Low Cost Options for Moderate Levels of Mercury Control
2007 Update on TOXECON II™

DOE/NETL Mercury Control Technology Conference

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Tom Campbell, ADA-ES, Inc.

DOE/NETL Project Manager: Andrew O'Palko
DOE Cooperative Agreement DE-FC26-05NT42307

Test Participants

- DOE/ NETL – Andrew O'Palko
- EPRI – Ramsay Chang
- Entergy – Independence Station
- ADA-ES
- DOE Phase II Participants
- Modeling
  - REI
  - NELS
  - ADA-ES

TOXECON II™ Evaluation Co-funders

Alliant
Atco Power
DTE
Entergy*
Oglethorpe Power
Southern Company
Xcel Energy

ADA-ES
Arch Coal
EPCOR
EPRI
NORIT Americas
Calgon Carbon

**** Host Sites***

TOXECON II™ Full-Scale Evaluation

- Entergy's Independence Steam Electric Station
  - 880 MW
  - PRB Coal from North Antelope
  - Test on 1/8 of Unit 2
- Cold Side ESP
  - 540 SCA
- Project goal
  - 50-70% Hg removal

- Ash sold for concrete
  - PAC/ash routed to separate silo during tests

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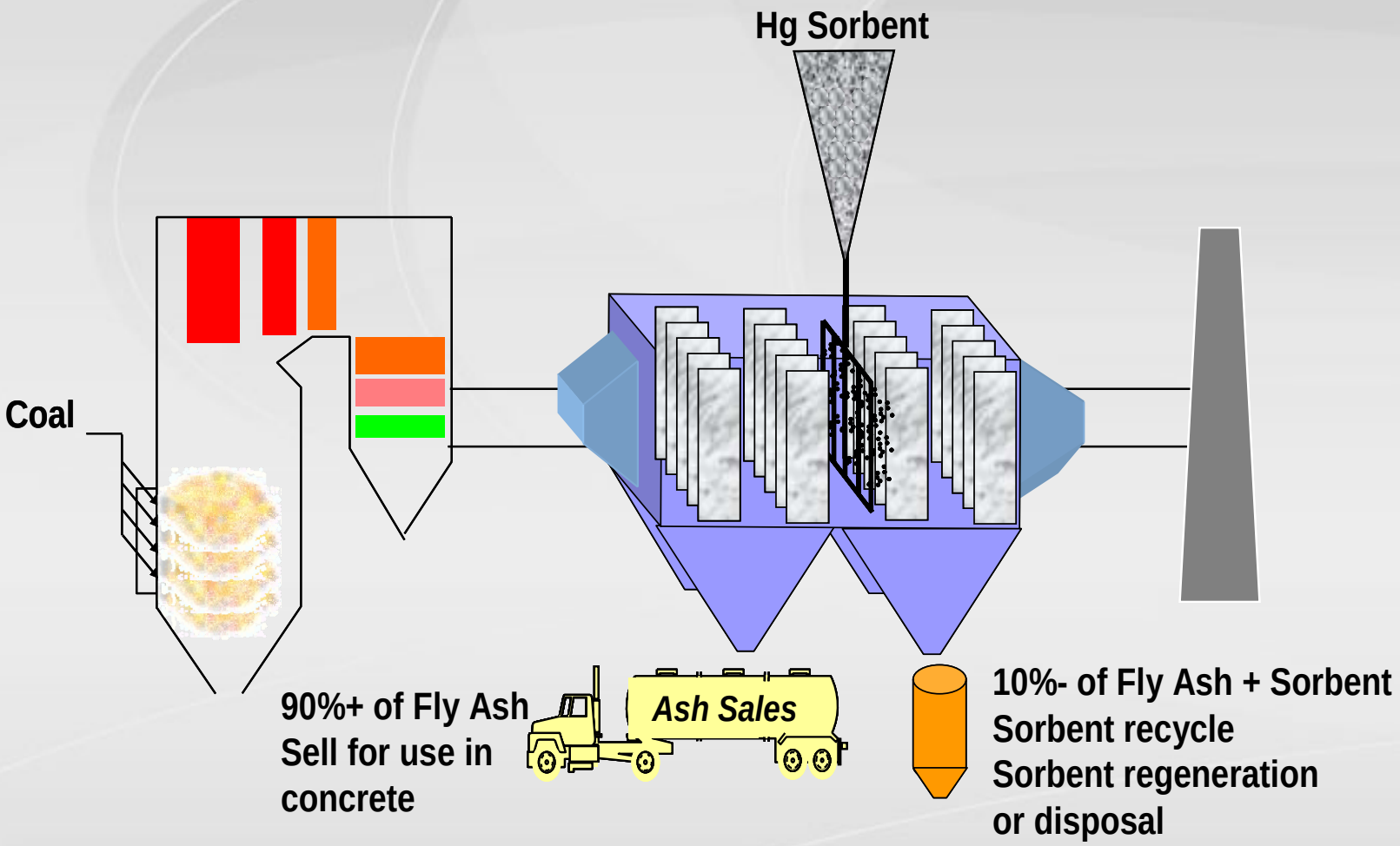
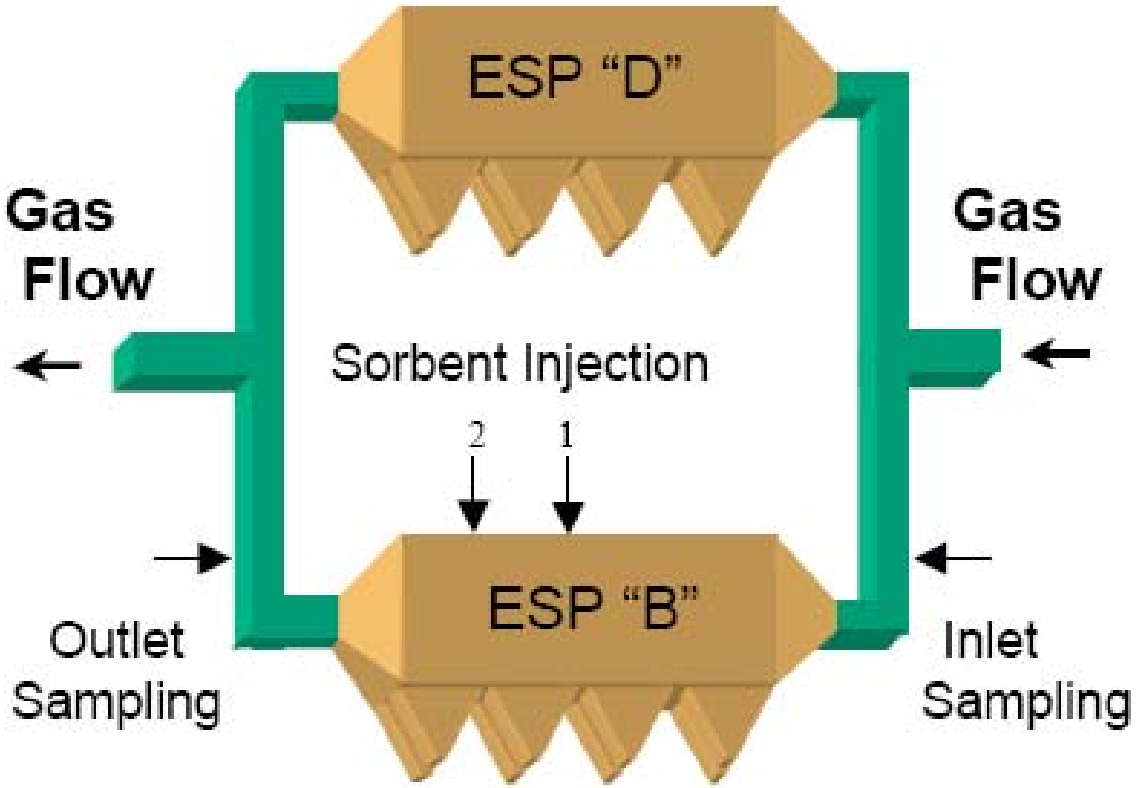
General TOXECON II Layout



