

# **Sorbent Injection for Small ESP Mercury Control in Bituminous Coal Flue Gas**

**DOE/NETL Mercury Program Review Meeting  
July 12<sup>th</sup>, 2005**

**Katherine Dombrowski  
Carl Richardson  
URS Corporation**

## Project Team



Dawn Deel (COR)



Mark Berry

Nick Irvin

Ken McBee



Carl Richardson

Katherine Dombrowski



Ramsay Chang



Sharon Sjostrom

Dave Muggli

## Project Background

- Financial Assistance Program DE-FC26-03NT41987
- Full-scale activated carbon injection tests at Southern Company's Georgia Power Plant Yates
  - Units 1 and 2
  - ESPs with SCA <math><200 \text{ ft}^2/1000 \text{ acfm}</math>



## Project Background

- Most previous ACI testing with ESPs performed on relatively large units
  - High levels of Hg removal possible
  - No apparent detrimental effects on ESP performance
- 70% of utility ESPs have SCA <300 ft<sup>2</sup>/1000 acfm
  - Sorbent injection performance in this size range not currently known
  - Effects on ESP performance not known

## Project Objectives

**Evaluate sorbent injection for Hg control  
in bituminous flue gas across small-  
sized ESPs and ESP/FGD**

- **Removal performance & variability**
  - **Optimal process conditions**
- **Balance of plant effects**
  - **ESP, FGD operation**
  - **Effects on byproduct ash, gypsum**

## Project Status

### Completed Tests

#### ■ Baseline Testing

##### - Units 1 and 2 (March-04)

- Flue gas characterization
- Ontario Hydro testing

#### ■ Parametric Testing

##### - Unit 1 (April-04)

- Effect of sorbent type, injection rate

##### - Unit 2 (March-04)

- Effect of FGC with Darco Hg

- Effect of injection rate



Test Plan  
Baseline Tests  
Parametric Test  
Long-term tests  
Cost Analysis  
Final Report

