"MARAMA / ICAC Mercury CEMS Webinar"

Tuesday, July 26, 2011

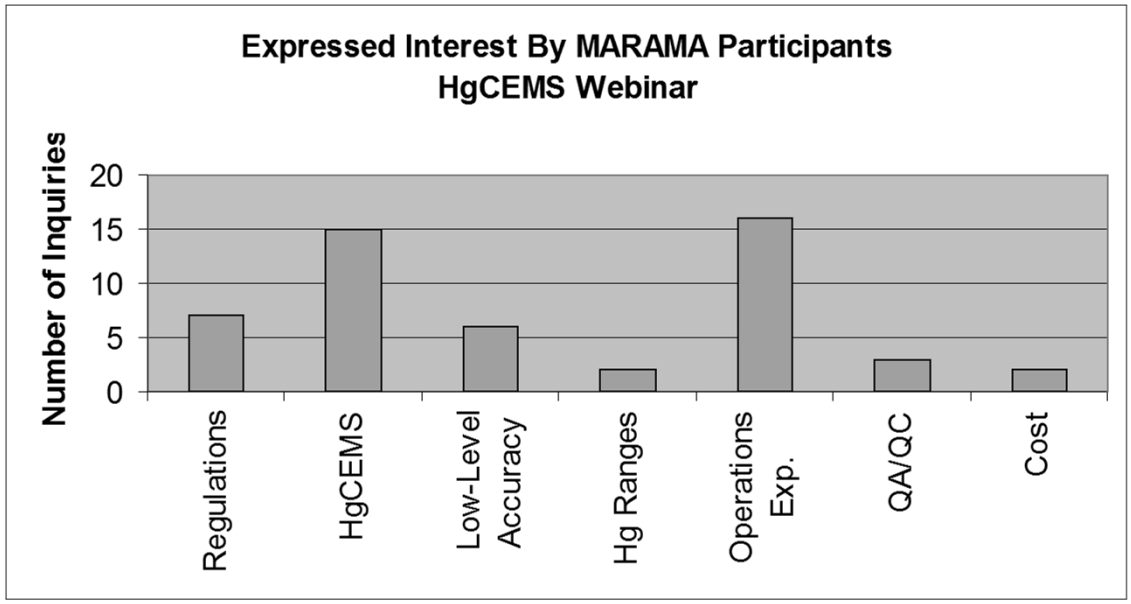
Presentation By

Karl R. Wilber, PE
General Manager, Tekran Instruments Corporation

www.tekran.com

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

MARAMA/ICAC
Mercury CEMS Webinar

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)***

MARAMA/ICAC
Mercury CEMS Webinar

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"

