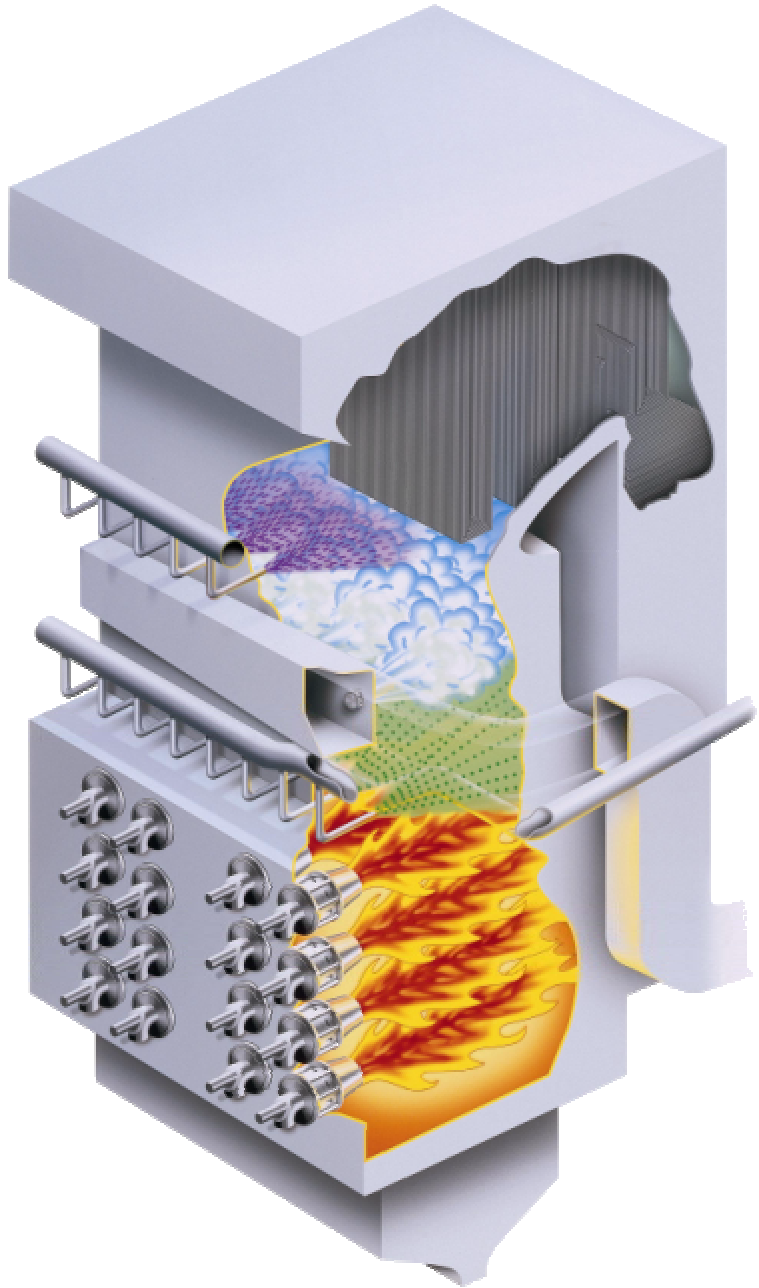
MERCURY CONTROL USING COMBUSTION STAGING



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DOE/NETL's
Mercury Control Technology
R&D Program Review Meeting
July 14, 2004

Pittsburgh, PA

imagination at work

GE approach to mercury control

Oxidizing Additives Injection
- Cl- and Br- containing
- Non halogen containing
- 60-90% Hg oxidation

