# "MARAMA / ICAC Mercury CEMS Webinar"

## Tuesday, July 26, 2011


**Presentation By**

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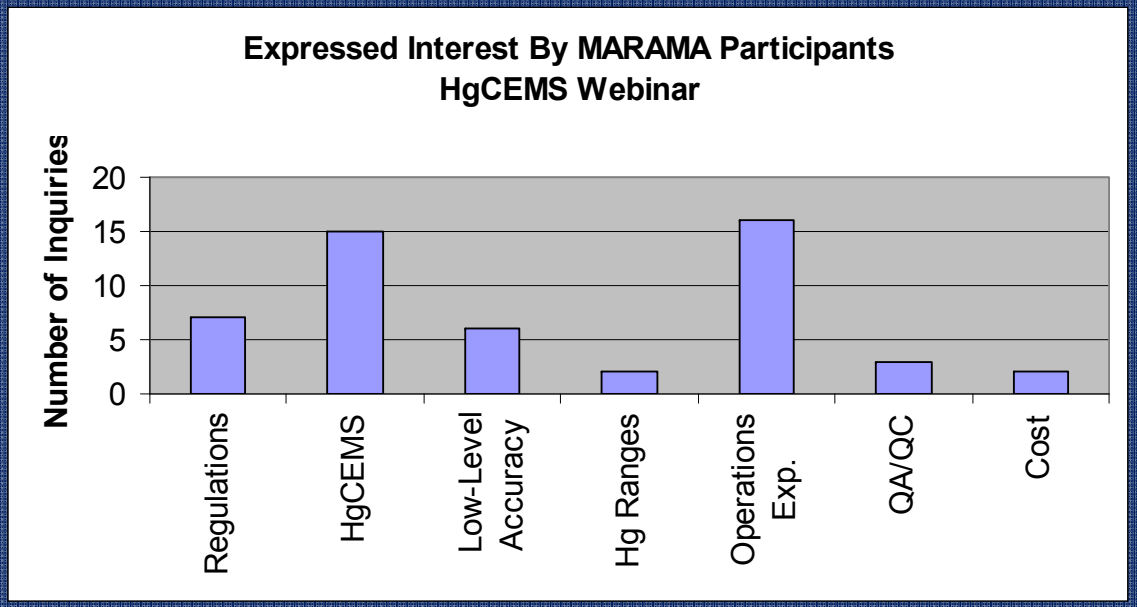
# Overview

*What do you want to learn or hear about?*



# Air Pollution Control and Monitoring Regulatory Frameworks in Play

- State and Local Regulations
  - Maybe more stringent than EPA EGU MACT
  - Will require new Air Pollution Control Equipment
  - Plant Operations and Reporting may be different
- Consent Decrees
- CAMR Vacature & Impacts
  - Many HgCEMS mothballed
  - Limited data for planning in some cases
- Projected EPA Utility MACT
  - Hg Emissions Limits 1.2 lbs/Trillion BTU (~1.5 ug/$m^3$ -w/o headspace)
  - Many Plants will be mothballed or decommissioned (some already announced)
  - New Abatement Strategies will be introduced – some not fully vetted yet
  - New Coal-Fired EGU Limits under review

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## *Use and Experience with HgCEMS*

- Selection of HgCEMS - Electronic or Sorbent Trap?
- HgCEMS Commissioning, Training
  - More complicated than Criteria Pollutant CEMS (e.g. SOx, NOx)
- Service and Maintenance Requirements
  - Early Stages 10-20 hours/week/HgCEMS
  - ~5 hours/week/HgCEMS after learning curve
- HgCEMS for Abatement Systems Performance Monitoring and Assessment
- Regulatory Reporting of Hg Emissions

# Tekran 3300 HgCEMS

## *Consists of:*

1. *Probe (M&C and Tekran designs – not shown),*
2. *Umbilical (Multiple Suppliers)*
3. *3310 Elemental ($Hg^0$) Calibrator*
4. *3315 Ionic ($Hg^{2+}$) Calibrator*
5. *3320 Conditioner*
6. *2537S Analyzer (same technology as Tekran Ambient Hg ––LLD <0.1 ng/m3, on-board Hg Perm Source )*
7. *Controller (multiple options)*

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## *Use and Experience with HgCEMS*

