TRACE
REGULATORY COMPLIANCE
THROUGH INNOVATION

Presented by:

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Universities Continuously Monitor Stack Emissions Utilizing Only Software

CampusEnergy2020
THE POWER TO CHANGE
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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)

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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.

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EPA AND STATE ACCEPTANCE

- 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

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PEMS Solution

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

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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)

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HOW A PEMS IS DEPLOYED

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

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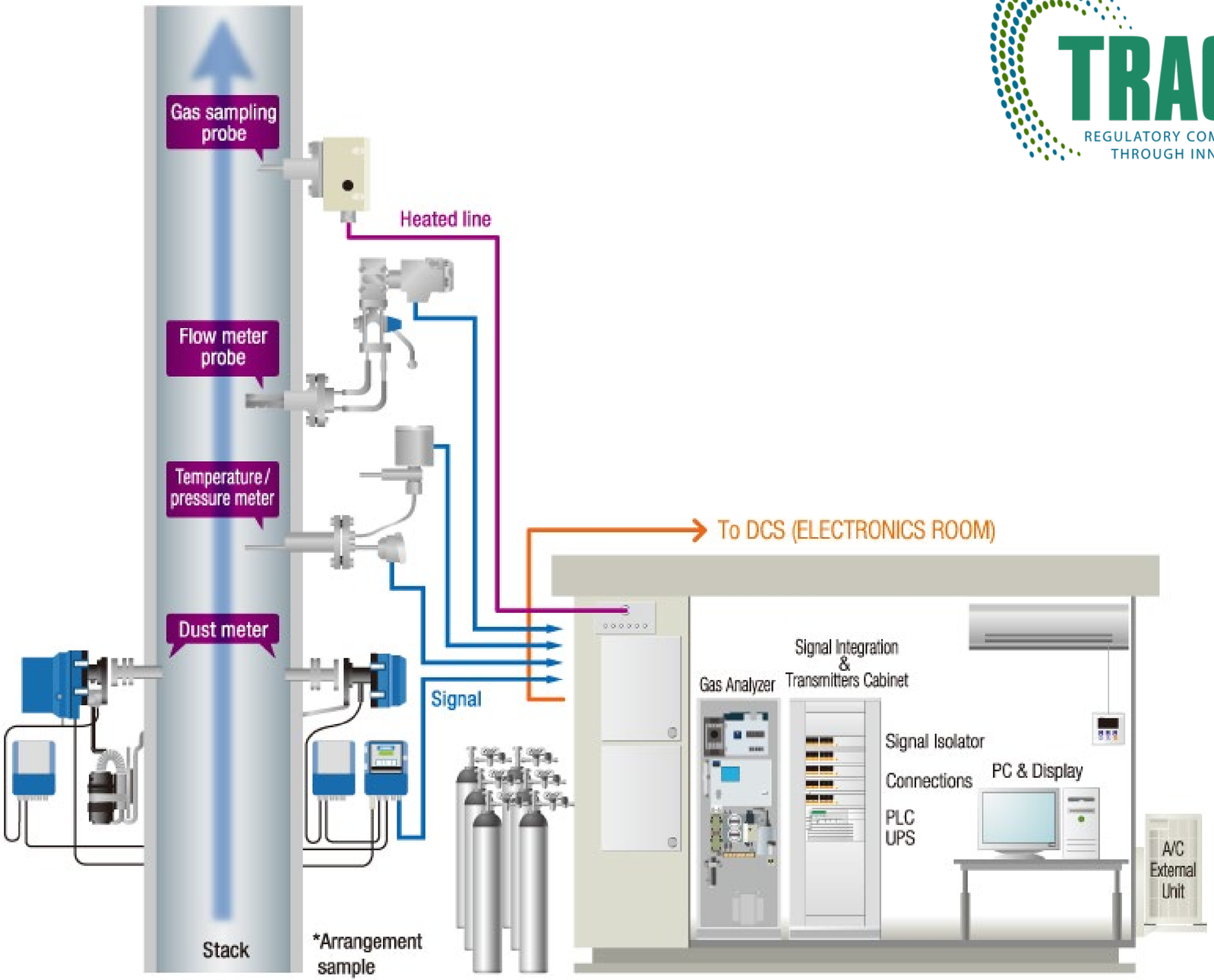
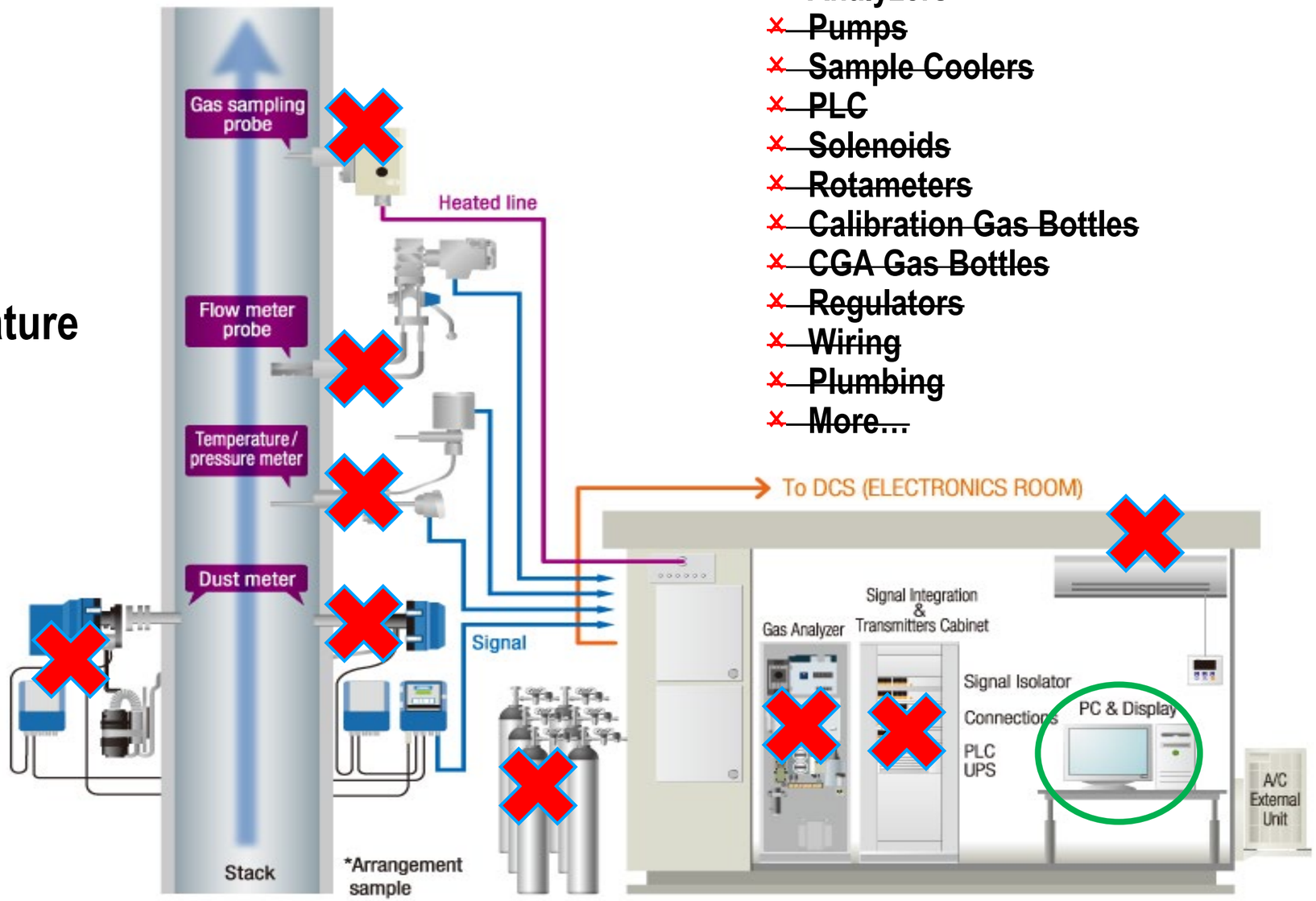
TYPICAL CEMS



