



*GE Power Systems
GE Energy and Environmental Research Corp.*

NO_x AND MERCURY CONTROL BY COMBUSTION MODIFICATIONS

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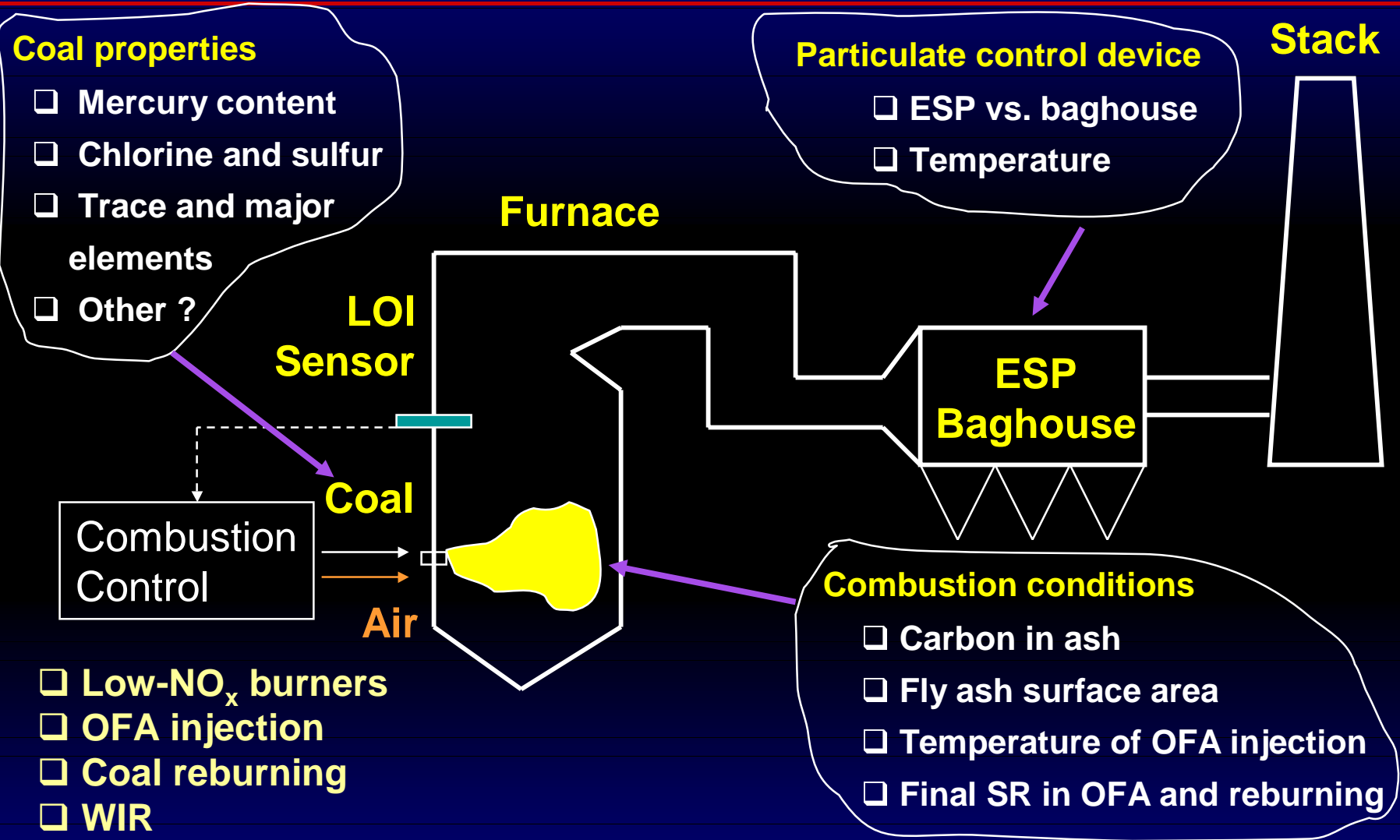
Objective

Develop technology for Hg control at cost significantly lower than activated carbon injection

Presentation Outline

- ❑ **Optimizing combustion modifications for combined Hg and NO_x control**
- ❑ **Experimental facility and pilot-scale results**
- ❑ **Future plans**

Combustion Modifications for NO_x/Hg Control



All three elements have to be optimized for maximum Hg control

Pilot-Scale Program on Integrated NO_x/Hg Control

□ Program goals:

- Optimize Hg removal in a 1 MMBtu/hr combustor
- Evaluate ESP and fabric filter efficiencies for Hg removal

□ Tests focused on optimizing:

