EGU MATS Compliance – HgCEM Systems Challenges and Opportunities.

Prepared for McIlvaine Company
Mercury Measurement and Capture Webinar
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by
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TEKRAN® Instruments Corporation a TSI company

Presentation Overview

- EGU MATS Compliance –*enough time?*
- Use of electronic HgCEM Systems for tuning Hg Abatement "Process", on-line monitoring and optimization, and compliance monitoring
- NIST Traceability – current state of affairs
- Proposed EPA limits for RATA – and more reasonable RATA tolerances.
- Example data.
- Conclusions

2011 Federal Register Notices – Mercury and Air Toxics and New Source Performance Standards

- Electric utility (MATS) and boilers and incinerators NSPS
- Pollutants
  - NSPS - SO2, NOx, PM filter
  - MATS – HCl, HF, and Hg
  - Alternative limits – PM, non-Hg HAP metals, SO2
- Testing and monitoring appendices
  - Hg CEMS and sorbent trap CMS
  - HCl and HF CEMS
- 211 pages
  - FR notice - 3 column Table of Contents
  - MATS rule – 2 column Table of Contents

U.S. EPA EGU MATS and Cement MACT

Summary – [Hg] must be really low ~ 1.5 ug/m^3 for EGUs

- EPA Electric Generating Unit Mercury and Air Toxic Standards (MATS) promulgated January 2012
- Targeted MATS Pollutants and limits

Pollutant	Existing Source Std.	New Source Std.
Mercury	1.2 lbs/T-BTU	0.35 lbs/T-BTU
PM	0.03 lbs/M-BTU	
HCl	0.002 lbs/M-BTU	

Deadline for Compliance – April, 2015

- The EPA Portland Cement MACT
- Targeted MACT Pollutants and limits

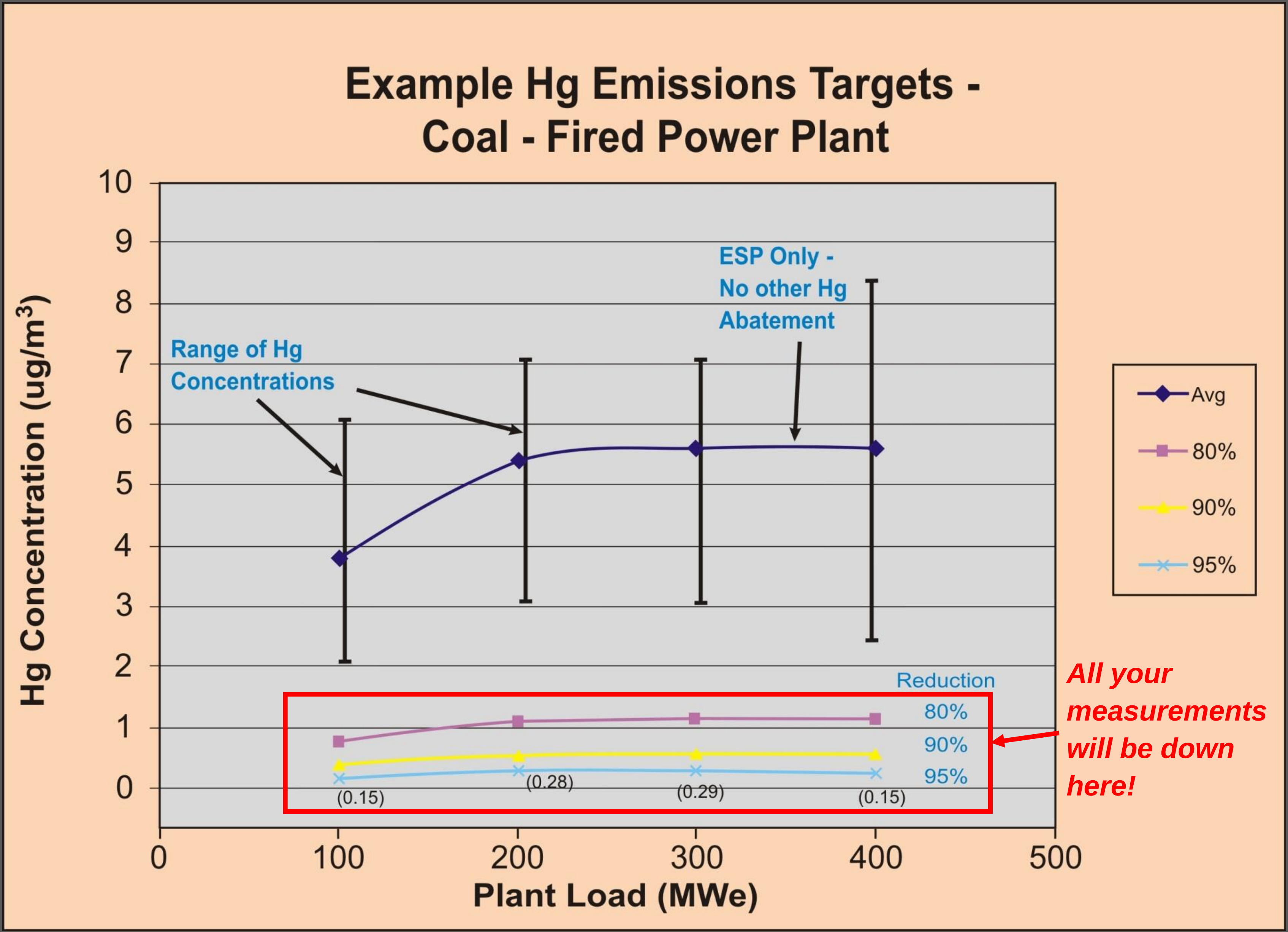
Pollutant	Existing Source Std.	New Source Std
Mercury	55 lbs/MM tons clinker	21 lbs/MM tons clinker
THC	24 ppmvd	24 ppmvd
PM	0,07 lbs/ton clinker	0.02 lbs/ton clinker
HCl	3 ppmvd	3 ppmvd
Organic HAP (Alternative to THC)	12 ppmvd	12 ppmvd