ISES ESP General Arrangement



SCA 542 ft^2/kACFM

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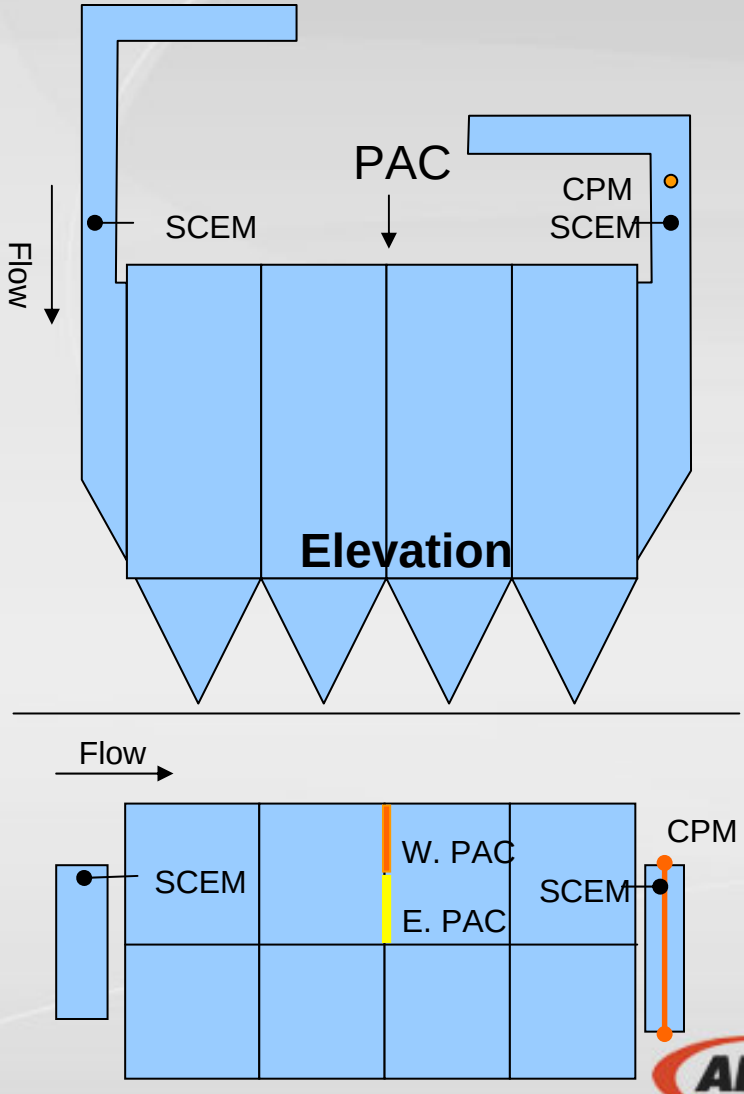
ESP Layout

NELS Model
½ of 4 ESP boxes on Unit 2
(3rd field not installed)



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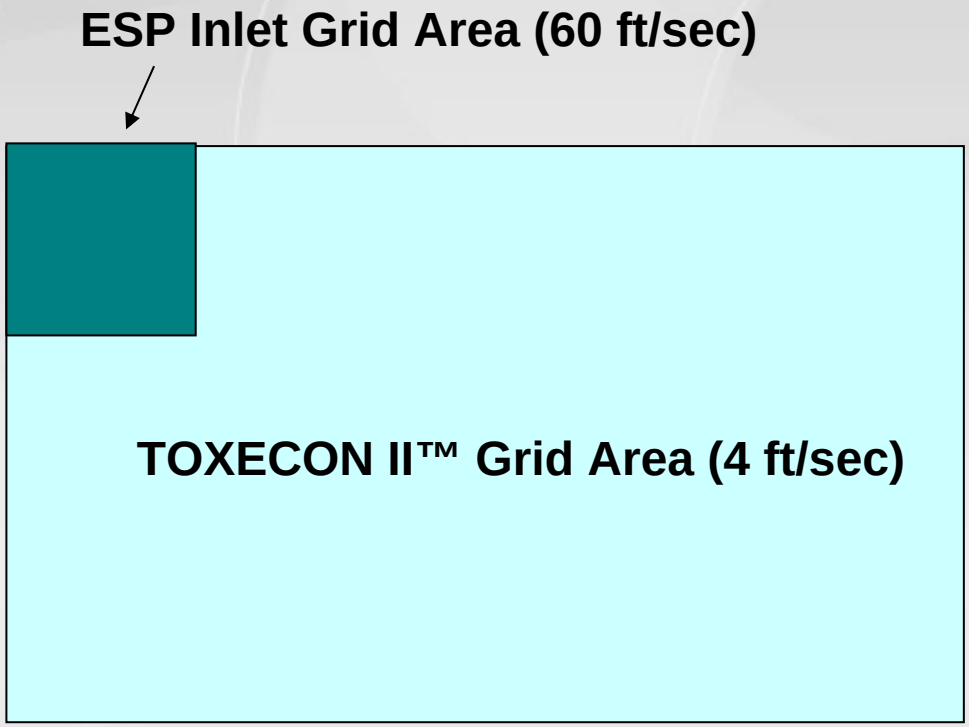
TOXECON II™ Design Challenge: Grid Size