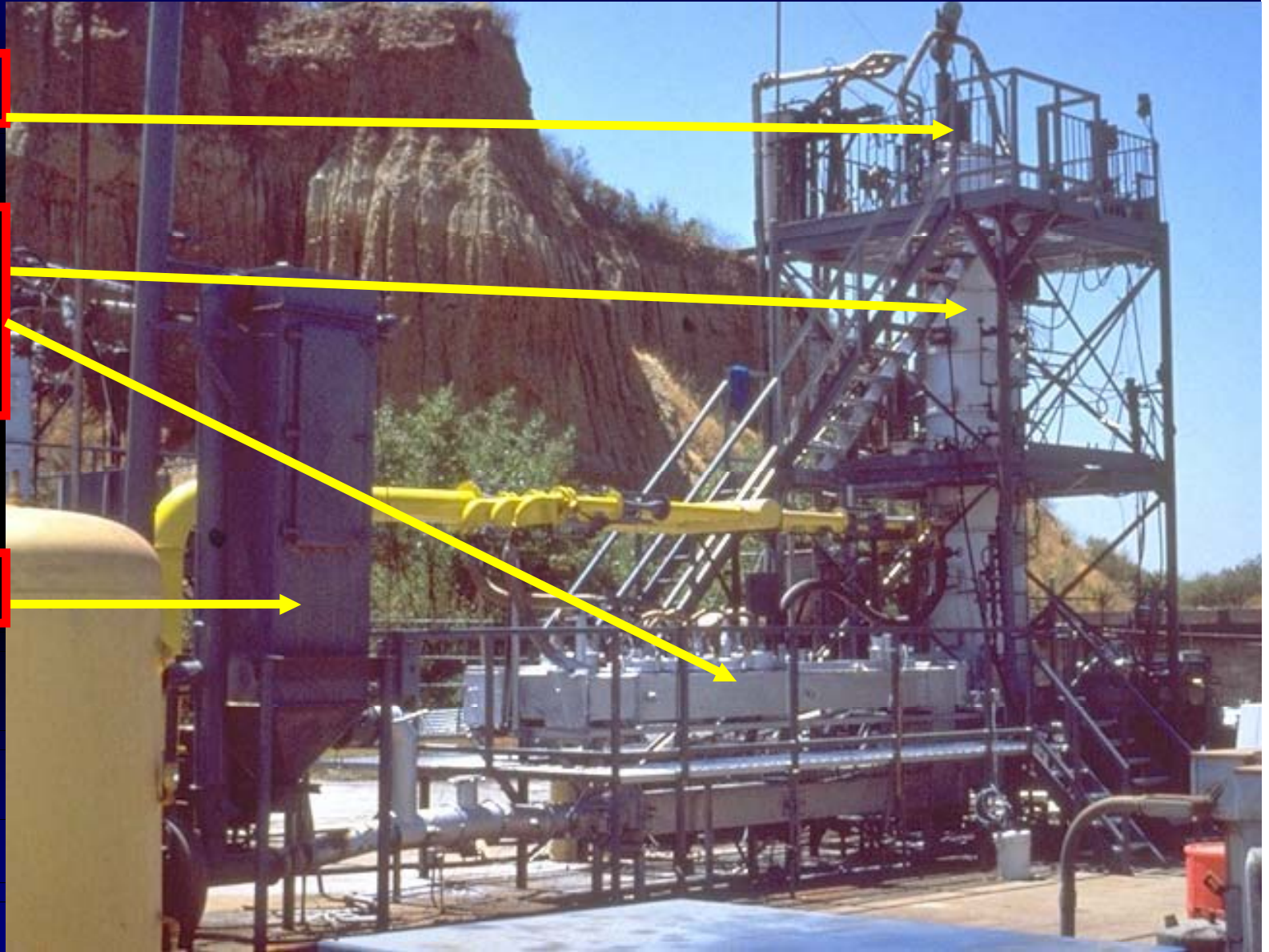
- Combustion conditions
- Conditions in ESP and FF
- Selecting coals

EER 1 MMBtu/hr Boiler Simulator Facility

Burner

**Furnace
and
convective
pass**

ESP



Mercury Analysis

□ Online Hg analyzer from PS Analytical (The Sir Galahad II)

- Atomic fluorescence
- Wet chemical converter
- Elemental (Hg^0) and total (Hg) mercury
- Hot filter with blowback

