Sorbent Injection for Small ESP Mercury Control

DE-FC26-03NT41987

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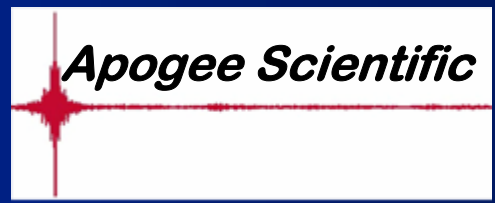

Tim Ebner

Project Objectives

Evaluate sorbent injection for Hg control in bituminous flue gas across small-sized electrostatic precipitators (ESPs)

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

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Project Background

- Financial Assistance Program DE-FC26-03NT41987
- 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^2/1000 acfm
  - Sorbent injection performance in this size range not currently known
  - Effects on ESP performance

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Project Background

- Full-scale activated carbon injection tests at Southern Company's Georgia Power Plant Yates
  - Units 1 and 2
    - 100 MW; low-sulfur eastern bituminous coal
  - ESPs with SCA <200 ft^2/1000 acfm
- Full-scale sorbent injection tests at Reliant Energy's Shawville Station Unit 3
  - 175 MW; medium-sulfur eastern bituminous coal
  - Two ESPs configured in series
    - SCA = 82, 230 ft^2/1000 acfm, respectively

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Project Status

All field testing completed

- Plant Yates Testing
  - Units 1 and 2 Parametric Tests (Spring-04)
  - Unit 1 Long-term test (Fall-04)
  - Site Reports Completed
  - Economic Analysis Completed
- Shawville-3 Testing
  - Parametric tests (July-06)
  - Data analysis on-going

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

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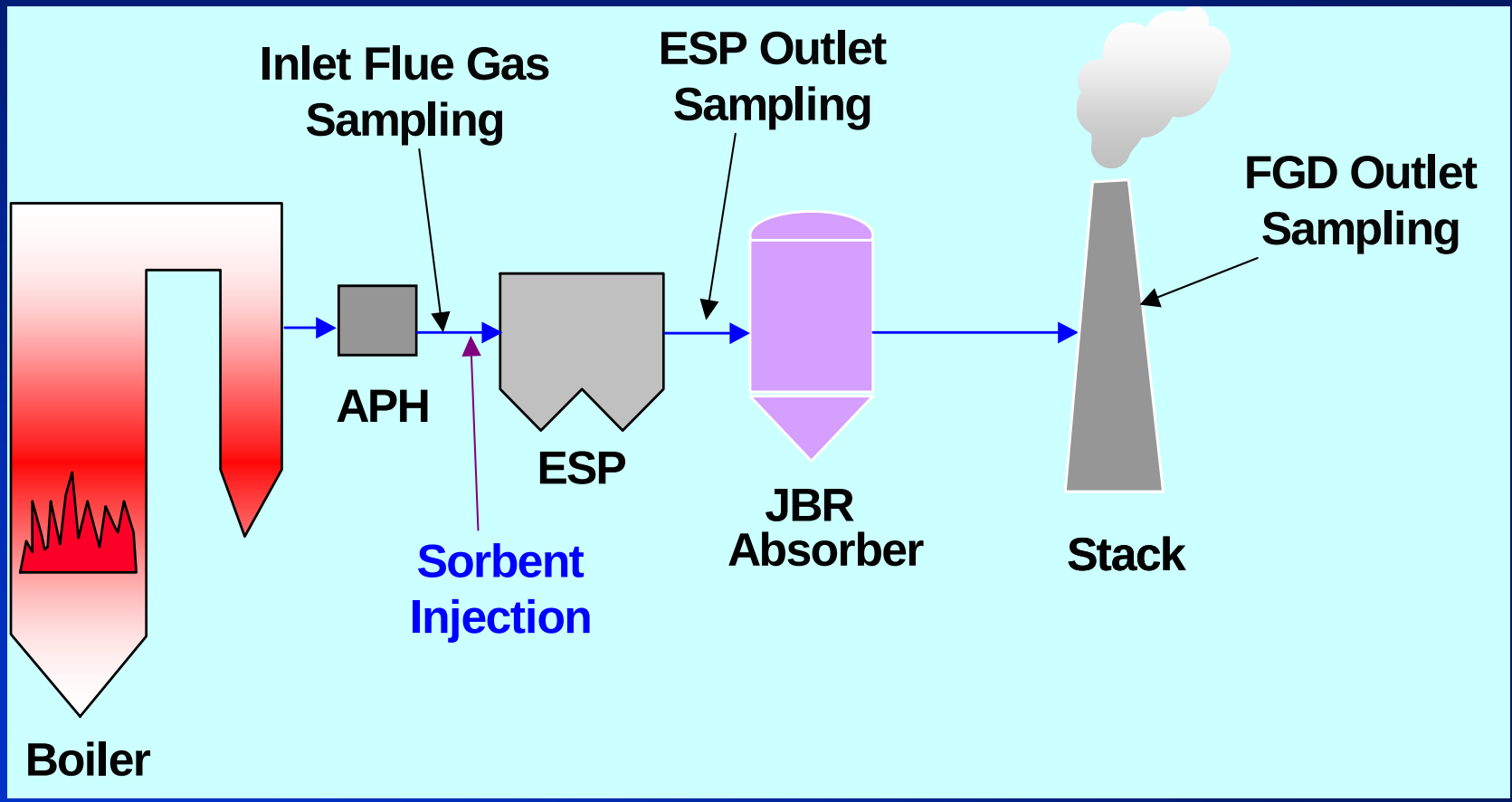
Plant Yates Unit 1 Configuration



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Summary – Plant Yates Results

Carbon Name	Manufacturer	Carbon Description	Cost ($/lb)
Darco FGD™	Norit Americas	Tx lignite-derived activated carbon; baseline carbon; 19 μm mean particle size	0.50
Super HOK	RWE Rhinebraun	German lignite-derived activated carbon; 23 μm mean particle size	0.35*
NH Carbon	Ningxia Huahui Activated Carbon Co.	Chinese chemically treated bituminous-derived activated carbon; 24 μm mean particle size	0.88

