

# Clean Coal Power Initiative

## **TOXECON™ Retrofit for Mercury and Multi-Pollutant Control**

**Dick Johnson  
We Energies  
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Cummins & Barnard**



# Project Partners & Co-Authors

- We Energies – Dick Johnson, Paul Sartorelli
- DOE NETL - Ted McMahon, Fred Sudhoff
- Cummins & Barnard, Inc. - Ron Utter, Jeff Cummings
- ADA-ES - Jean Bustard, Richard Schlager, Dave Muggli
- EPRI - Ramsay Chang



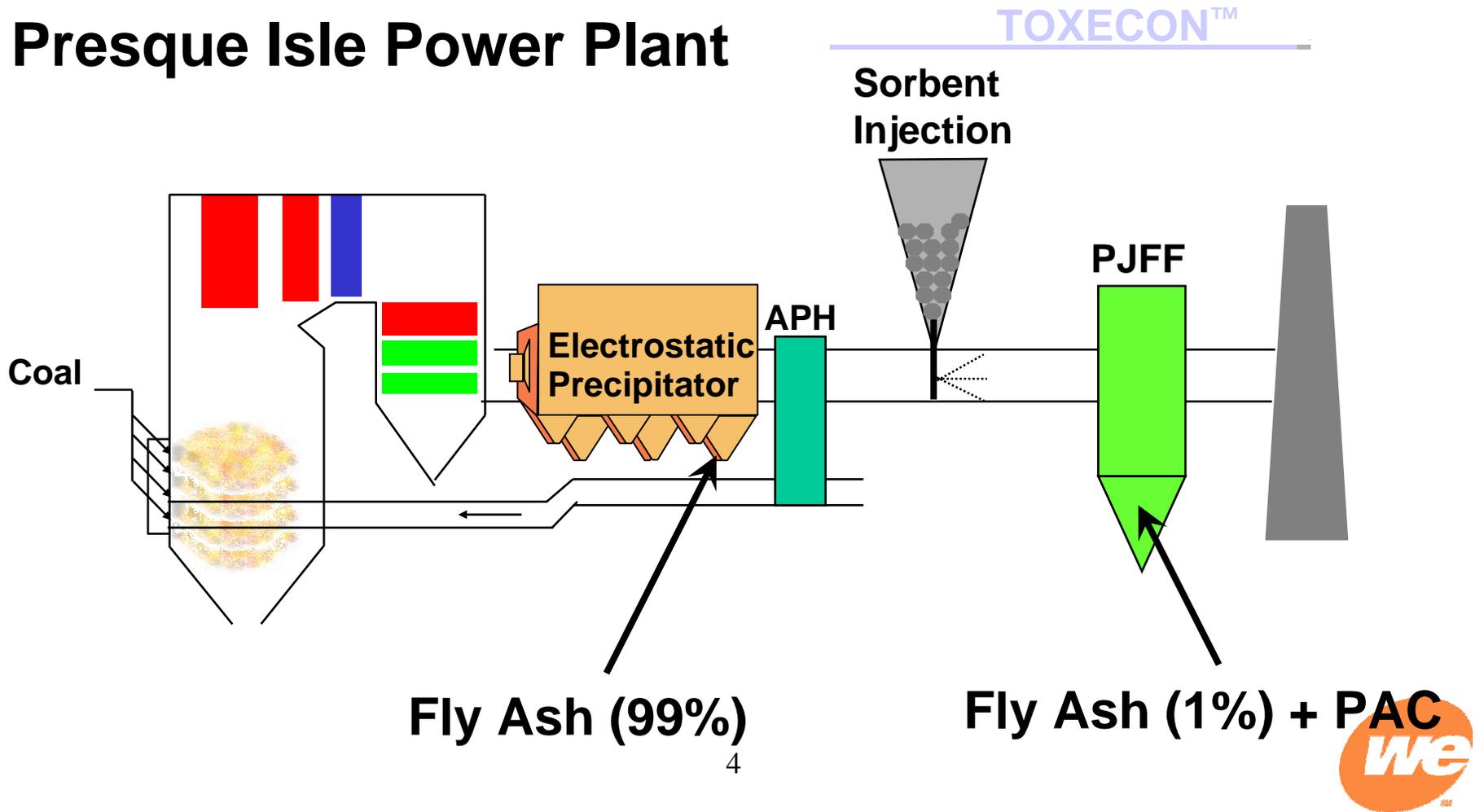
# TOXECON™ – 270 MW Demonstration

- A Mercury and Multi-Pollutant Control Technology
- Presque Isle Power Plant, Marquette MI
  - Units 7-9
  - PRB Coal
- \$53.3M
  - \$24.9M DOE
  - \$28.5M We Energies
- 90% Hg Control
  - \*  $\text{SO}_2 \Rightarrow 70\%$
  - \*  $\text{NO}_x \Rightarrow 30\%$



# TOXECON™ Configuration

## Presque Isle Power Plant



# Project Goals

- Achieve at least 90% mercury removal.
- Increase collection efficiency of PM, especially during upset conditions.
- Demonstrate mercury CEMs as a reliable mercury measuring system.
- Successfully integrate the entire system so that all subsystems are operating at peak performance.
- Determine viability of sorbent injection for SO<sub>2</sub> and NO<sub>x</sub> control.
- Recover at least 90% of mercury captured in the ash.
- Minimize waste disposal with a target of 100% utilization.

# Benefits of TOXECON™ Project at PPIP

Pollutant	Annual Emission Reduction
Mercury	82 pounds
Particulate Matter	32 tons
SO <sub>2</sub>	4,020 tons*
NO <sub>x</sub>	1,470 tons*

**Multi-pollutant strategy reduces the release of all pollutants at the Presque Isle Power Plant to very low levels.**

**\* - Potential**

# Project Details

- Program duration
  - ❖ Pre-award Feb 2003 – Feb 2004
  - ❖ March 2004 – March 2009
- 19 Tasks
  - ❖ Pre-award
  - ❖ Design and Construction
  - ❖ Demonstration