- HgCEMS Low-Level Measurements Accuracy
- Hg Generators – Tekran 3310 ($Hg^0$), 3315 ($Hg^{2+}$), Permeation Source ($Hg^0$)
- EPA NIST-Traceability Requirements and Compliance
- "Hot-Swap" Program
- Development of Operating Strategies to Incorporate Start Up, Shut Down, and Malfunction

# Some Challenges and Opportunities with HgCEMS Operations

*Example Challenges*

- More Complicated than Conventional CEMS
- Greater cost of Operations including NIST Traceability
- Expensive Heated Umbilicals – and some failures of same

*Example "Opportunities"*

- Electronic HgCEMS can be used to monitor and optimize the performance of abatement systems such as ACI
- Hg Emissions data can be used to track and forecast 30-day rolling averages and manage Plant or Fleet-wide Hg Abatement optimization

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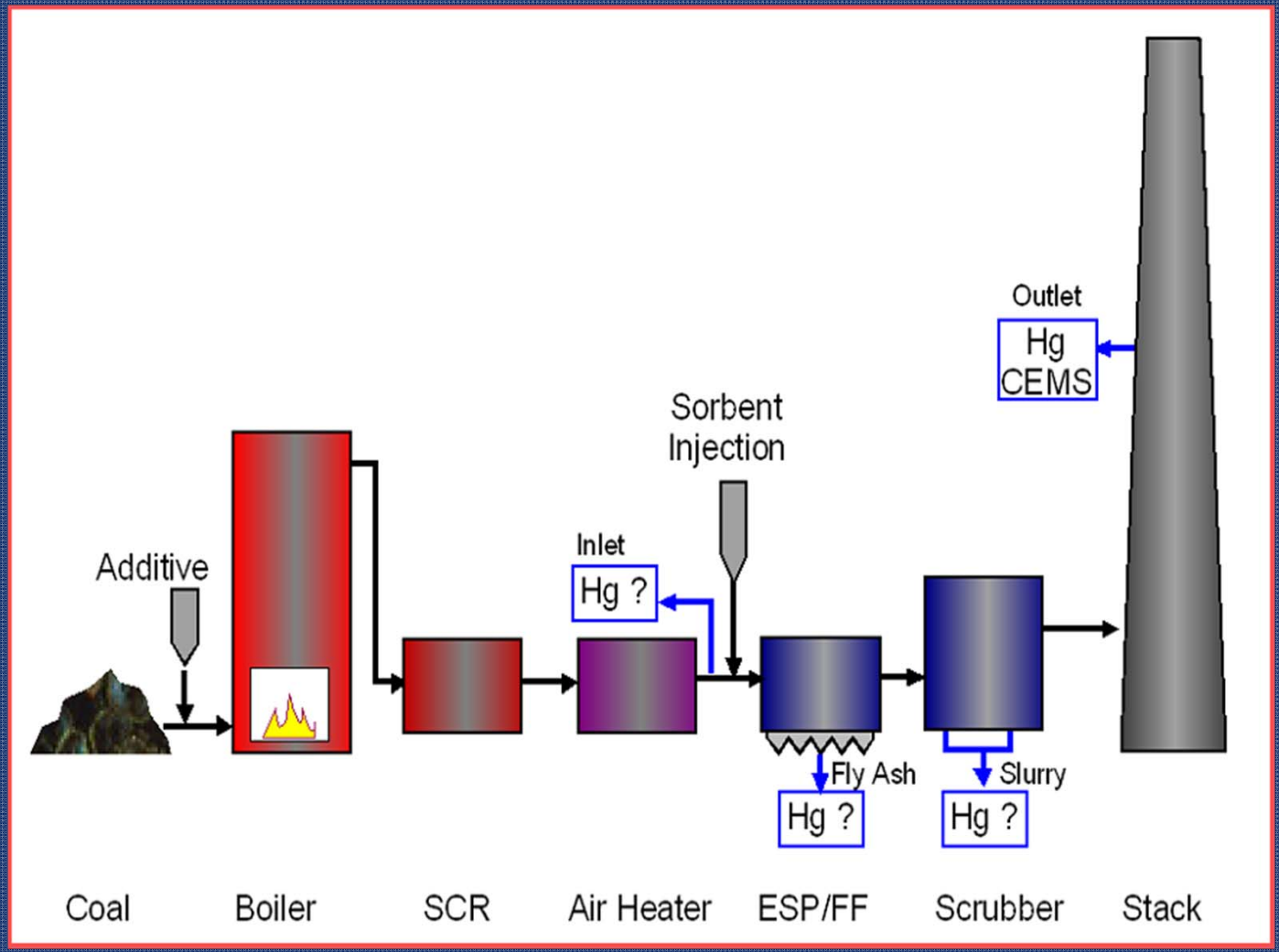
## *Summary of HgCEMS Applications*

