Results of a Long-Term Mercury Control Project for a PRB Unit with an SCR, Spray Dryer and Fabric Filter

11th Annual EUEC Conference and Expo
Tucson, Arizona
January 30, 2008

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Project Co-Funders

- Rocky Mountain Power
- Norit Americas
- Calgon Carbon
- Thermo Fisher
- Teledyne Monitor Labs
- Arch Coal
- Roundup Trading International
- Westmoreland Coal Sales
- Air Sampling Associates
Project Goals

• Install commercial equipment to meet anticipated mercury regulations
  – Install a sorbent injection system and integrate into plant controls
  – Install a commercial Hg CEM and integrate into plant DAHS
  – Develop and implement a feedback control system

• Demonstrate and maintain 90% mercury removal

• Determine representative operating costs
  – Operate equipment according to pending and anticipated regulations
  – Evaluate the cost reduction potential from using feedback control from the Hg-CEMs
Hardin Station

121 MW
Coal: PRB
(Absaloka Mine)
0.65% sulfur
<20 ppm chlorine
~ 0.04 μg/g Hg (dry)
LNB and SCR
SDA
FF
SDA Inlet Injection and Sample Ports
SCR
SDA
Air Heater
Gas Flow
Fabric Filter

Outlet Sample Ports

FF

SDA
Injection Equipment Installation
Mercury CEMS
CEM QA/QC Protocol

- Daily zero/span check more strict than CAMR
  - CAMR “Critical” at calibration Error > 5%
  - ADA-ES “Maintenance”
    2.5 % (± 0.5 μg/m³) = high maintenance
    1% (± 0.2 μg/m³) = low maintenance
- Weekly Converter Check (system integrity)
  - Oxidized mercury calibrator installed 11/5/07
- Quarterly linearity check
- Annual RATA test
  - More frequent abbreviated relative accuracy tests will be conducted for the DOE project

Method 30A or 30B recommended for RATA tests
90% control = ~ 0.4 μg/m³ at Hardin outlet
Effect of CEM Upgrades: Nitrogen Generator

Before

After
Results: Baseline Mercury Removal

Hardin Baseline Test - Summary of Mercury Measurements

<table>
<thead>
<tr>
<th>Time Period</th>
<th>SDA In</th>
<th>Stack</th>
</tr>
</thead>
<tbody>
<tr>
<td>1020-1302</td>
<td>1</td>
<td>4/26/2007</td>
</tr>
</tbody>
</table>

Hg, ug/wscm

Part. Hg
Hg0
Hg+2
CEM Avg
STM 2
STM 1
Baseline and Co-Benefit: Effect of Boiler Load

- Low native mercury removal at full load
- Native mercury removal can be as high as 50% at reduced load
- PAC more effective at reduced load
Coal Blending: December 2006

- Tested two Western Bit coals at two ratios, 7 & 14%
- It was difficult to evaluate performance because coal mercury content changed during testing.
# Coal Blending: December 2006

<table>
<thead>
<tr>
<th>Blend Coal</th>
<th>Blend Ratio</th>
<th>Hg Removal (Native ~ 10%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>West Elk</td>
<td>7%</td>
<td>10-30%</td>
</tr>
<tr>
<td>West Elk</td>
<td>14%</td>
<td>50+%</td>
</tr>
<tr>
<td>Bull Mountain</td>
<td>7%</td>
<td>0-10%</td>
</tr>
<tr>
<td>Bull Mountain</td>
<td>14%</td>
<td>0-10%</td>
</tr>
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**Note:** Exact increases were difficult to assess due to changes in base coal mercury.
PAC Injection and Coal Additive Results
SDA+ FF, PRB and ND Lignite Fuels

Hg Removal (%)

Injection Concentration (lb/MMacf at ~ 290°F)

- Hardin Parametric, KNX+ PAC
- Hardin Long-Term, PAC
- Untreated Carbons

- DARCO Hg Holcomb
- DARCO Hg Stanton U10
- 208CP Holcomb
- 208CP Stanton U10
- DARCO Hg-LH Holcomb
- DARCO Hg-LH Stanton U10
- BPAC Stanton 10

ADA-ES
Long-Term Test: Sept ’07–July ‘08

Graph showing:
- HgT In, Hg0 In, HgT Out, Hg0 Out concentrations over time.
- Load, MW, and % Hg Removal over time.
- AC Loading, lb/MMBTU, and % Hg Removal over time.

Key points:
- Outage.

Graphs are color-coded and labeled accordingly.
Remote CEM Monitoring: Stack Hg

ADA-ES CEMS DAILY OPERATION REPORT

SYS ID # 94
LOCATION: RMP HARDIN OUTLET

DATE: 10/24/2007
DOCUMENT REVISION: 0710-04

MERCURY MEASUREMENT AND CALIBRATIONS

- HG TOTAL CHANNEL
- HG ELEMENTAL CHANNEL
- HG OXIDIZED CALCULATED

MERCURY CONCENTRATIONS

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<th>DATA</th>
<th>AVG</th>
<th>MIN</th>
<th>MAX</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td>HG TOT</td>
<td>0.25</td>
<td>0.17</td>
<td>0.37</td>
<td>0.03</td>
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<tr>
<td>HG ELEM</td>
<td>0.25</td>
<td>0.17</td>
<td>0.38</td>
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<tr>
<td>HG OX</td>
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<td>-0.03</td>
<td>0.06</td>
<td>0.01</td>
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MERCURY CONCENTRATIONS – FILTERED

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Summary

- **Native Mercury Removal**
  - Very low (typically << 20%) at full load
  - As high as 50% at reduced load
- **Coal Additives**
  - Up to 85% mercury removal with KNX™ during short-term parametric tests
- **Coal Blending**
  - Bull Mountain: only marginal increases in mercury removal
  - West Elk: 14% blend resulted in 50+% mercury removal
- **PAC Injection** - Both FLUEPAC™MC PLUS and DARCO® Hg-LH can achieve 90% mercury removal at 1.5-2 lb/MMacf
- **Injection Controls** - recently upgraded with feedback from CEMS
- **Training** - Staff received initial CEM and AC system training
- **O&M Cost** - Data currently being collected to determine cost estimates
Questions?