## Project Status

### Completed Tests

#### ■ Long-Term Injection Testing

##### - Unit 1 (Nov-Dec 2004)

- Super HOK injection
- 30 day test
- Ontario Hydro testing

#### ■ Additional Parametric Testing

##### - Unit 1 (Jan 2005)

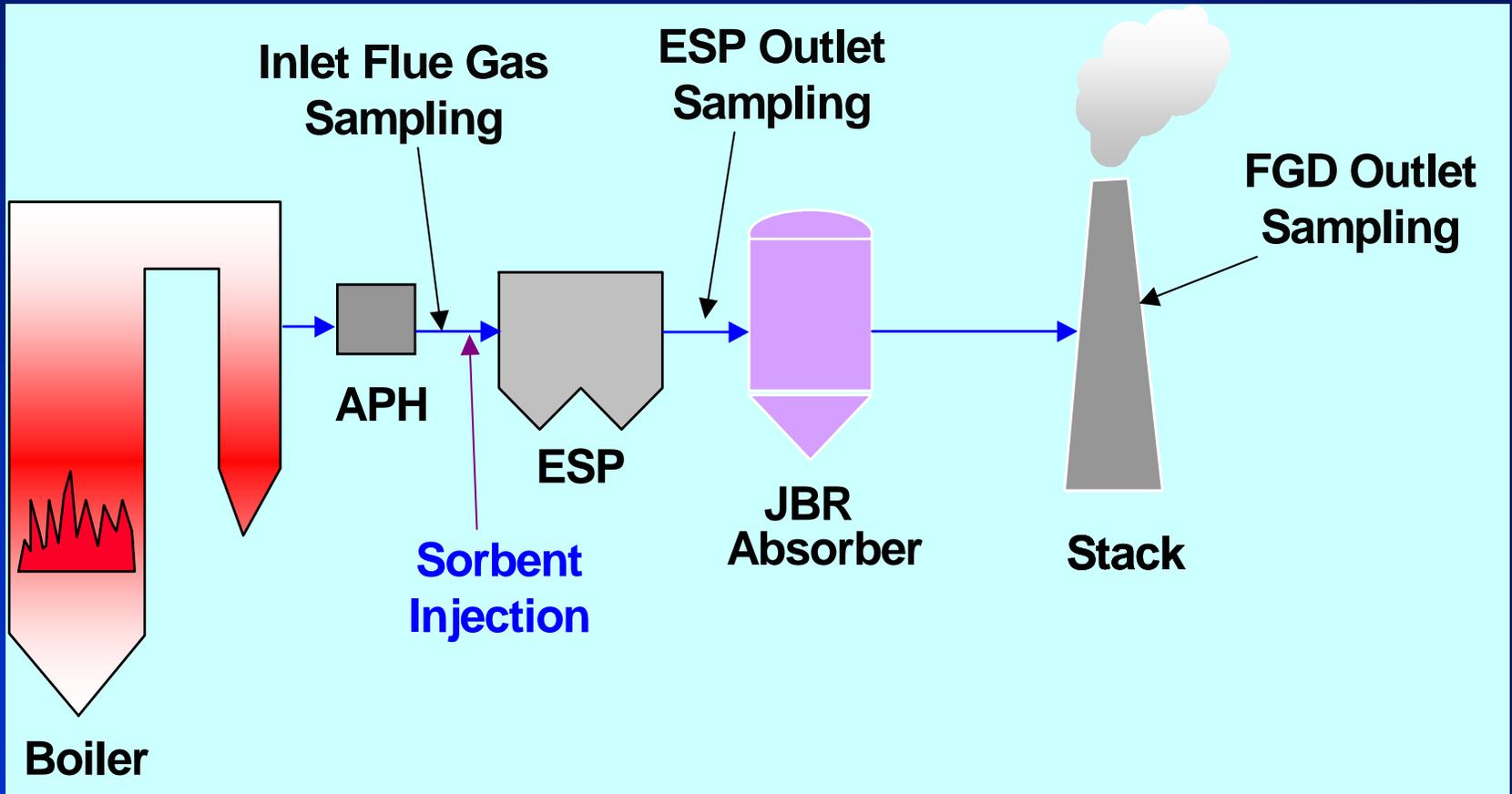
- Tested alternate sorbents



# Georgia Power Plant Yates Unit 1

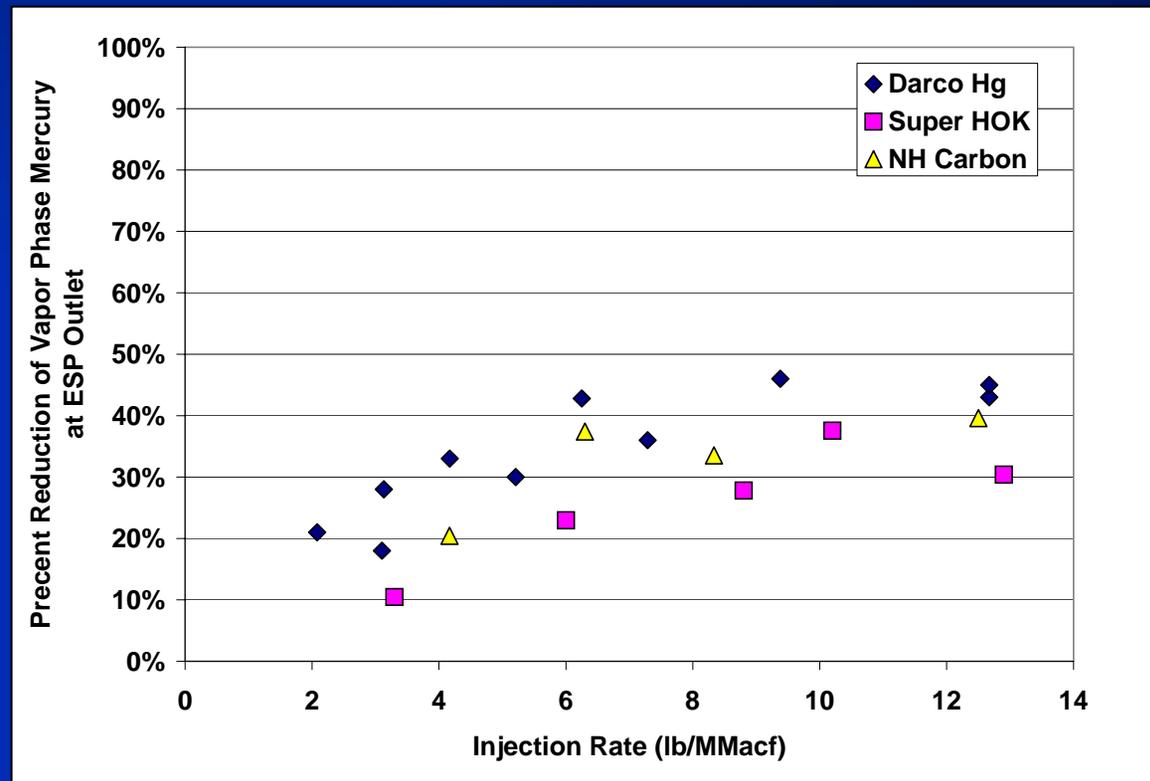
|                              |                     |
|------------------------------|---------------------|
| <b>Boiler</b>                |                     |
| Type                         | CE Tangential Fired |
| Nameplate (MW)               | 100                 |
| <b>Coal</b>                  |                     |
| Type                         | Eastern Bituminous  |
| Sulfur (wt%, dry)            | 0.8 – 1.5           |
| Mercury (ppm, dry)           | 0.05 – 0.15         |
| Chloride (ppm, dry)          | 100 – 600           |
| <b>ESP</b>                   |                     |
| Type                         | Cold-side           |
| SCA (ft <sup>2</sup> /kacfm) | 173                 |

