Predictive Emission Monitoring Systems (PEMS) FAQ

- **What are PEMS?**
  The acronym PEMS stands for Predictive Emission Monitoring Systems and designates software analyzers able to provide a reliable and real-time estimation of emission properties by means of a model, using process values (temperature, flow, pressure) as input variables.

- **Are PEMS approved by the environmental legislation?**
  PEMS are widely recognized (e.g. US-EPA, Europe, Middle East) as a source for emission monitoring: depending on the local legislation, they can be used as a primary source of monitoring or as a backup of traditional analyzers.

- **Does ABB have a field-proven solution to offer for PEMS applications?**
  Yes. ABB has developed and applied a proprietary software tailored for PEMS solutions: ABB Inferential Modeling Platform (IMP). IMP is structured in two modules:
  - IMP Model Builder for data processing, model building and testing and off-line simulations;
  - IMP On-Line for field deployment and real-time execution.

- **Which are the basic elements within a PEMS?**
  In order to deliver a complete PEMS application, it is necessary a PC (typically a Server, but also a laptop could easily cover all the requirements) hosting IMP On-Line. The PC must communicate with plant DCS or historian to gather input values needed for emission estimation and to write predicted values. The other crucial component of PEMS installations is Inferential Modeling Platform, the software toolkit that runs the models and provides the estimation of emissions. Depending on the application, a Data Acquisition System (DAS) may be required: for typical applications where PEMS are used as a backup of CEMS, the DAS of the existing Emission Monitoring System (EMS) can be used. ABB has the experience and the know-how to properly realize any customized configuration.
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- **How does PEMS work?**
  The models installed in the PEMS PC have to be fed with values of the main operating parameters identified during the development phase. This is performed typically through a standard OPC connection, where IMP acts as a Client and the DCS (or plant historian, etc.) as the OPC Server. The same protocol is used to transfer emission estimations from IMP to the plant control system or any other data repository used by the Customer.
  As an option IMP can communicate also through ODBC protocol.

- **What are the requirements for PEMS solutions?**
  Plant shall be instrumented (temperature, pressure, flow sensors monitoring the main units involved) and automated (DCS or PLC).

- **Can PEMS work as an alternative to hardware analyzers?**
  PEMS can be used both as a back-up of traditional hardware analyzers and as the only emission monitoring system, depending on application, local regulation and site constraints.

- **Can PEMS be sold in place of traditional CEMS solutions?**
  PEMS should be considered as a complement to the traditional CEMS. Depending on application and local constraints, good engineering practice may require installing CEMS, PEMS or a wise combination of the two technologies. More and more complex, large projects will include traditional HW-based CEMS side-by-side with PEMS for selected units. One of the main interests for plant operators, enforced by legislation, is to increase the availability of their EMS: through the adoption of PEMS as a back-up of traditional hardware analyzer, EMS uptime can be increased up to 99.5%.
  ABB is pleased to make available its comprehensive portfolio and its extensive experience and competences to design together with the Customer the best possible solution independently from technology or commercial shortages.
What are the typical target units/processes where PEMS can be applied?
PEMS are solutions applicable across the industry. Although ABB has successful references also on complex process units (FCC, SRU, etc.), the most typical targets for PEMS are related to units like gas turbines, boilers, furnaces, internal combustion engines, etc.

What kind of pollutant emissions can be monitored?
PEMS are perfectly suited to estimate all the most common pollutant from process industry: NOx, SO2, CO, CO2, Flue gas flow, etc. For some specific contaminant, as particulate, care should be taken to check the characteristics of the analytical instrumentation.

What are the different phases in a PEMS project?
The first step of a PEMS project is represented by the Kick-Off Meeting (KOM) at Customer site in order to gather information about plant operations, available instrumentation and plant control architecture. KOM requires the presence of plant personnel.
After KOM, PEMS applications are developed through a series of phases:
- Data collection is crucial to obtain the set of data needed for models development: the variables included in the dataset are both relevant process variables (e.g. temperature, pressure and flow) and the emission values;
- Design and testing are the steps devoted to off-line model creation and validation: through advanced mathematical techniques included in IMP, ABB engineers are able to identify the key variables and train the models.
- Final commissioning involves the installation of the IMP On-Line on the PEMS PC and the on-line deployment of predictive models.

Is there any difference in project development if PEMS are designed as a primary source instead of as a back-up of traditional CEMS?
The main difference between the two cases is represented by the data collection step: when PEMS are developed as an integration of an existing EMS, emission data are
already available and normally stored in the EMS database. In this case, it is sufficient to extract and merge them with process values read from plant historian.

On the contrary, if PEMS are designed to be the only monitoring system, it is necessary to arrange a measuring campaign for the collection of emission data; this requires installing a temporary analyzer at plant site for a few days (typically 10-15 days) to obtain the baseline emission data, which will be used to build the mathematical model. Emission data have to be merged with process parameters values to complete the set of information needed for model building.

- **Is any project step performed at customer site?**
  Only a fraction of the project has to be performed on-site: this is limited to the initial data collection and the final commissioning, while all the other steps can be performed by ABB technicians and engineers at their office.

- **How does PEMS compare with HW-based CEMS in terms of price?**
  When applicable PEMS are consistently cheaper than CEMS. The CAPEX saving is only the initial part of the benefit: even larger savings are obtained during process operation because of the limited maintenance activity (typically 1 week per year) and almost no consumables. The life cycle saving, over a 5-year time-horizon can easily exceed 50%.

- **Which references can ABB boast?**
  ABB flagship product IMP has been successfully applied to provide highly reliable model-based monitoring and real-time estimation in power and process industries in five continents. ABB has installed model-based strategies for environmental purposes on Turbo-compressor stations, sulfur recovery units, FCC and other refinery units and even on a polymer plant.