

NACAA - ICI Boiler MACT

Pretense for New and Innovative Technologies

Software CEM[®]

**Predictive Emissions Monitoring
System (PEMS)**

Software CEM (PEMS)




Cost Effective Monitoring & Compliance

- Model-based software solution
- Standardized, software application and deployment methodology
- Software footprint with no moving parts, frequent recalibrations or exposure to harsh environments



Highly Accurate & Reliable Emissions Monitoring & Reporting

- Sensor Validation with Peer Redundancy
- Model Analytic Engine
- Real-time Reporting (optional) 



Environmental and Industry Experience & Expertise

- Proven experience with global project implementation
- International, national and local regulatory experience

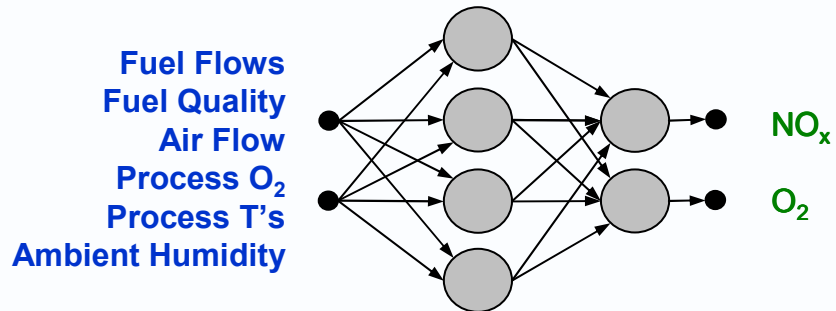


The PEMS Solution

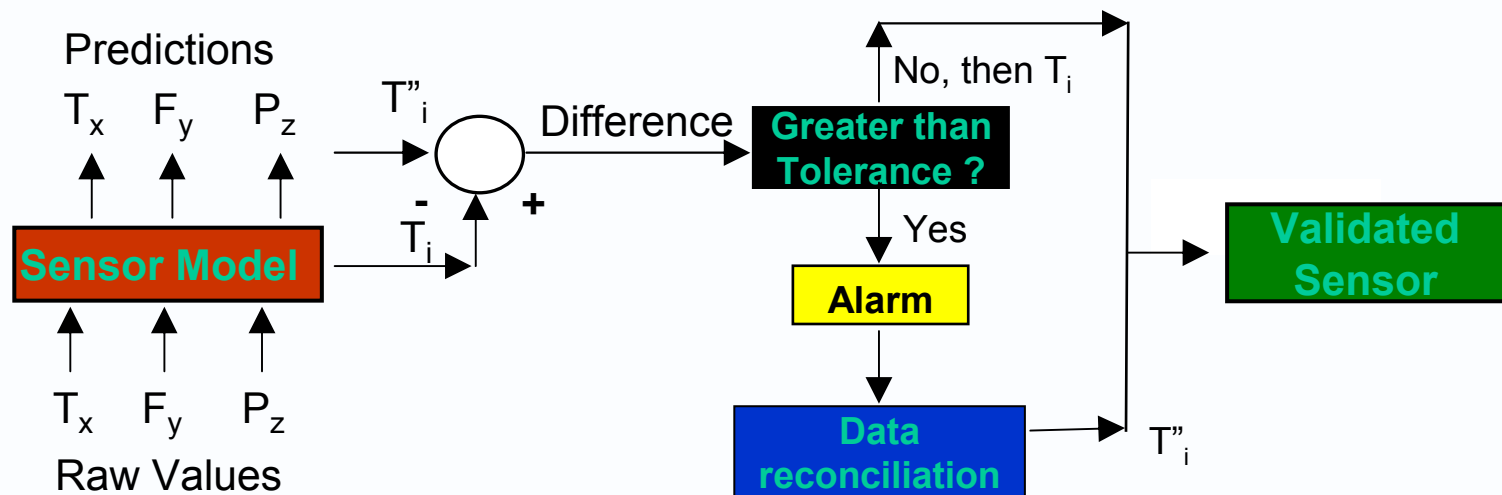


Predictive Emissions Monitoring System consists of

- An emission model that reflects the relationship between process operations and ambient conditions to emissions.



- A sensor validation system to ensure the accuracy of the predicted emissions data.



Sensor Validation



- Definition
 - An algorithm imbedded in the emissions model to check raw inputs for validity and reconstruct variables that are out of specification due to failure or drift by using surrounding information to predict what the failed sensor value should be.
- Method
 - Development of a model for each key PEMS inputs via Pavilion’s non-linear modeling technology.
 - Model inputs accuracy with $R^2 > 95\%$
 - 6 accuracy factor options configured with sensor specific model input behavior.
- Results
 - Sensor Validation is a unique patented process that provides Pavilion Technologies “Software-CEMS” to achieve the USEPA mandated 95% uptime of a predictive emissions monitoring system (PEMS).