## Plant Yates Unit 1 Configuration



## Long-term Injection Test

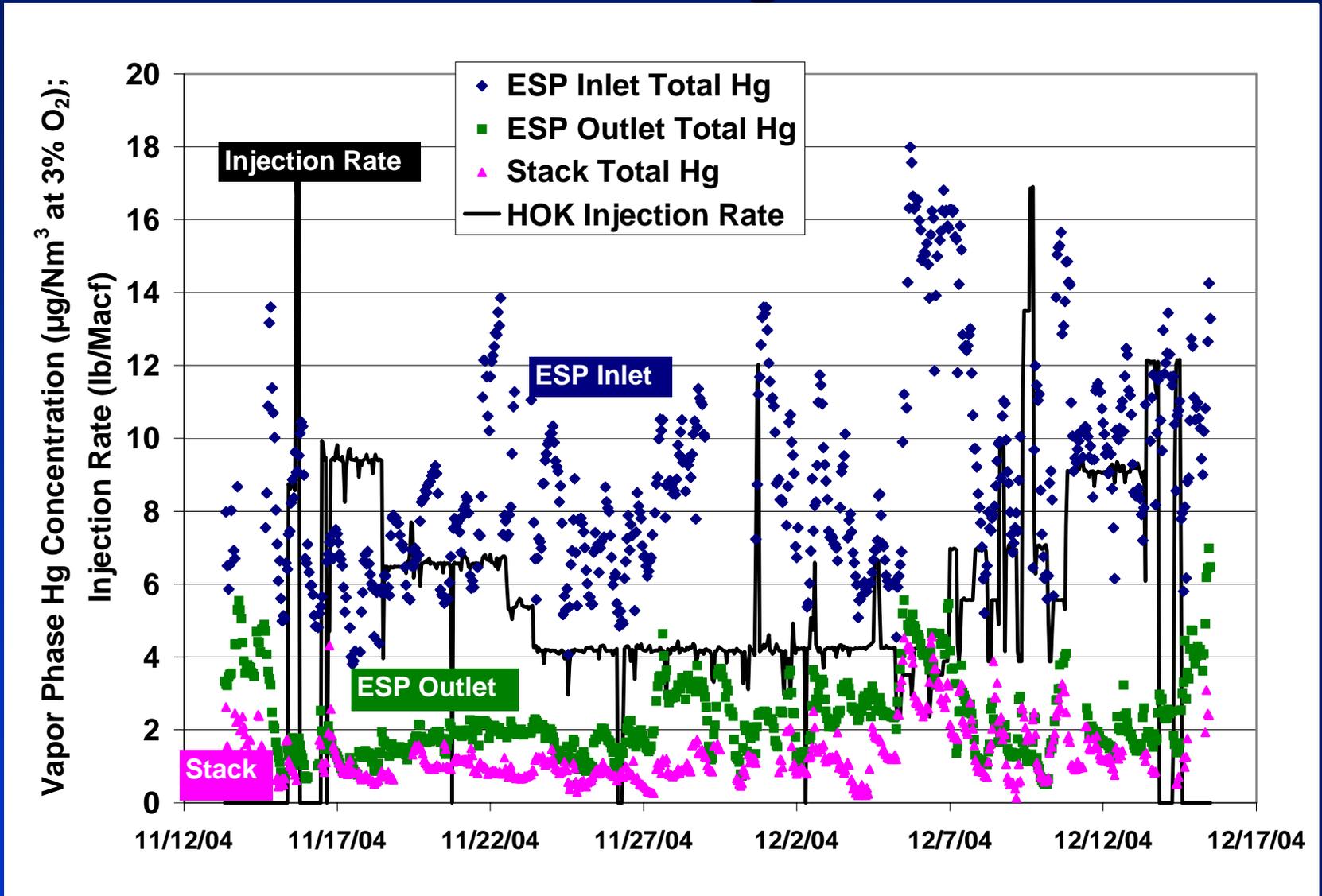
- RWE Rheinbraun's Super HOK chosen for 30-day injection test
  - Low cost
  - Performance only slightly less than other carbons