Deadline for Compliance – September, 2015

Impact of Regulations

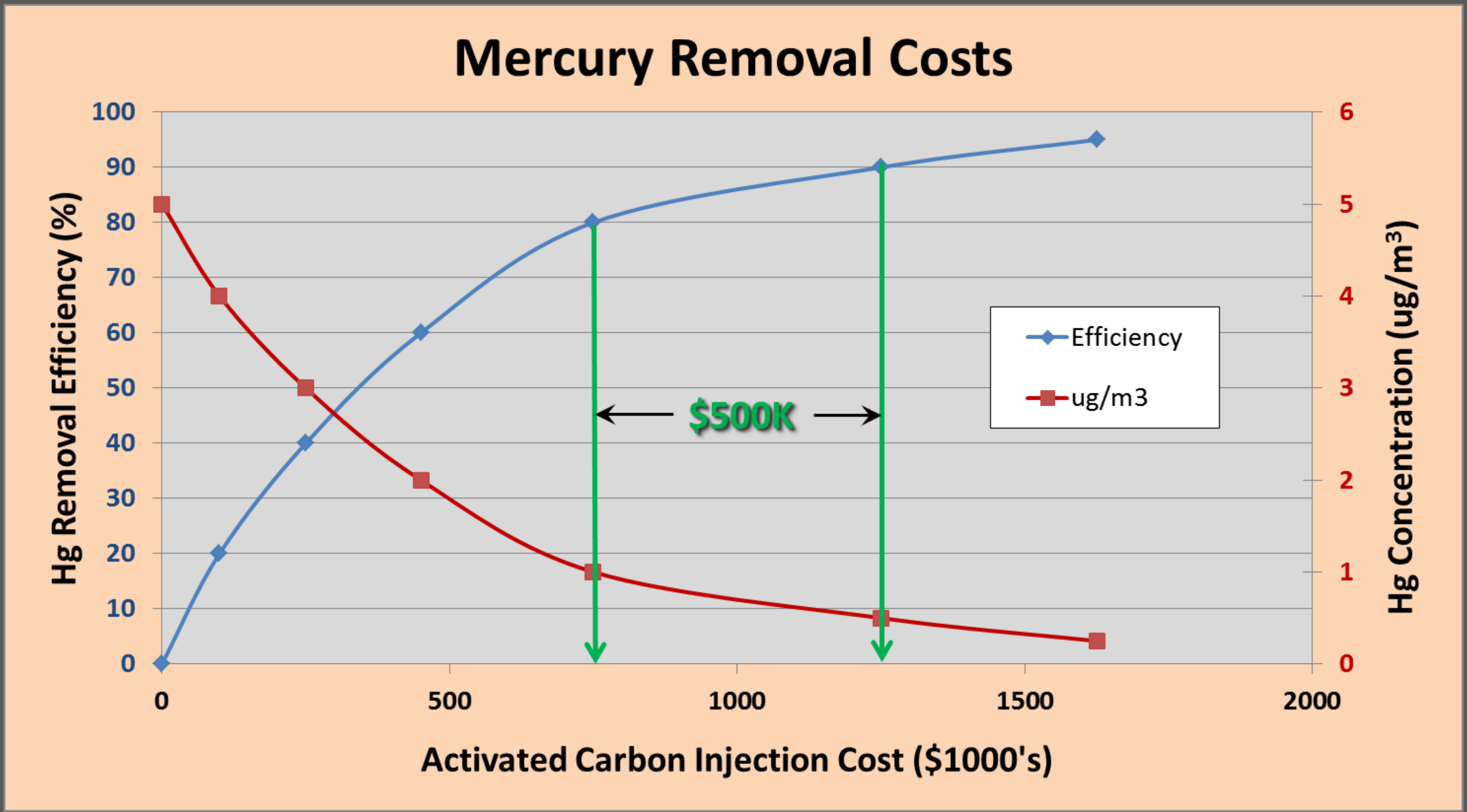
1. New Air Pollution Control Strategies
2. New or Improved Monitoring Technologies
3. Proof of Performance of 1 & 2
4. Compliance Monitoring and Reporting
5. Control Systems Performance Monitoring and Optimization
6. Plant Retirements

We are still in the learning process – and compliance deadlines on upon us!


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
Reduction
80%
90%
95%
(0.15)
(0.28)
(0.29)
(0.15)
Avg
80%
90%
95%
All your measurements will be down here!
10
9
8
7
6
5
4
3
2
1
0
0
100
200
300
400
500

Economics of Hg Removal - 500 MWe Plant

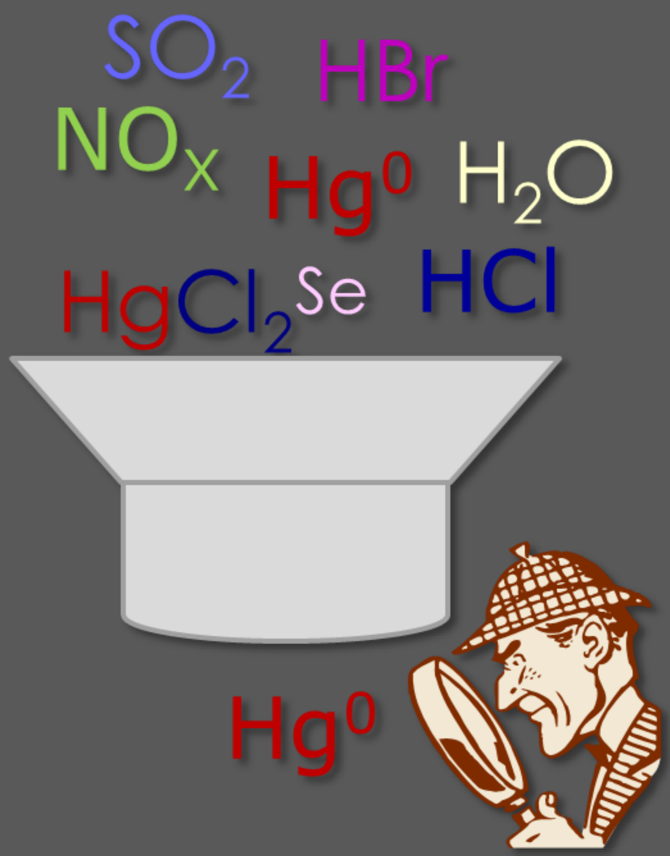
Accurate Measurement and Traceability are Critical



Reduction in Hg emissions from 80 – 90% using ACI costs an additional $500K! (reduction from 1.0 to 0.6 μg/m^3)