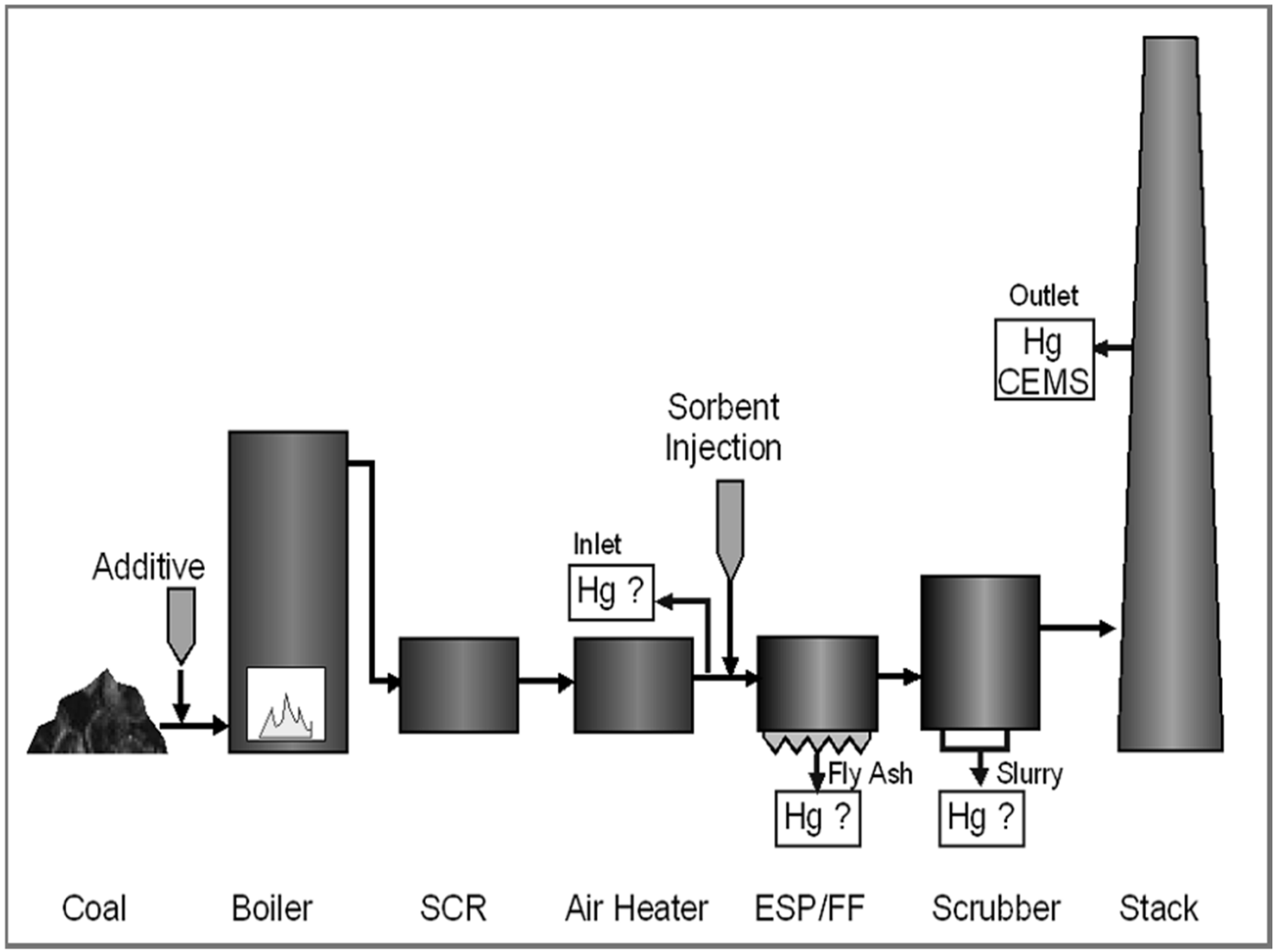
- Electronic HgCEMS can be used to monitor and optimize the performance of abatement systems such as ACI
- Hg Emissions data can be used to track and forecast 30-day rolling averages and manage Plant or Fleet-wide Hg Abatement optimization

MARAMA/ICAC
Mercury CEMS Webinar

Summary of HgCEMS Applications

Application	Issues	Comments
Coal-Fired EGU	Wet Stack Carryover	Hg 0.0 – 40 ug/m^3 Will be 10 – 20 % of above
Portland Cement	Large Swings in Hg Mill On/ Mill Off	Mill On Hg 1.0 – 50 ug/m^3 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 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