□ Manual method

- EPA method PRE-003 (Ontario Hydro)
- EPA method 101A

□ Mercury in coal and fly ash

Air and Fuel Staging

□ Coal type

- Kittanning
- North Antelope
- Ohio
- Utah

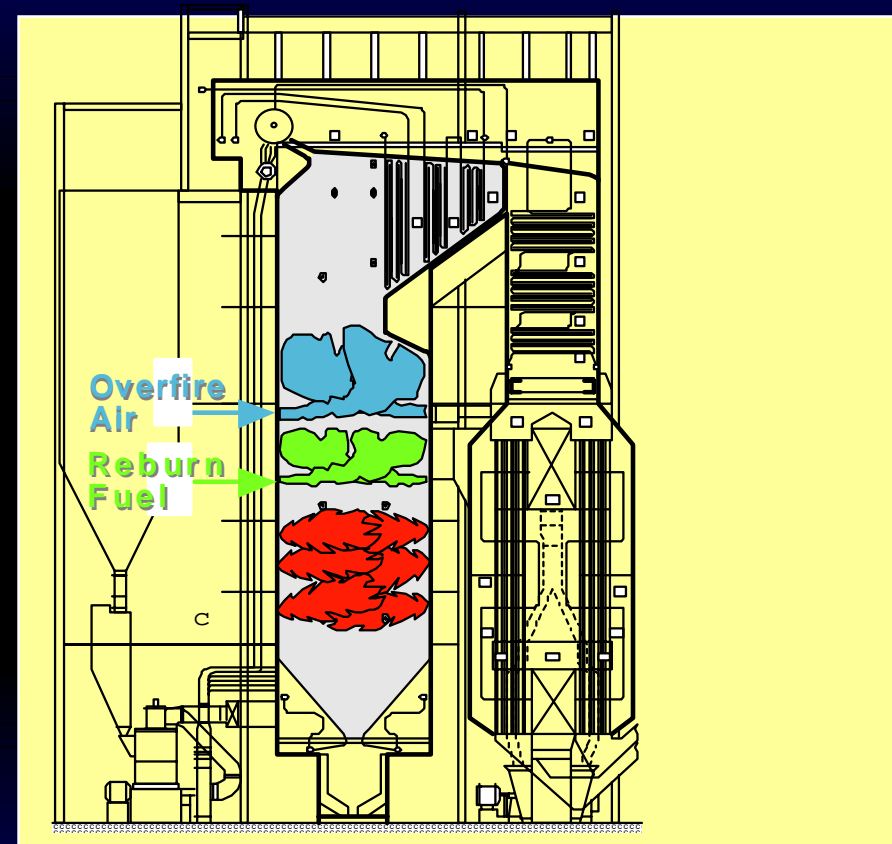
□ Combustion conditions

- Air staging (OFA)
- Fuel staging (reburning)