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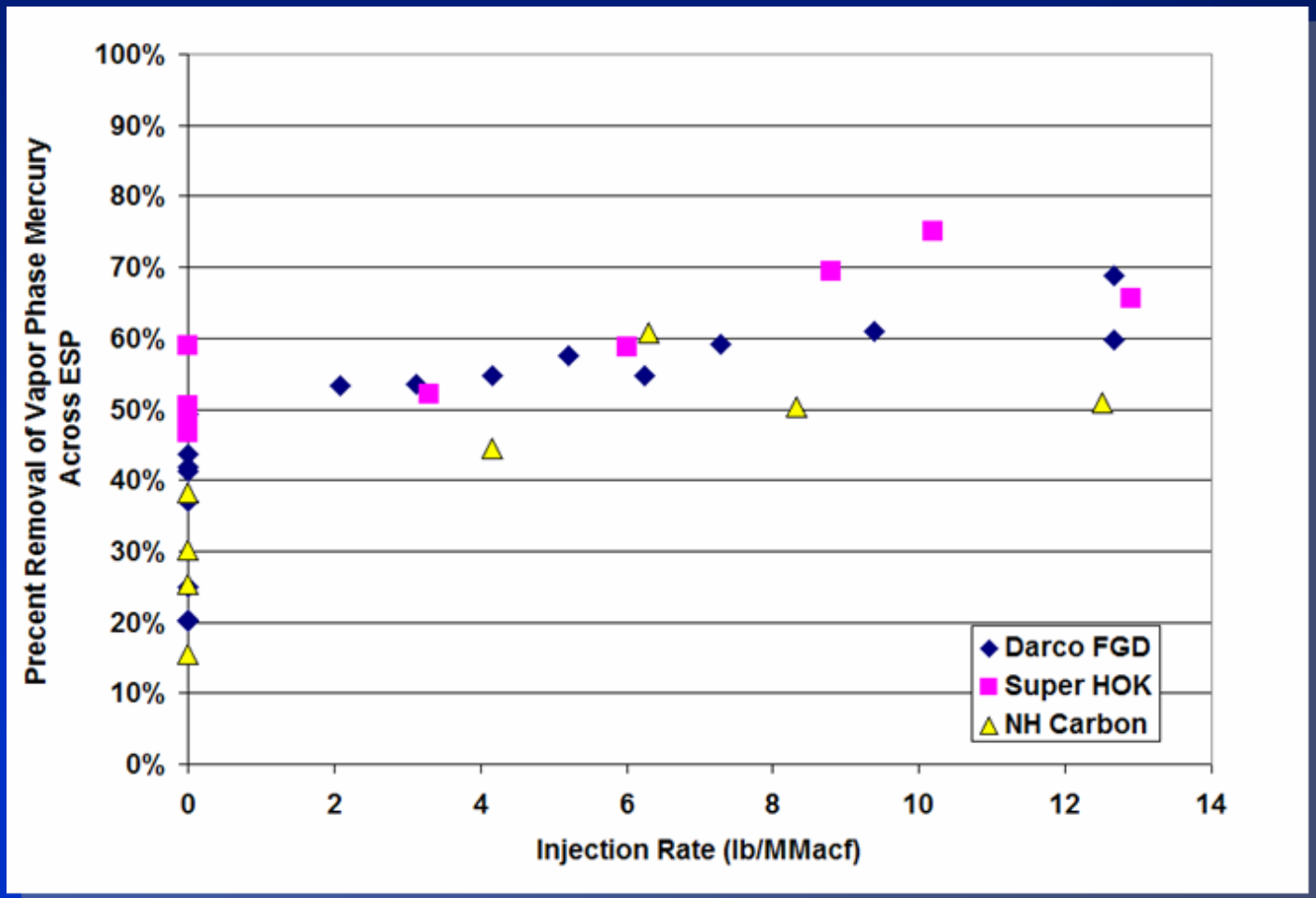
Summary – Plant Yates Results

Hg Removal Across Unit 1 ESP



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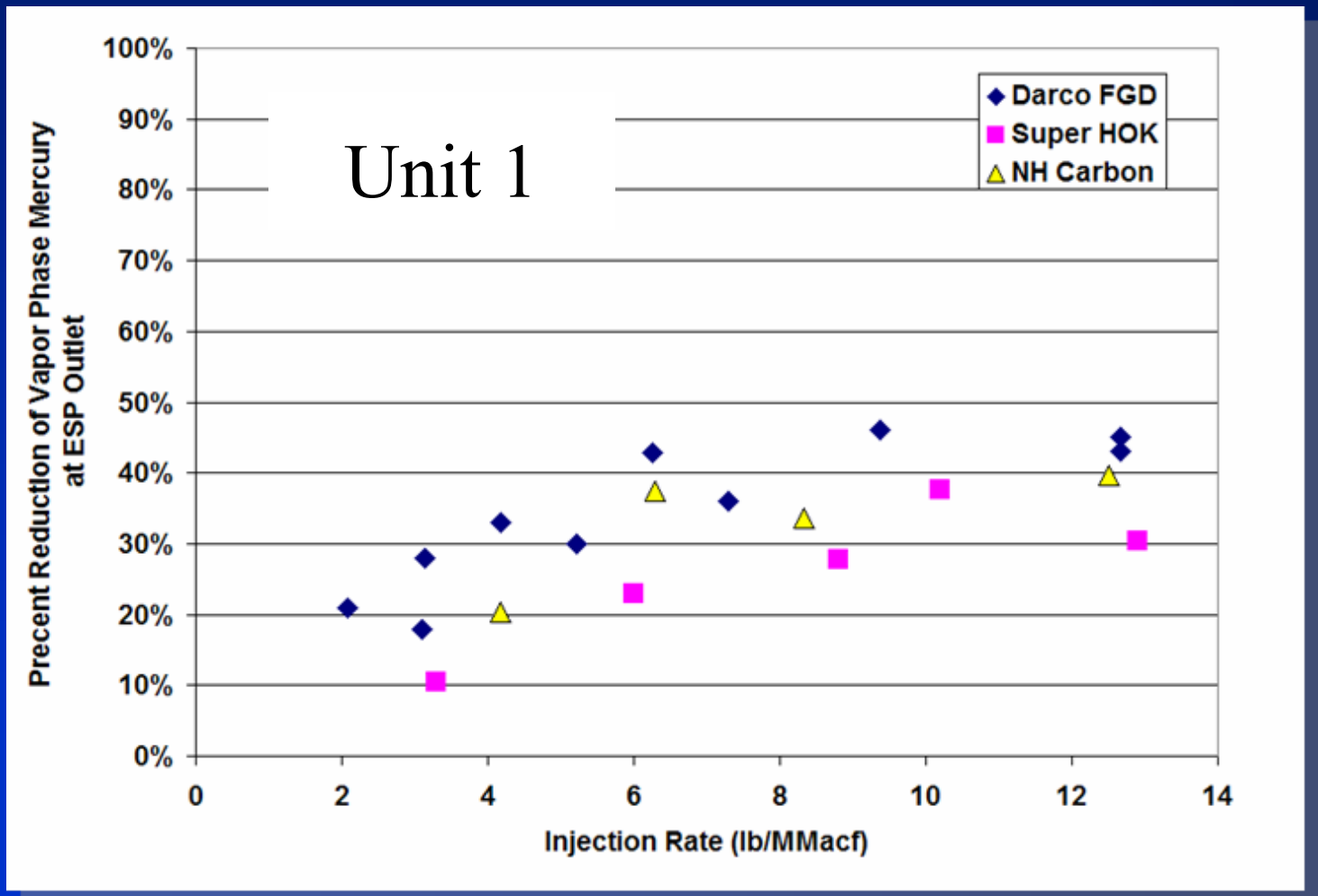
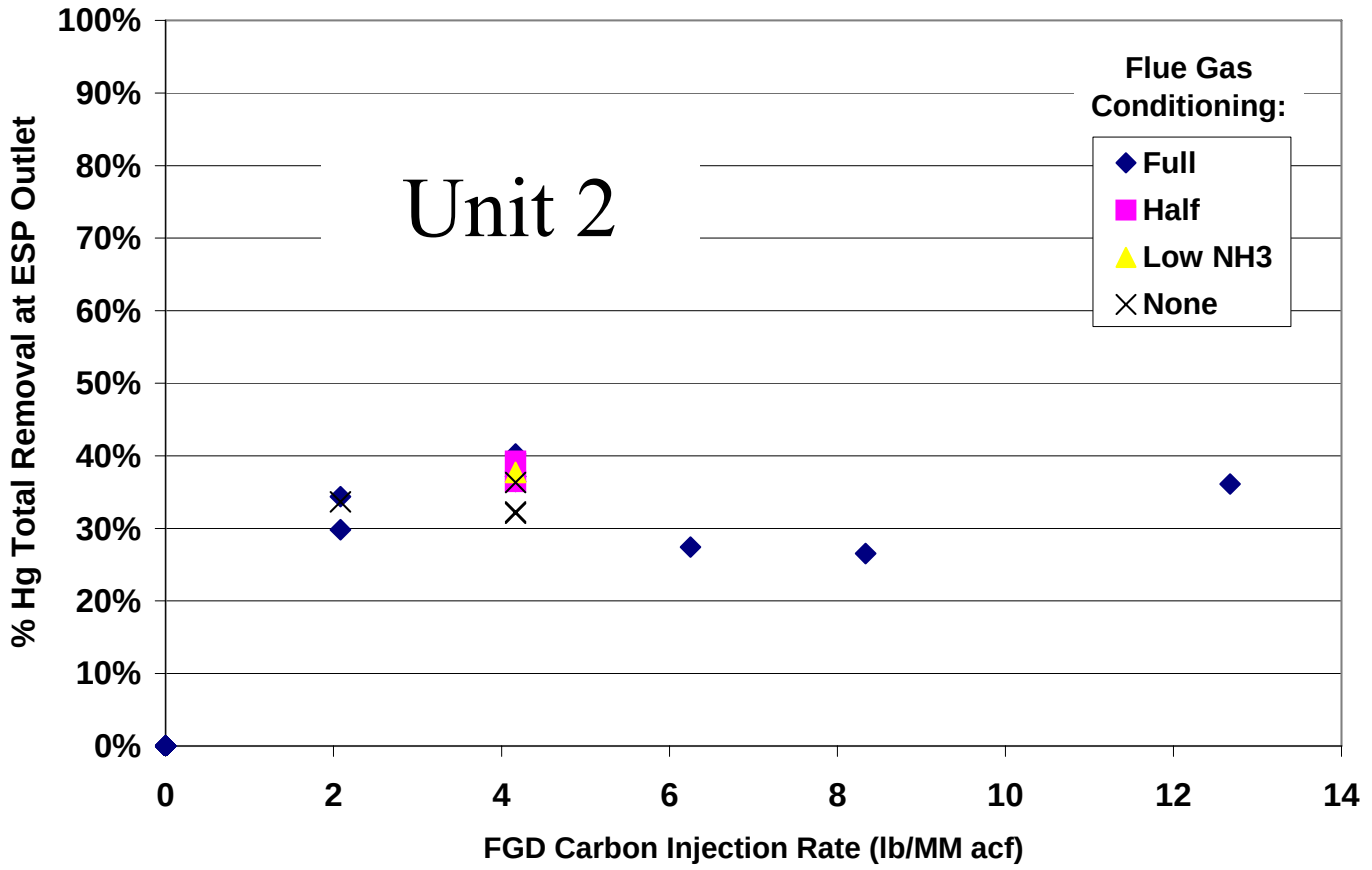
Summary – Plant Yates Results