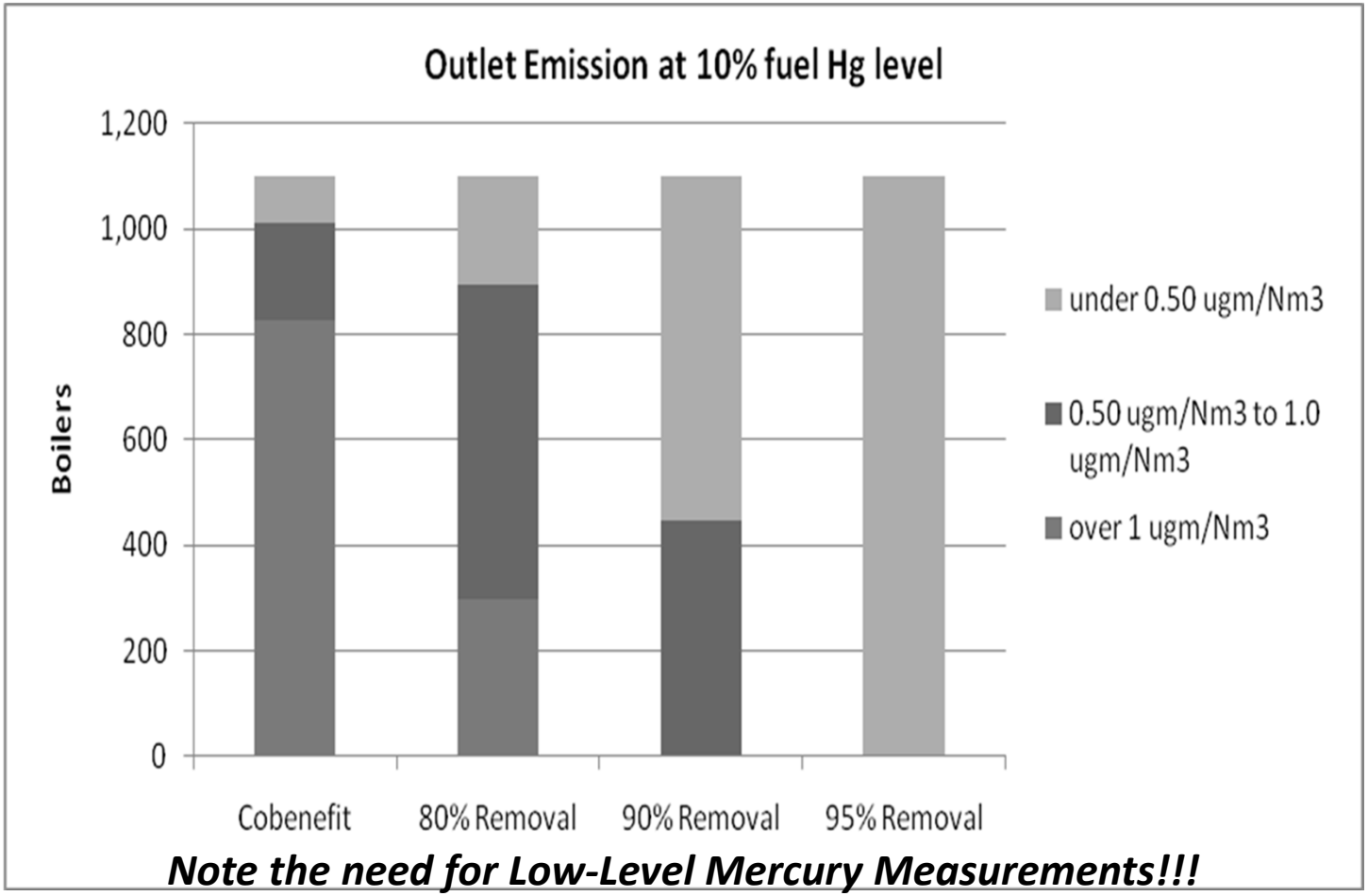
EGU - Mercury Monitoring and Analyses Opportunities