□ Particulate control device

- Fabric filter
- ESP

Staging

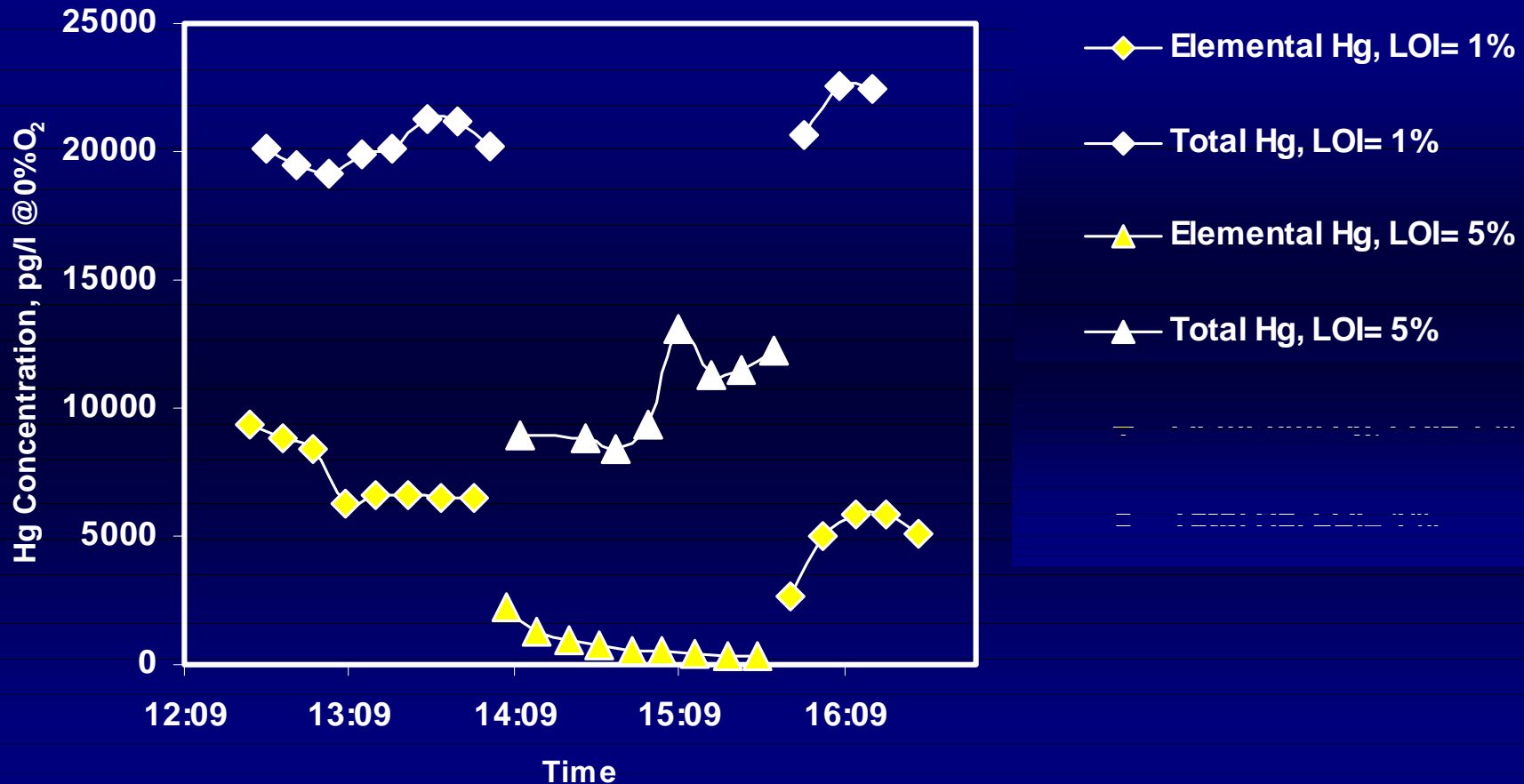


In air staging, high carbon fly ash is formed in the main comb. zone
In reburning, high carbon ash is formed in reburning zone

Typical Pilot-Scale Experimental Data (FF)

Total and Oxidized Mercury in Flue Gas

Air Staging



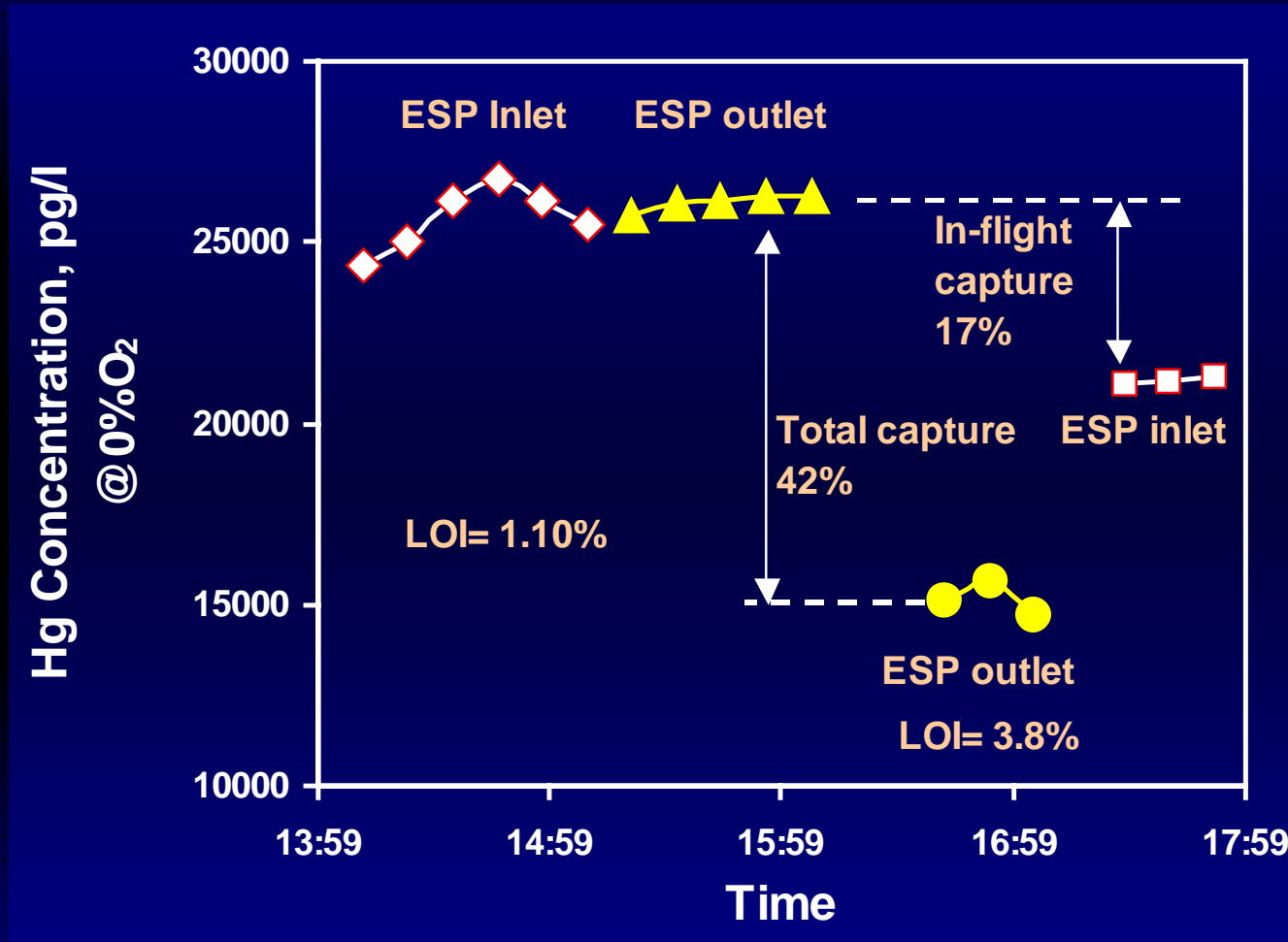
Tests demonstrate Hg removal by fly ash

Mercury concentration at baseline conditions does not change

Typical Pilot-Scale Experimental Data (ESP)