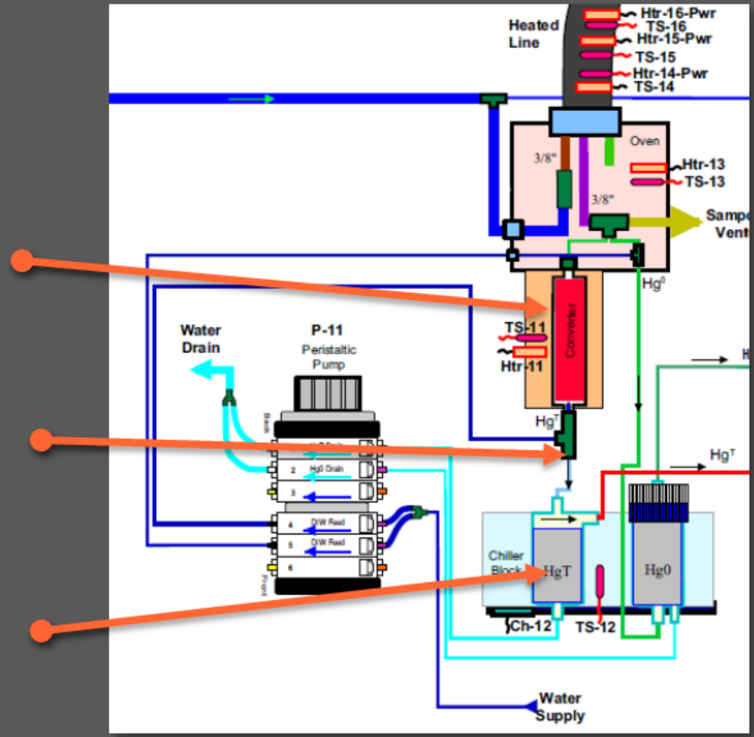
Accurately Measuring pptv - Levels of Mercury in Flue Gas

- 1 µg/m³ Hg = 112 parts per trillion (v/v)
- Many potential interferences and losses.
- Tekran R&D spent 1998 to 2003 understanding flue gas mercury reactions in the laboratory – and we're still learning
- Mercury appears in different species
  - Elemental - Hg^0
  - Ionic - Hg^{2+}
  - Particulate-bound - Hg^P
- Detectors can only measure Hg^0



Oxidized mercury conversion and interference prevention: The Tekran approach (pat'd)

- Task: quantitatively convert all Hg^{2+} to Hg^0 with no back reactions in the presence of high concentration redox compounds and reactive surfaces
- Proprietary thermal converter material set at 700C
- DI water mist injected into tail of thermal converter to "fix" Hg^0 from potential back reactions and eliminate interferences
- Gas is rapidly chilled, water condenses carrying away reactive compounds, and Hg^0 in a clean gas matrix goes to the analyzer



New 3300xi HgCEMS

Same trusted components with improved physical design

3300 HgCEM

3340

2537S

3310

3315

3320

3300Xi HgCEM

2537Xi+ *Analyzer*

System controller

3310Xi

Hg^0 Calibrator

** wall mounted **

3321

- *Conditioner*
- *Controller*
- *Oxidizer Option*

Tekran New Generation HgCEM System

3321 Sample Conditioner and Control Unit

Converter Conditioner Components

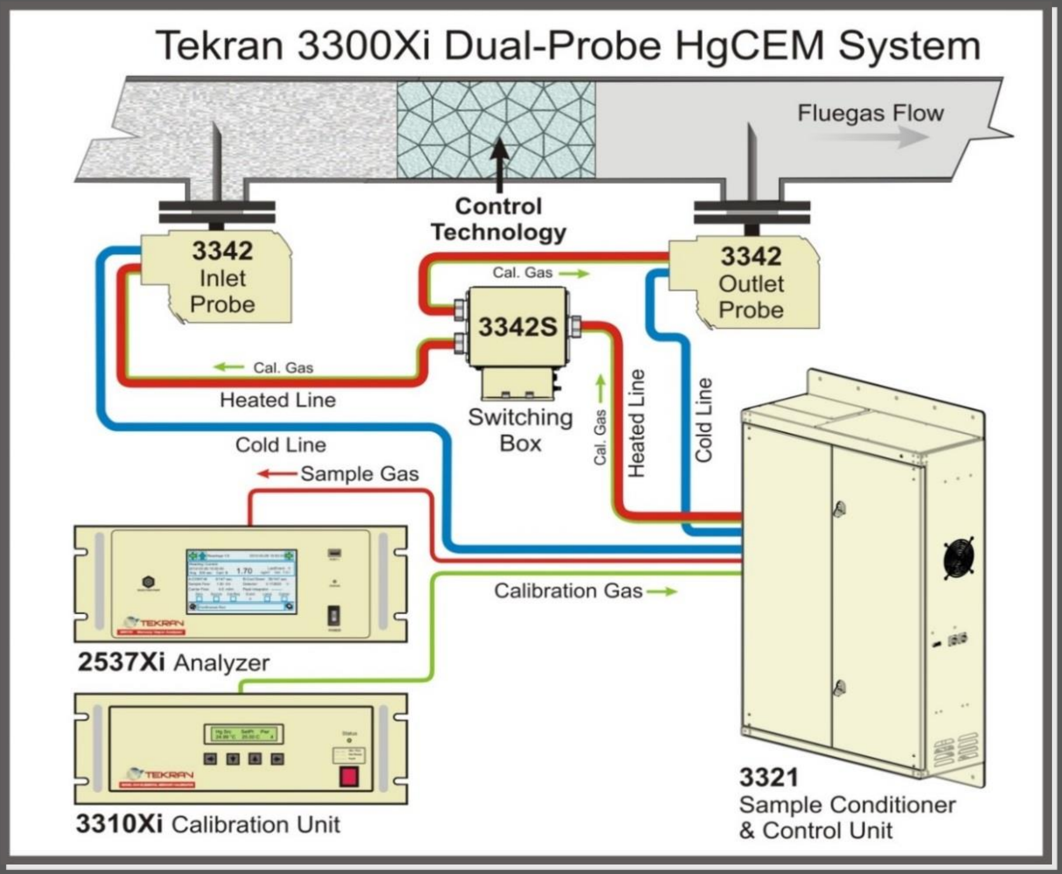
$HgCl_2$ Generator

- Oxidizer Type
- Optional

- Modular Power Panel
- Modular Umbilical Heaters
- Probe Control Hardware
- Modular Electronics