CO/O_2 sensors

Combustion sensors

Activated carbon to trim Hg emissions

Stack

Coal and Air control

APH

ESP

FF retrofit

Fuel

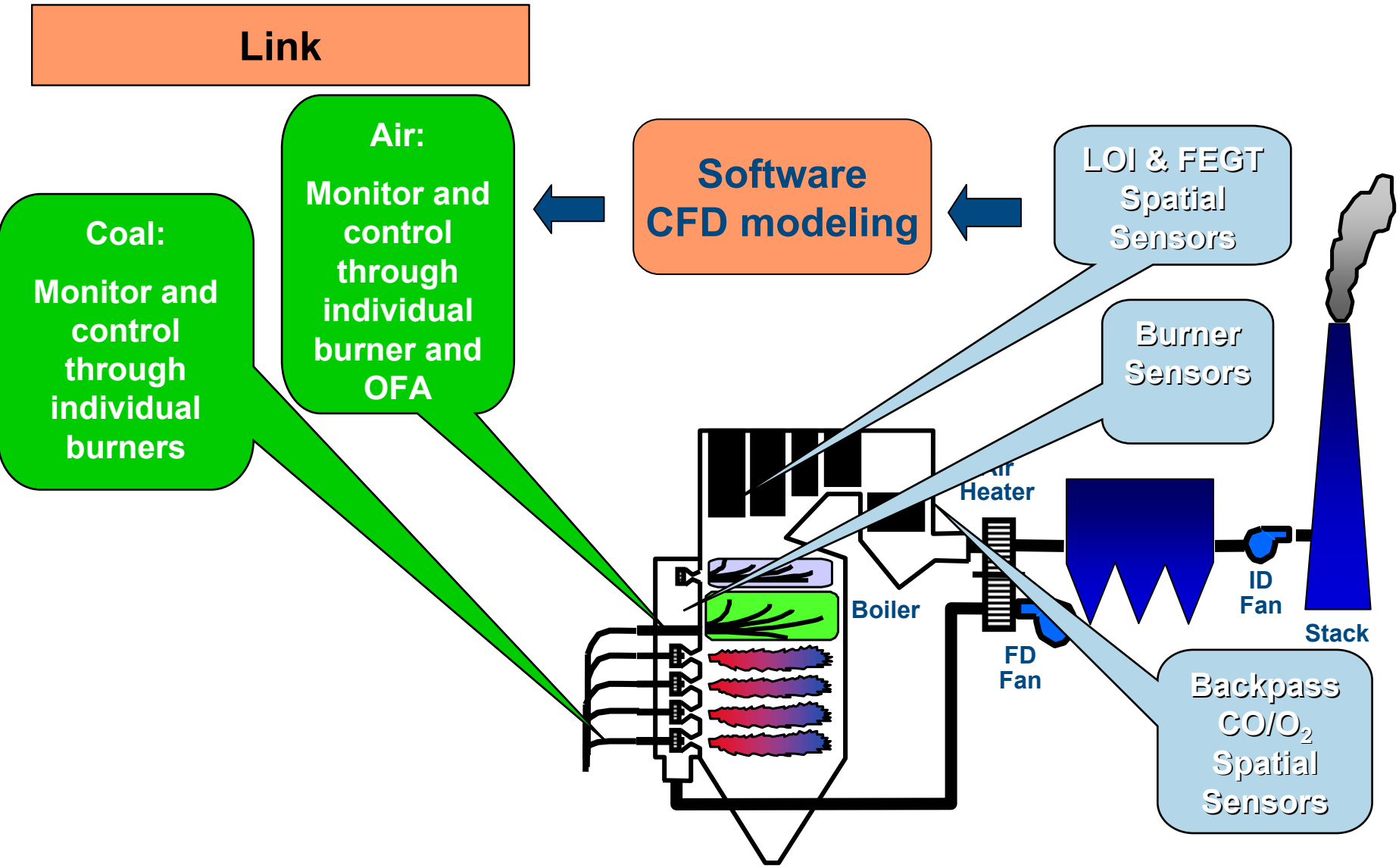
Air

Coal Properties
- Mercury content
- Chlorine & sulfur
- Trace & major elements

Combustion Staging
- SOFA
- Coal reburning

Effect on Mercury
- 20-30% improvement in Hg oxidation
- Increases carbon in ash content

Combustion optimization



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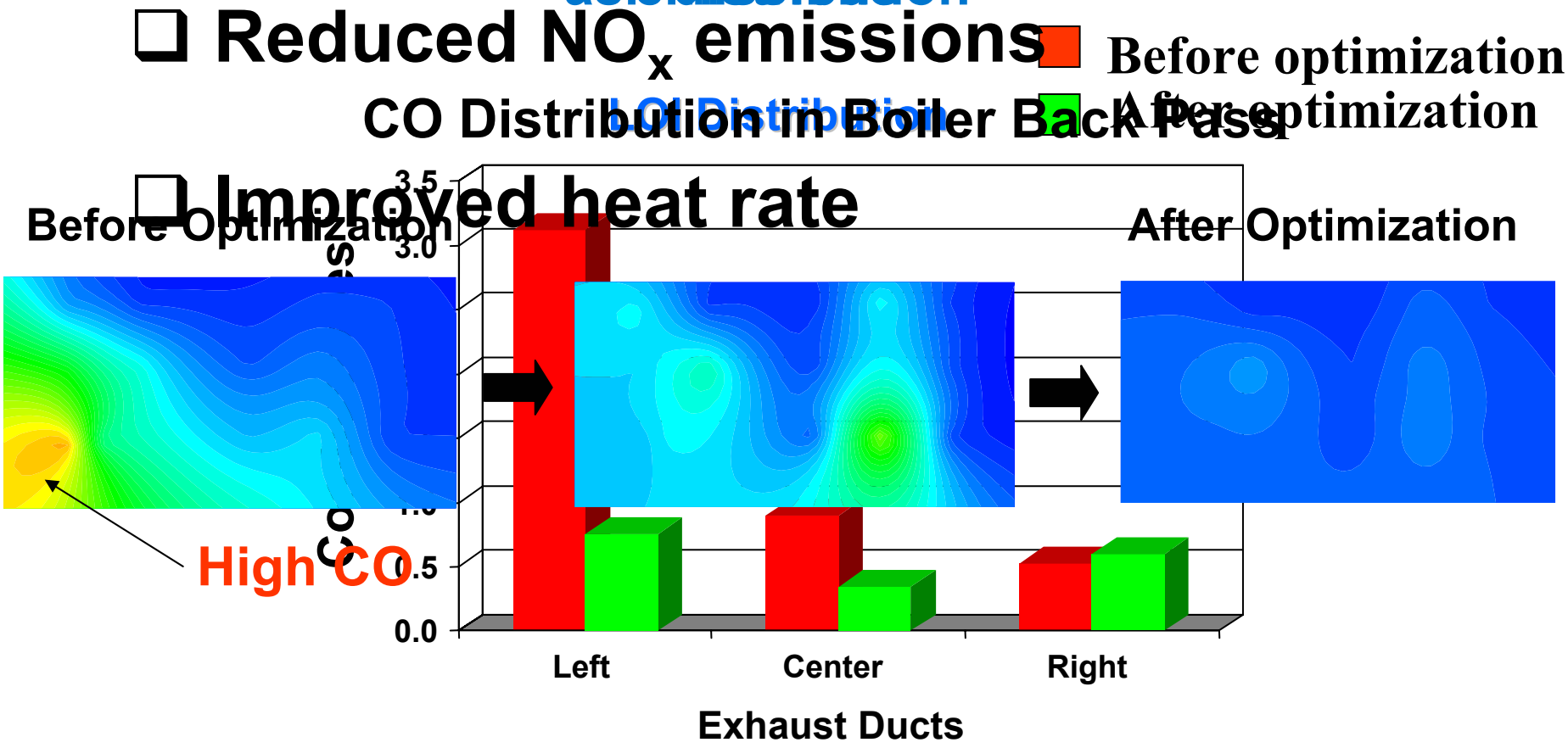
Benefits of combustion optimization

Other benefits:

- Reduced NO_x emissions
- Improved heat rate



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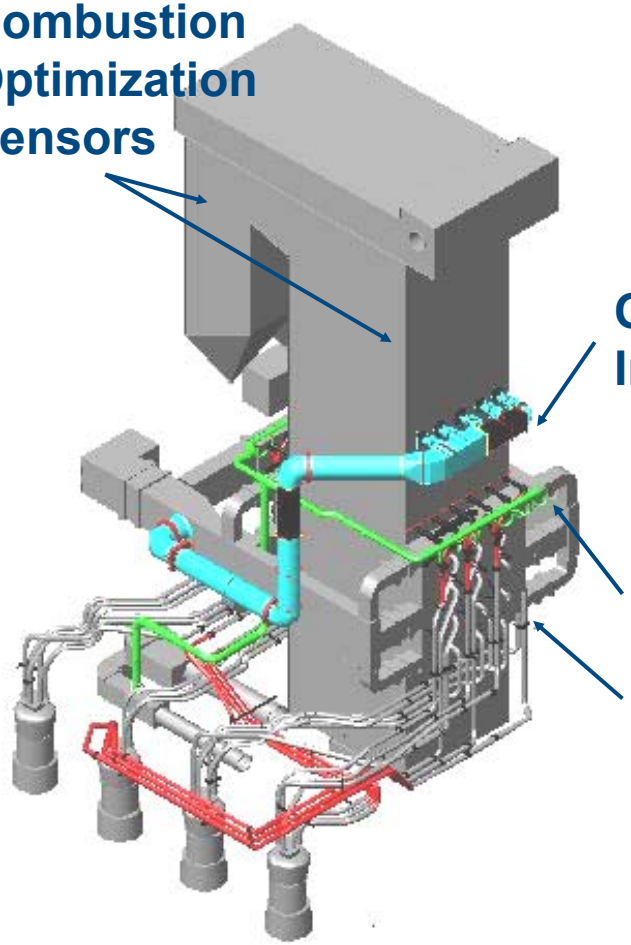
Demonstration of CO/CM for Hg control using bituminous coal

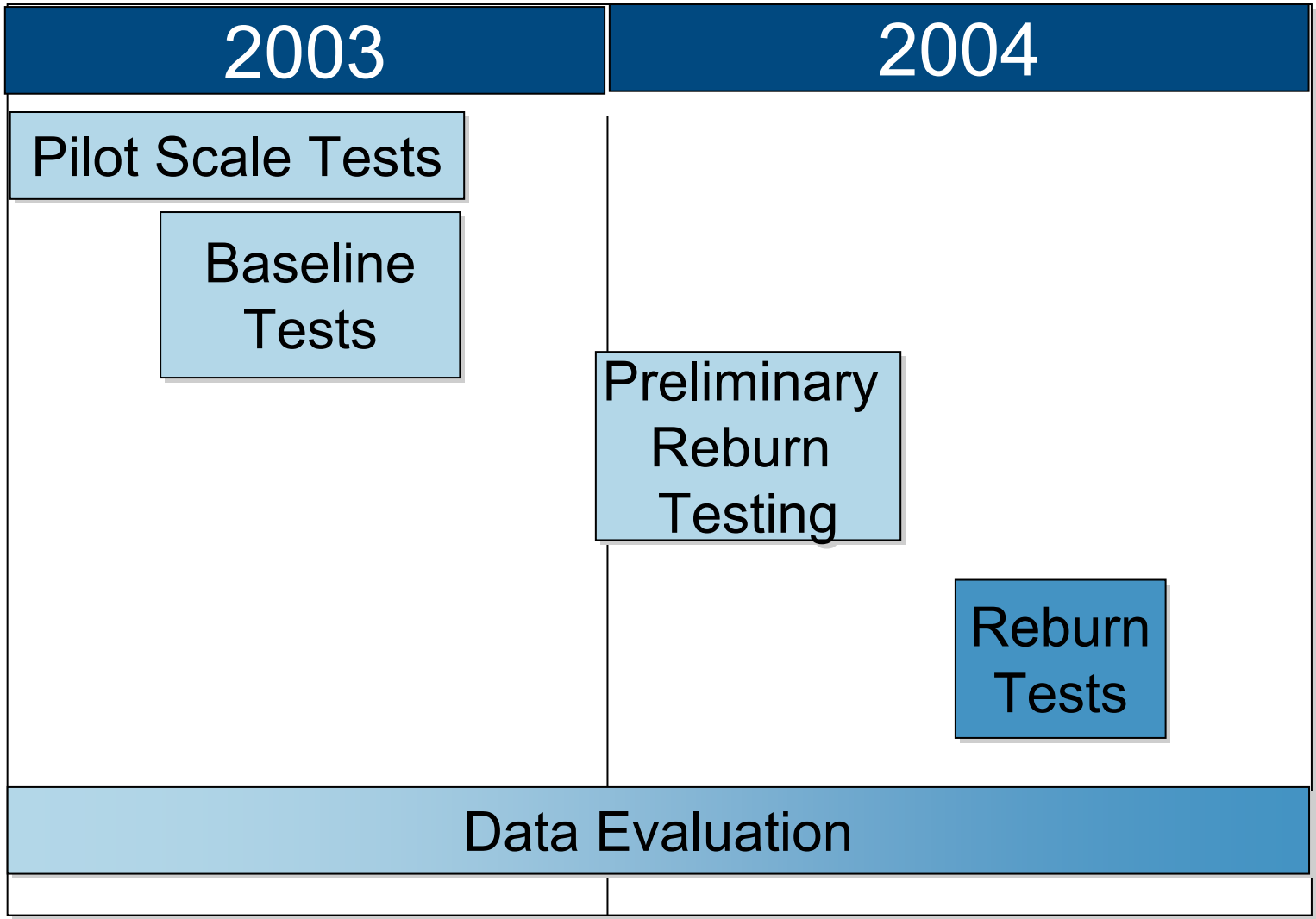


- **Project period:**

January 2003 – January 2005

- **Green Station Unit 2**
- **Capacity: 250 MW**
- **Fuel: Bituminous coal**
- **System:**
  - **Coal reburn system**
  - **Coal dampers**
  - **Combustion sensors**
  - **Cold-side ESP & wet scrubber**