ESP Hg Removal Due to Activated Carbon

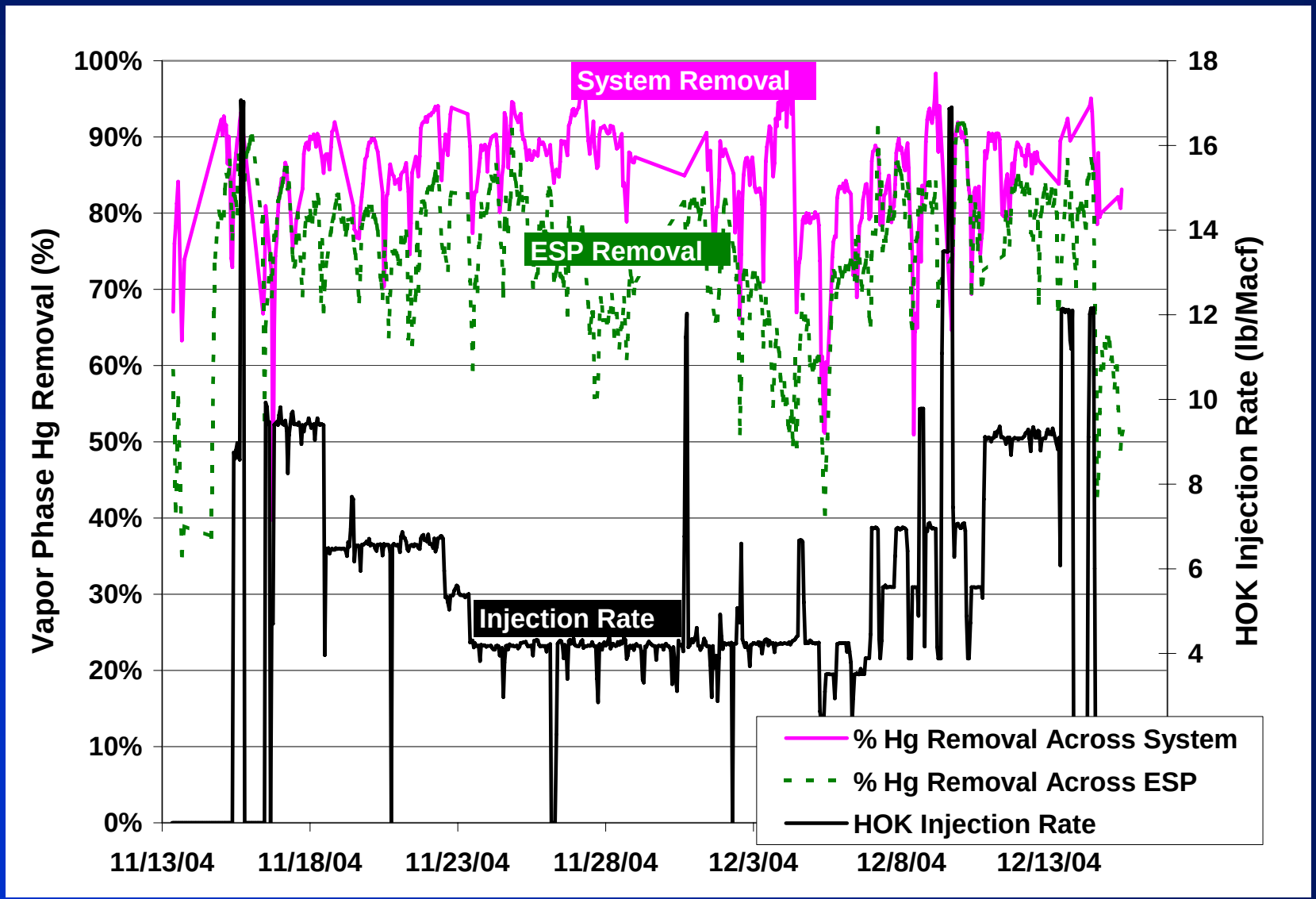


Summary – Plant Yates Results

ESP Hg Removal Due to Activated Carbon



Mercury Removal during Long-term Test