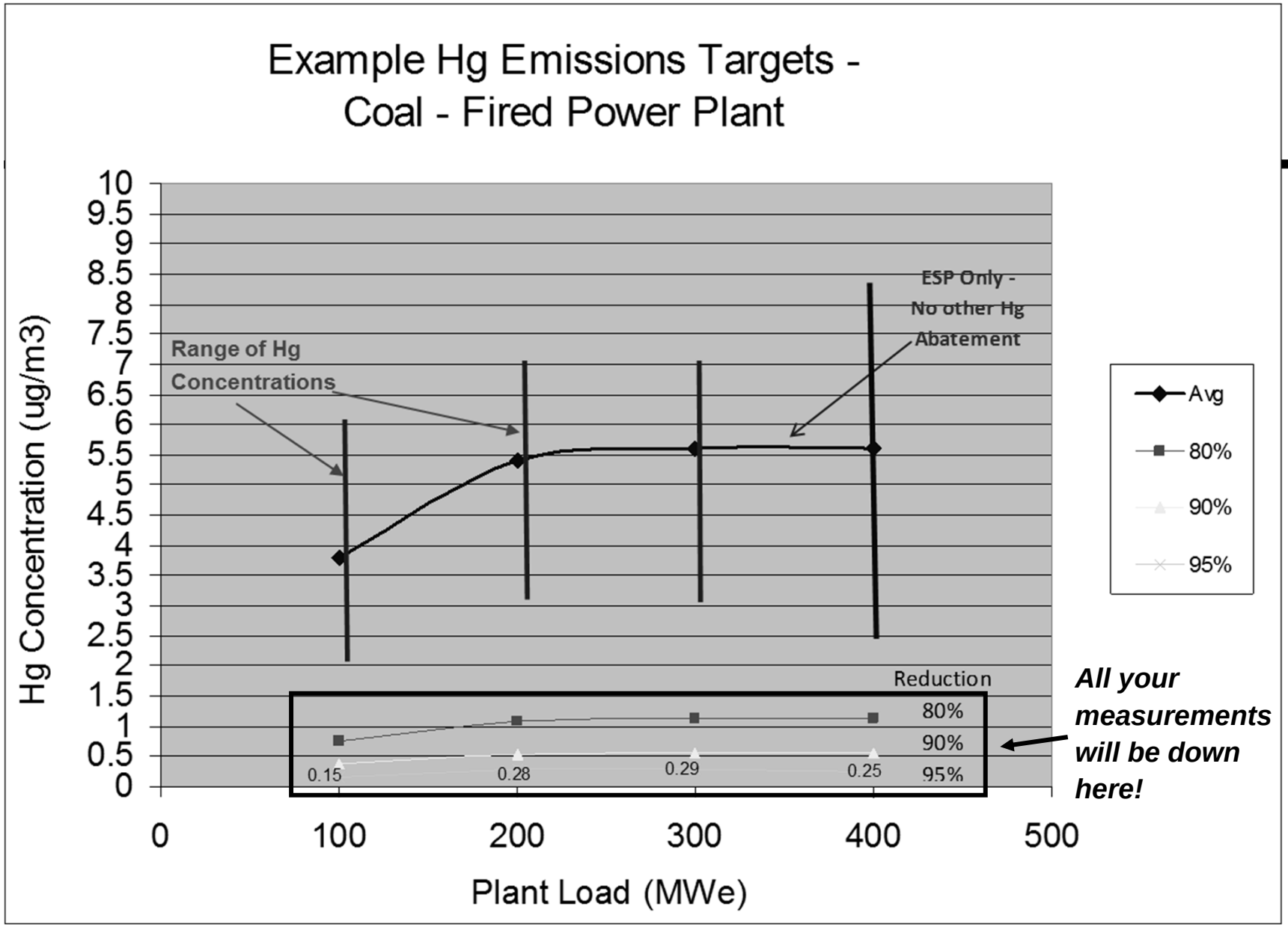
Importance of Monitor Availability and Accurate Low-Level Hg Measurements