Silo and Booster Blower

Injection Grid

2006 Test Results – Summary

- Achieved project goal of 50 to 70% Hg removal
- TOXECON II™ Hg removal limited to < 80% at full load with up to 8 lb/MMacf DARCO® Hg-LH
- TOXECON II™ Hg removal varied significantly with load (lower removal at high load)
- Hg removal > 80% with pre-ESP injection of DARCO® Hg-LH at 1 to 2 lb/MMacf

Suspected that poor distribution contributed to conflicting results from injection upstream of ESP versus TOXECON II™ grid

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2007 Testing

- Goals for Testing
  - Improve mercury removal efficiency
  - Inject continuously to evaluate grid operability
  - Minimize sorbent use
    - Manage costs
    - Minimize potential of increased particulate emissions
  - Assess impact of injection on particulate emissions (through EPRI funding)
- Baseline/Parametric/30 day test with Lance Design 2 January – February 2007
- Five-Day Continuous Injection Test with Lance Design 3 May 2007

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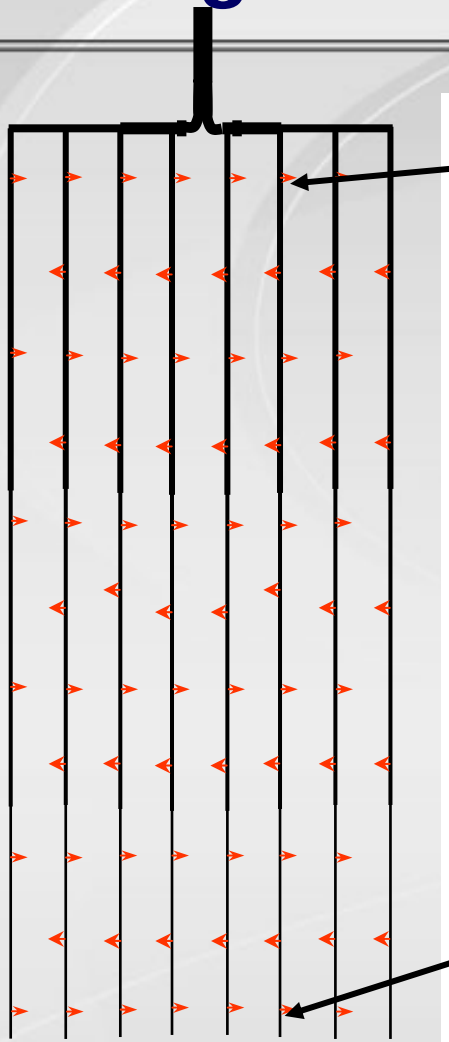
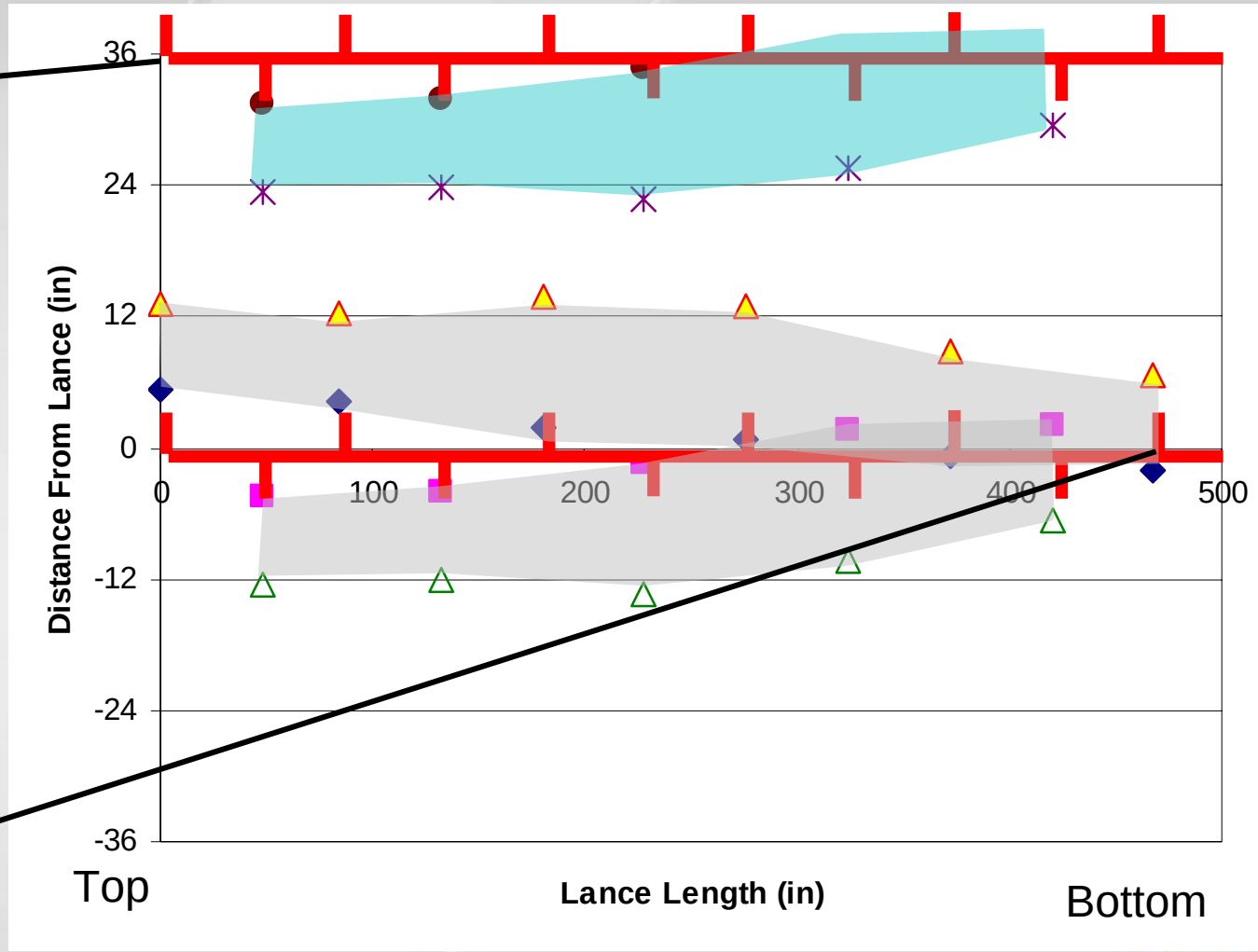
Original Lance Design – High Load