- ✓Fuel flow rate
- ✓Fuel BTU
- ✓Air Flow rate
- ✓Combustion Temperature



- ~~Analyzers~~
- ~~Pumps~~
- ~~Sample Coolers~~
- ~~PLC~~
- ~~Solenoids~~
- ~~Rotameters~~
- ~~Calibration Gas Bottles~~
- ~~CGA Gas Bottles~~
- ~~Regulators~~
- ~~Wiring~~
- ~~Plumbing~~
- ~~More…~~

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PEMS Components:

- Computer
- Application Software
  - PEMS Modeling
  - DAHS Reporting

• Utilizes signals from existing process monitors (Fuel flows, temperatures, pressures, etc)

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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

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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.

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HOW A PEMS IS DEPLOYED CONTINUED

- 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)

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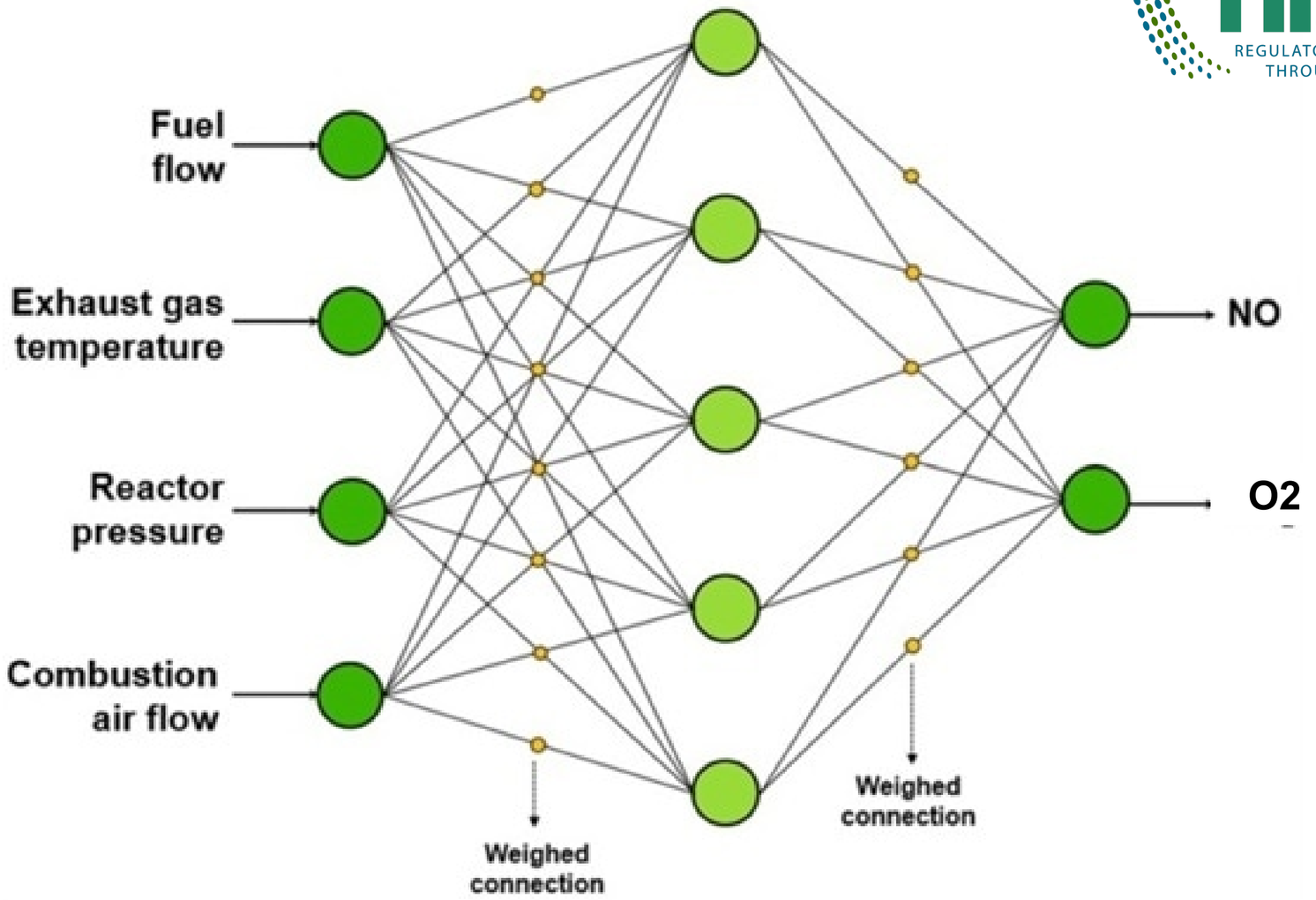
CALUCLATING PEMS PARAMETERS