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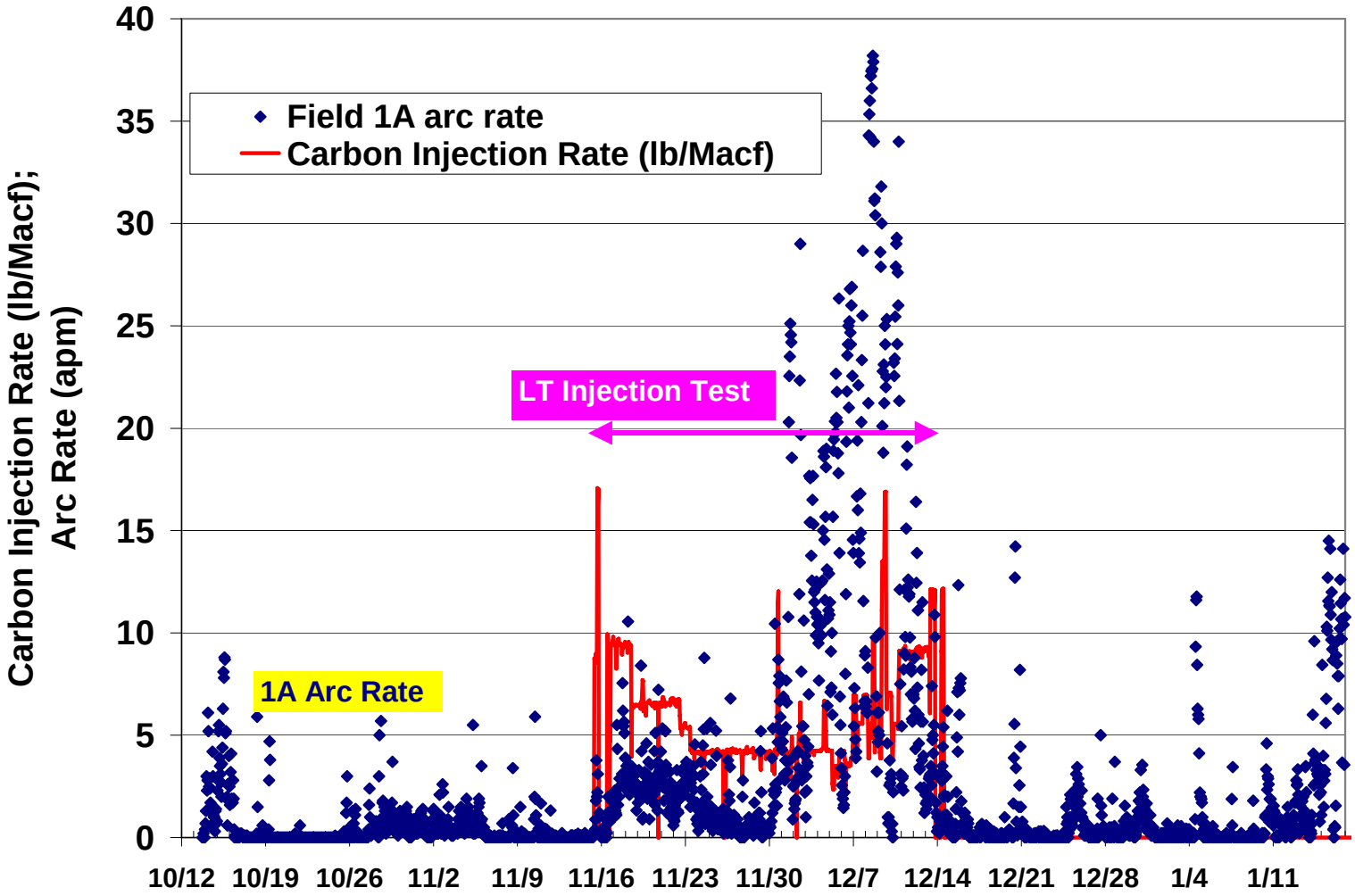
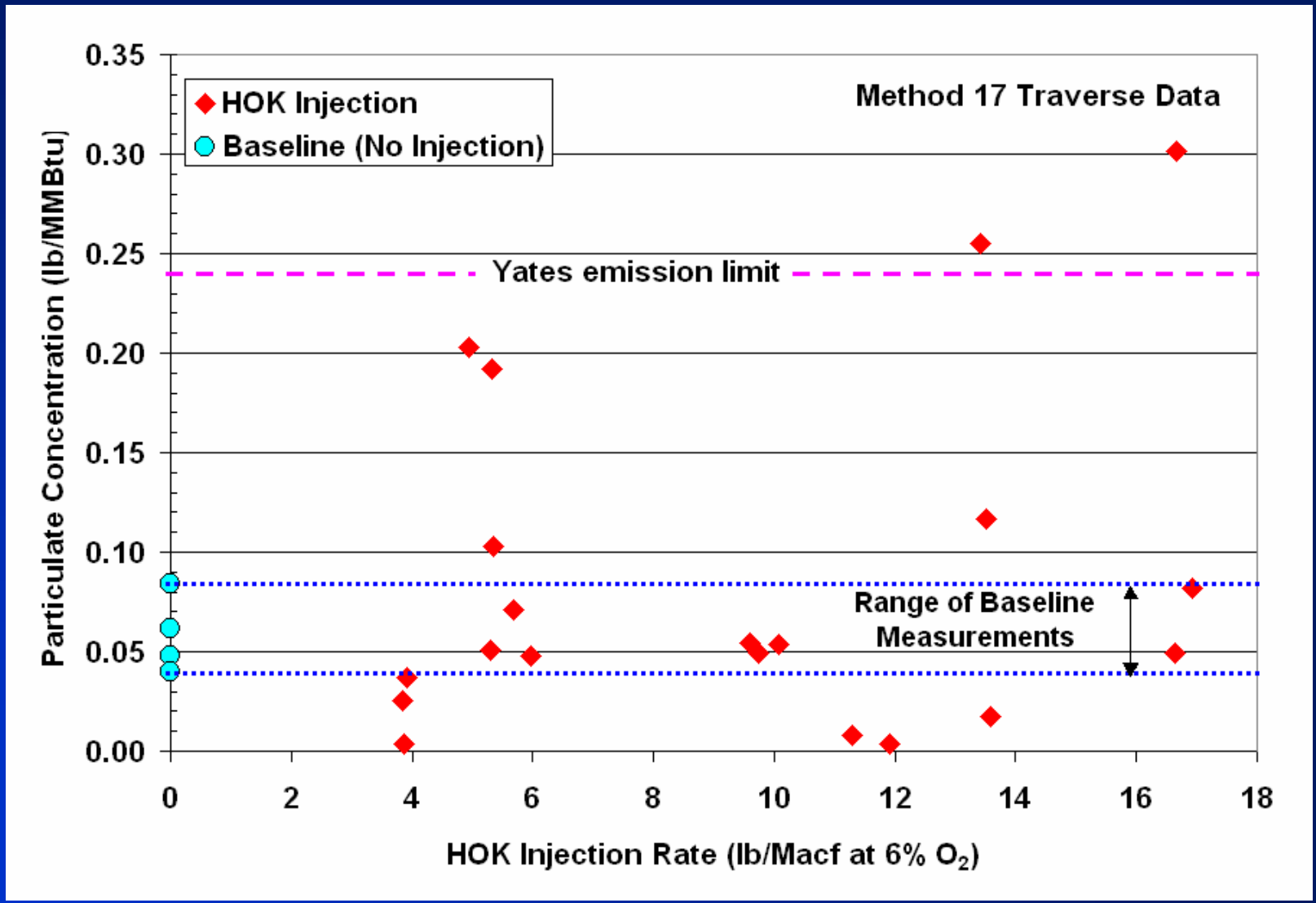
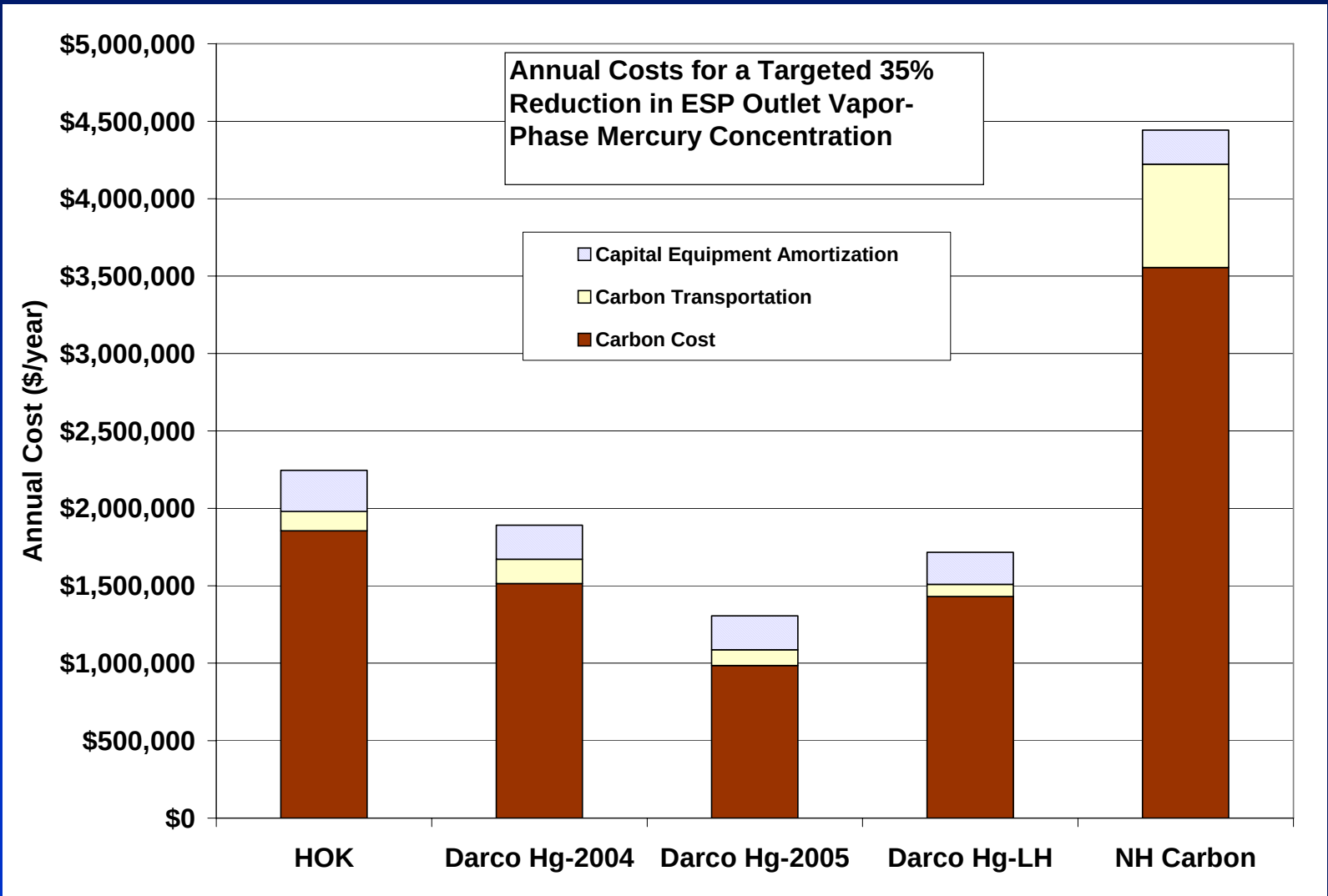
ESP Arcing During Long-term Injection