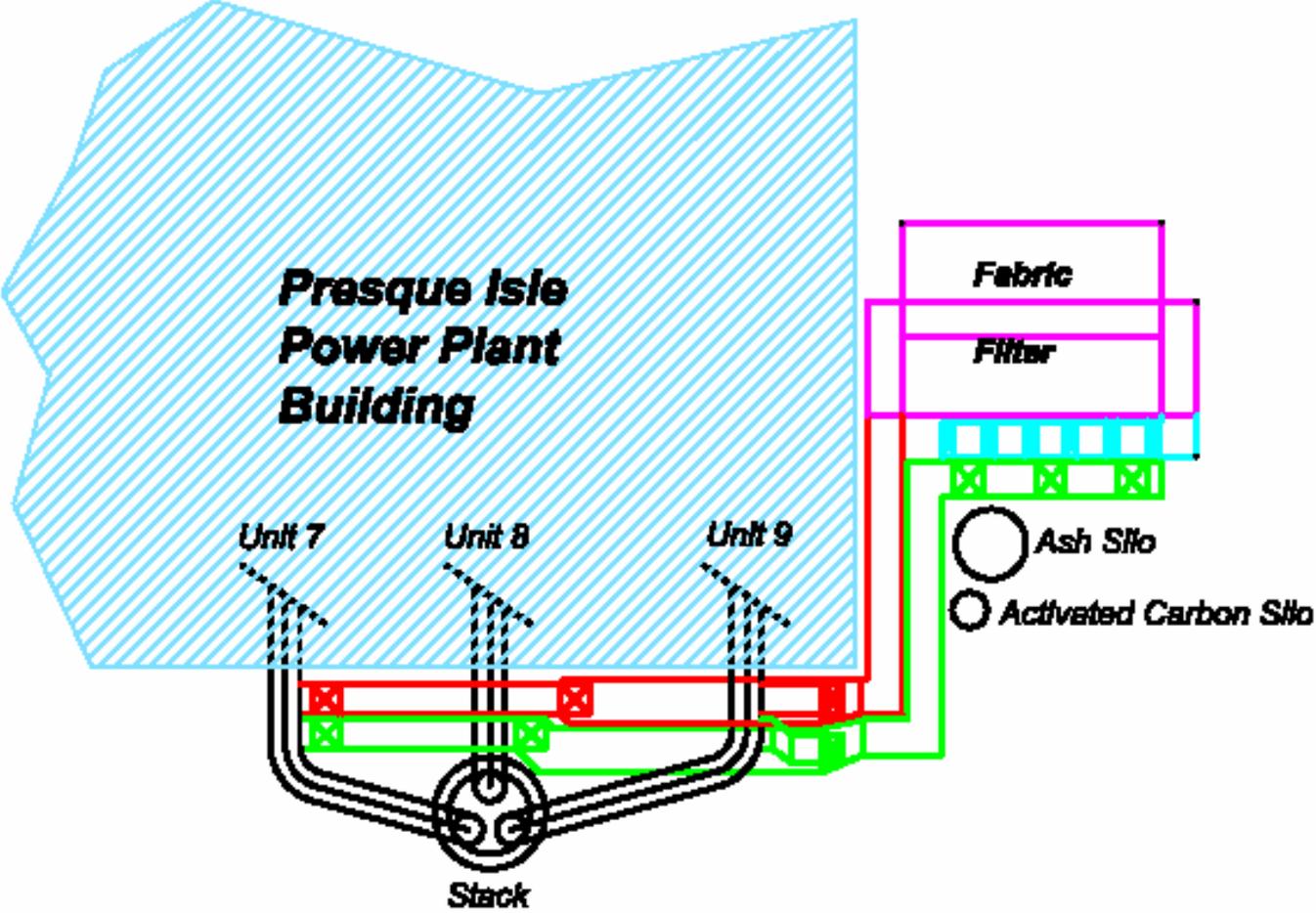
# Task Breakout

- Pre-award (Feb '03 to Feb '04)
  - Project Management Plan
  - NEPA
- Design & Construction (Mar '04-Jan '06)
  - BOP
  - Equipment Procurement
  - Erection
  - Start-up
- Demonstration (Jan '06-Mar '09)
  - Mercury Optimization Jan '06–Dec '06
  - SO<sub>2</sub>/NO<sub>x</sub>/Ash 2007

# Project Update

- FONSI (Finding of No Significant Impact) issued September 2003
- Start of Construction July 04
- Fabric Filter vendor selected August 2004
- Pre-operation testing in various stages
  - Sorbent screening tests, April 2005
  - Mercury CEM launched commercially in May 2005
    - Thermo Electron's Mercury Freedom System
- Public Design Document Issued July 2005
- First unit tie in scheduled for November 2005
  - All units in service by January 2006

# Layout



# Ductwork Before



# PIPP Ductwork in Progress



# PIPP Duct Installation





# PIPP Duct Installation



# PIPP Baghouse



# PIPP Baghouse



# PIPP Fan Installation



# PIPP Duct Installation



# Public Design Document

- Purpose - to provide non-proprietary design information
- Includes
  - Technology Overview
  - Design Basis
  - Costs

# Technology Design Basis

- Design based on results from pilot- and full-scale tests funded by NETL and EPRI
  - Pilot-scale proof of concept tests by EPRI
  - Phase I NETL Full-Scale Hg Control Tests
  - Year-long TOXECON™ test at Plant Gaston