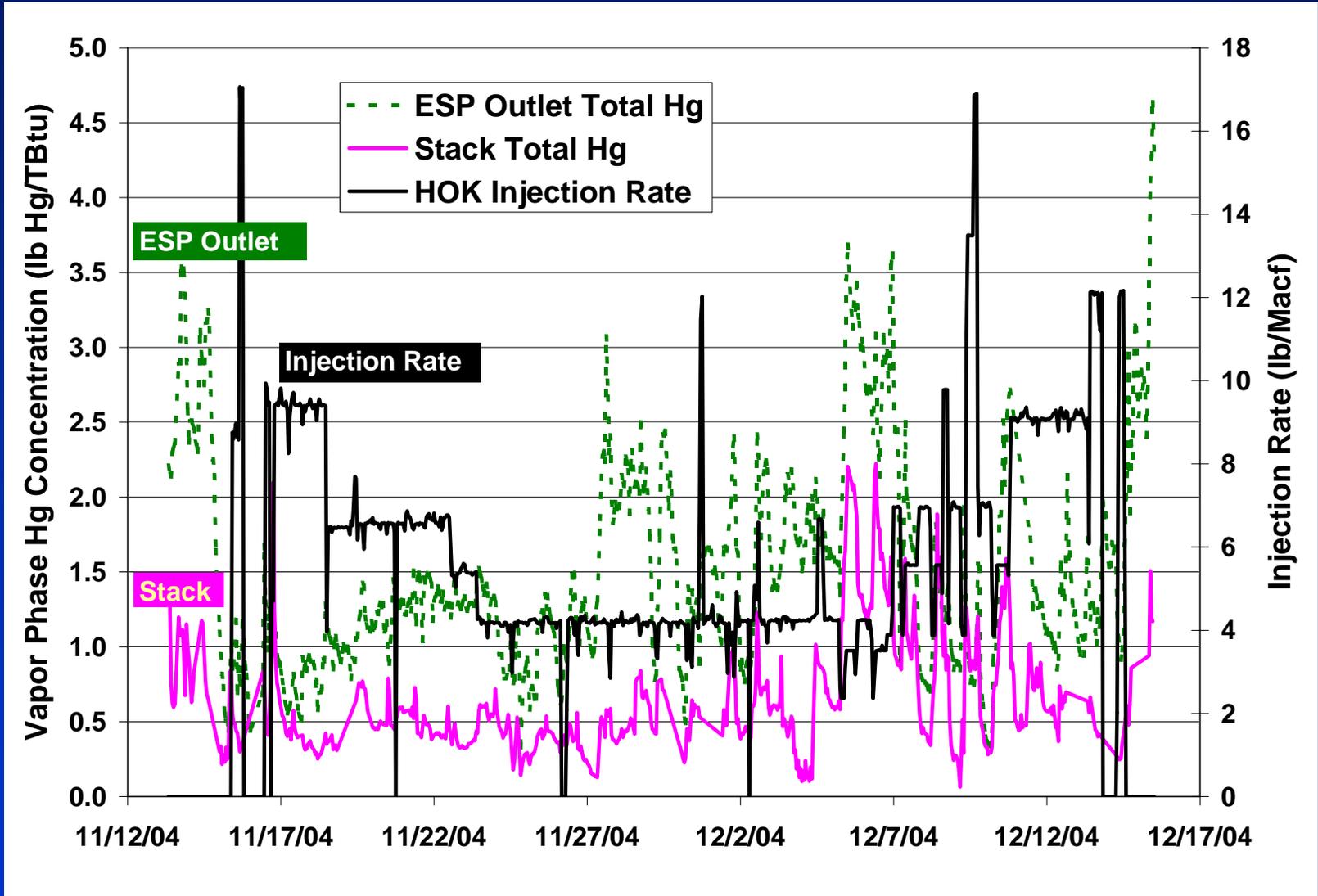
## Long-Term ACI Test Objectives

- Operate at a steady carbon injection rate in lb/Macf
- Test a range of carbon injection rates throughout the test period
- Test high versus low load operation
- Analyze ESP operational data
  - Arc rate
  - ESP outlet emissions
- Analyze JBR operational data