ESP Outlet Particulate Concentrations



Economic Analysis – Plant Yates Data



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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, outlet emissions were 0.5-3.5 lb/TBtu
  - Combination of 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

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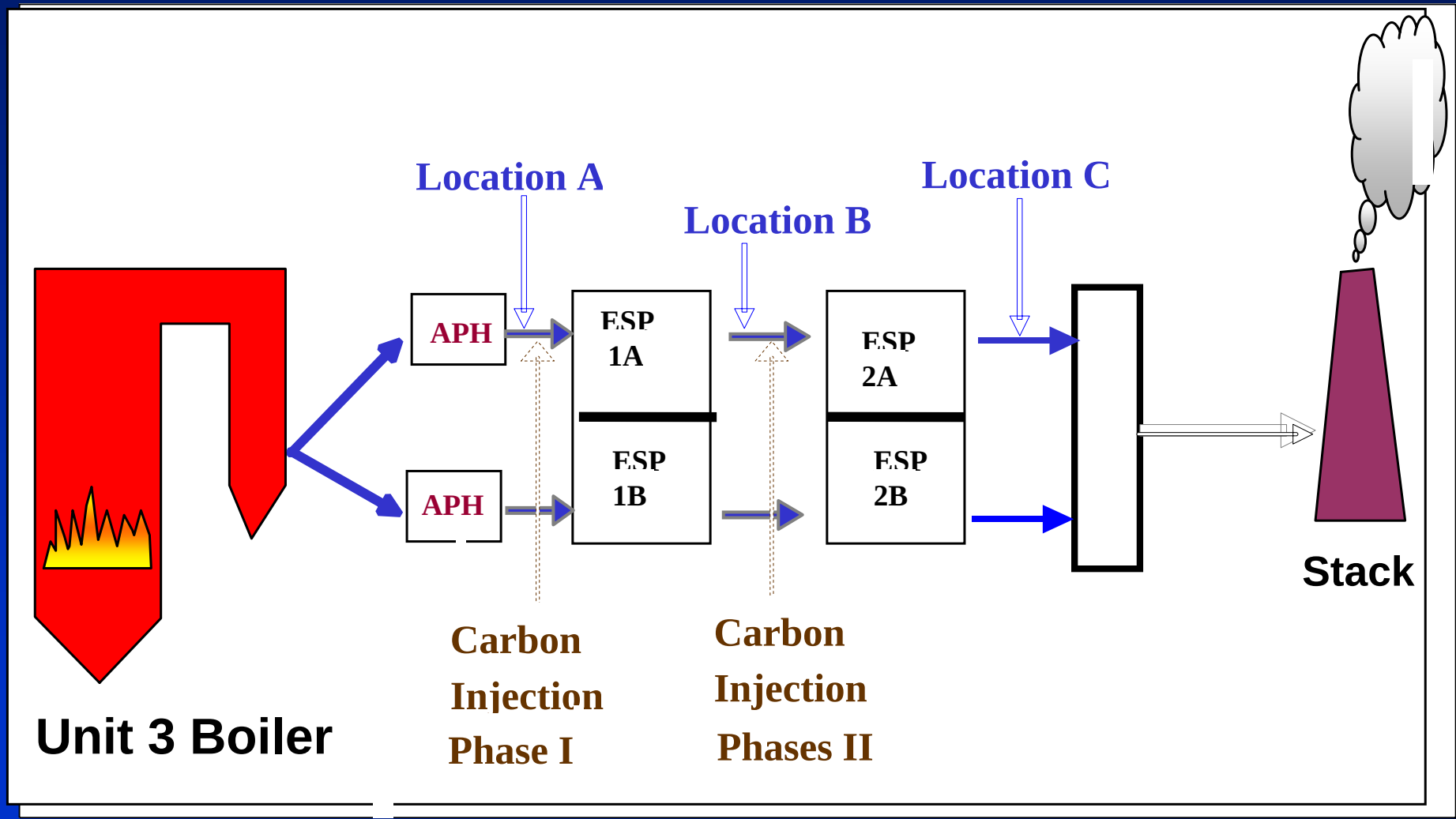
Shawville 3 Configuration