# Equipment Costs

<b>TOXECON™ and Balance-of-Plant Equipment and Installation Costs Presque Isle Power Plant Units 7, 8, and 9</b>	
<b>Budget Item Description</b>	<b>Cost</b>
<b>Baghouse</b>	
Baghouse Supply and Erection	\$10,000,000
<b>Equipment</b>	
Electrical Equipment	\$600,000
Controls (Including Enclosure)	\$425,000
Air Compressor/Dryer	\$140,000
ID Booster Fans	\$1,200,000
Ash System	\$650,000
PAC System	\$700,000
Dampers	\$650,000
Expansion Joints	\$100,000
Ductwork and Structural Steel	\$3,100,000
<b>Erection</b>	
Construction Supervision and Indirects	\$2,400,000
Foundations	\$1,550,000
Electrical Installation	\$1,200,000
Mechanical and Structural Installation	\$7,500,000
<b>Other</b>	
Engineering Costs (A/E and Utility)	\$3,930,000
Mercury Continuous Emissions Monitors (2)	\$300,000
<b>TOTAL</b> (excludes testing program costs)	<b>\$34,445,000</b>



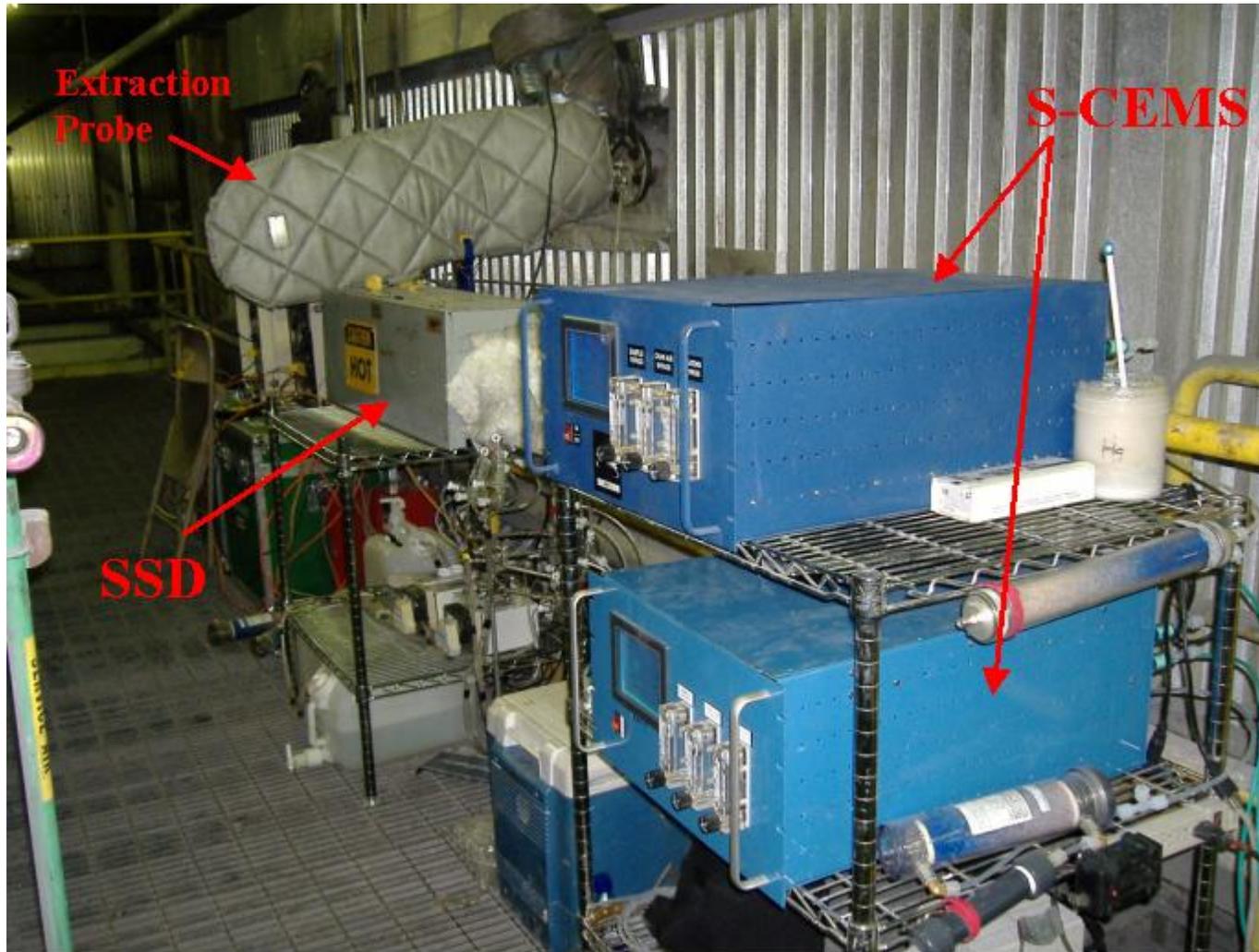
# Temperature Issues

- Temperature (350 – 370°F)
- Concern
  - Performance of activated carbons
  - Bag life
- Options being evaluated
  - Air heater modifications
  - Spray cooling
  - Alternative sorbents

# Sorbent Screening Tests

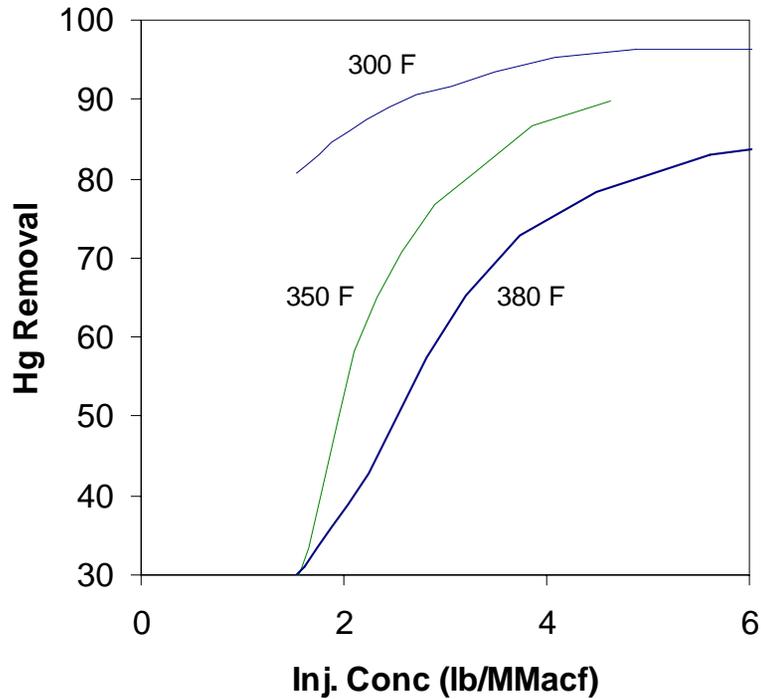
- Evaluated standard and treated activated carbons at three different temperatures (300, 350 and 370°F)
- Evaluated seven experimental sorbents