Wall-mounted
- cabinet closed

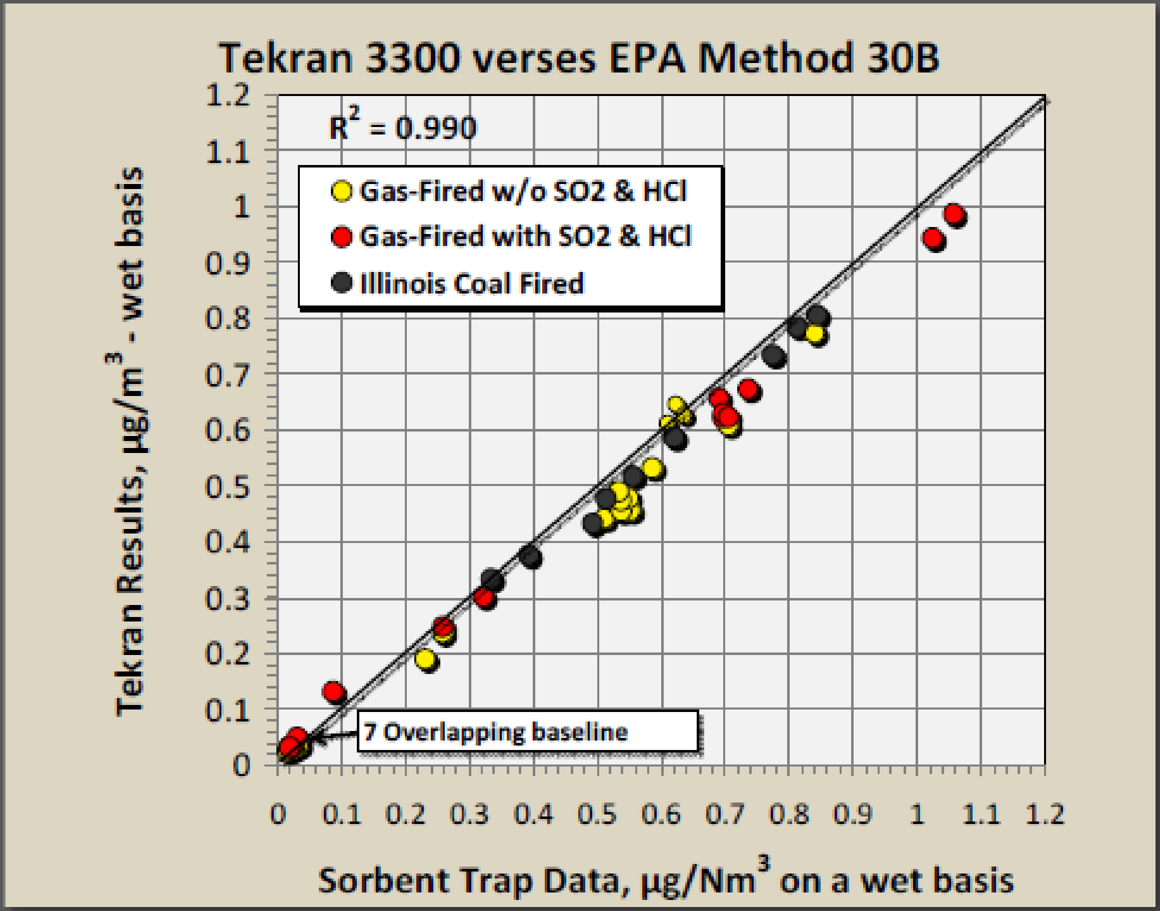
Tekran 3300Xi Dual Port Sampling



Applications:

- Mercury control technology
  - Research and development
  - Acceptance testing at new installations
  - Optimization and performance monitoring
- Regulatory monitoring of multiple, close-proximity emissions stacks.

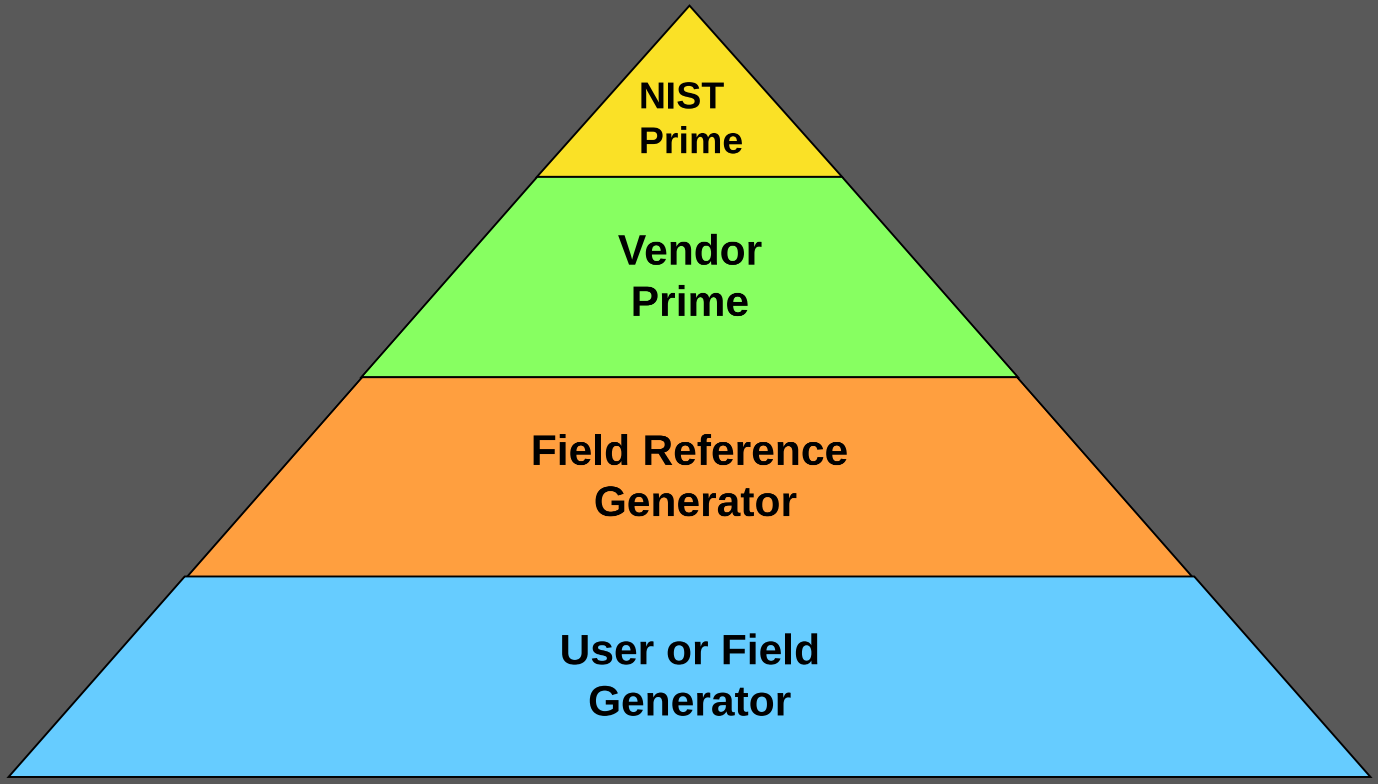
EERC Study Low-Level Measurements
(funded by EPRI, ICCI, CATM)



NIST Traceability Protocol

- Elemental Hg generators used vs. Hg cylinder gas.
- NIST Traceability involves unbroken chain of calibrators – and ongoing adherence to U.S. EPA traceability protocol.
- EGU's typically 0 - 10 µg/m^3
- Portland Cement - two levels
  - Mill On – e.g. (0-30 µg/m^3)
  - Mill Off – e.g. (0 – 300 µg/m^3)
- Corrections Required in Emissions if Calibration Fails

NIST Traceability Protocol for Hg Generators Unbroken Chain of Comparisons[1]



[1]Slide courtesy of Jeff Ryan, U.S. EPA Clean Air Markets

NIST Hg Generator Calibration Levels
(as received from NIST Dec. 2013)