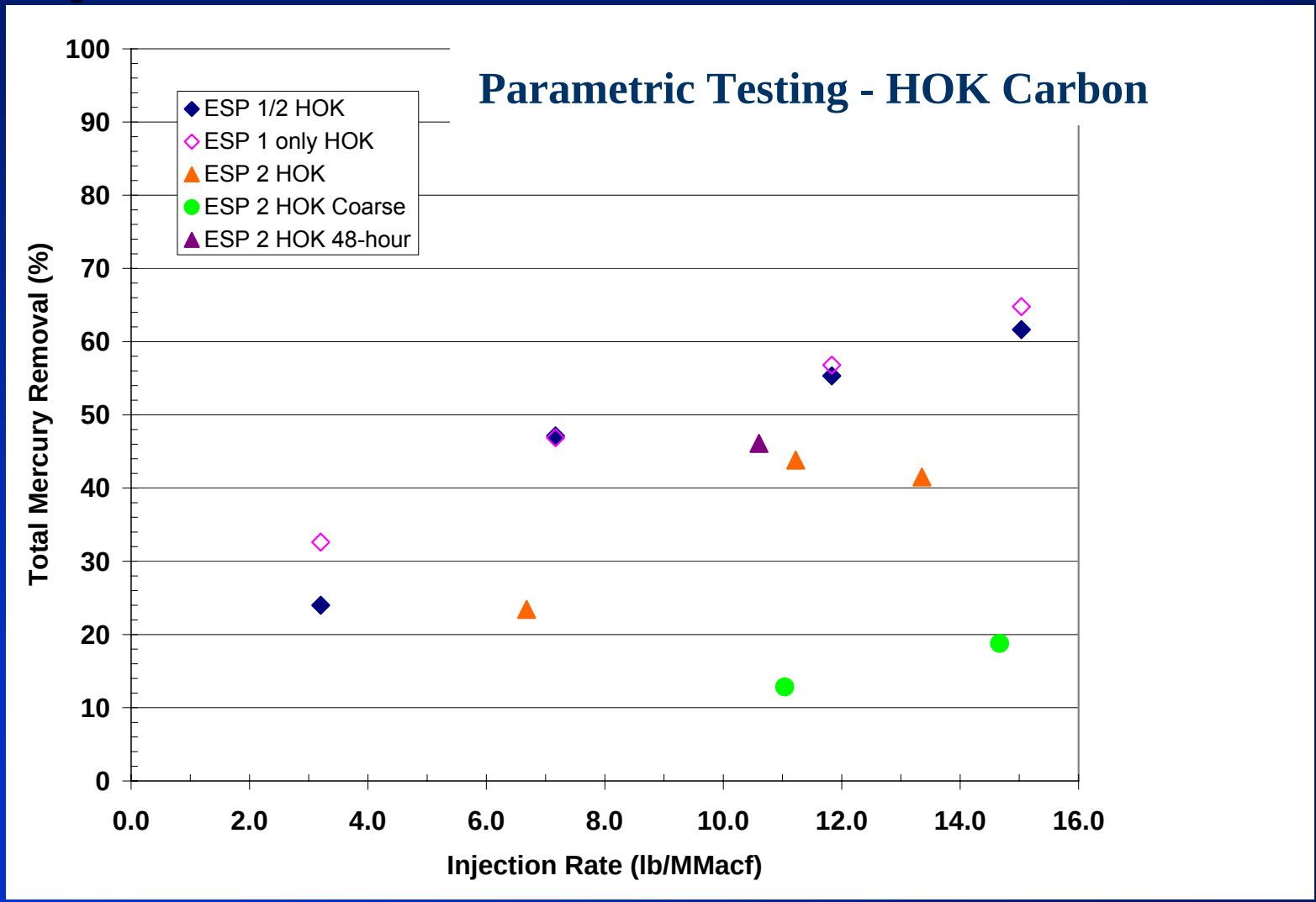
Sorbents Evaluated at Shawville

Sorbent	Supplier	Description
Super HOK	RWE (Germany)	Activated German lignite; d_{50} = 24 µm
HOK – Coarse	RWE (Germany)	Activated German lignite; d_{50} = 63 µm
Darco Hg	Norit Americas (Marshall, TX)	Activated Texas lignite
Darco Hg-LH	Norit Americas (Marshall, TX)	Activated Texas lignite treated with bromine
Darco Hg/High Calcium Hydrated Lime	Norit Americas (Marshall, TX /Chemical Lime (Dallas, TX)	30/70 mixture of Darco Hg with high surface area hydrated lime (for SO_3 control)