Phase II - New Distribution Design

- Installed new penetrations to allow on-line lance insertion and maintenance
- Redesigned lances for better top to bottom carbon distribution
- Redesigned nozzles for better plume development and to better direct carbon into gas flow
- Redesigned carrier air distribution for better penetration into gas passages

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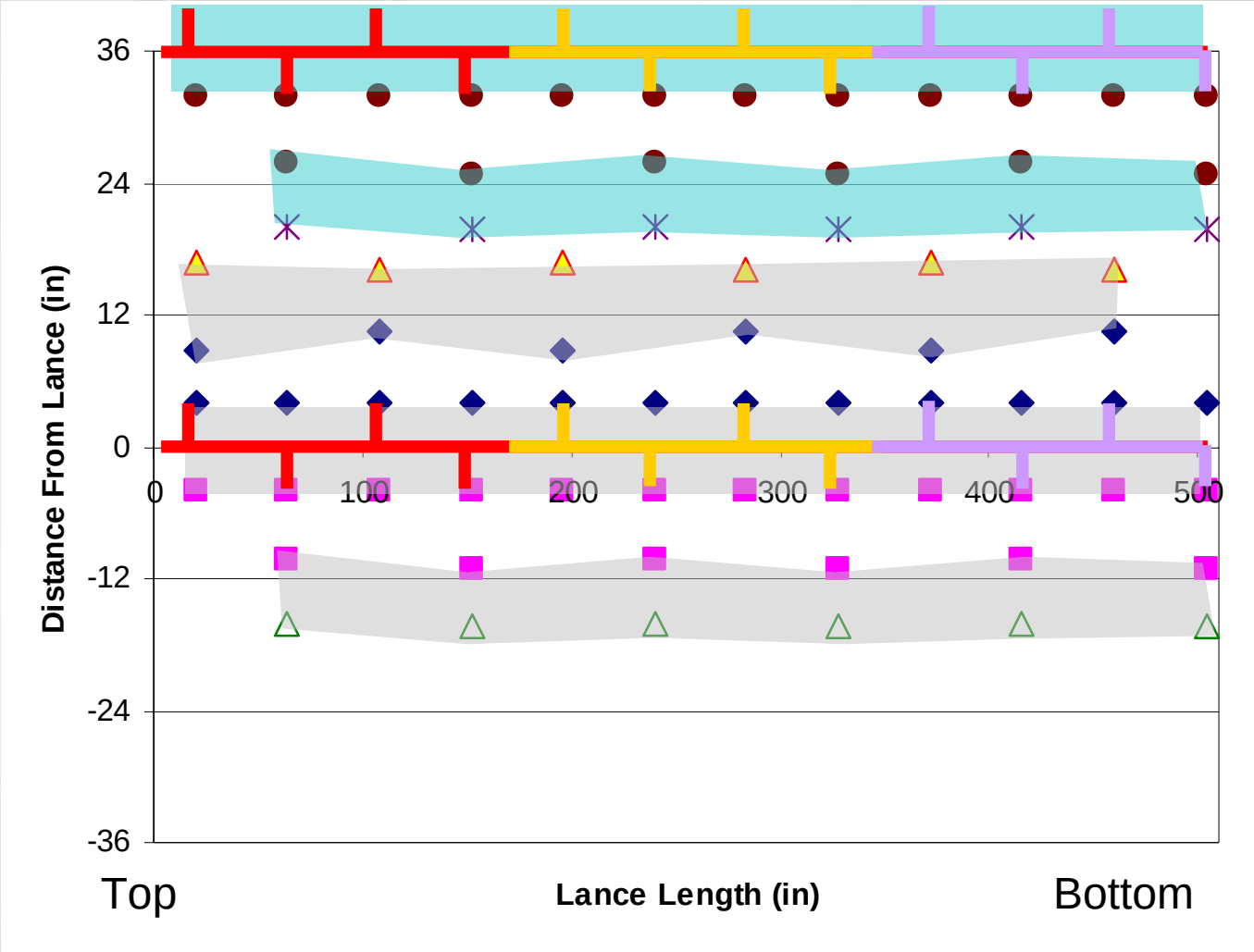
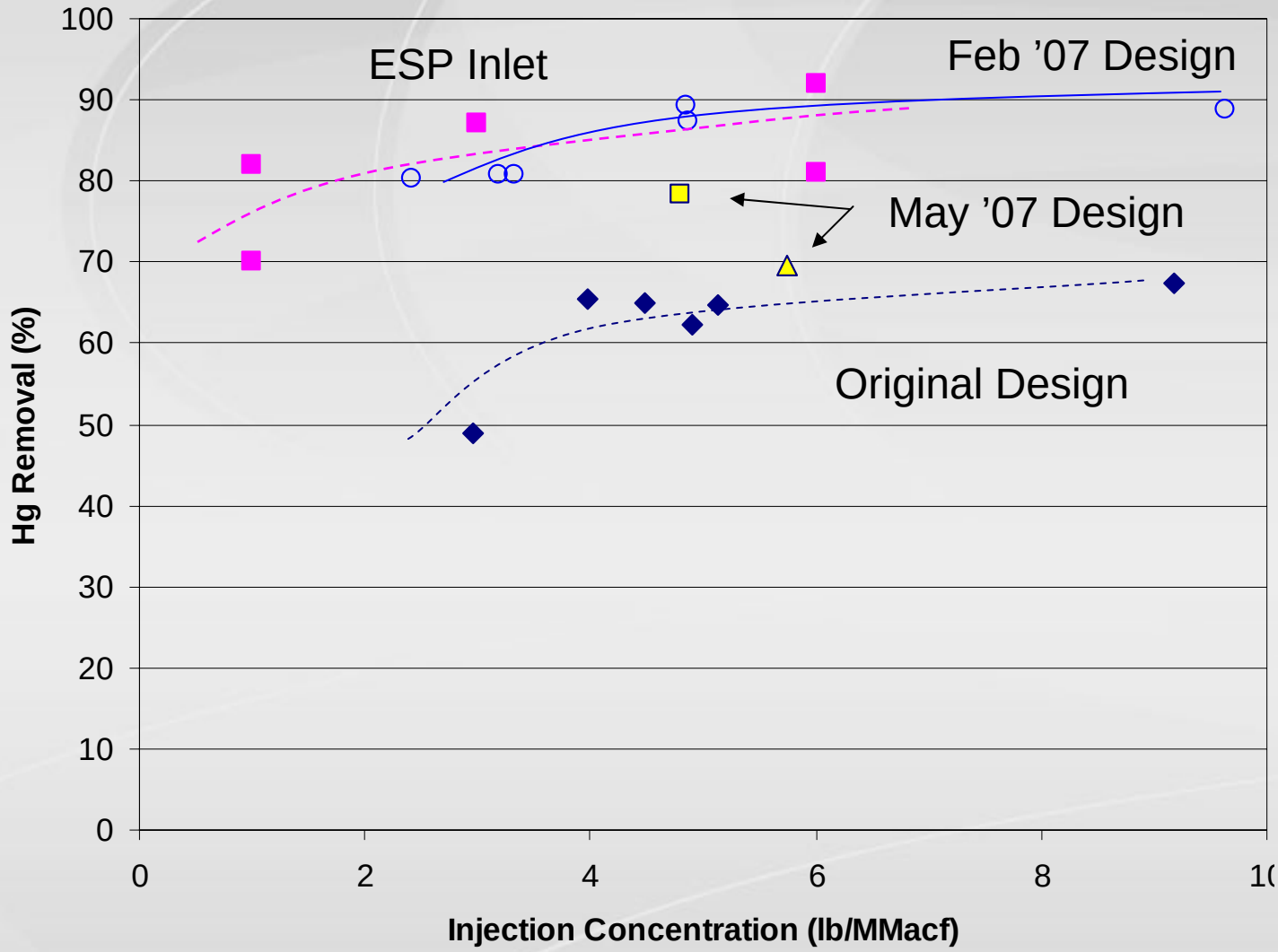
Design 2 – High Load