- 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

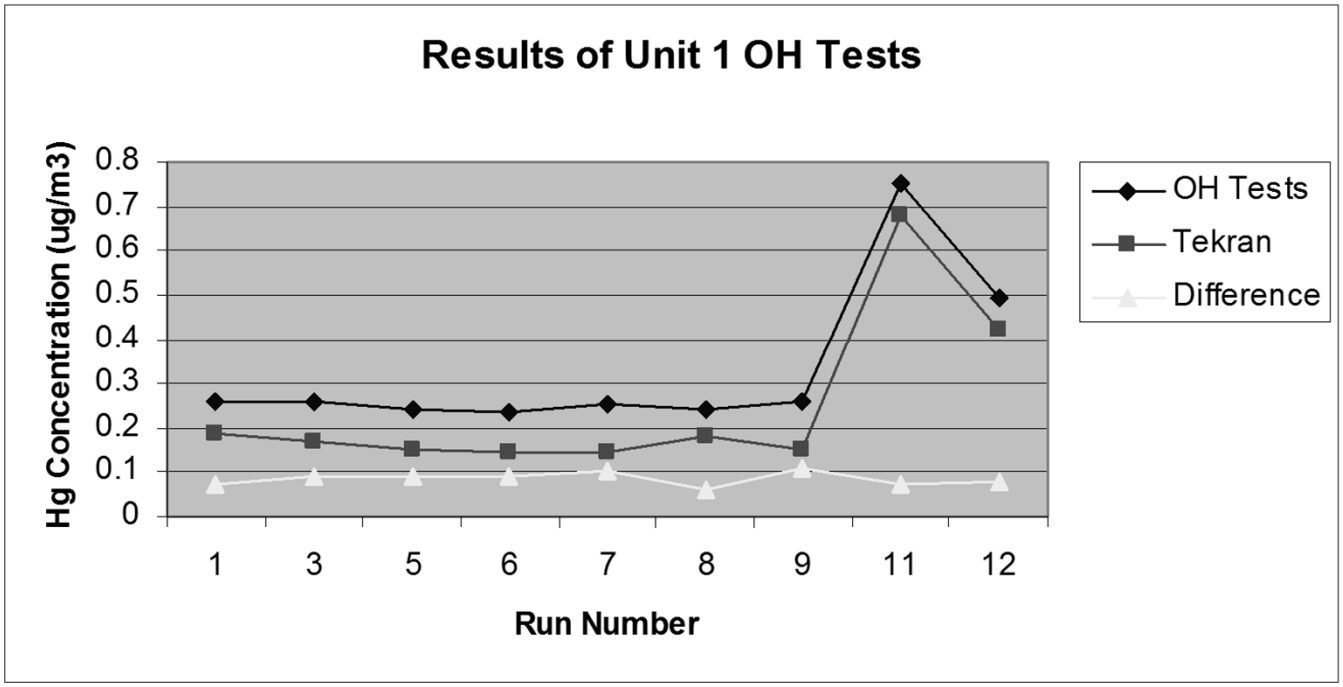
Projection of Low-Level Hg Concentrations



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


Example Hg Emissions Targets -
Coal - Fired Power Plant
Hg Concentration (ug/m3)
Plant Load (MWe)
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!

