the same accuracy of traditional CEMS equipment and provided an availability well above 99 %.

This was the first EPA-certified PEMS application in the UAE and, four years from the commissioning, the Customer decided to upgrade the system.

After the service activity, PEMS passed a new RATA, confirming its compliance to environmental standards.

4 years after first commissioning, the system has been upgraded and again validated.



ABB Measurement & Analytics

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