| Application | Issues | Comments |
|---|---|---|
| Coal-Fired EGU | Wet Stack Carryover | Hg 0.0 – 40 ug/$m^3$<br>Will be 10 – 20 % of above |
| Portland Cement | Large Swings in Hg<br>Mill On/ Mill Off | Mill On Hg 1.0 – 50 ug/$m^3$<br>Mill Off 0 – 1000 ug/$m^3$ ! |
| Waste to Energy | Chlorides variations or sample train contamination | Hg Abated 1.0 – 10 ug/$m^3$ |
| Munitions Incineration | High Swings in Hg Loadings<br>and Concentrations | Hg 0.0 – 1000 ug/$m^3$ ! |
| Abatement Research | Different Technologies, ACI, FGD, DSI, ESPs, FF, KNX (CaBr) | Assist Pollution Control Equipment Providers in Laboratory/Pilot Research and Field Validation Tests |

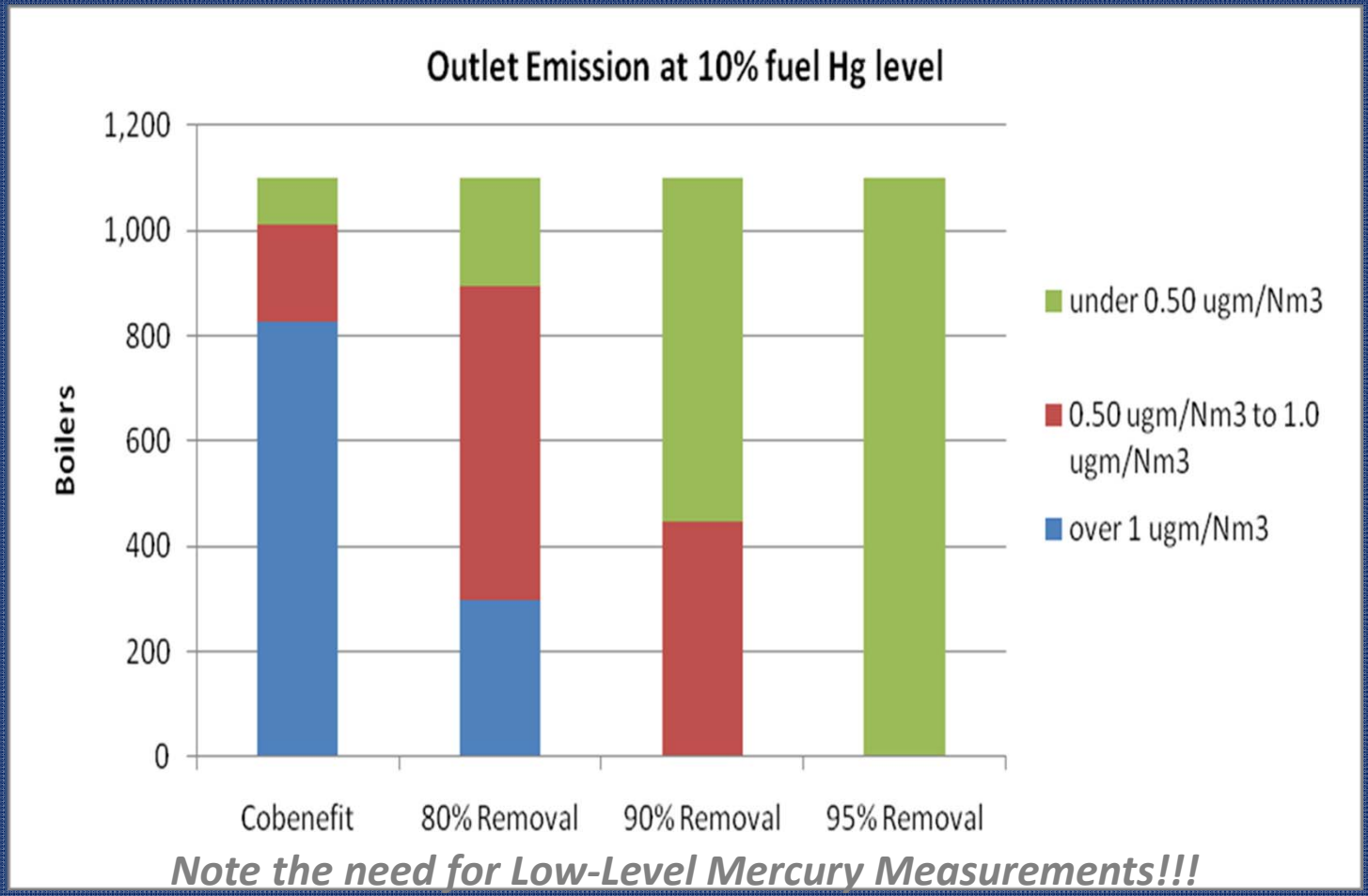
# EGU - Mercury Monitoring and Analyses Opportunities