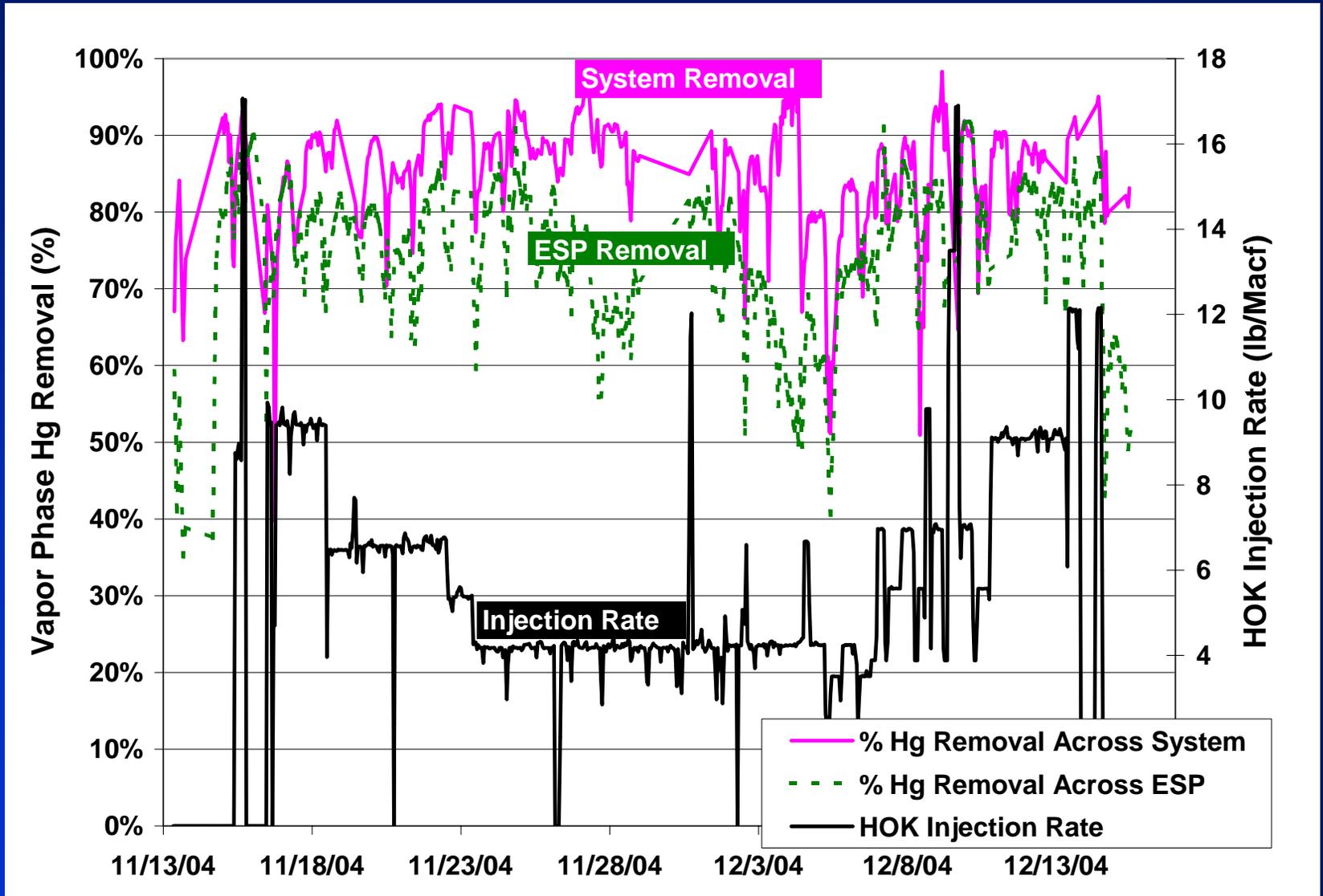
# Measured Flue Gas Hg Concentrations



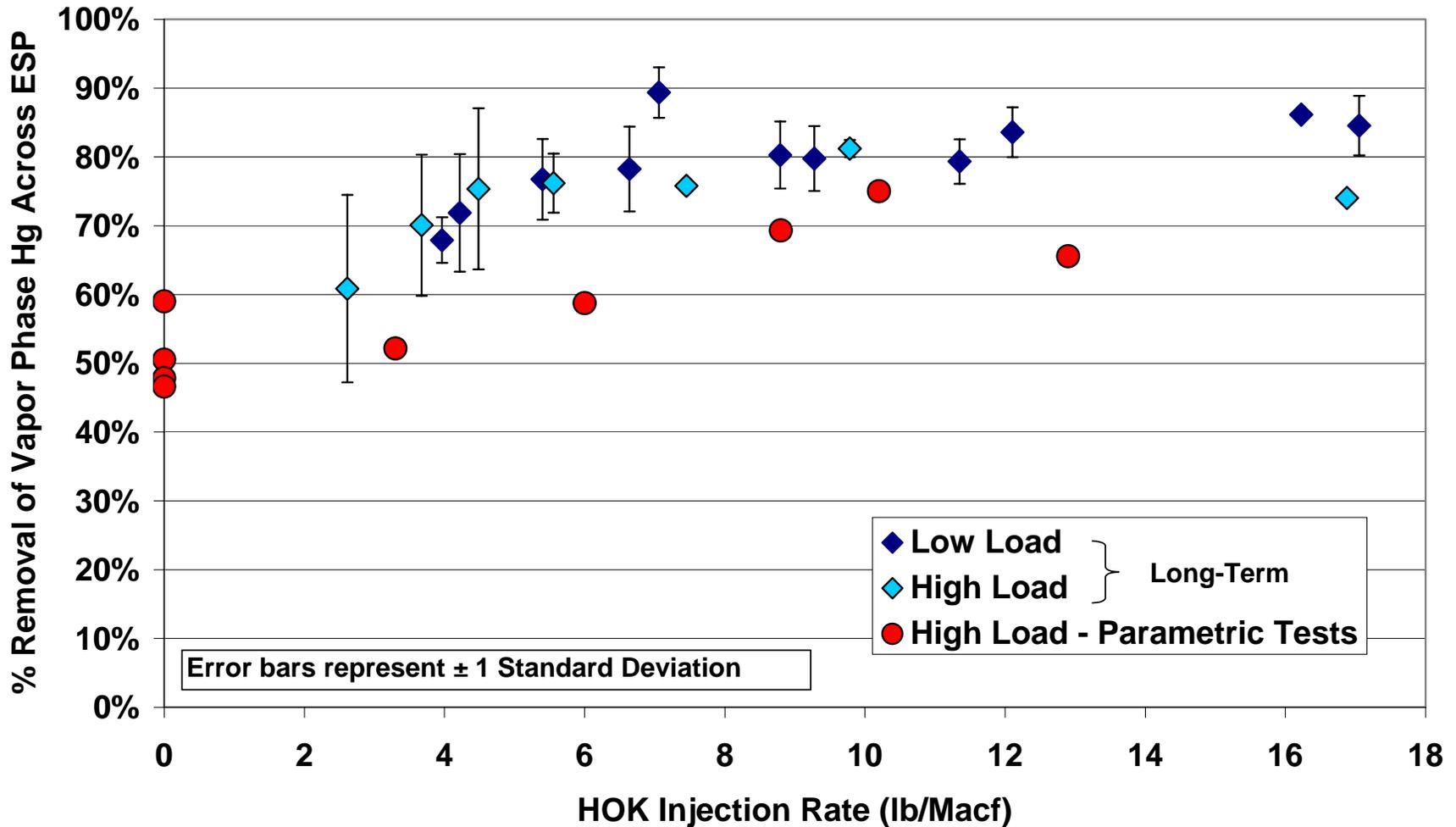
## Emissions in lb Hg/Trillion Btu



# Mercury Removal during Long-term Test



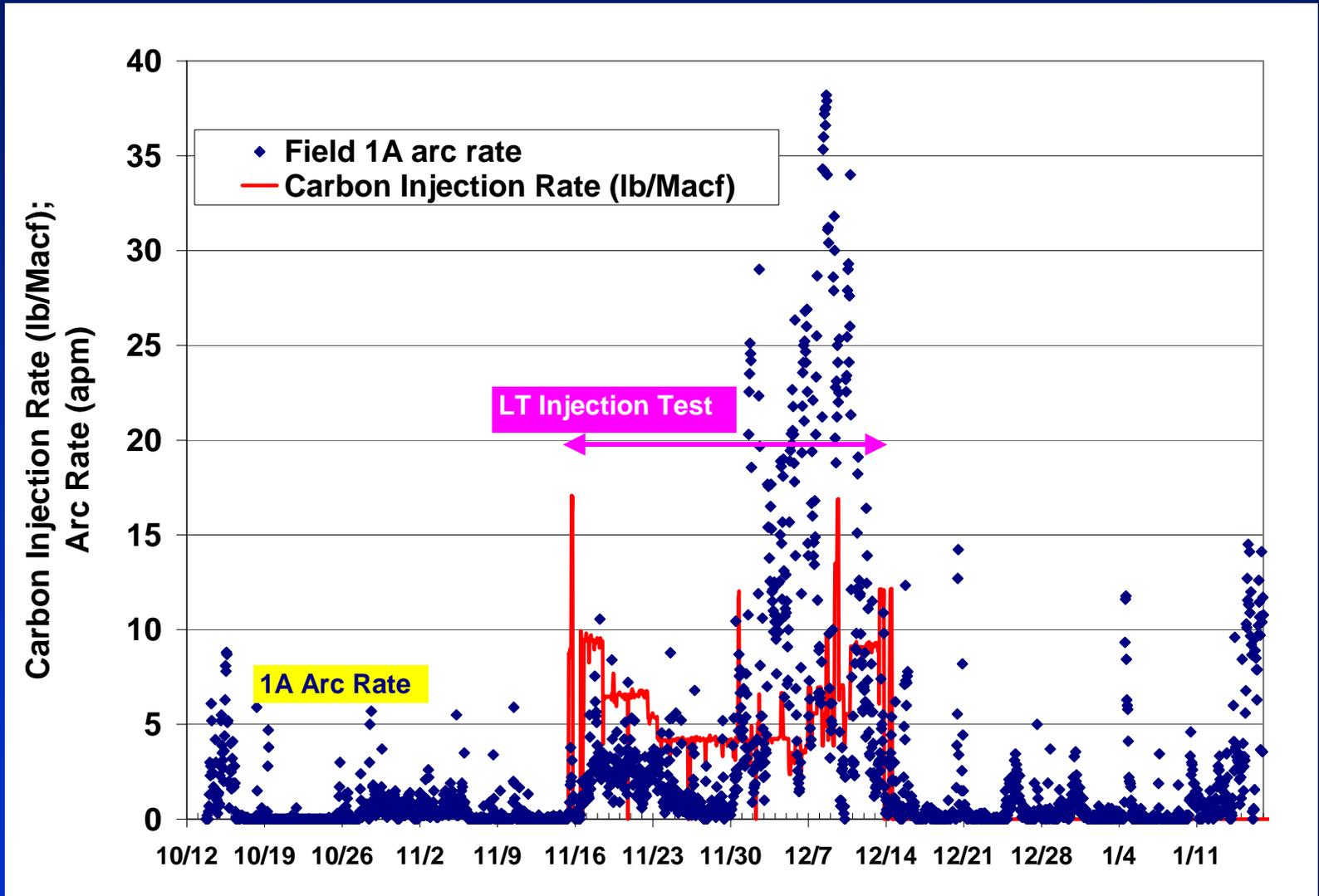