ISES TOXECON II™ Results Summary



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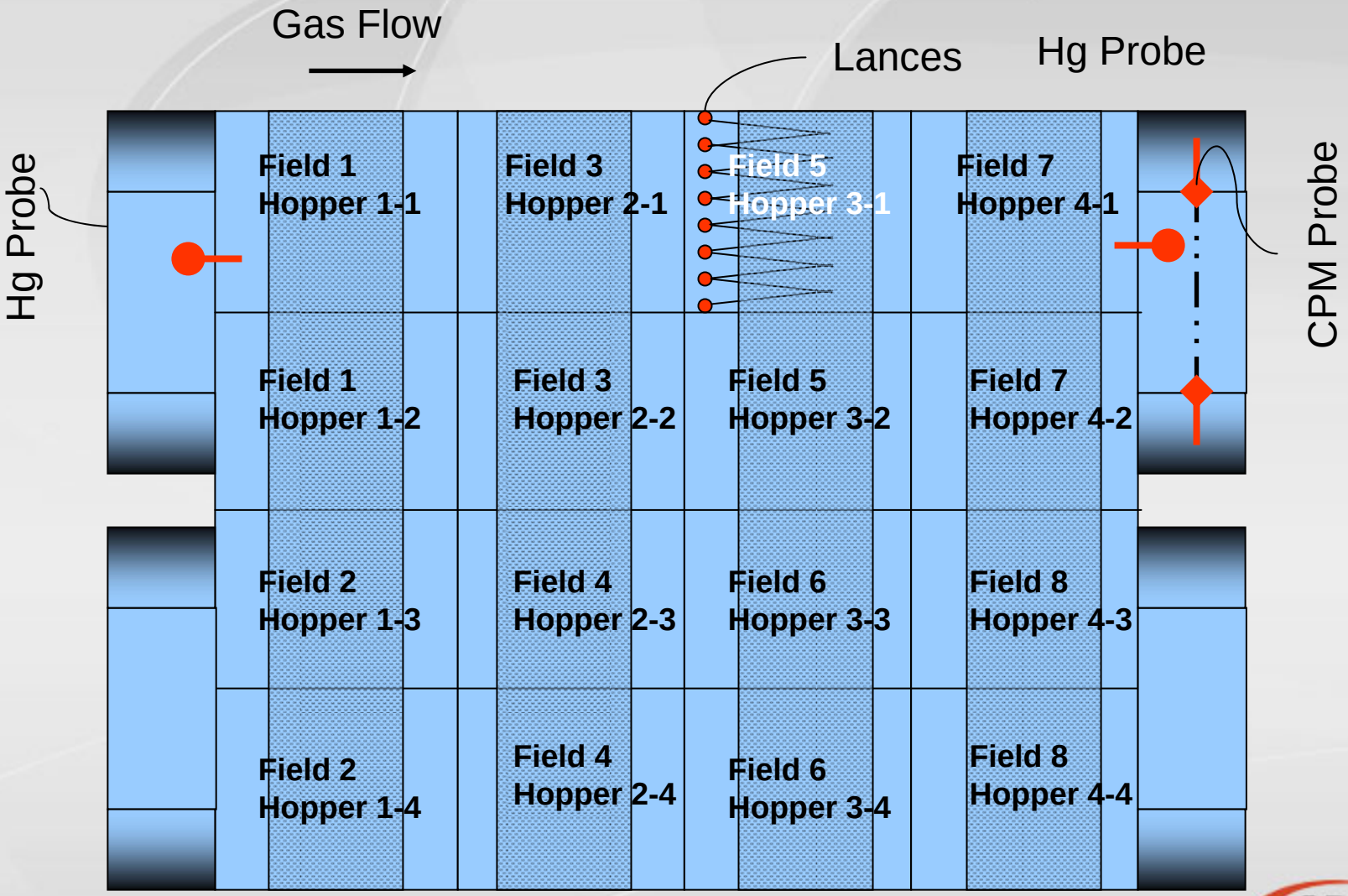
Hopper, E Field, and Spring 2007 Lance Locations