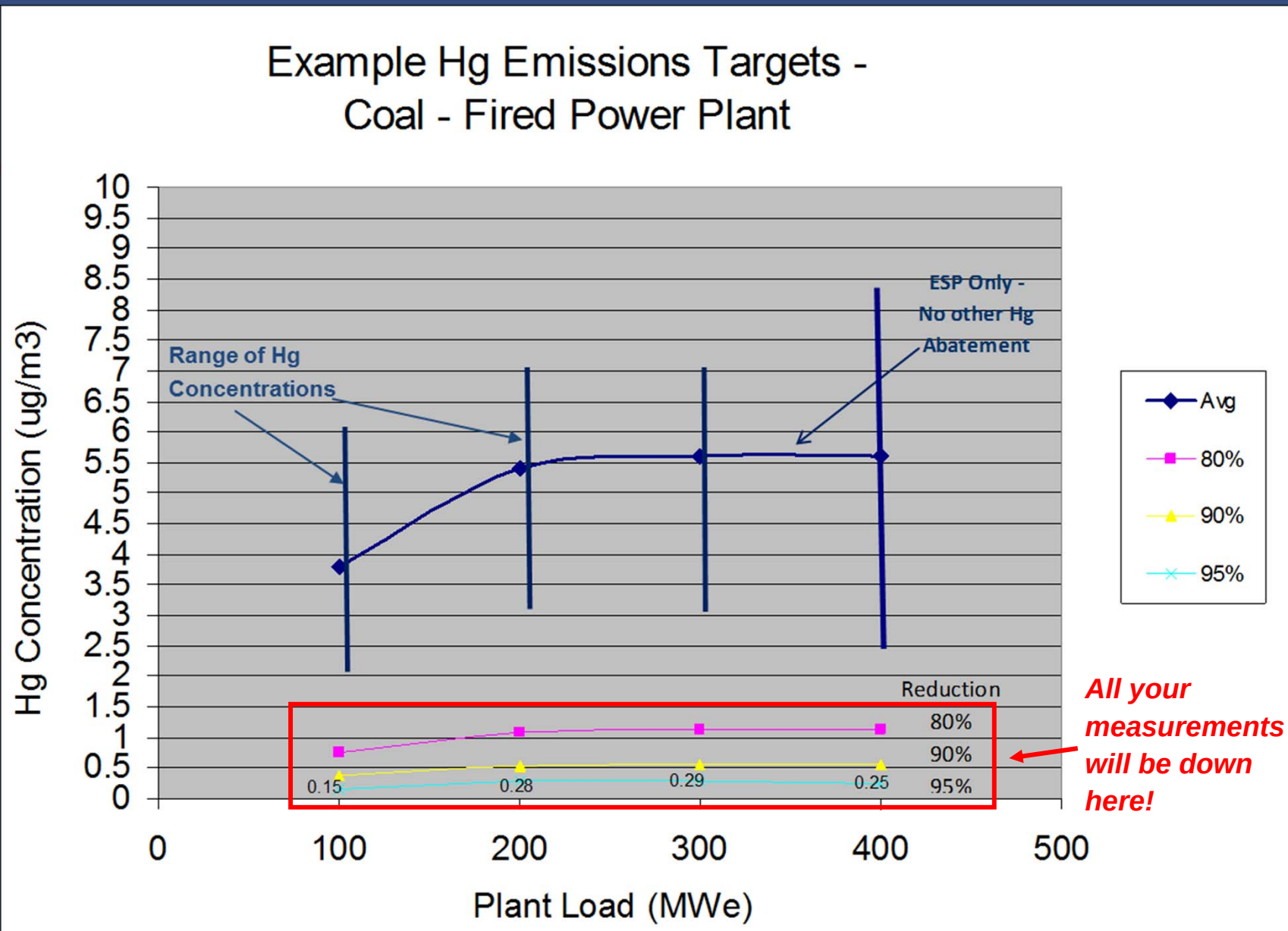
# Importance of Monitor Availability and Accurate Low-Level Hg Measurements