## Effect of Load on Hg Removal



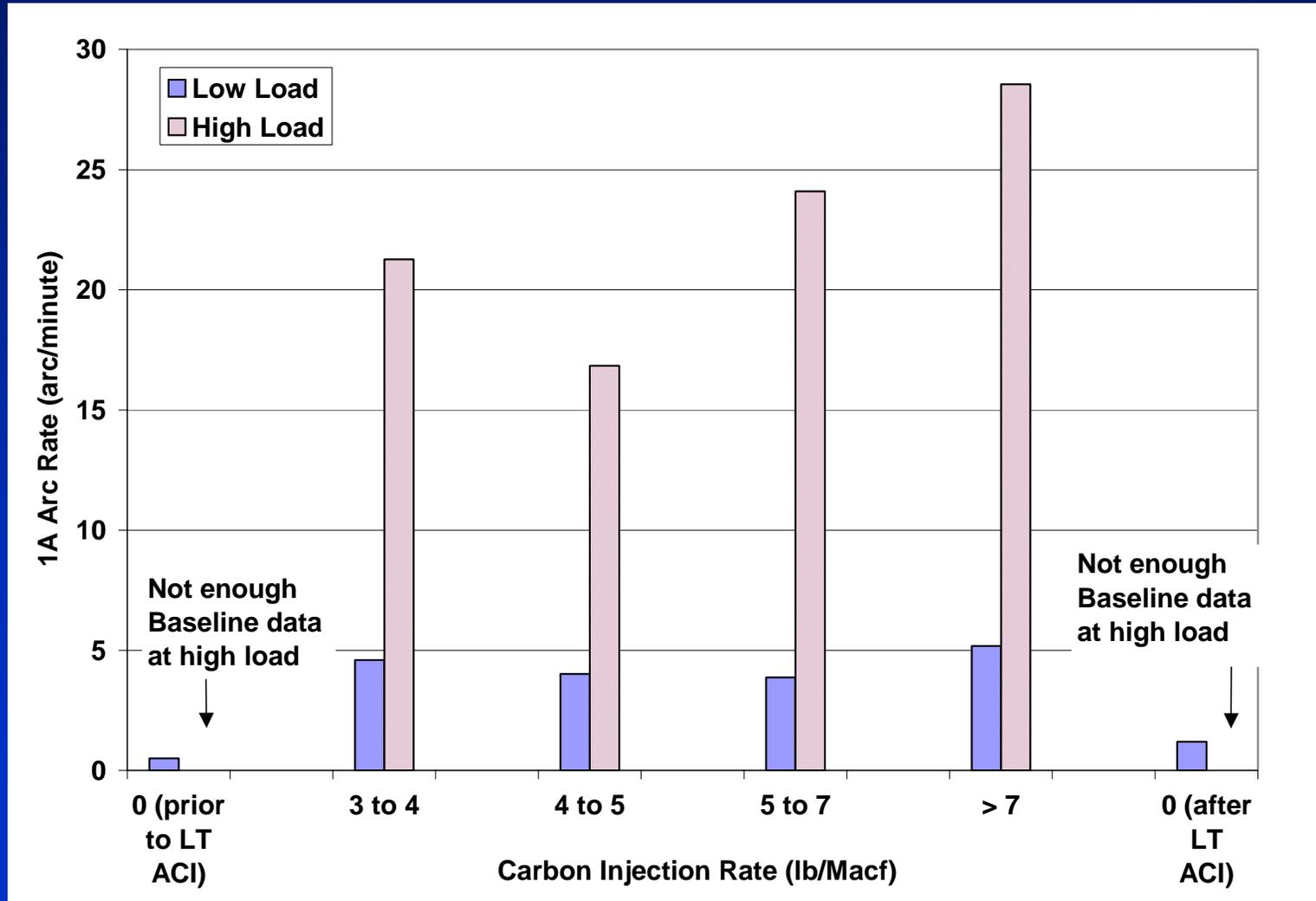
## ESP Operational Data Analysis

- Evaluate carbon breakthrough from ESP
- Evaluate Sparking
  - A discharge from the high voltage system to the grounded system; self-extinguishing