Using Predictive Emission Monitoring Systems (PEMS) Measurement and Analytics (2015)

- 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

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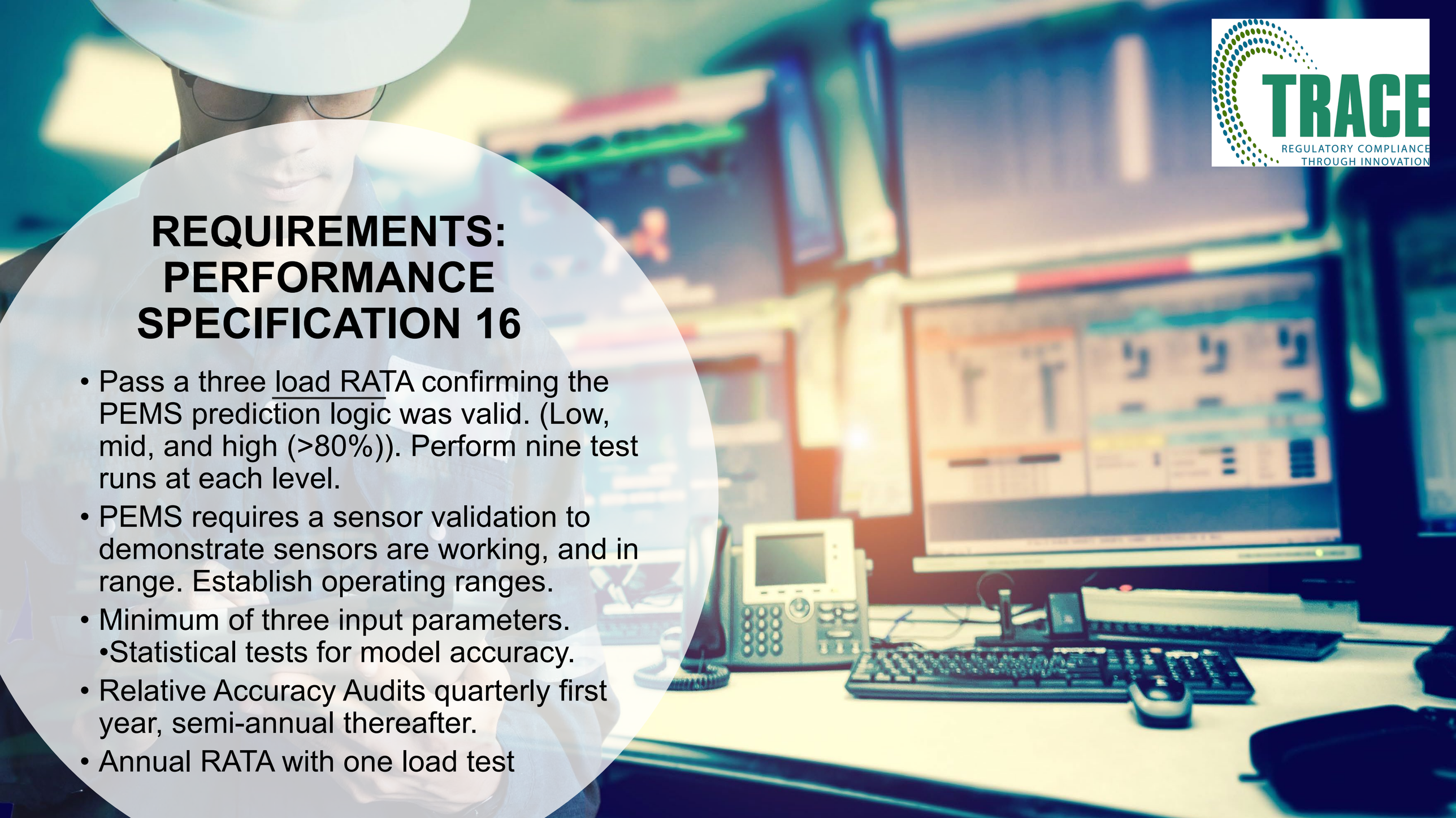