- Demonstrate compliance with MACT regulations
- Avoid Penalties associated with Data Substitution
- Document and predict 30-day rolling averages of Hg emissions *(includes Start Up, Shut Down and Malfunction)*
- Support accurate performance and optimization of Hg control equipment

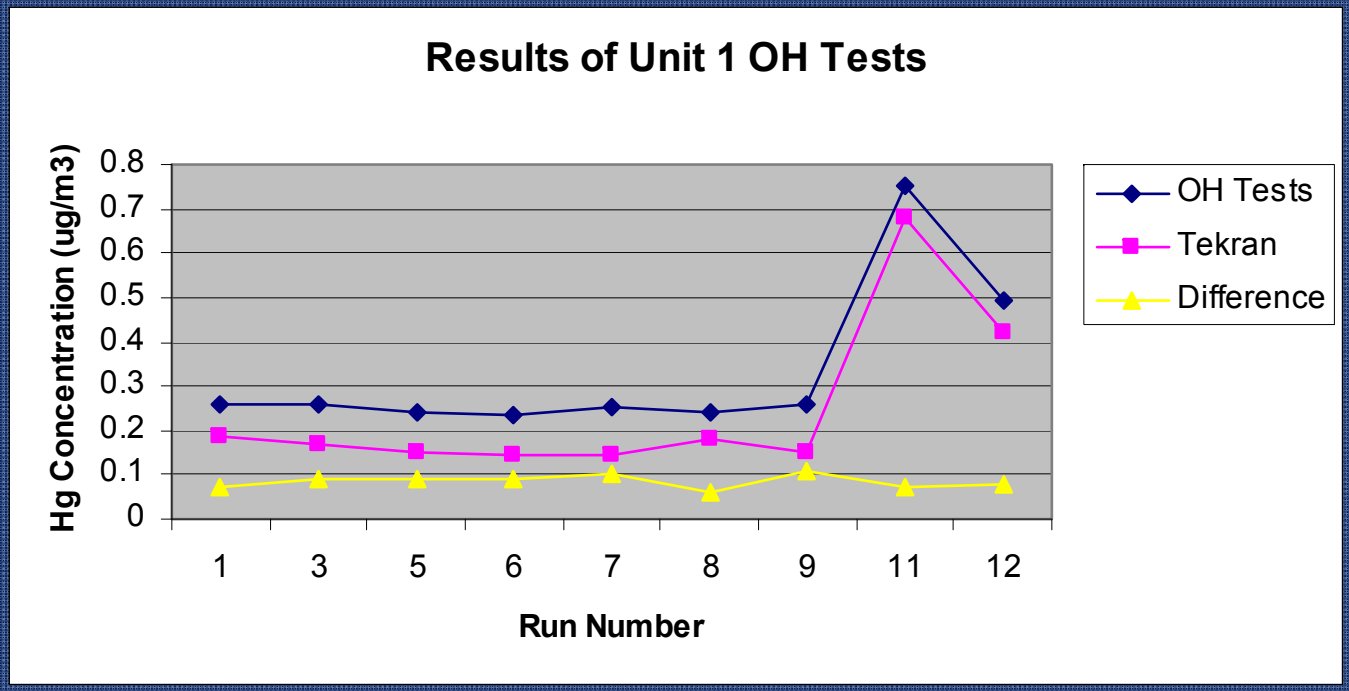
# Projection of Low-Level Hg Concentrations




*Note the need for Low-Level Mercury Measurements!!!*


Example Hg Emissions Targets -
Coal - Fired Power Plant
Hg Concentration (ug/m3)
10
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Range of Hg
Concentrations
ESP Only -
No other Hg
Abatement
Avg
80%
90%
95%
Reduction
80%
90%
95%
0.15
0.28
0.29
0.25
All your
measurements
will be down
here!
0
100
200
300
400
500
Plant Load (MWe)