National Institute of Standards and Technology (NIST)
Mercury Generator Calibration Points

	Low-Level (µg/m3)	High-Level (µg/m3)	
Typical Levels of Interest for EGU MATS and many Mill-On PC MACT Conditions	0.200	41.00	Likely levels for Portland Cement Mill- Down Conditions
	0.501	85.00	
	1.100	140.10	
	1.313	148.12	
	1.925	186.77	
	2.740	233.99	
	4.774	291.78	
	5.701		
	8.098		
	9.499		
	11.033		
	17.102		
	19.000		
	23.003		
	28.006		
	38.890		

Method 30B

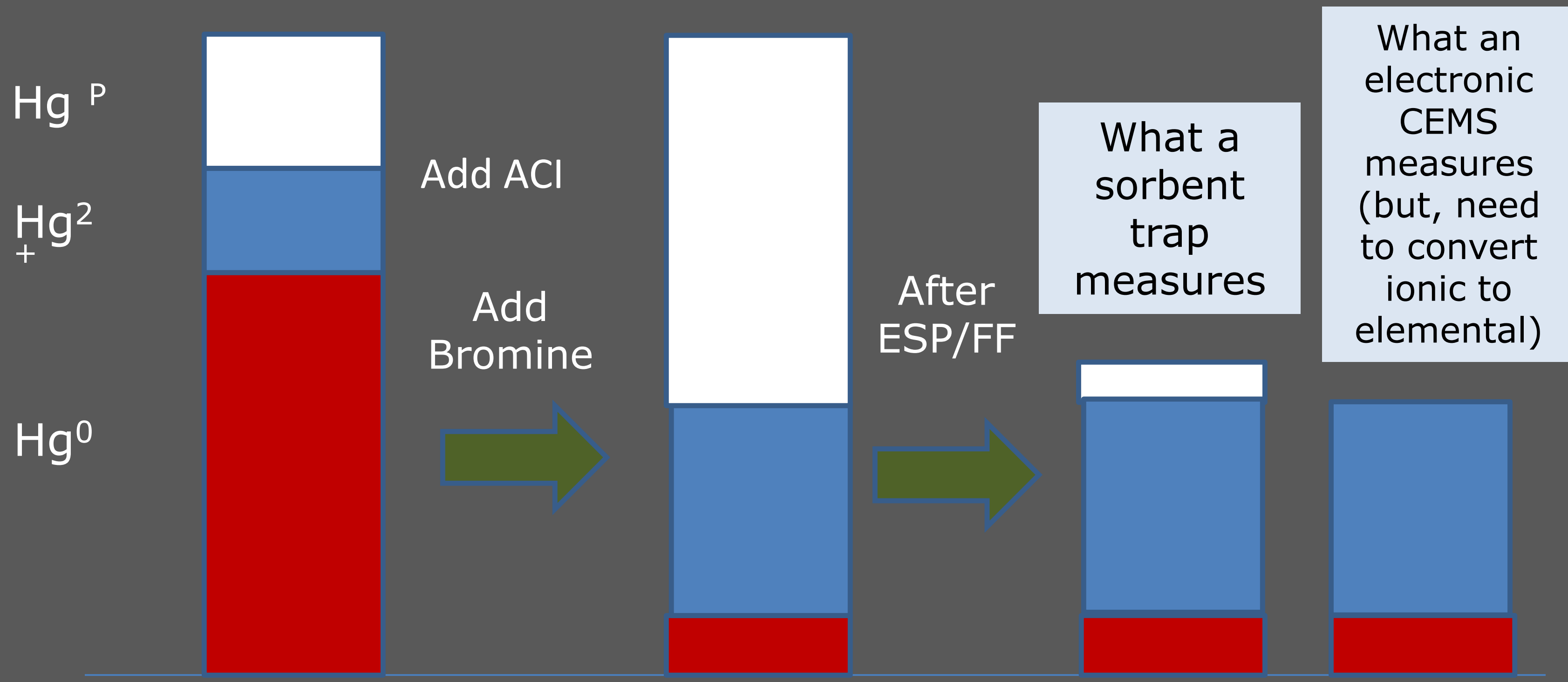
- This method is only intended for use only under relatively low particulate conditions (e.g., sampling after all pollution control devices)
- This method is designed to measure the mass concentration of total vapor phase Hg in flue gas, including elemental Hg (Hg^0) and oxidized forms of Hg (Hg^{2+}), in micrograms per dry standard cubic meters (µg/dscm)
- Sorbent Traps have:
  - mineral wool section (intended for PM),
  - primary capture section,
  - secondary (breakthrough) capture section
  - final mineral wool section
- Hg^P that is captured in the trap is included in the analysis

Apex Method 30B Mercury Sorbent Traps

Andover Technology Partners

Why do plants use Activated Carbon Injection, Bromine, etc.?

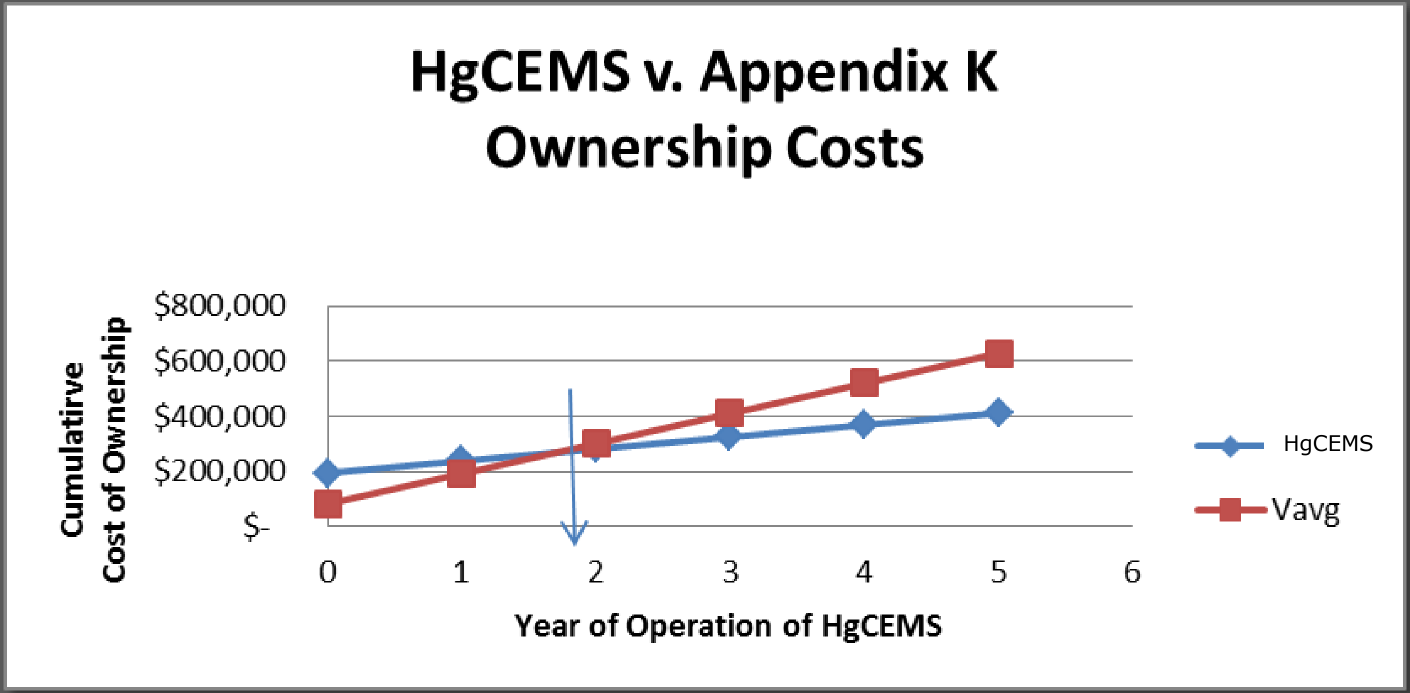
ACI captures Hg^0, Bromine helps oxidize Hg making it easier to capture on PM or in a scrubber.
- Which increases the Hg content of the particulate!