Model Validation



- Definition
 - A routine that applies known values to the sensor inputs and verifies the values against known outputs.
- Method
 - Predetermined input values are applied to the PEMS and output values are then calculated. These values are compared to the know output values from the know input values (developed during modeling and RATA). Values are compared and determined via the Software CEMS that they are in accuracy compliance.
- Results
 - An equivalency to a EPA mandated Quarterly audit.
- Advantages
 - Model Validation is run daily
 - No material and labor costs

Statement of Work



- Create Definition
 - Kick-off meeting
 - Functional Design
 - Design of Experiments
- Data Collection
- Application Development
- Application Exposition
- PEMS Installation
- Validation
- Certification

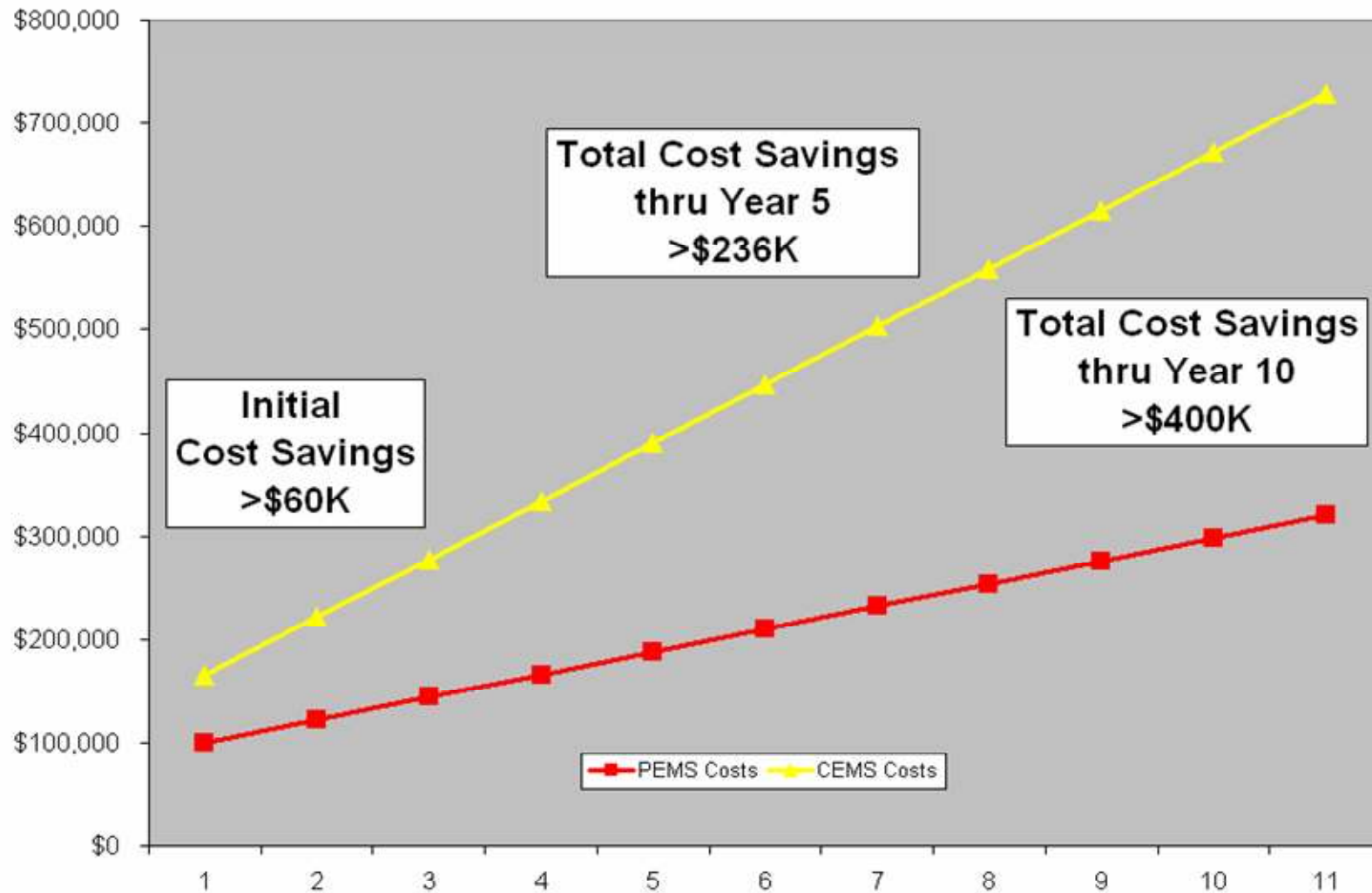
Design Principals

PEMS Applications – Industry Independent



<i>Industry Independent</i>	Natural Gas	No. 2 Fuel Oil	Other Fuel Oils	Refinery Gas	Process Gas	Combined Fuels
Boilers	<p><i>All Combinations Valid for PEMS Applications</i></p>					
Turbines						
Turbines with Duct Burners						
Dryers with Thermal Oxidizers						
Reciprocating Engines						
Process Heaters						
Olefin Furnaces						
Crude Heaters						