DOE funded program on mercury control



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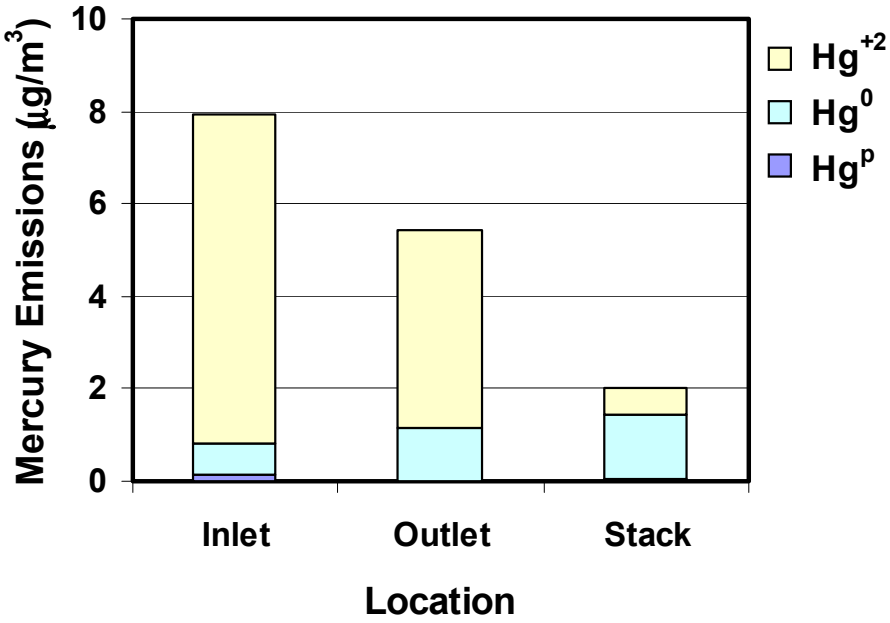
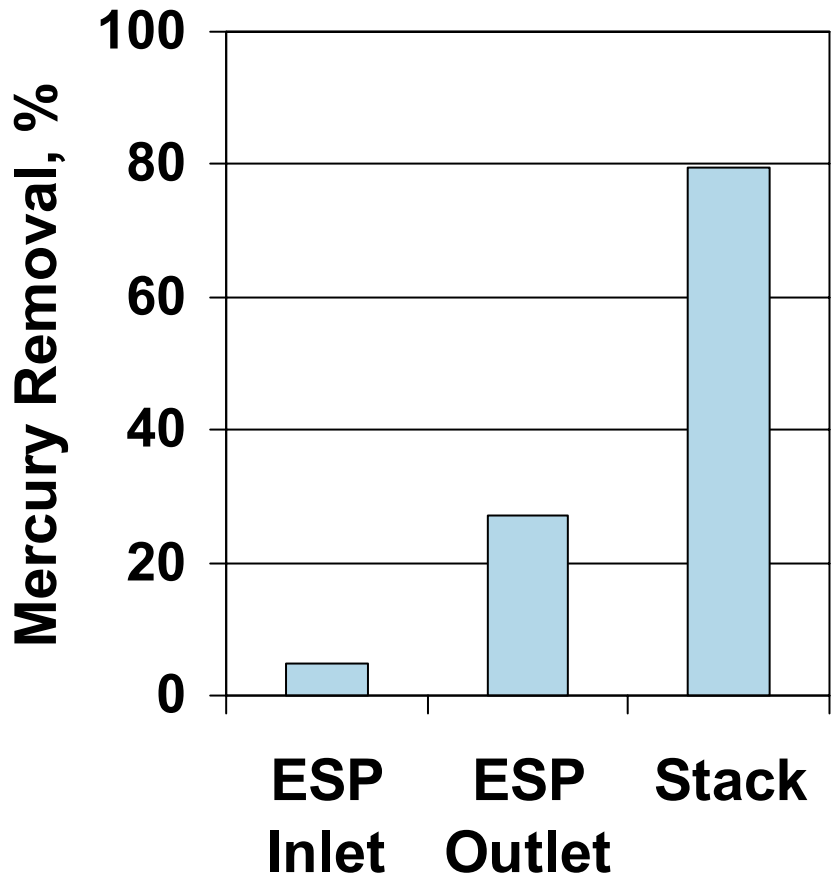
Field testing activities

- **Baseline testing**
  - **September 2003**
  - **SOFA**
  - **Mercury sampling using OH method at ESP inlet, outlet, and stack**

- **Preliminary reburning testing**
  - **January 2004**
  - **Reburning**
  - **Mercury sampling using OH method at ESP inlet, outlet, and stack**