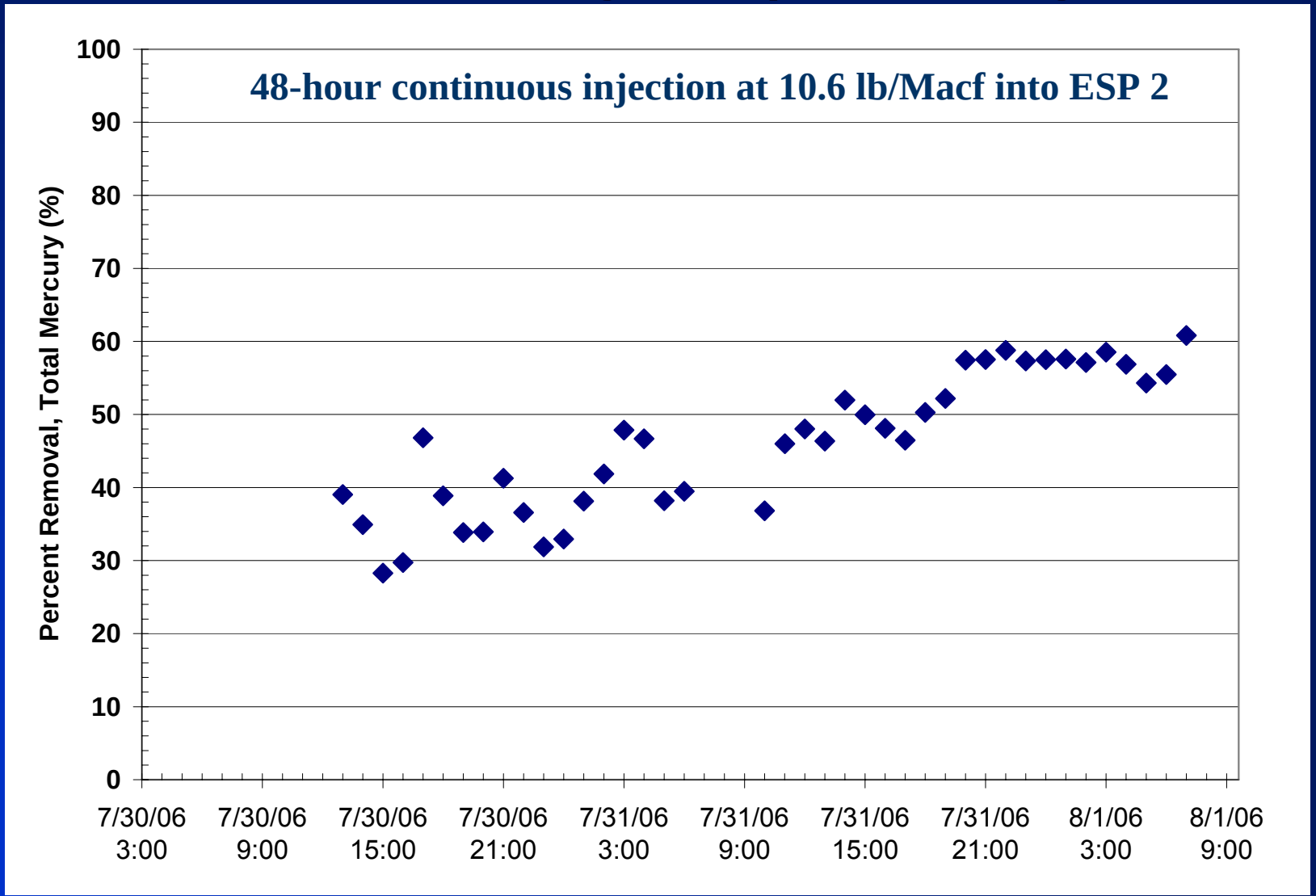
Shawville 3 Summary

- Baseline Testing
  - Hg values range: 26 – 43 µg/Nm^3 @ 3% O_2
  - Oxidation high: >80% at ESP-2 outlet
  - Hg removal to fly ash occurs upstream of ESPs
  - Little to no Hg removal across ESPs
- Sorbent Injection Testing
  - Effect of injection rate and location
  - Co-injection of high surface area lime
    - Pre-mixed; separate injection configurations
  - Impact of SNCR operation

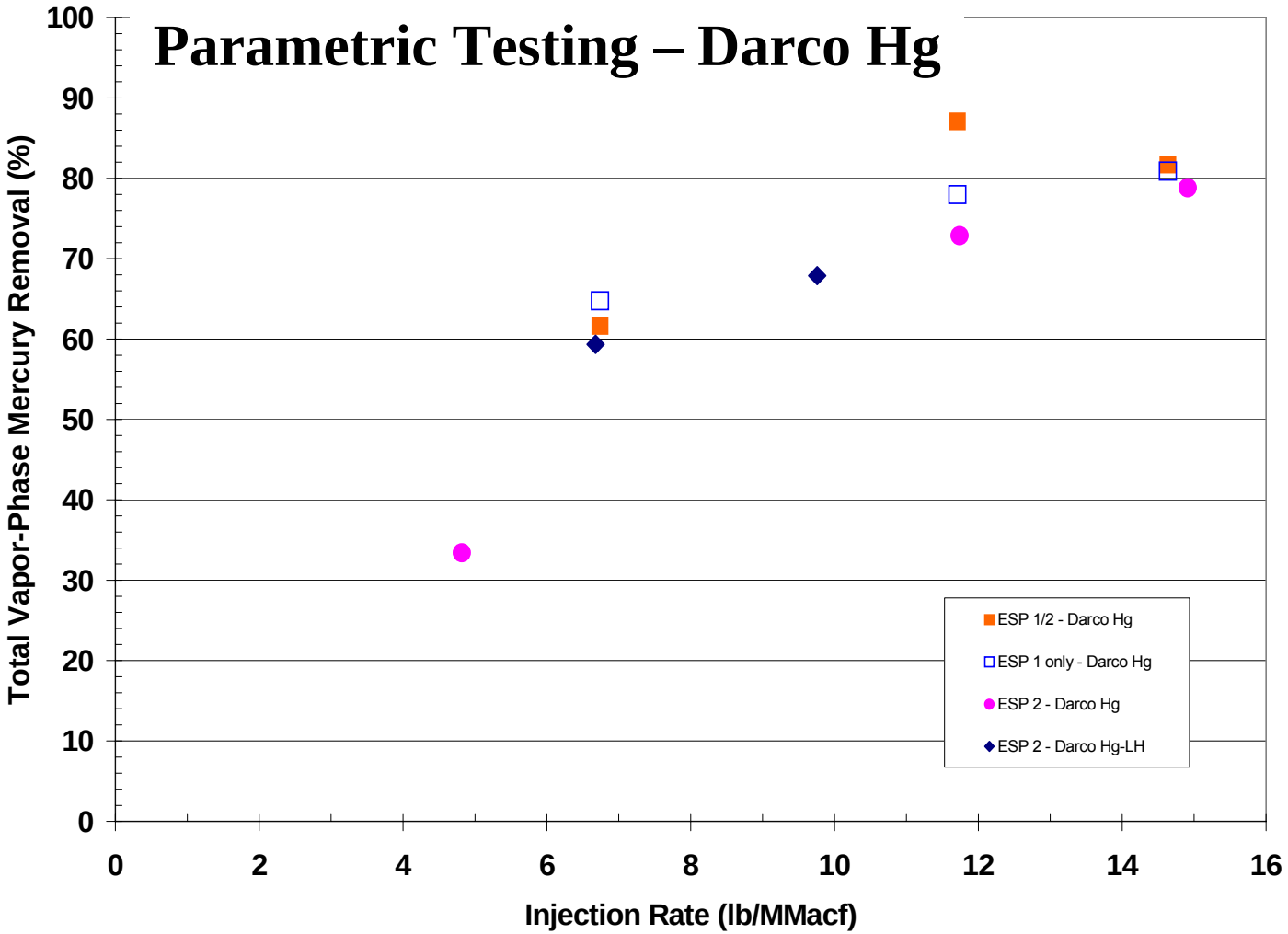
Shawville 3 Summary – Super HOK Injection