PEMS – Lower Cost of Ownership versus CEMS



PEMS by the Numbers



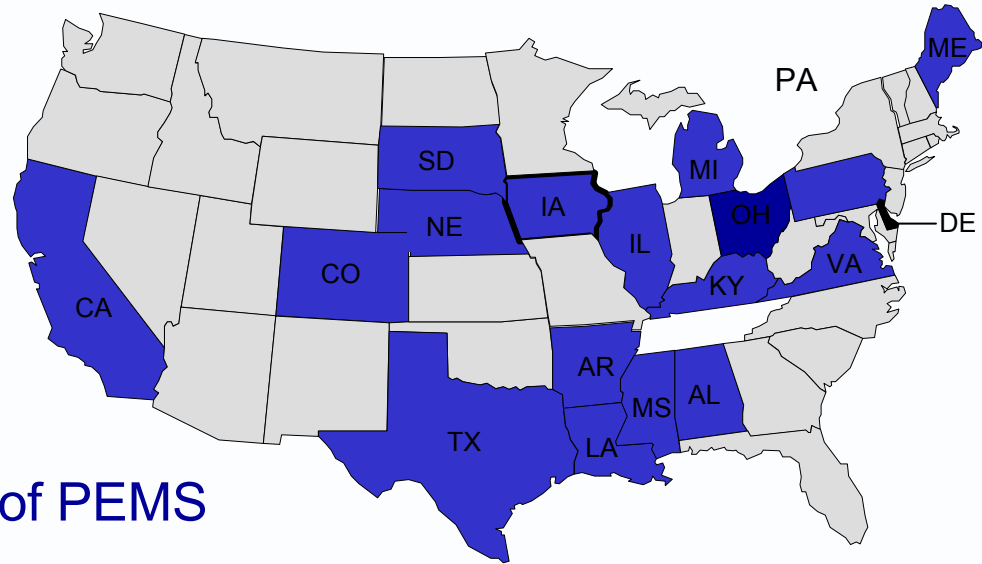
>220 PEMS

- 167 PEMS in Texas
- 70 PEMS in Refining

82 Projects

- 14 Ethanol

18 States' EPA approved the use of PEMS



8 Countries (approved or currently validating use)

- USA, U.K., Norway, France, Netherlands, Saudi Arabia, New Zealand, Italy, UAE



Challenges

Netherlands NO_x Emissions Credit Trading

- **Continuous NO_x Emissions Monitoring if > 100 MWth**
- **CEMS (hardware) or PEMS (software)**

Pernis, The Netherlands



Performance Requirements

- **En-14181: QA standards for continuous emissions monitoring at stationary sources**
 - NO_x accuracy $\pm 20\%$
 - Availability > 97%

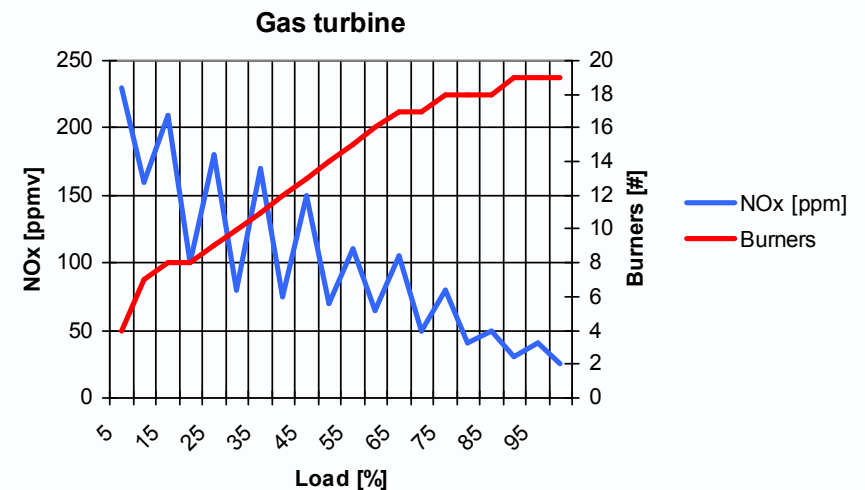
Gas Turbine

- **160 MWth, 19 burners, dry low NO_x**

Extremely Short Project Schedule

- **Urgently replace poor performing monitoring system**

NO_x profile relative to burners in operation



The Benefits



- Performance
 - Accurately and reliably predicts NOx emissions on complex sources such as the dry low NOx gas turbine:
 - NOx emissions accuracy +/- 9.2% (exceeds the requirement of +/- 20%)
 - Patented Sensor Validation provides 100% availability
- Fully automated quality assurance testing
 - Minimal maintenance required (lower TCO)
- Met Tight Project Schedule
 - Project duration: < 5 weeks including:
 - P.O. and contract completion
 - Model development and deployment
 - Stack testing
 - Certification in accordance with EN-14181
- Fast time to value
 - Quicker ROI