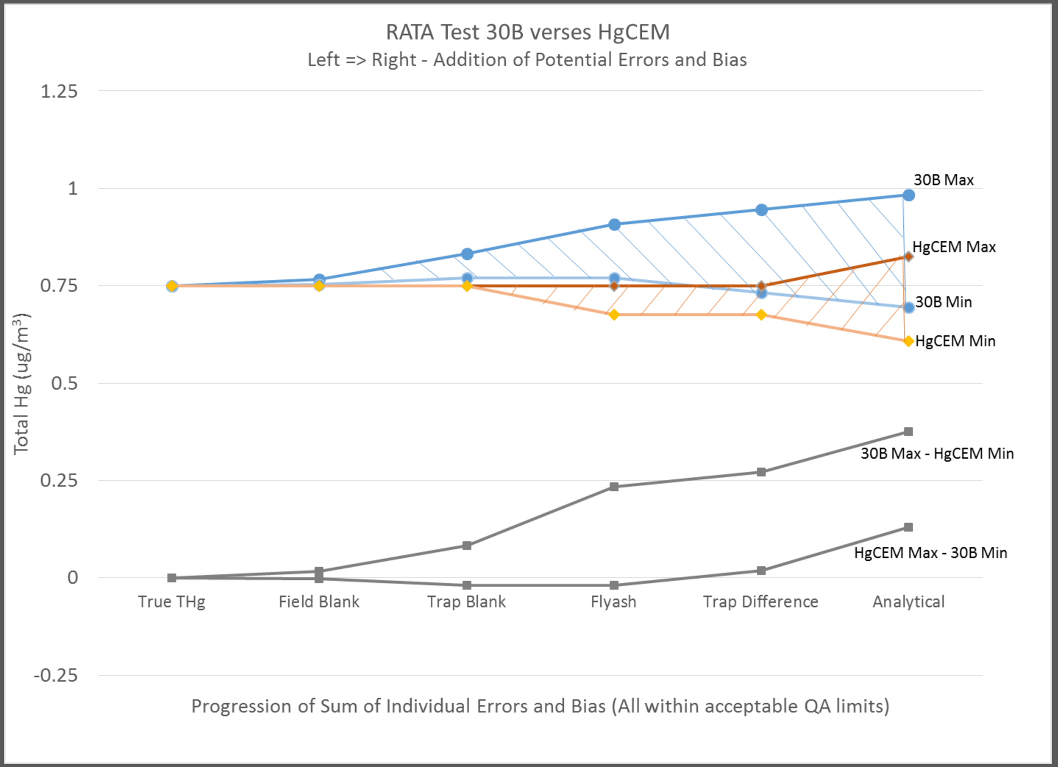
The Electronic HgCEMS vs. Sorbent Trap

Feature	Electronic HgCEMS	Sorbent Trap
Capital Cost (including installation)	2+ times higher than Sorbent Trap	$75-$100K
Operations and Maintenance Costs (see next slide)	Lower than Sorbent Trap	-Requires routine retrieval and analyses of traps - Traps are consumables
Training and Complexity	Higher Level Training – more complex	-Comparatively simple to operate
Real-time feedback for Process and APCD	Valuable for “real-time” assessments and process feedback and control	- No capability for real-time feedback - data only available after days of exposure and analytical processing delays

The Electronic HgCEMS vs. Sorbent Trap Total Cost of Ownership



- The 30B mercury coming from field blank, trap blank and particulate are always positive and must always be included in the 30B Total Hg.
- For the HgCEM, mercury scrubbing by the flyash on the filter may cause a negative bias.
- Dual 30B trap difference and analytical for both can cause positive or negative bias.
- Worst case is 0.38 ug/m³ difference between methods that pass all QA criteria.