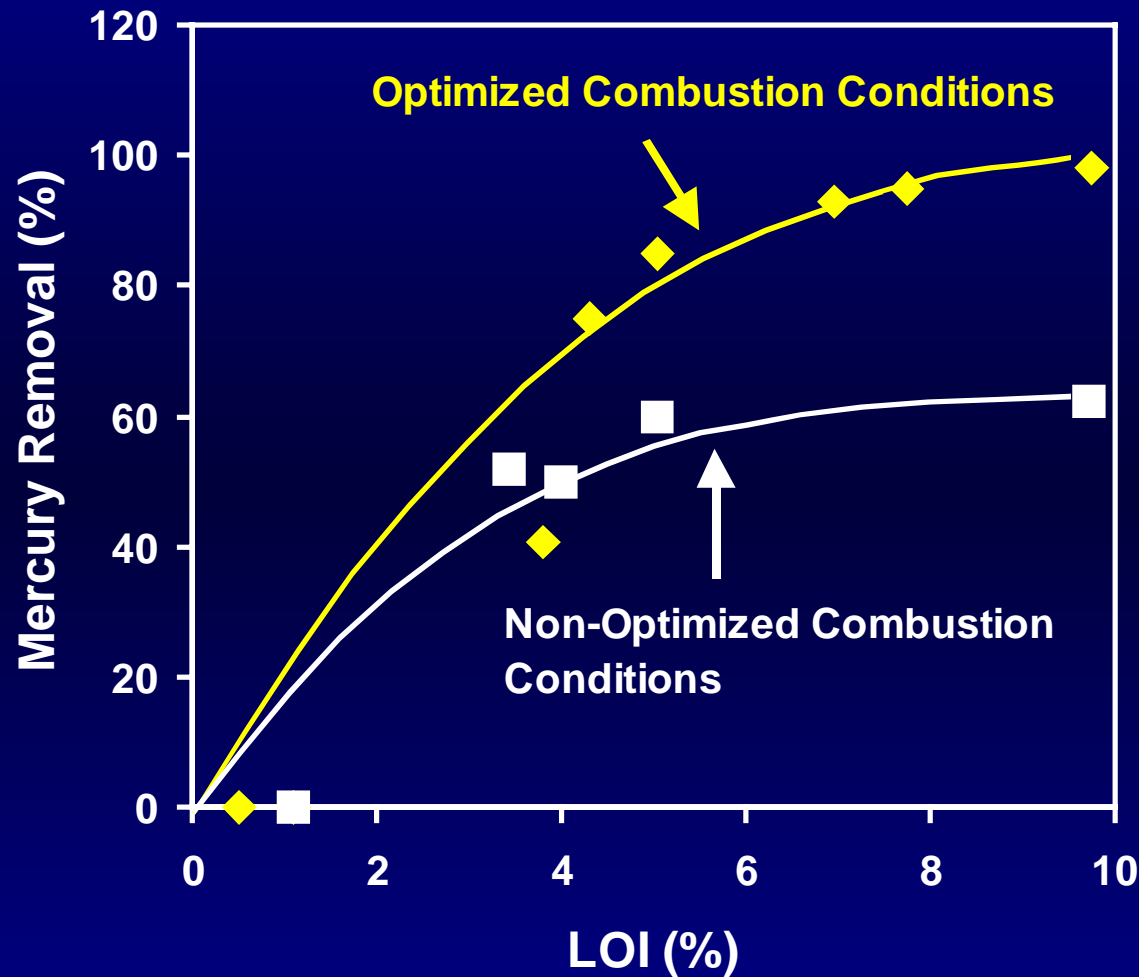
Total Mercury

Air Staging



Mercury is adsorbed in-flight and across ESP

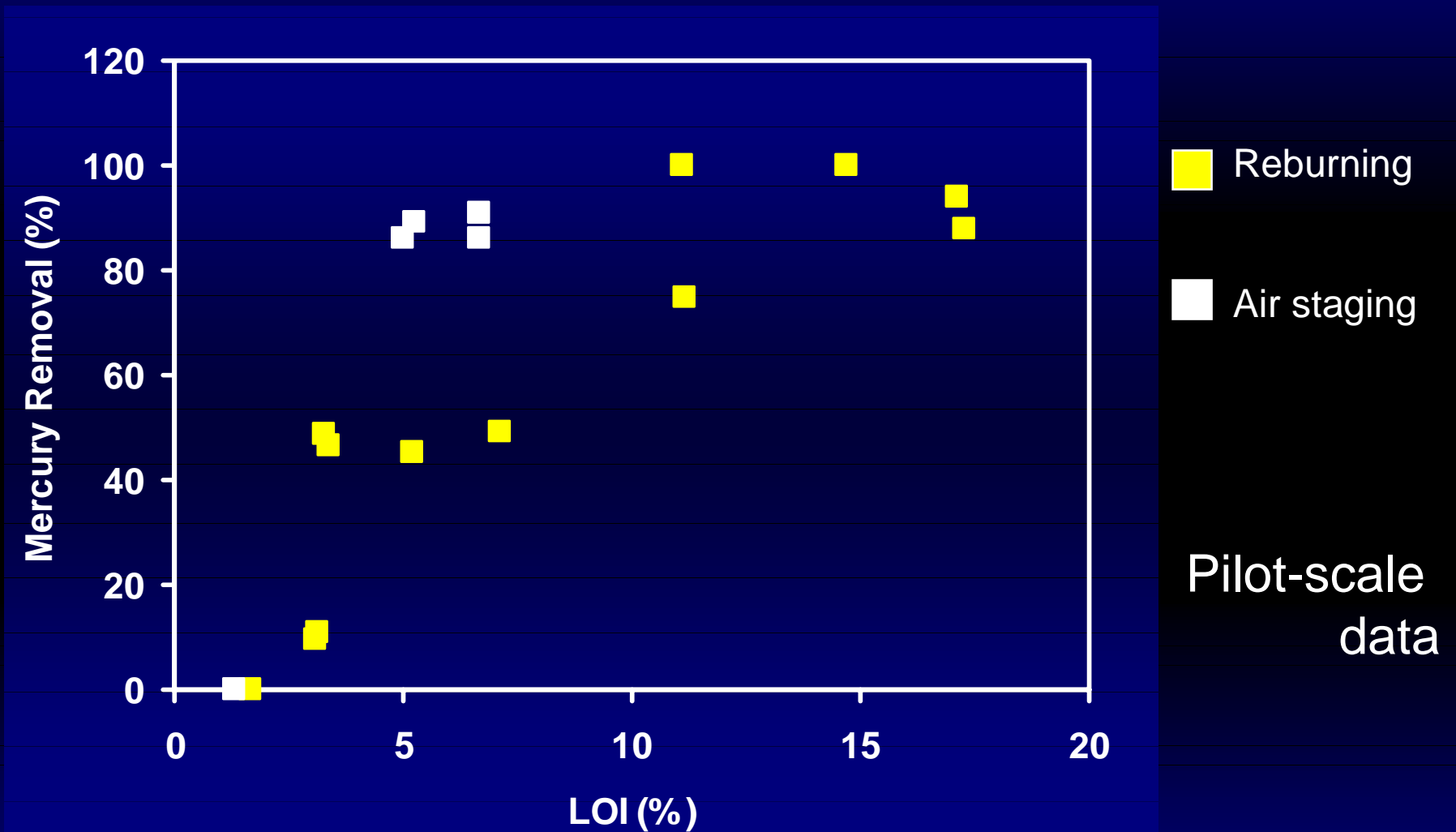