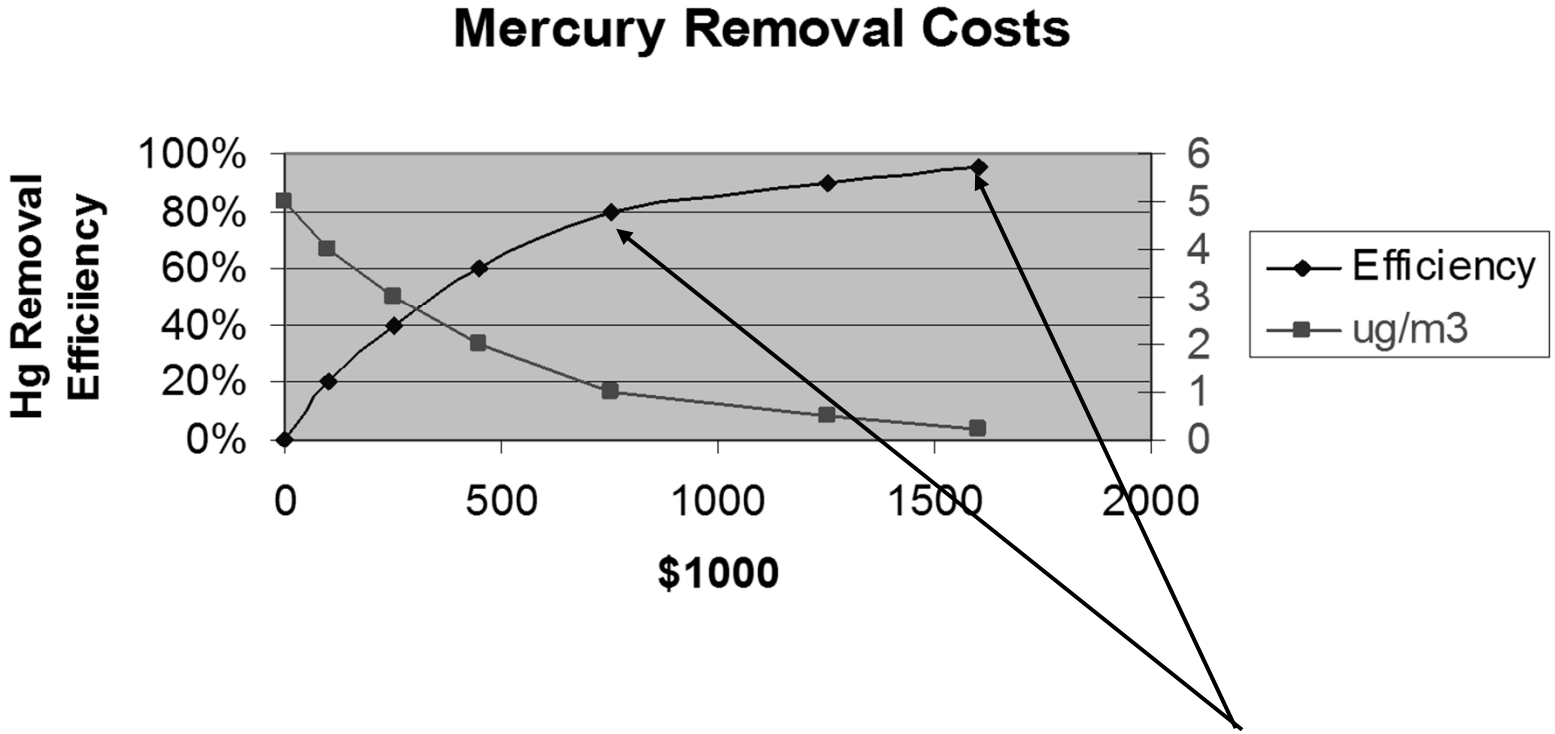
Tomorrow's RATAs May All Look Like This!



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

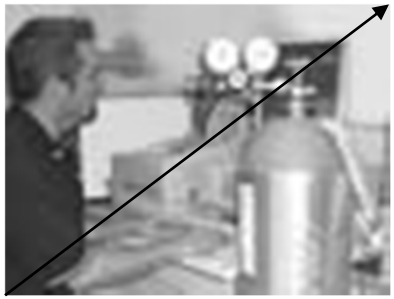


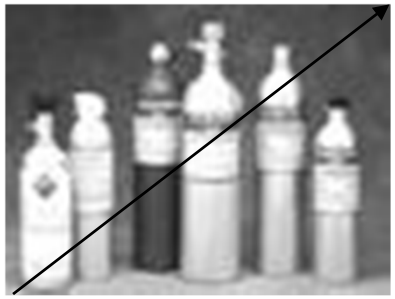
The last 15% removal may cost an additional 50%. ($ 1 million/year !)

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*

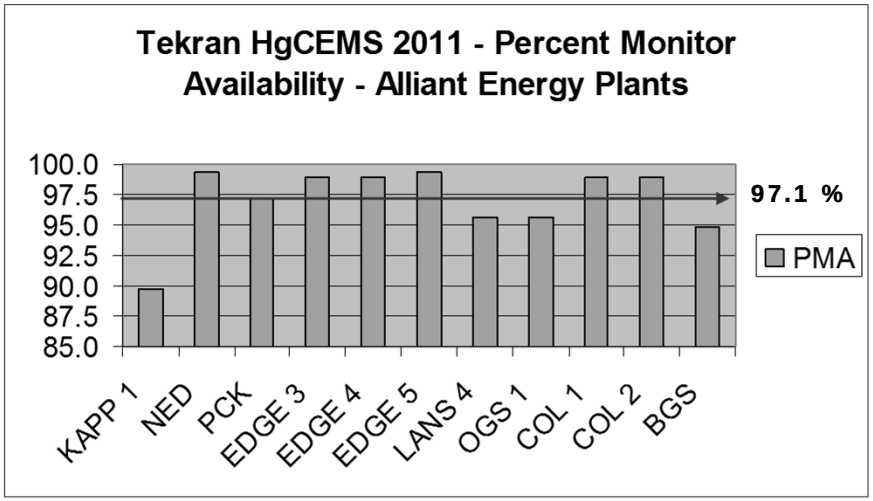
Mercury Traceability

- 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.