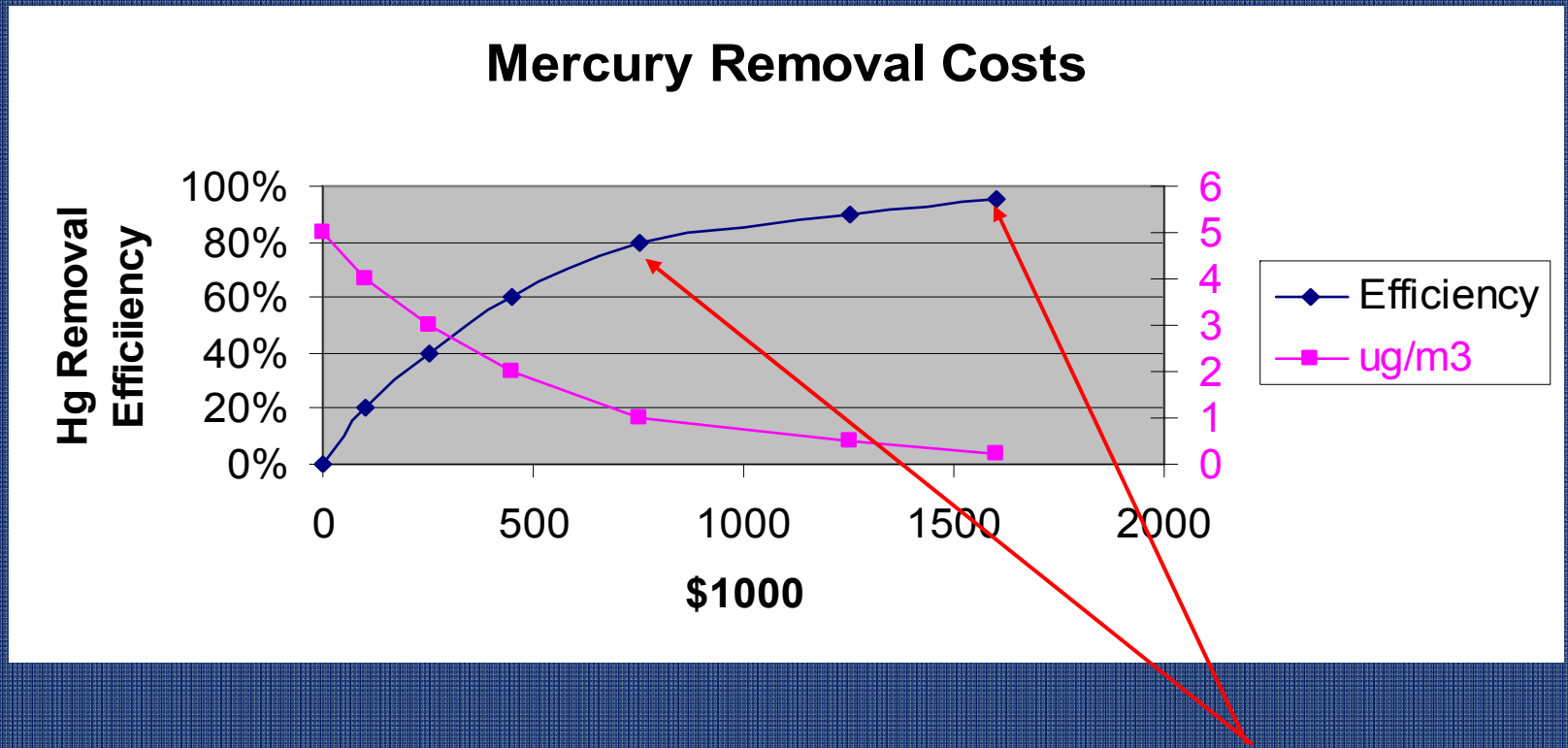
# Tomorrow's RATAs May All Look Like This!