Mercury Capture Across ESP



Air Staging
ESP temperature 350 °F

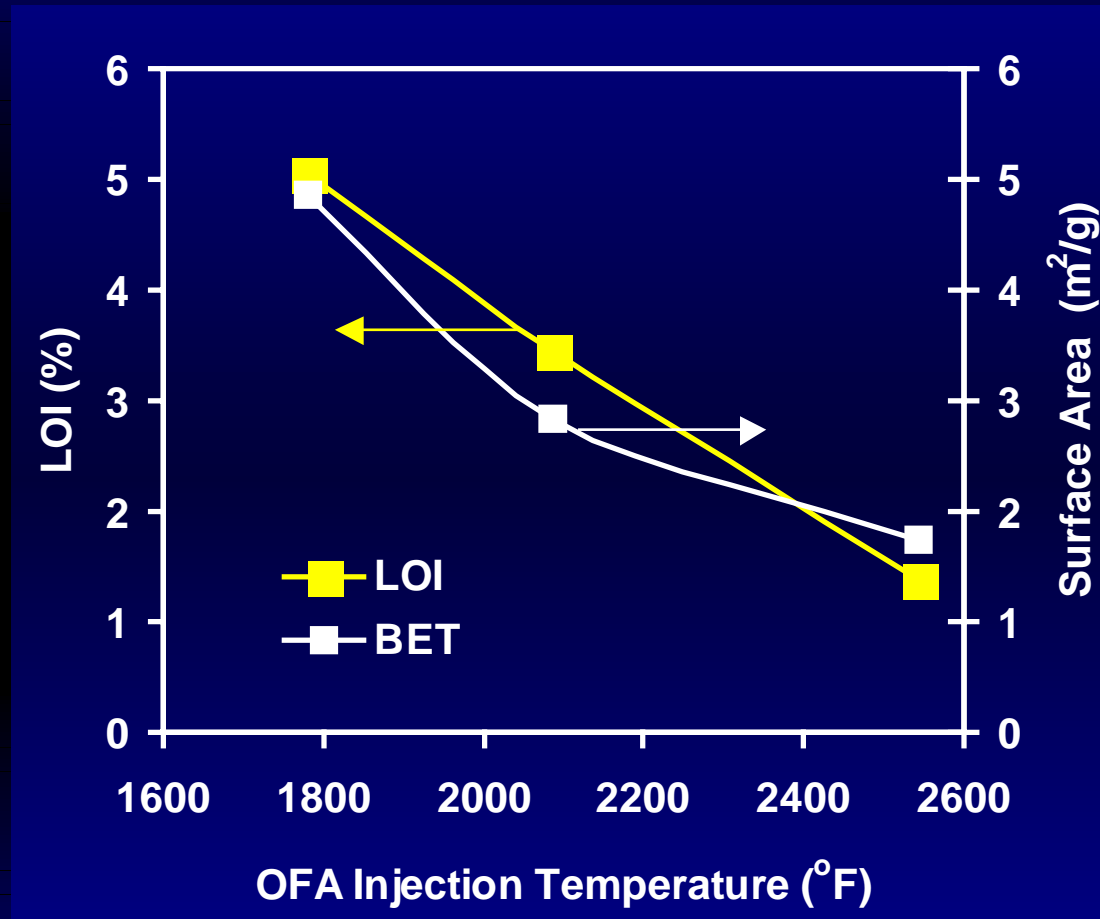
**Optimizing combustion conditions can improve Hg adsorption
by fly ash**