EPA Allegheny Armstrong Plant Comparison of Sorbent Trap Results

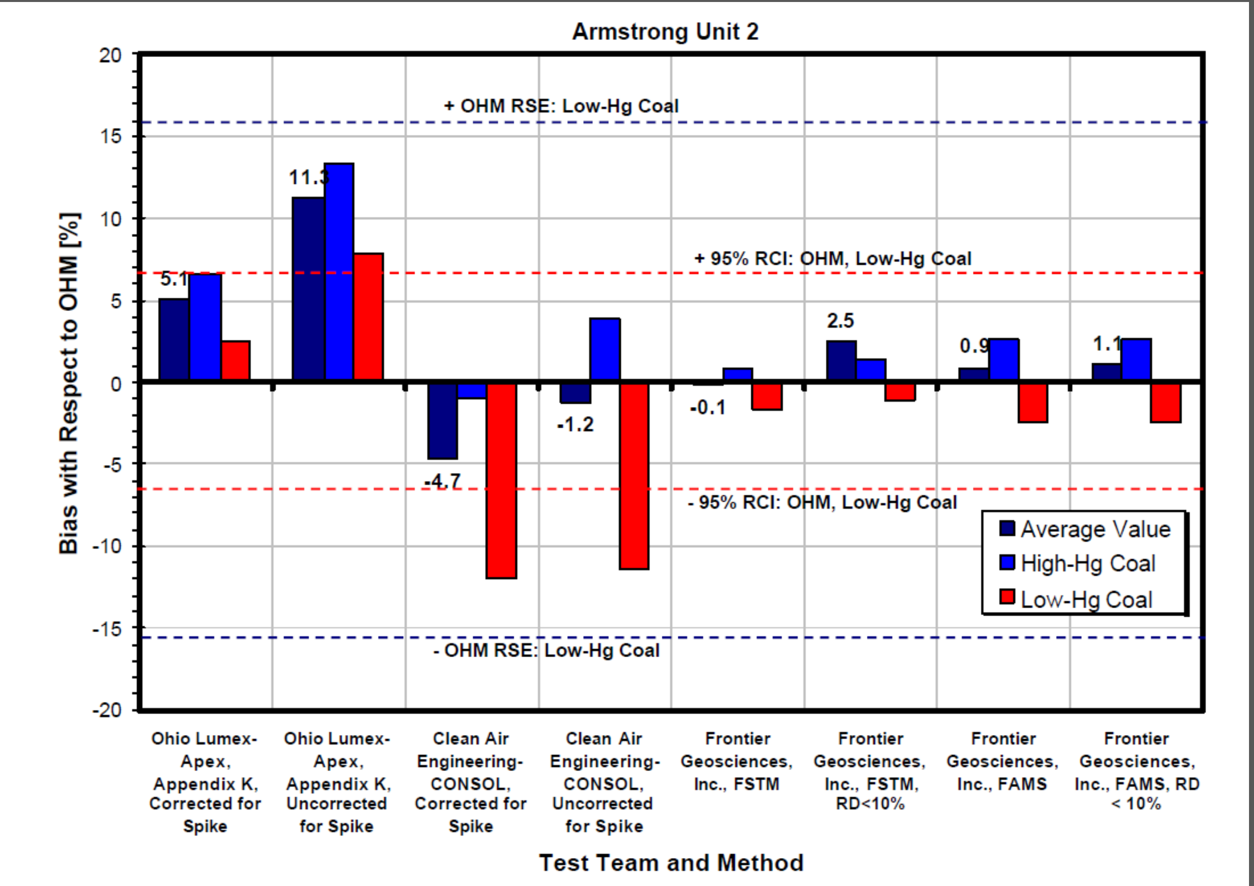
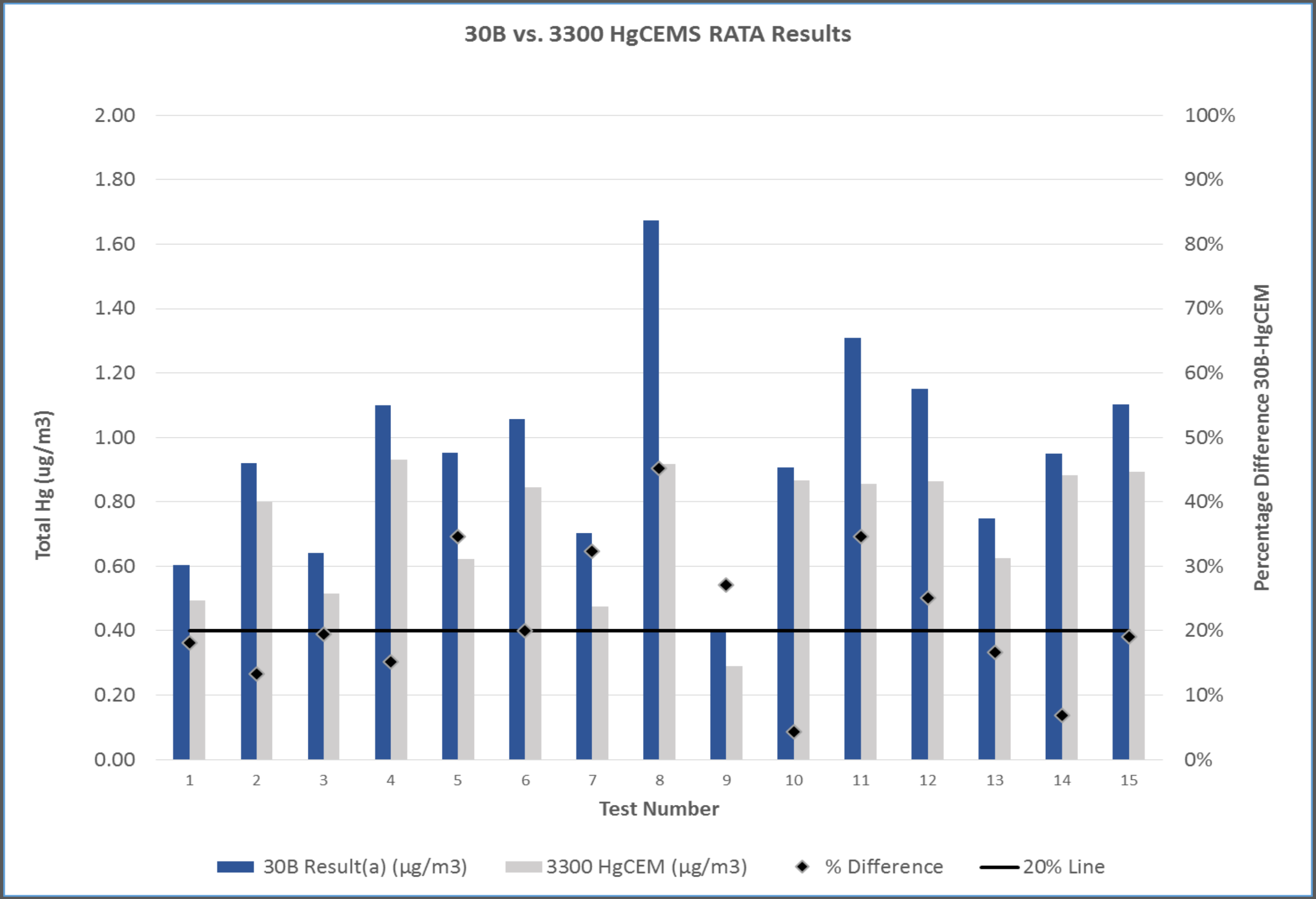