- Evaluate Arcing
  - A discharge of substantial magnitude; not self extinguishing
  - May cause damage to the ESP insulators

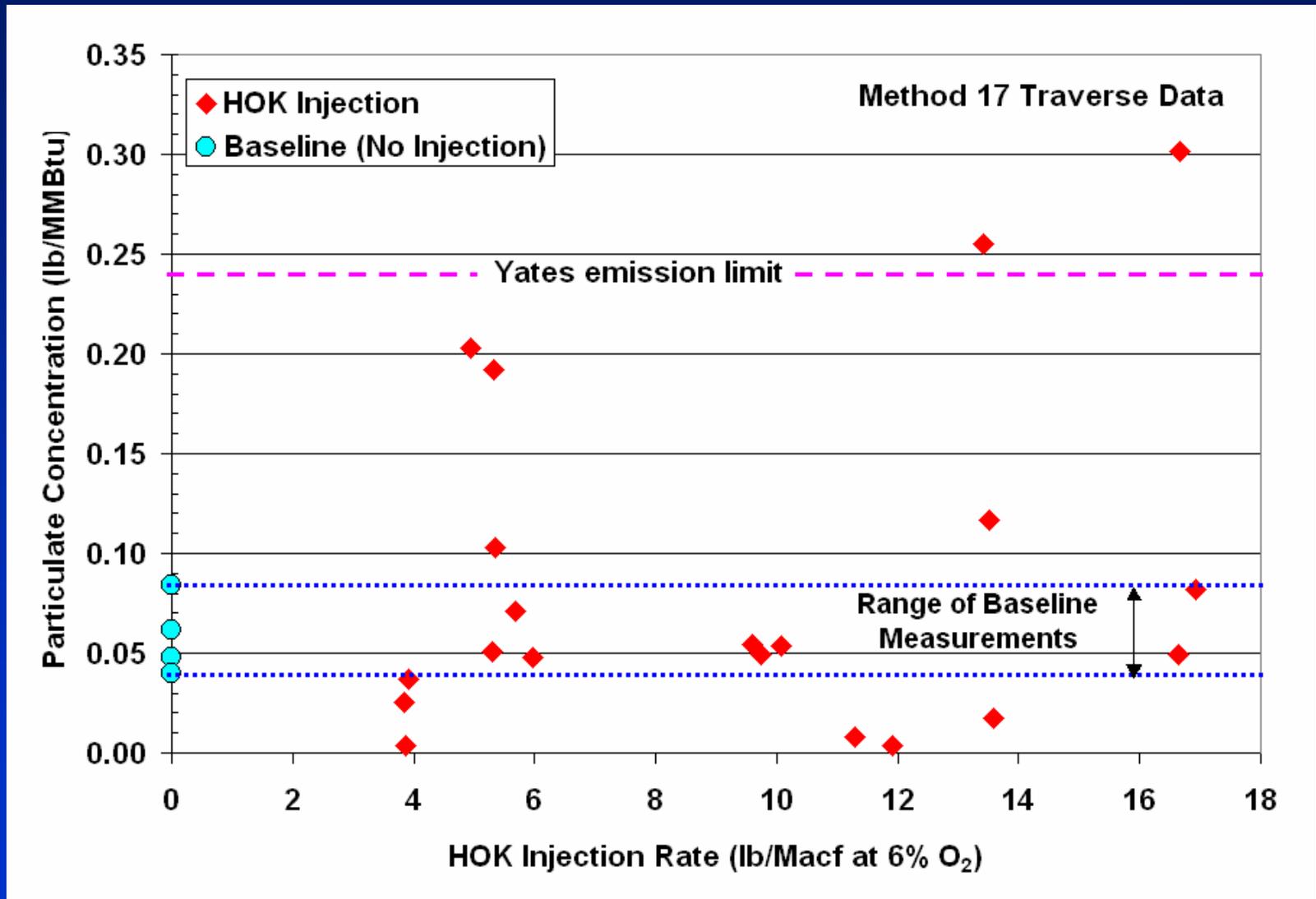
## ESP Arcing During Long-term Injection