Baseline results in agreement with expected performance





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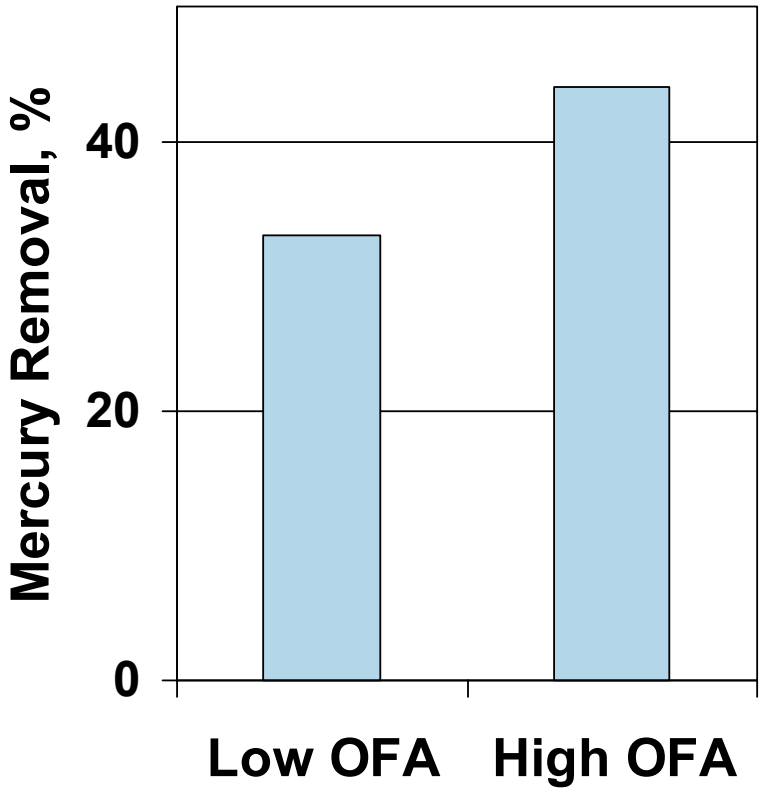
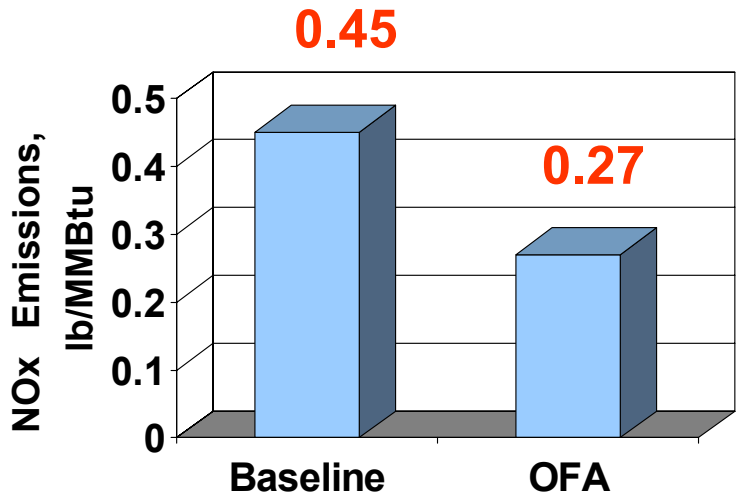
Mercury and NO_x reduction in air staging (OFA)

Mercury Removal at ESP Outlet



NO_x Reduction



OFA improves mercury removal and provides ~40% NO_x reduction

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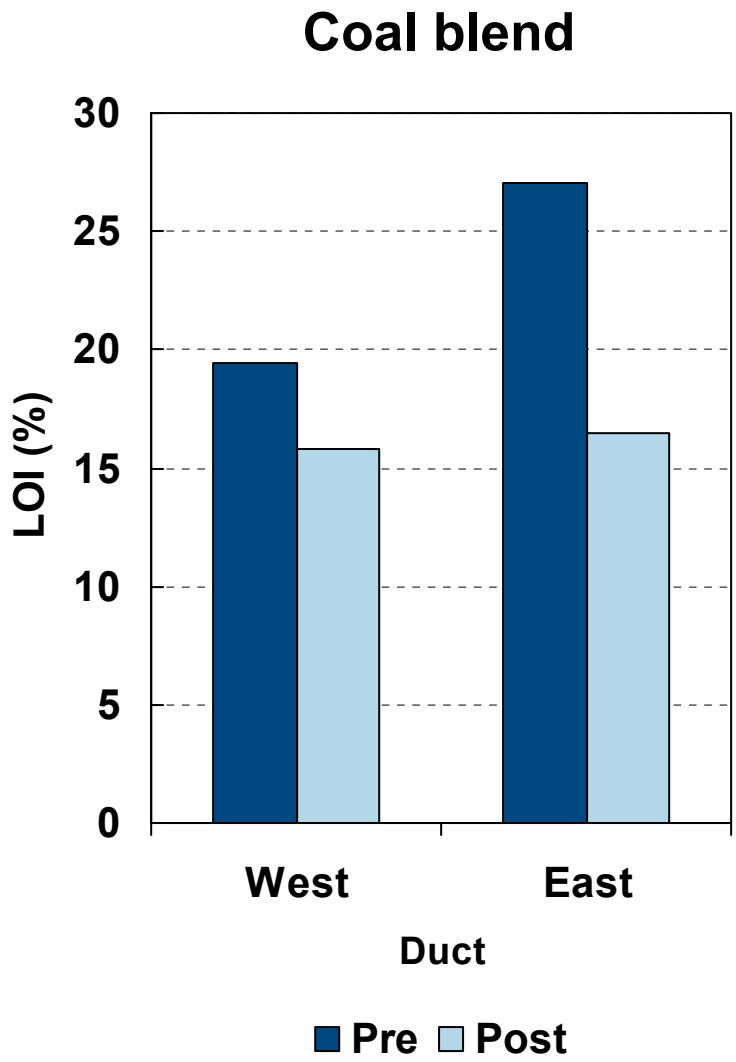
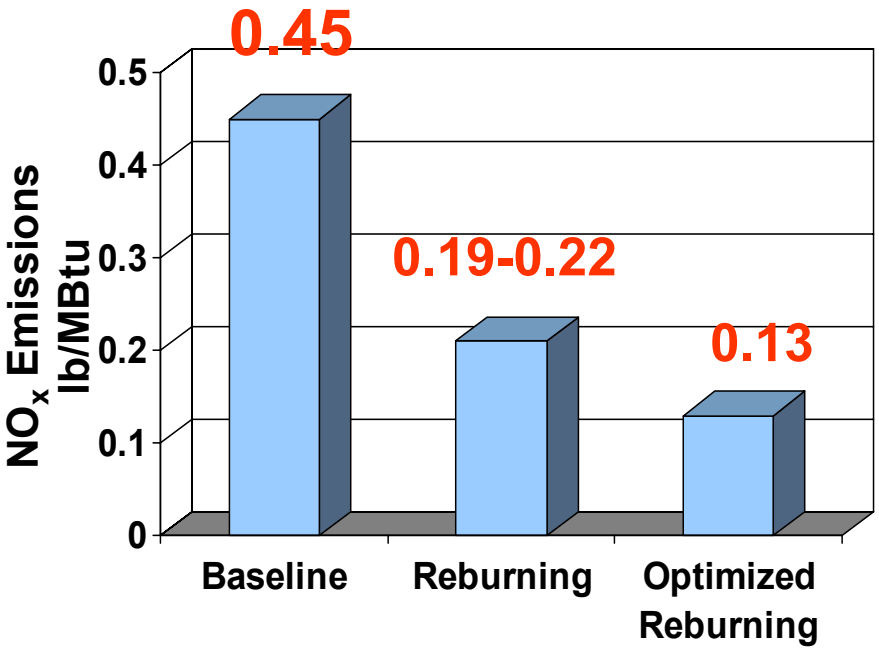
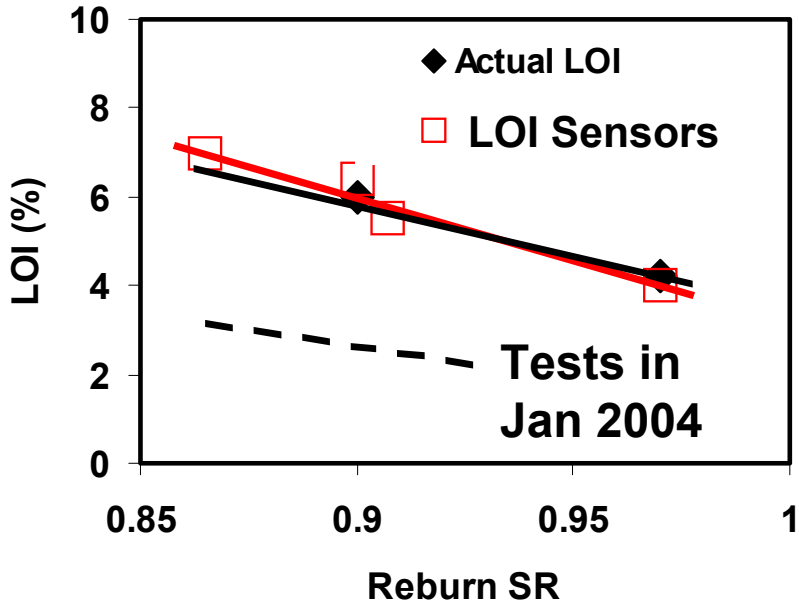
Combustion optimization