REQUIREMENTS: PERFORMANCE SPECIFICATION 16

- 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

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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

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PEMS DATA ACQUISTION SYSTEM

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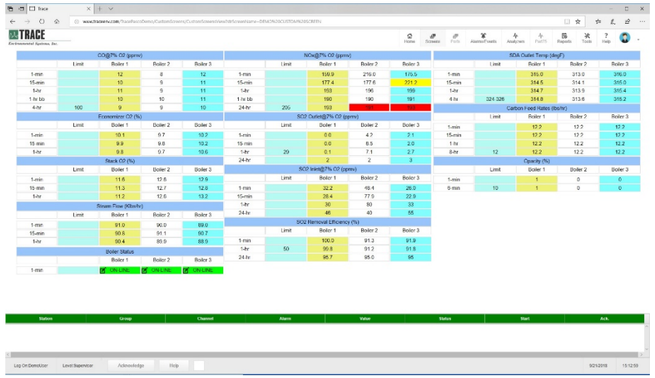
Environmental Systems, In

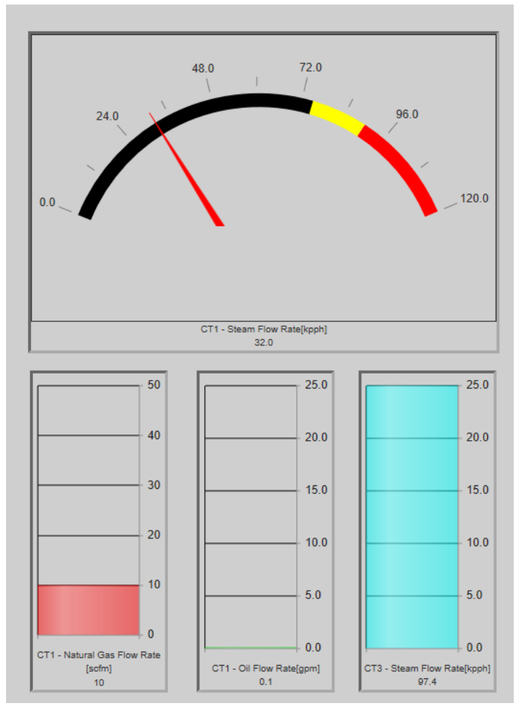


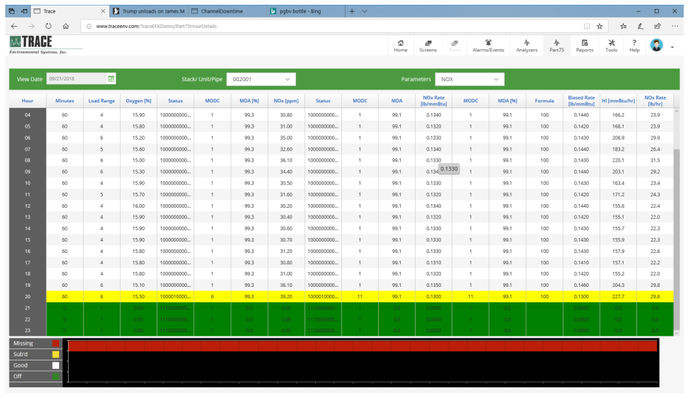
Data Summary Report

Company: ABC Trash to Energy Corporation
1234 Garbage Blvd
Trashtown, FL 12345

Data Group: U-1>1HR DATA
Report Name: No Title
Start of Report: 08/01/2018 00:00
End of Report: 08/01/2018 23:59
Validation: Valid Data Only

Group#-Channel#	G39-C4	G39-C1	G39-C6	G39-C7
Long Descrip.	U1-1Hr St	U1-1Hr St	U1-1Hr St	U1-1Hr St
Short Descrip.	COsc	O2s	SO2sc	NOXs
Units	ppmc	%	ppmc	ppm
Range	0-1500	0-21	0-500	0-500
08/01/2018 00:00	9	11.1	6.3	137
08/01/2018 01:00	8	11.3	1.9	136
08/01/2018 02:00	9	11.3	2.6	135
08/01/2018 03:00	7	11.1	2.2	136
08/01/2018 04:00	7	11.3	18.6	129
08/01/2018 05:00	6 <	11.2 <	4.7 <	134 <
08/01/2018 06:00	7	11.1	0.8	136
08/01/2018 07:00	7	11.0	0.6	138
08/01/2018 08:00	9	11.3	0.4	132
08/01/2018 09:00	7	11.1	0.3	138
08/01/2018 10:00	9	11.3	0.0	133
08/01/2018 11:00	7	11.1	1.1	140
08/01/2018 12:00	8	11.2	0.1	133
08/01/2018 13:00	7	11.0	0.0	139
08/01/2018 14:00	7	11.0	0.6	143