# Sorbent Screening Tests

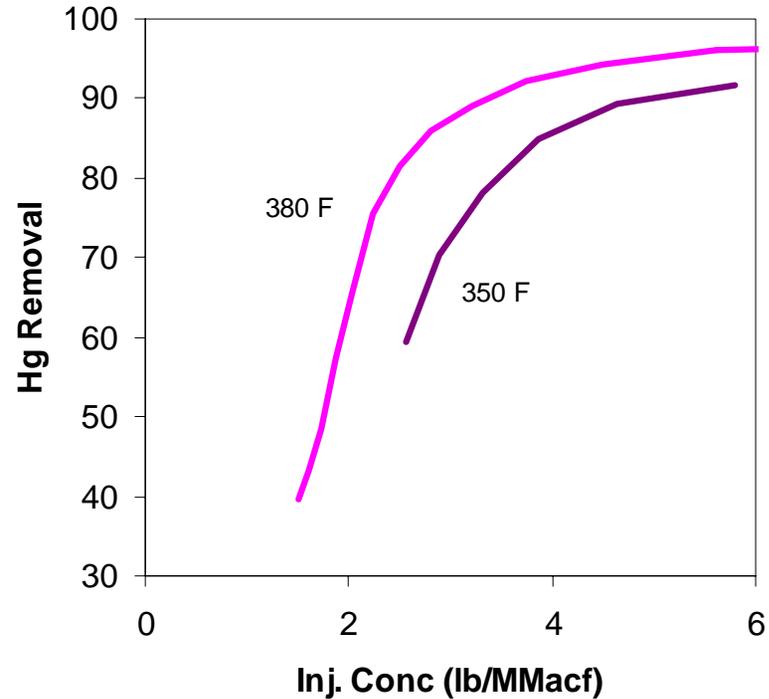


# Temperature Effect

## Darco Hg



## Darco Hg-LH



# Test Bags

- Evaluating alternative fabric designs
- Test fabrics will be installed for start-up
  - High perm PPS fabrics
    - Lower pressure drop
  - Dual density
    - High efficiency, lower pressure drop
  - P84
    - High temperature fabric
  - Kermel
    - New fabric

# Mercury CEM

- Partnership between ADA-ES and Thermo Electron to field validate new Mercury CEM components
- First tests February 2004
- Commercial system launched May 2005
- Installed at PIPP in June 2005

# PIPP CEM Installation



# PIPP Probe Installation



# The Mercury Freedom System™



- Dilution based measurement
- High sensitivity
- Modular design
- No expensive consumables
- No support chemistry
- No flue gas moisture analyzers
- True continuous monitoring

# Thermo/ADA-ES Hg CEMS Field Validation

Site	Gaston	Holcomb	Meramec	Brayton Point
Coal Type	LSEB	PRB	PRB	Blended (Low Sulfur/High Cl <sub>2</sub> )
Control Equipment	HSESP / Fabric Filter	Spray Dryer / Fabric Filter	ESP	ESP
Mercury Composition	50% Hg <sup>0</sup> 50% Hg <sup>+2</sup>	80% Hg <sup>0</sup>	80%+ Hg <sup>0</sup>	High % Hg <sup>+2</sup>
Status	Completed	Completed	Completed	Completed

# Thermo/ADA-ES Hg CEMS Field Validation (Continued)

Site	Eastern Bituminous- Wet Scrubber Site	Eastern Bituminous Site	Presque Isle	Conesville
Coal Type	Eastern Bituminous Coal	LSEB	PRB	HSEB
Control Equipment	SCR & Wet Scrubber	ESP	ESP	ESP / WFGD
Mercury Composition	20% Hg <sup>0</sup>	80% Hg <sup>0</sup>	80%+ Hg <sup>0</sup>	High % Hg <sup>+2</sup>
Status	Active	Active	Planned - June	Planned - 2005

# EPA Field Results

## Trimble County, KY

### Initial Certification Results

1. **7-day Cal Error Test**, 2 points, zero and upscale **passed**  
passing criteria: <5% span or <1 ug/m<sup>3</sup>
2. **Linearity Check**, 3 points, low, mid, high **passed**  
passing criteria: <10% of ref tag or <1ug/m<sup>3</sup>
3. **Cycle Time** **passed**  
passing criteria: <15 minutes to 95%
4. **Converter Efficiency** **passed**  
passing criteria: <5% of span
5. **Relative Accuracy** **passed**  
passing criteria: <20% of mean RM, need to match 9 valid  
*Or for low emitters (<5 ug/m<sup>3</sup>): < 1ug/m<sup>3</sup> difference*

# Conclusions

- CCPI demonstrations provide key support for the commercialization of new technologies
- Preliminary full-scale testing essential for establishing design basis and reducing risk
- First commercial mercury control system will be operational this year
  - CCPI provides mechanism to evaluate strategic design components

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