- **Coal line balancing**
  - Manually operated coal line balancing dampers
  - Maximum mass flow variation of ±10 %
- **Burner tuning**
  - Oxygen balance at the economizer exit grid
  - 3 x 4 grid of O_2 probes in each of the ducts
  - Maximum O_2 variation for all points was 12.5 percent



Effect of optimization on NO_x and LOI





Combustion optimization improves NO_x reduction and reduces LOI

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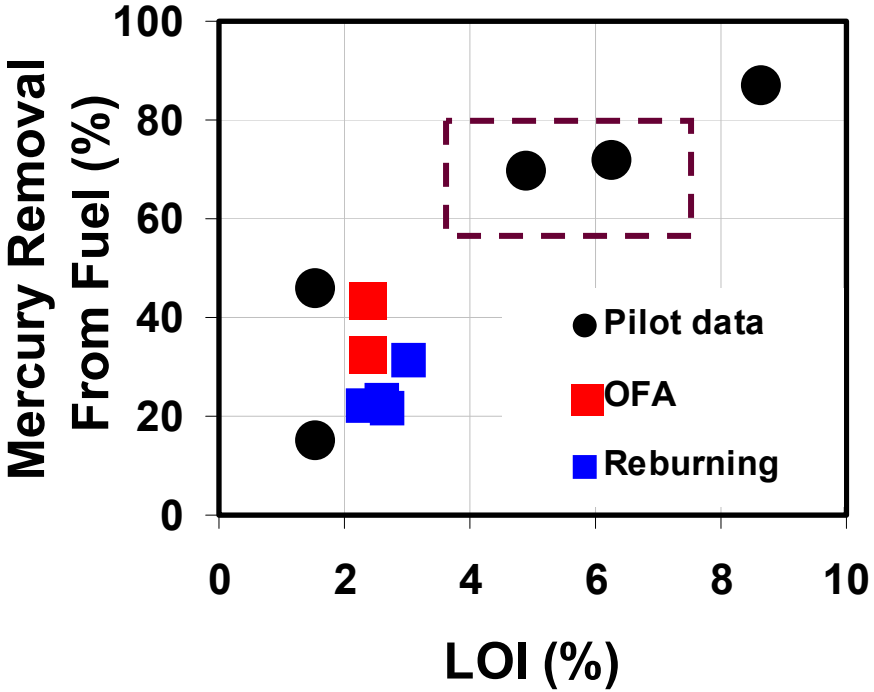
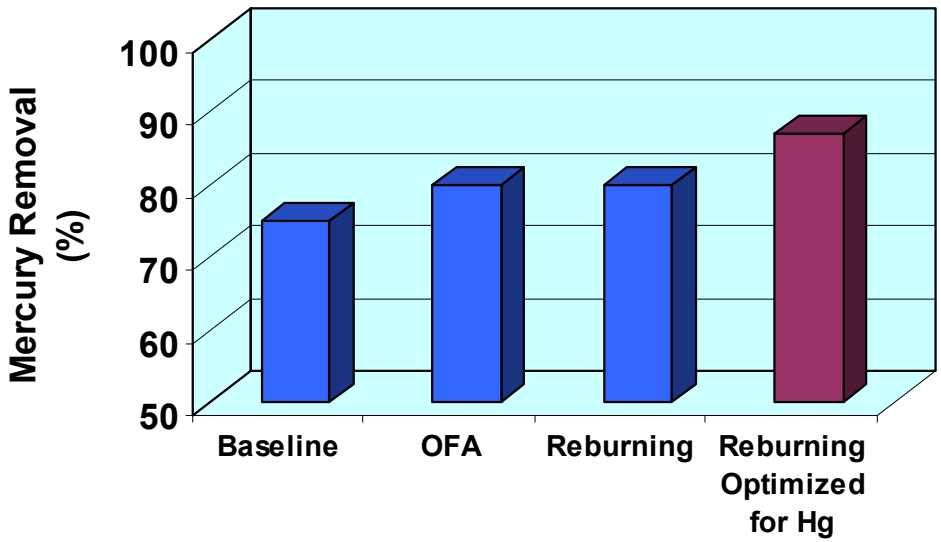
Mercury removal in coal reburning

