Universities Continuously Monitor Stack Emissions Utilizing Only Software

Presented by:
Jim Toolen, V.P. of Sales
PROBLEM STATEMENT

• There is a need to meet the regulatory requirement for continuous stack emission monitoring for two large boilers at a University and at an industrial plant in Eastern US (40 CFR Part 60 and State requirements)

• Also, to do so in a way that reduces the carbon footprint and reduces cost of ownership as compared to other means of Continuous Stack Monitoring (CEMS)
Case Study

TRACE’s innovative PEMS solution has recently been successfully deployed and certified at a University and an industrial plant in the Northeast. (Contact information can be provided should you wish to discuss with them)

This presentation compares the factors that contributed to decision making that lead to choosing PEMS rather than CEMS.
- Boilers at or greater than 100 MMBtu/Hr. heat input capacity are subject to US EPA 40 CFR Part 60 Subpart Db… and thus must continuously monitor their stack emissions for NOx and O2.

- Permits will often read: “……Continuous monitoring shall occur with the use of a CEM or approved alternative methodology”… which is PEMs
PEMS Solution

Deploy a software based emissions monitoring system to reduce your carbon footprint!
REDUCED CARBON FOOTPRINT

- PEMs (software) requires no requirement for any preventive or periodic maintenance or spare parts

- Very low power consumption since this is a software solution (110vac to the PC)

- Does not require daily calibration gases nor the transport of those bottles

- This contrasts with the University’s experience with CEMs (220 vac and 110 vac), plant air, calibration gases)
NEW SOURCE: (once all source tuning is complete)

• Temporary CEMS, in a trailer, is deployed for a period ranging from one to three weeks

• The source operates and is cycled through its operating range (including a SU/SD is ideal)

• The temporary CEMS monitors and stores 1 minute emission values over that period

• SCADA/DCS is also monitoring and collecting process parameters during that period and the two data sets are temporally matched
✓ Fuel flow rate
✓ Fuel BTU
✓ Air Flow rate
✓ Combustion Temperature
PEMS Components:

- Computer
- Application Software
  - PEMS Modeling
  - DAHS Reporting

• Utilizes signals from existing process monitors
  (Fuel flows, temperatures, pressures, etc)
PEMs users realize significant operational cost savings

- NO hardware to maintain
- NO spare parts
- NO calibration gases
- NO analyzer failures
- Significantly reduced operator and I&C technician time
HOW A PEMS IS DEPLOYED CONTINUED

- Stack emission data along with the process data is then used to configure the PEMS and create the models (engineering and data correlation analysis occur and the model is trained and tested prior to deployment.

- Communication (handshaking) is established between the PEMS computer and the plant Control System (DCS or SCADA) via OPC or Modbus.

- Real time operating parameters (fuel flow, temperatures, pressures, source status, etc.) are fed to the PEMS and utilized by the PEMS model to provide real time emission values, alarms, exceedances, etc.
Commissioning Complete: PEMS, like CEMS, is subject to initial RATA Certification and ongoing quarterly and annual QA testing

- Initial Certification:
  - Three (3) load RATA
  - F-test
  - Bias check
  - Correlation Analysis

- On going QA:
  - Quarterly Audits Relative Accuracy Audits (RAA)
  - Annual RATA (Single Load)
CALUCLATING PEMS PARAMETERS

- U.S. EPA Performance Specification 16 (PS-16)
- Promulgated in 2010
- Provides operating and testing requirements and protocols for assessing the acceptability of PEMS when they are installed and operating
- PEMS as an alternative to CEMS
REQUIREMENTS:
PERFORMANCE SPECIFICATION 16

- Pass a three load RATA confirming the PEMS prediction logic was valid. (Low, mid, and high (>80%)). Perform nine test runs at each level.
- PEMS requires a sensor validation to demonstrate sensors are working, and in range. Establish operating ranges.
- Minimum of three input parameters.
- Statistical tests for model accuracy.
- Relative Accuracy Audits quarterly first year, semi-annual thereafter.
- Annual RATA with one load test
Replacing existing CEMS with PEMs

• **Minimal Risk:**
  • PEMS can operate in parallel with the CEMS for any length of time
  • Use of CEMS Historical Data (and historical process data):
  • Most complete data set by utilizing years of the existing CEMS emission data and process data to build the PEMS models
PEMs in Parallel

- Fine tune model
- Complements existing CEMS
- Gain confidence of data
- Compare quarterly reports
- Phase out old equipment
When **NOT** to use a PEMS

- Solid fueled sources (Coal, Biomass, re-fuse, etc.)
- Varying gas concentration fuels (ex: Pipeline natural gas that is supplemented by waste or syn-gas)
- Sources with fuels that have unknown or varying heat content
- Sources that have regular, extreme operating swings
PEMS DATA ACQUISITION SYSTEM
IS A PEMS THE SOLUTION FOR YOU?

Boilers:
- Boilers at or greater than 100 million Btu/hr., HHV
- Standard fuel supply/quality or known Heat Input (i.e. natural gas, #2 oil)
- Control system that requires minimal boiler operator intervention
- Consistent operating methodology
<table>
<thead>
<tr>
<th>AT A GLANCE</th>
<th>PEMS</th>
<th>CEMS</th>
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<tbody>
<tr>
<td>Capital Cost</td>
<td>$</td>
<td>$$$</td>
</tr>
<tr>
<td>Installation Time</td>
<td>Up to 45 DAYS</td>
<td>UP to 14 Weeks</td>
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<tr>
<td>Startup</td>
<td>1 Day</td>
<td>2-4 Days</td>
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<tr>
<td>Training</td>
<td>1 to ½ Days</td>
<td>Min 3 Days</td>
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<tr>
<td>Emergency Service</td>
<td>Remote Access eliminates any need if an issue should arise</td>
<td>Can be as much as $2000 per Days</td>
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<td>Calibration Gas</td>
<td>N/A</td>
<td>Require safe storage plus demurrage expense</td>
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<tr>
<td>Preventative Maintenance</td>
<td>$0 Normal calibration of process instruments is already taking place</td>
<td>Daily, monthly, quarterly, semi and annual</td>
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<tr>
<td>Data Availability</td>
<td>Normally 100%</td>
<td>Issues arise including failed calibrations and equipment maintenance and failures</td>
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<td>Data Accuracy</td>
<td>Accurate as a CEMS</td>
<td>CEMS may drift</td>
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<tr>
<td>Obsolescence</td>
<td>Update PC Hardware</td>
<td>Analyzers last 5-8 years on average</td>
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<td>Support Contact</td>
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PEMS Components:

• Computer
• Application Software
• PEMS Modeling
• DAHS Reporting
PEMS
INCREASE
MONITOR
AVAILABILITY
LESSONS LEARNED

PEMS is a highly accurate solution:
- Primary Environmental Compliance Solution
- Reliable back up to the traditional CEMS
- Benchmark to validate maintenance actions
- Transitioning from aging CEMS

Financial: Starting with initial capital expenditures then extending through its life by having minimal maintenance and on-going certification cost

PEMS has some significant advantages:
- No preventive or periodic maintenance program.
- Almost no power consumption and no plant air consumption
- No need for any consumables and spare parts

Studies have shown the overall life cycle cost in 5 years is reduced up to 50% compared to CEMS
QUESTIONS?
THANK YOU

Jim Toolen
201-670-7077
jtoolen@traceenv.com