**Average Difference <0.09 µg/m³**

*(Actual RATA Results on Tekran 3300 System)*

# Example: Mercury Abatement Annual Cost
## Sorbent Injection – 500 Mwe Coal-fired Plant

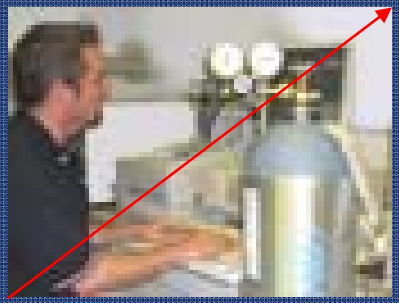



*The last 15% removal may cost an additional 50%. ($ 1 million/year ! )*

***Low-level measurement accuracy more important than ever !***

## Are there traceable calibration gas cylinders for Hg?

***No***. There are currently no acceptable Hg calibration gases available in cylinders – as exist for SOx, NOx, etc.



# What is NIST Traceability for Mercury About?

- EPA has released interim traceability protocols for Hg calibrators (July 2, 2009) (http://www.epa.gov/airmarket/emissions/mercury/hgmonitoring.html)
- NIST may not currently be prepared for the PC MACT regulations:
  1. *Not yet capable of certifying low (sub µg/m$^3$) concentrations for MACT Utility rule; lowest point to date is 0.5 µg/m$^3$ with 5-6% uncertainty (2σ)*
  2. *Have not yet certified high-level (~250 µg/m$^3$) concentrations for PC MACT*
  3. *Cannot certify $HgCl_2$ generators*

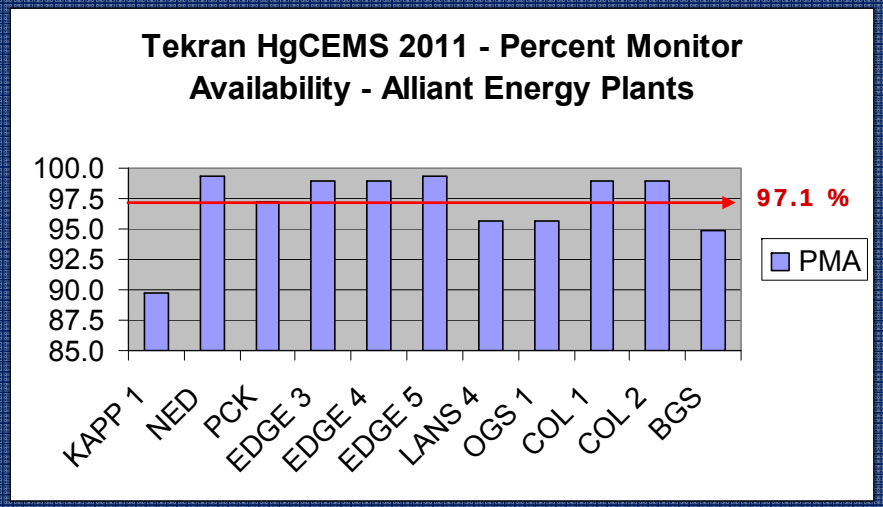
# Mercury Traceability

- Tekran has and continues to assist NIST and EPA with the “science” of Hg Generator Traceability.
- Tekran 3300 HgCEMS have three (3) Hg generators on board.
  - Elemental Generator ($Hg^0$), Permeation Source and Ionic ($Hg^{2+}$)
  - Only Tekran HgCEM Systems Hg generators can be extended to 8 rolling quarters before certification.
- Tekran can support traceability programs for any electronic HgCEMS.

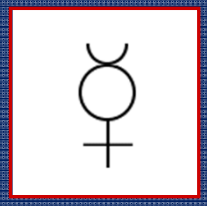
Tekran Hg Calibrators – HOT – Standby System for NIST Traceability

# Why are CEM Commissioning, Training, and Service/Aftermarket Support Important?

**Commissioning** process: validates CEM performance, initiates site awareness and ownership of systems, establishes relationship between supplier and owner. **Training** is critical for on-site ownership of CEM Operations, Maintenance, etc. Particularly beneficial for Percent Monitor Availability (PMA% - see graph) and Abatement Systems Performance Monitoring and Optimization (Slide 20). **Service/Aftermarket Support** is ***Critical*** for on-going compliance and "ownership" of CEMS Operations and Maintenance.