Effect of LOI
On Mercury Removal at ESP Outlet



Mercury Removal at the stack



Increasing LOI will improve mercury removal

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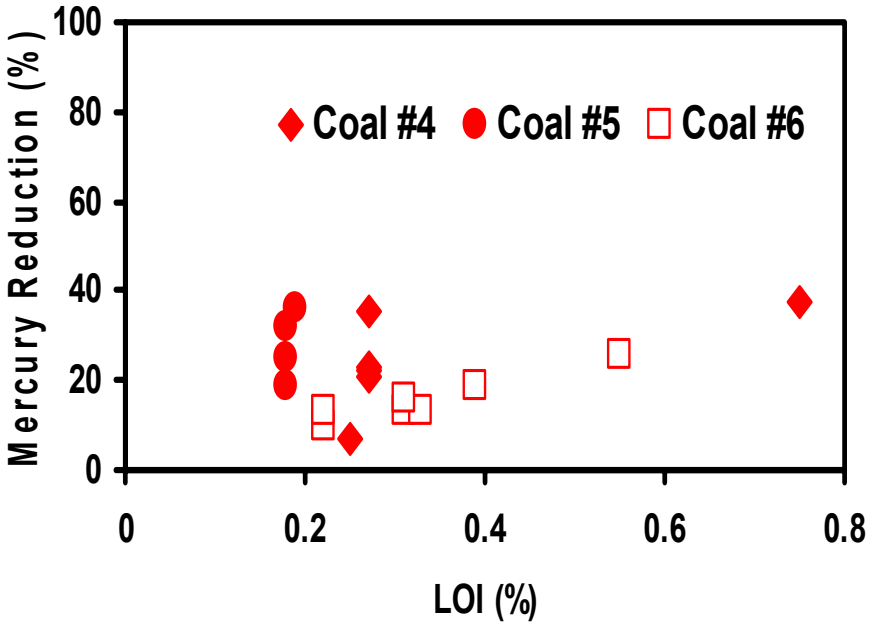
Pilot-Scale data on the effect of combustion staging on mercury emissions for PRB coals

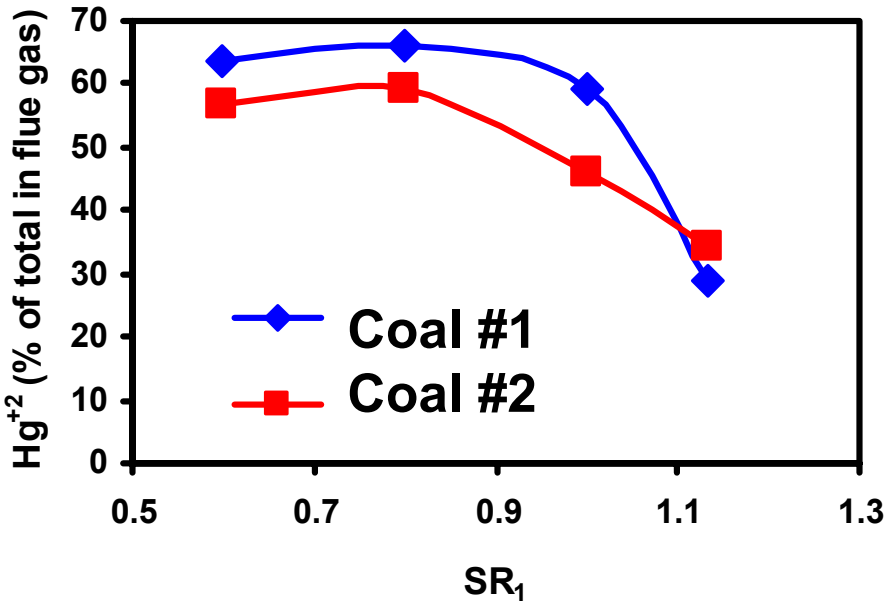
- Boiler Simulator Facility ($1x10^6$ Btu/hr, 300kW)
- Simulation of combustion conditions and time-temperature profile in full-scale utility boiler
- Test variables include combustion conditions, coal type, and coal blending
- Continuous mercury measurements

PRB: mercury removal in air staging (SOFA)

Mercury removal on fly ash in ESP



Effect of SOFA on Hg oxidation



- 20-30% mercury removal in air staging
- Improvement in Hg oxidation under deep staging

BSF data

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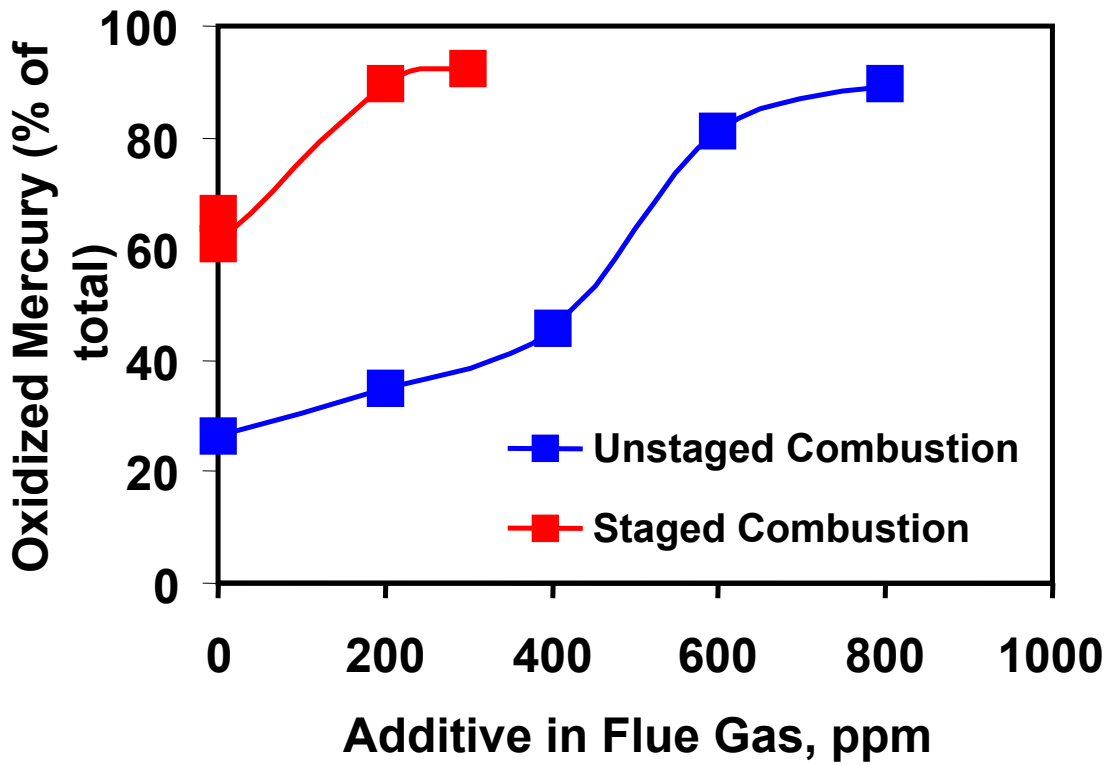
Hydrogen peroxide injection for mercury oxidation



