"MARAMA/ICAC Mercury CEMS Webinar"

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Presentation By

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Overview

What do you want to learn or hear about?

![Bar graph showing expressed interest by MARAMA participants for HgCEMS Webinar. The graph displays the number of inquiries for topics such as Regulations, HgCEMS, Low-Level Accuracy, Hg Ranges, Operations, Exp., QA/QC, and Cost. The number of inquiries ranges from 0 to 20.]
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/m³ -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 (Hg⁰) Calibrator*
4. *3315 Ionic (Hg²⁺) 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 ($\text{Hg}^0$), 3315 ($\text{Hg}^{2+}$), Permeation Source ($\text{Hg}^0$)
- 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
## Summary of HgCEMS Applications

<table>
<thead>
<tr>
<th>Application</th>
<th>Issues</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal-Fired EGU</td>
<td>Wet Stack Carryover</td>
<td>Hg 0.0 – 40 ug/m³</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Will be 10 – 20 % of above</td>
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<tr>
<td>Portland Cement</td>
<td>Large Swings in Hg Mill On/ Mill Off</td>
<td>Mill On Hg 1.0 – 50 ug/m³</td>
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<tr>
<td></td>
<td></td>
<td>Mill Off 0 – 1000 ug/m³ !</td>
</tr>
<tr>
<td>Waste to Energy</td>
<td>Chlorides variations or sample train contamination</td>
<td>Hg Abated 1.0 – 10 ug/m³</td>
</tr>
<tr>
<td>Munitions Incineration</td>
<td>High Swings in Hg Loadings and Concentrations</td>
<td>Hg 0.0 – 1000 ug/m³ !</td>
</tr>
<tr>
<td>Abatement Research</td>
<td>Different Technologies, ACI, FGD, DSI, ESPs, FF, KNX (CaBr)</td>
<td>Assist Pollution Control Equipment Providers in Laboratory/Pilot Research and Field Validation Tests</td>
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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

All your measurements will be down here!
Tomorrow’s RATAs May All Look Like This!

Results of Unit 1 OH Tests

Hg Concentration (ug/m³)

Run Number

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 ($\text{Hg}^0$), Permeation Source and Ionic ($\text{Hg}^{2+}$)
  - Only Tekran HgCEM Systems Hg generators can be extended to 8 rolling quarters before certification.

- Tekran can support traceability programs for any electronic HgCEMS.
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.

![Graph showing Percent Monitor Availability for Alliant Energy Plants with a 97.1% availability.](image)
Summary of EERC Low-Level HgCEMS Data

Tekran 3300 versus EPA Method 30B

- $R^2 = 0.990$
- Gas-Fired w/o SO2 & HCl
- Gas-Fired with SO2 & HCl
- Illinois Coal Fired

Thermo Freedom versus EPA Method 30B

- $R^2 = 0.745$
- Gas-Fired w/o SO2 & HCl
- Gas-Fired + SO2 & HCl
- Illinois Coal Fired
Some Potential EPA Actions

- **Fix RATA limits**
  - Not too tight, but a window of ±0.8 µg/m³ when measuring < 1 µg/m³ is not appropriate

- **Expand EPA “NIST Traceability” Protocols**
  - Must work lower than Span Range of 5 µg/m³
  - While they are at it …
    - Verify that protocols work at high concentrations for Cement MACT rule (e.g. 250 µg/m³ 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/m³ 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 $\text{sub-} \mu \text{g/m}^3$ 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