Figure E-5: Sorbent Trap Bias Error With Respect To OHM

Comparative 30B and Electronic HgCEM System Measurements



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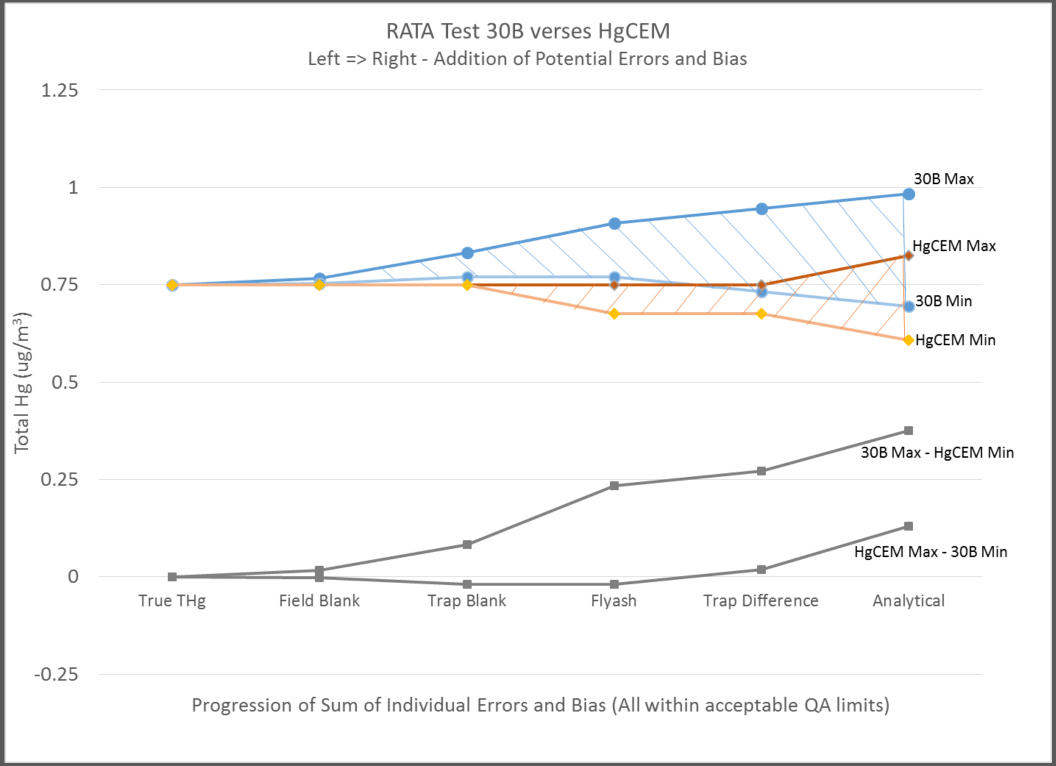


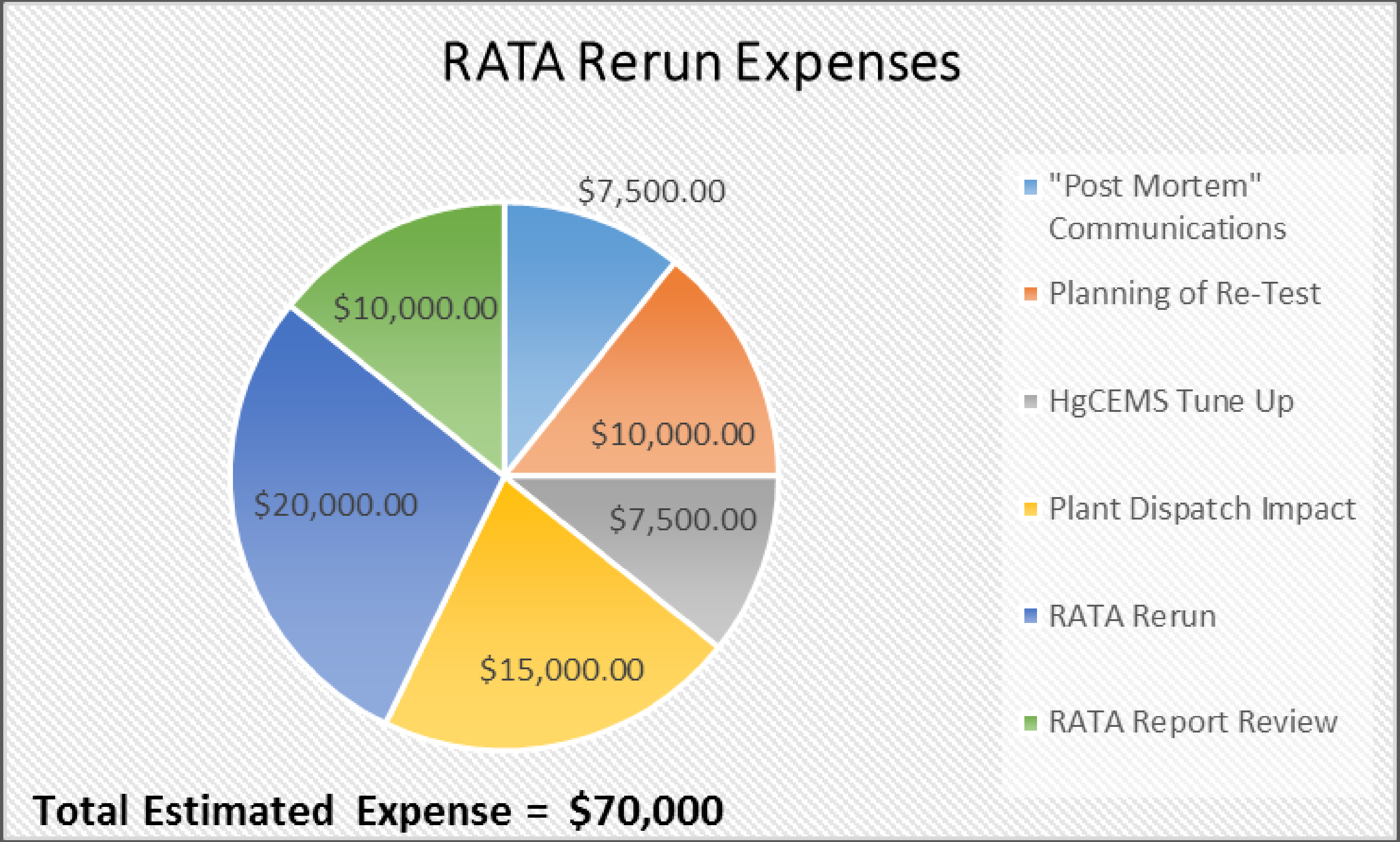
EPA PROPOSED RATA TOLERANCE UPDATES 17-February-2015

- If Hg Concentrations **>** 50% of Emission Limit (i.e.> ~0.75 µg/m^3) HgCEMS within **20%** of Method 30B
- If Hg Concentrations **<** 50% of Emission Limit (i.e. <~0.75 µg/m^3) HgCEMS within **10%** of Emissions Limit (i.e. 0.15 µg/m^3)

Opinions –

- *above tolerances -not practical or based on current empirical information.*
- *Run off of "Top Ten" RATA testers on same stack would be insightful*

RATA "Do-Over" Dollars



Where Are We Now in the U.S.?

- New parameters to be measured including PM, Hg, HCl, THC
- Low-level measurements and Reference-Methods challenges and potential disconnects
- EPA Published Updates of EGU MATS 17-Feb-2015 – Federal Register – out for review.
- *We're all still learning.*
- *Compliance deadlines in April 2015!*