08/01/2018 15:00	8	11.4	9.6	132
08/01/2018 16:00	8	11.4	45.1	129
08/01/2018 17:00	10	11.5	55.8	130
08/01/2018 18:00	7	11.3	19.3	136
08/01/2018 19:00	6	11.2	0.0	135
08/01/2018 20:00	8	10.9	0.2	136
08/01/2018 21:00	7	11.2	1.0	135
08/01/2018 22:00	7	11.0	3.7	140
08/01/2018 23:00	6	11.1	2.3	137
Period Average =	8	11.2	8.4	135
Period Max Value =	10	11.5	55.8	143
Period Min Value =	6	10.9	0.1	129
Period Totals =	1.8100E+2	2.6840E+2	1.7720E+2	3.2490E+3
Period % Recovery=	100.0	100.0	100.0	100.0





IS A PEMS THE SOLTUION 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

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CASE STUDY RESULTS

AT A GLANCE	PEMS	CEMS
Capital Cost	$	$$$
Installation Time	Up to 45 DAYS	UP to 14 Weeks
Startup	1 Day	2-4 Days
Training	1 to ½ Days	Min 3 Days
Emergency Service	Remote Access eliminates any need if an issue should arise	Can be as much as $2000 per Days
Calibration Gas	N/A	Require safe storage plus demurrage expense
Preventative Maintenance	$0 Normal calibration of process instruments is already taking place	Daily, monthly, quarterly, semi and annual
Data Availability	Normally 100%	Issues arise including failed calibrations and equipment maintenance and failures
Data Accuracy	Accurate as a CEMS	CEMS may drift
Obsolescence	Update PC Hardware	Analyzers last 5-8 years on average
Support Contact	$	$$

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PEMS Components:

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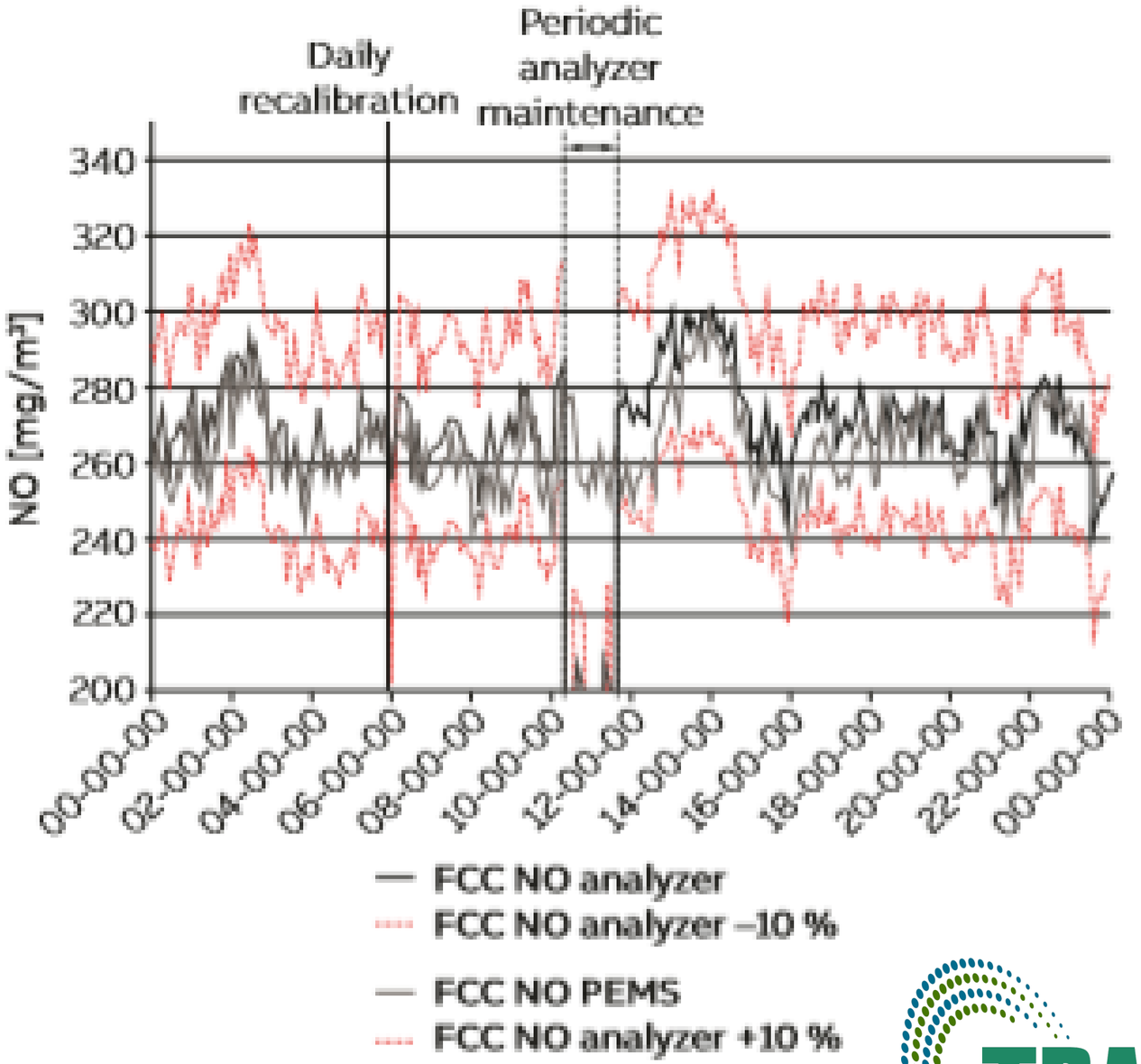
PEMS INCREASE MONITOR AVAILABILITY



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LESSONS LEARNED

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

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

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QUESTIONS?


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THANK YOU

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