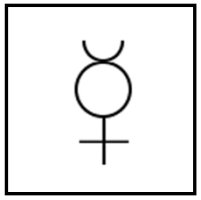
Tekran Hg Calibrators – HOT – Standby System for NIST Traceability

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.

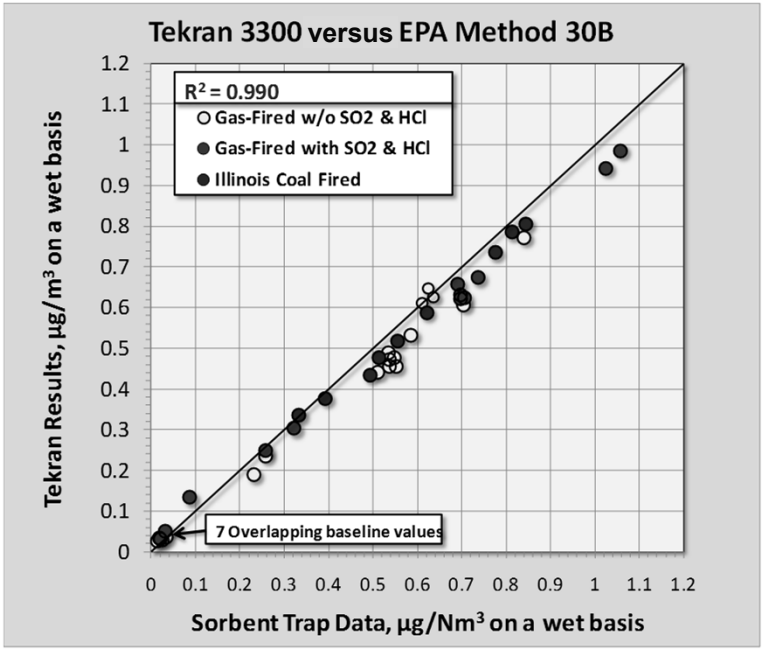


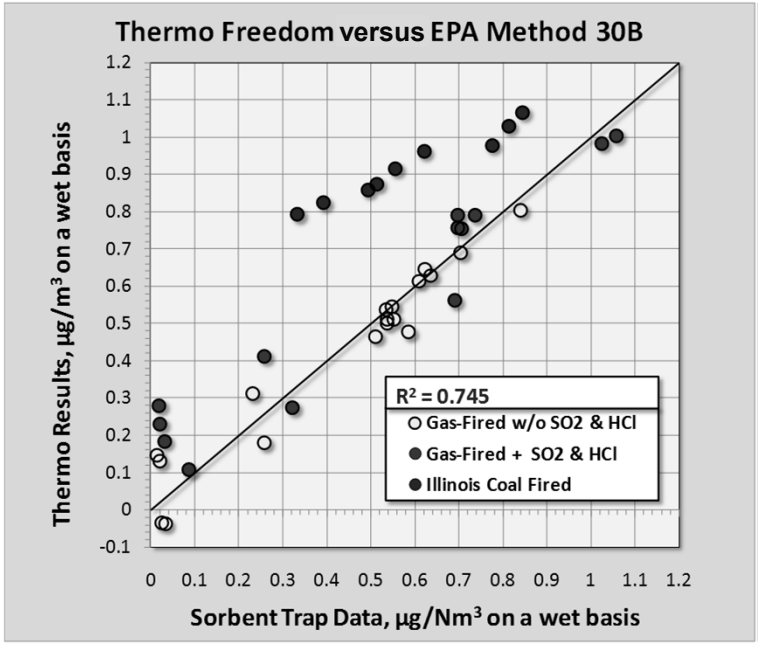
Definitive Low-Level CMM Study



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

MARAMA/ICAC
Mercury CEMS Webinar

Discussion and Action Items

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