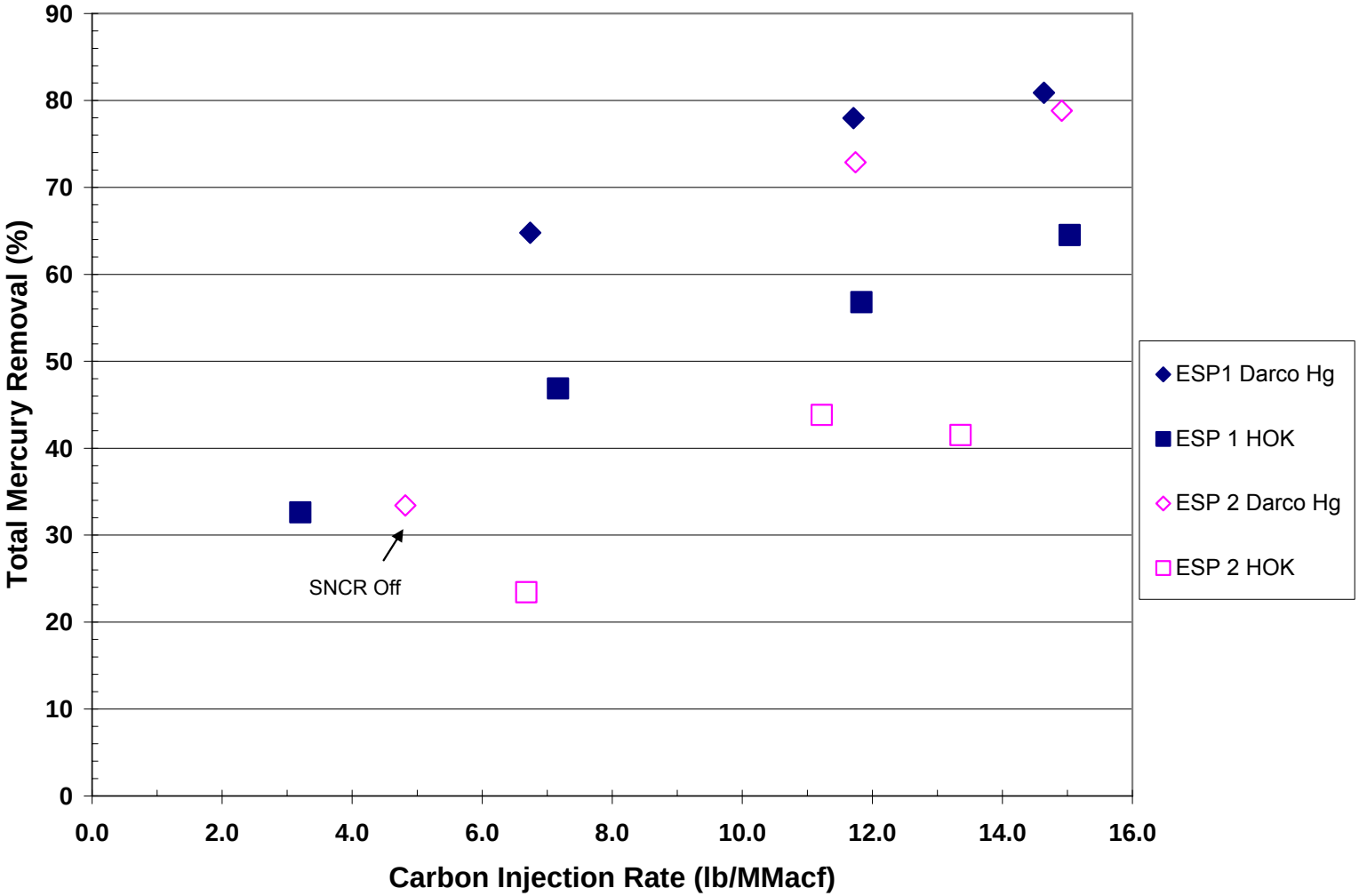
Shawville 3 Summary – Super HOK Injection



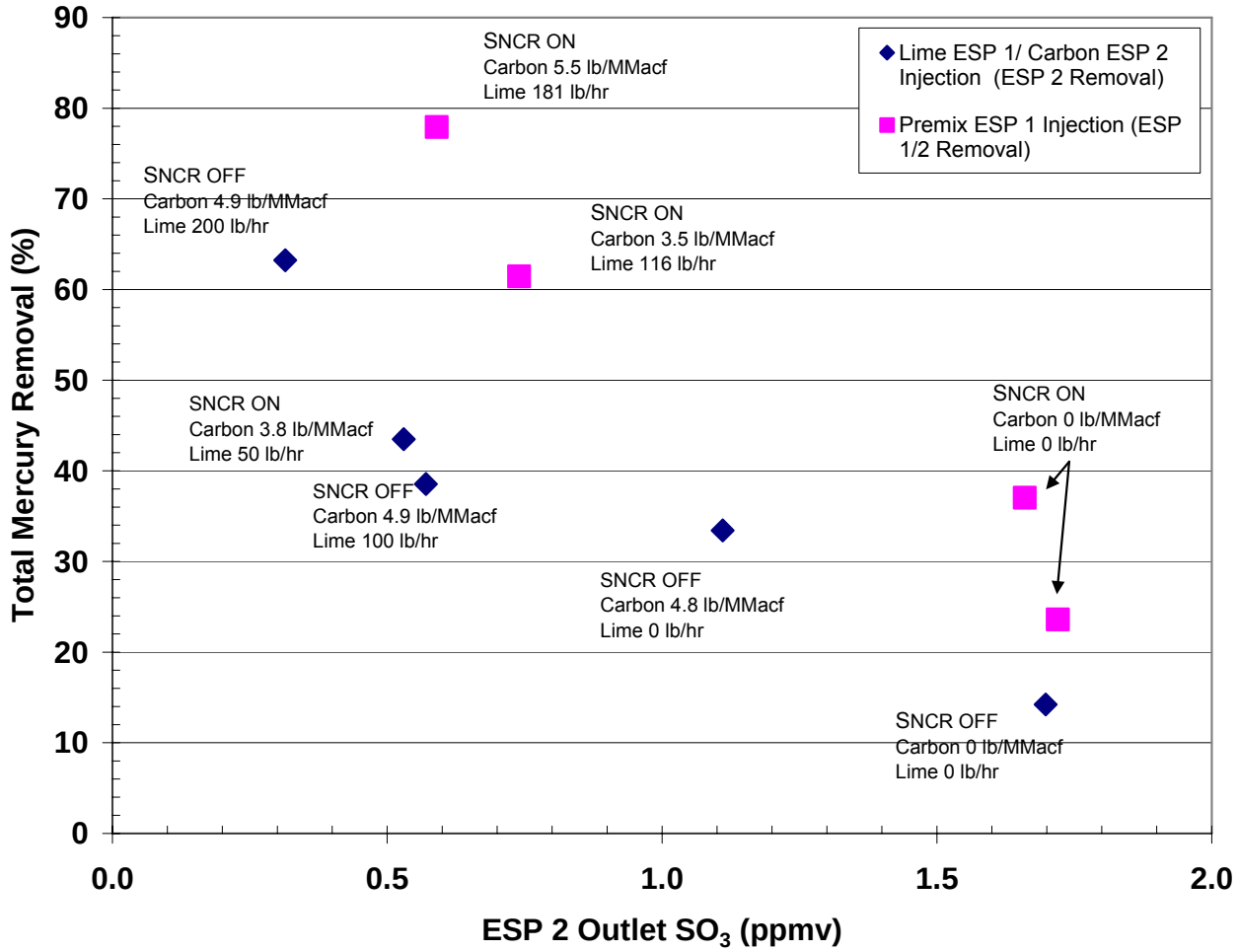
Shawville 3 Summary



Shawville 3 Summary - HOK vs Darco



Shawville 3 Summary – Comparison of SO_3 Levels and Sorbent Mercury Removal



Shawville Summary

- High levels of mercury removal achieved across small ESPs
- Better performance with Darco-Hg than Super HOK
- Apparent effect of SO_3 at very low levels (<2 ppm)
- ESP performance
  - Electrical properties (TBD)
  - PM removal (single-point M17)
    - Baseline outlet emissions
      - 0.013 to 0.020 gr/dscf
    - ACI outlet emissions
      - 0.009 to 0.030 gr/dscf

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Future Project Plans

- Completion of Shawville data/results characterization (Q1FY07)
- Complete Shawville Site Report (Q1FY07)
- Project Close-out