BSF data

Caballo Rojo (PRB) coal

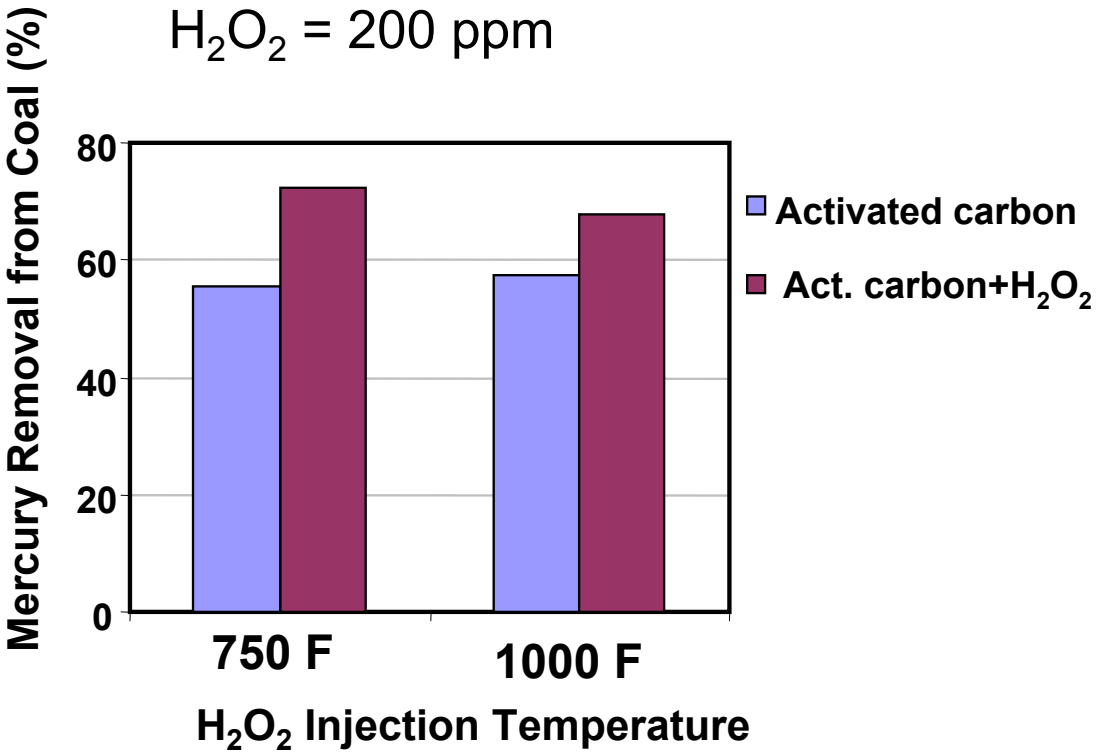
Injection temperature
700 –1200 °F

- **70-90% mercury oxidation using H_2O_2 injection**
- **Mercury is oxidized in air staging**
- **Air staging reduces requirement for the additive injection**

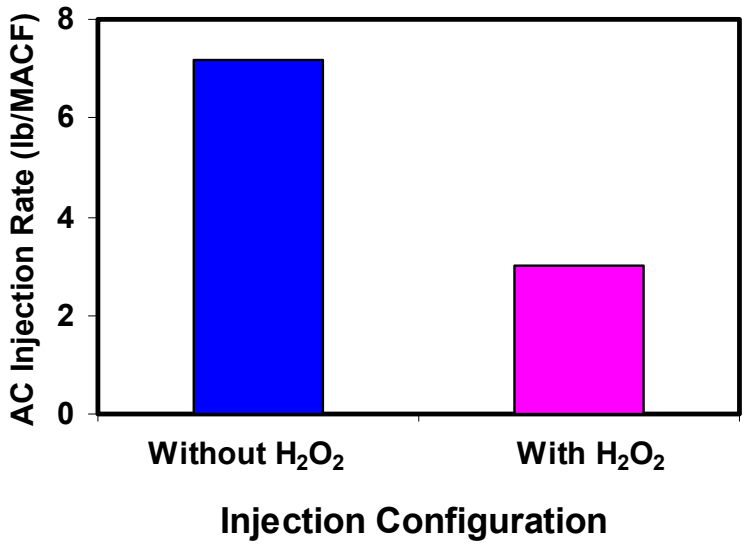
Effect of H_2O_2 injection on AC activity

PRB coal

AC injection rate 3.6 lb/Macf
H_2O_2 = 200 ppm



Mercury Removal efficiency 70%



Hydrogen peroxide injection reduces requirements for AC injection

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Summary

- Combustion modifications and optimization – available and proven
- GE approach will reduce NO_x and CO emissions, improve plant reliability and heat rate while providing mercury control
- GE mercury solution is tailored to plant configuration
- Cost of mercury control using GE approach is lower than that of activated carbon injection

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