Summary of Test Data with FF



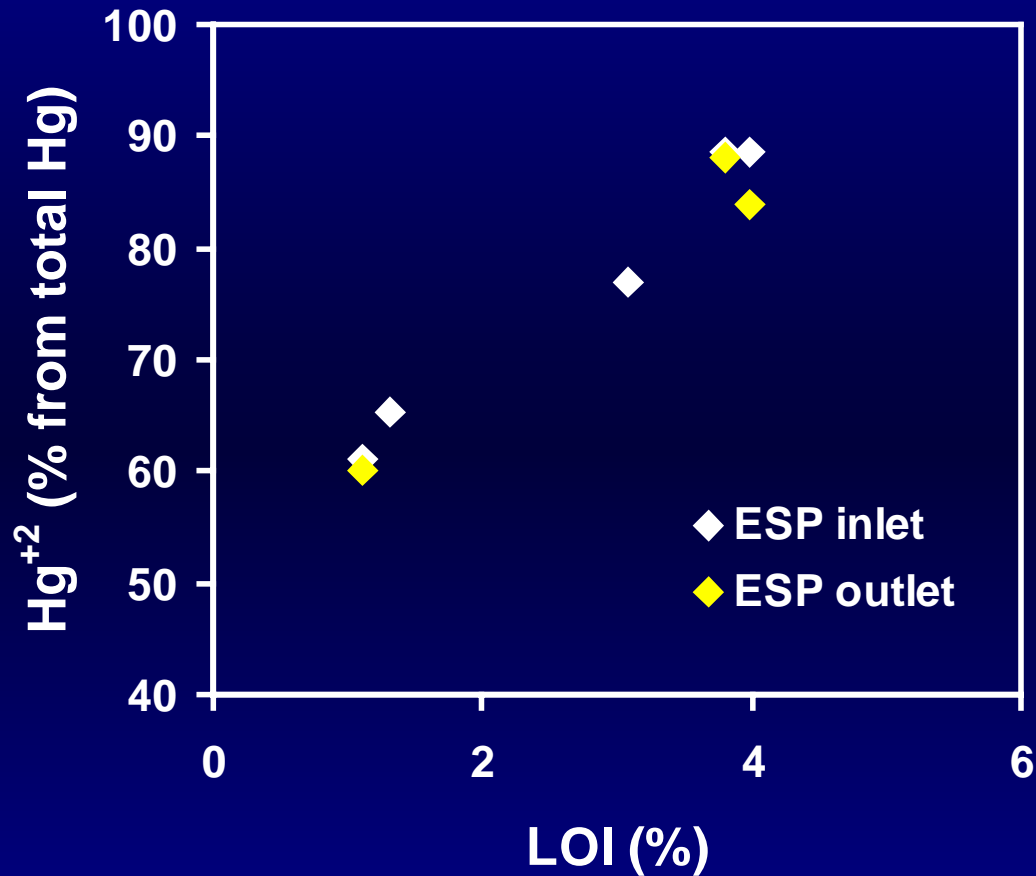
Efficient Hg Control Can Be Achieved at LOI /5%