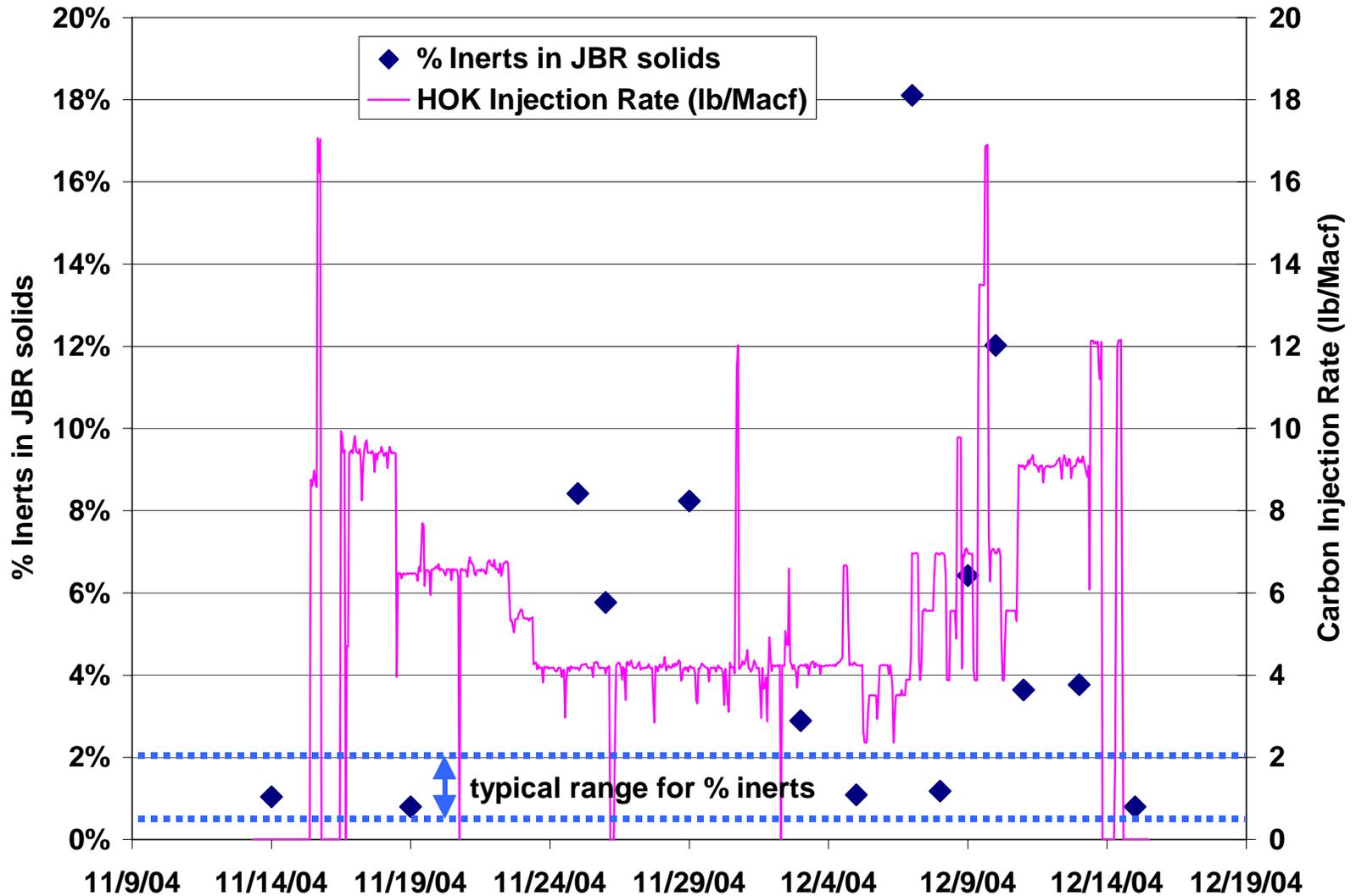
## Average ESP Arc Rates during Long-Term ACI



## ESP Outlet Particulate Concentrations



## FGD Inerts Analysis



## Summary of Results

- Large variations in ESP inlet Hg concentration
- Vapor Hg removals typically 65 to 85% across ESP at 4 lb/Macf
  - With ACI only, ESP outlet emissions were 0.5-3.5 lb/TBtu
  - With ACI, JBR outlet emissions were less than 2 lb/TBtu
- ESP Effects
  - Increase in ESP arcing with ACI
  - Particulate breakthrough measured at ESP outlet
  - Carbon particles found in M17 filters and JBR scrubber

## Future Plans

- Further Characterize Baseline Particulate Emissions
- Issue U1 and U2 Site Reports
- Issue Final Report