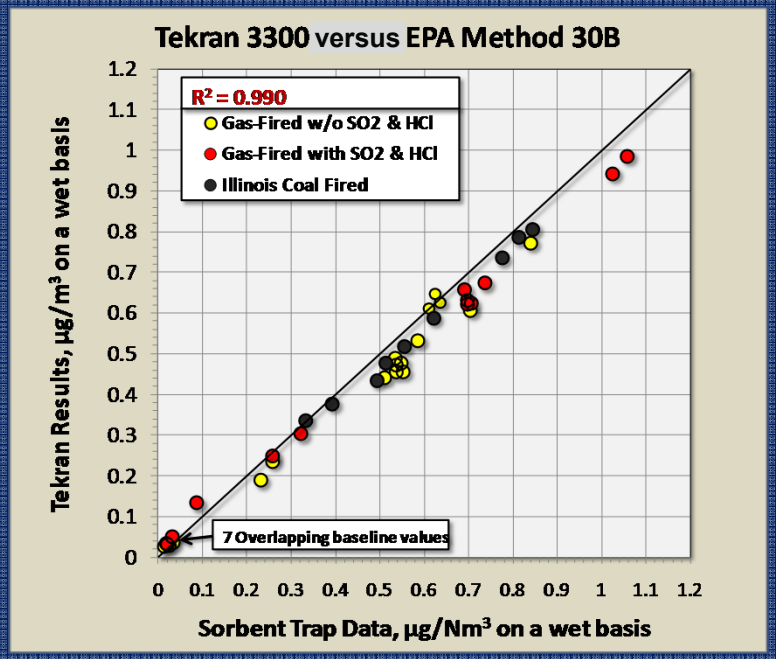


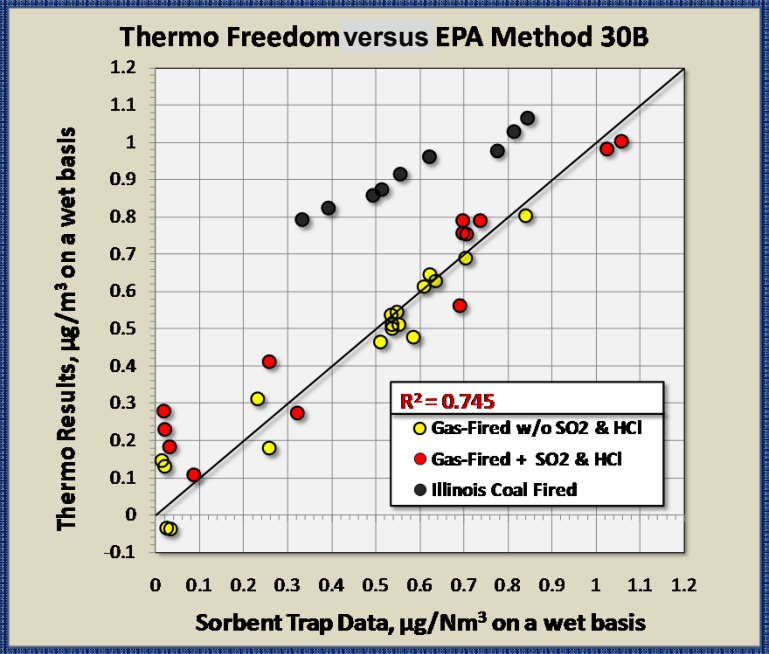
# Definitive Low-Level CMM Study



*EERC - ICCI - EPRI*

# Summary of EERC Low-Level HgCEMS Data



# Some Potential EPA Actions

- Fix RATA limits
  - Not too tight, but a window of ±0.8 µg/m$^3$ when measuring < 1 µg/m$^3$ is not appropriate
- Expand EPA "NIST Traceability" Protocols
  - Must work lower than Span Range of 5 µg/m$^3$
  - While they are at it …
    - Verify that protocols work at high concentrations for Cement MACT rule (e.g. 250 µg/m$^3$ Span Range)

# NIST Actions Needed

*EPA must fund these activities since NIST will not likely devote the resources to do it on their own*

- Improve NIST ability to measure lower concentrations with less uncertainty
  - Best current ability: 0.5 µg/$m^3$ with 6.1% uncertainty (@95%)
- "Routine" elemental generator certifications can take multiple attempts and require over a year to complete!

# NIST Actions Needed

- Ability to certify *high* concentrations for Cement MACT
- Learn how to measure $HgCl_2$
  - Maybe even certify $HgCl_2$ generators ?
  - Not that essential since current CMMs all use $Hg^0$ to calibrate themselves
- Other things for NIST to tackle:
  - Resolve $Hg^0$ headspace vapor concentration issue
  - Resolve the difference in calibrator outputs:
    - $HgCl_2$ liquid vaporization vs. elemental oxidation difference

# Summary

- EERC low-level mercury study was very well done
  - Reports still need some work
- Existing Tekran Series 3300 systems can easily measure *sub-µg/m*$^3$ mercury levels in actual coal flue gas effluent streams
  - Good zeros, accurate readings under all conditions
  - Shown in both EERC study and in the field since 2005
  - Have never failed a RATA at any level *(Over 200 done)*
- EPA and NIST have some work to do to get ready for the Utility MACT

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## *Discussion and Action Items*

- Review of Objectives and Expressed Areas of Interest
- Other Questions and Answers
- Action Items