Optimizing Air Staging: Effect of OFA Injection Temperature



OFA system can be optimized to increase LOI and fly ash surface area

Mercury Speciation in Flue Gas



Air Staging

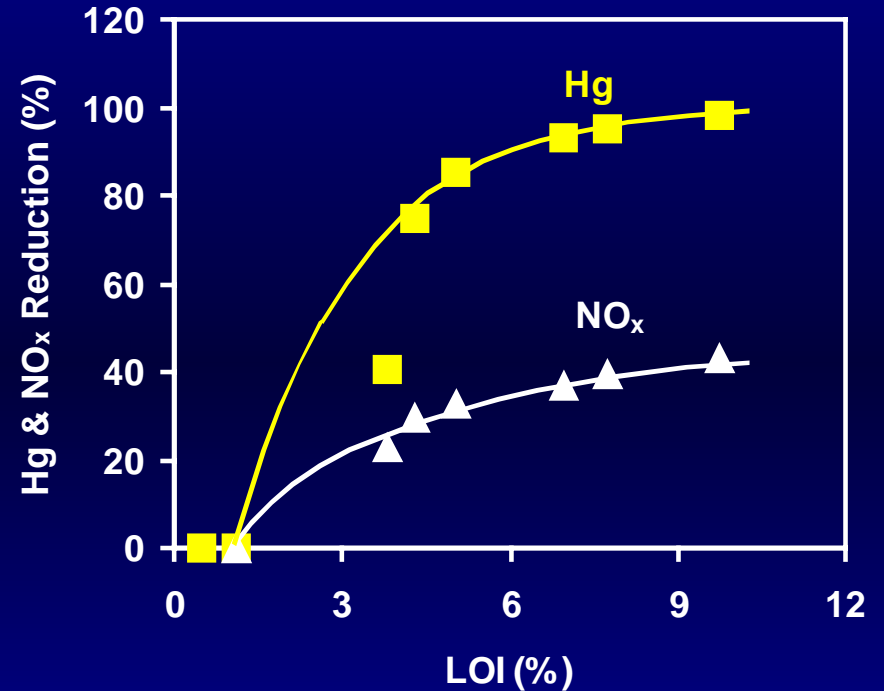
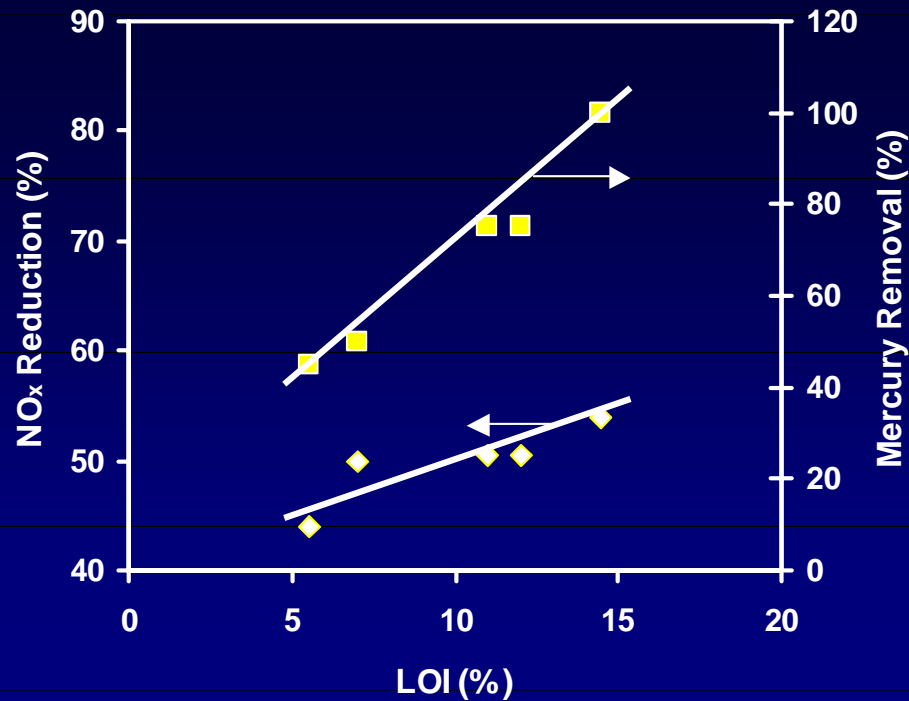
ESP at 350 °F

Elemental mercury is oxidized on fly ash

Optimizing Reburning for NO_x Reduction

Reburning heat input - 20%

Air Staging



Synergism of Hg and NO_x Controls

Pilot-scale data

Full-Scale Testing

Challenges to Overcome:

- ❑ Efficiency of Hg removal is coal specific
 - ❑ Mercury content
 - ❑ Chlorine content
 - ❑ Fly ash formed from PRB coals typically has low LOI
- ❑ PCD temperature has to be 350 °F or lower
- ❑ Limited abilities to optimize combustion conditions for existing installations

Summary

- **Combustion modifications can be used for integrated NO_x/Hg control**
- **Up to 95% Hg removal can be achieved by “*in situ*” formed fly ash on fabric filter and ESP at LOI = 5-15% for some coals**
- **Efficiency of Hg removal is coal specific**