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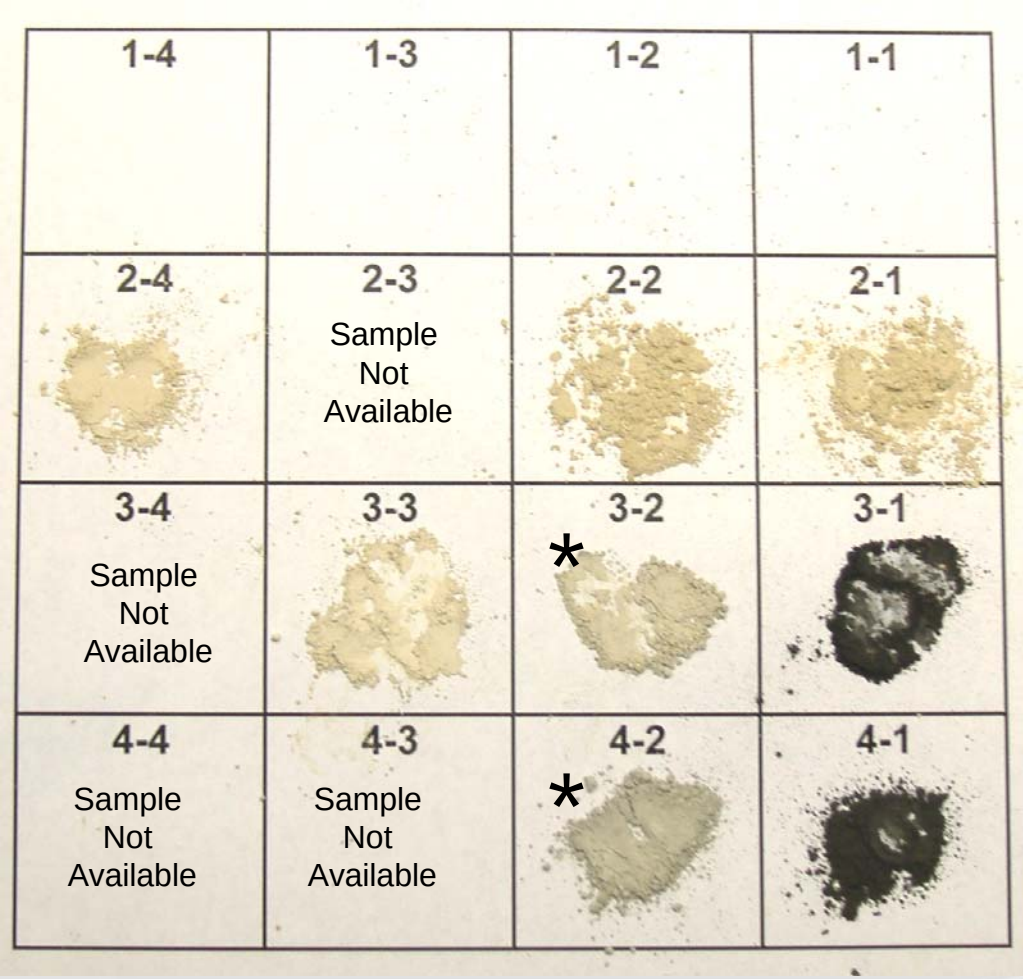
Hopper Ash Comparison



Ash Analyses
LOI (%)
Hg (ng/g)

2-4 0.44 192	**2-3**	**2-2** 0.21 173	**2-1** 0.22 198
3-4	**3-3** 0.94 460	**3-2** 1.00 609	**3-1** 18.75 4425
4-4	**4-3**	**4-2** 2.44 893	**4-1** 15.15 6940

* = Carbon migrating towards control side

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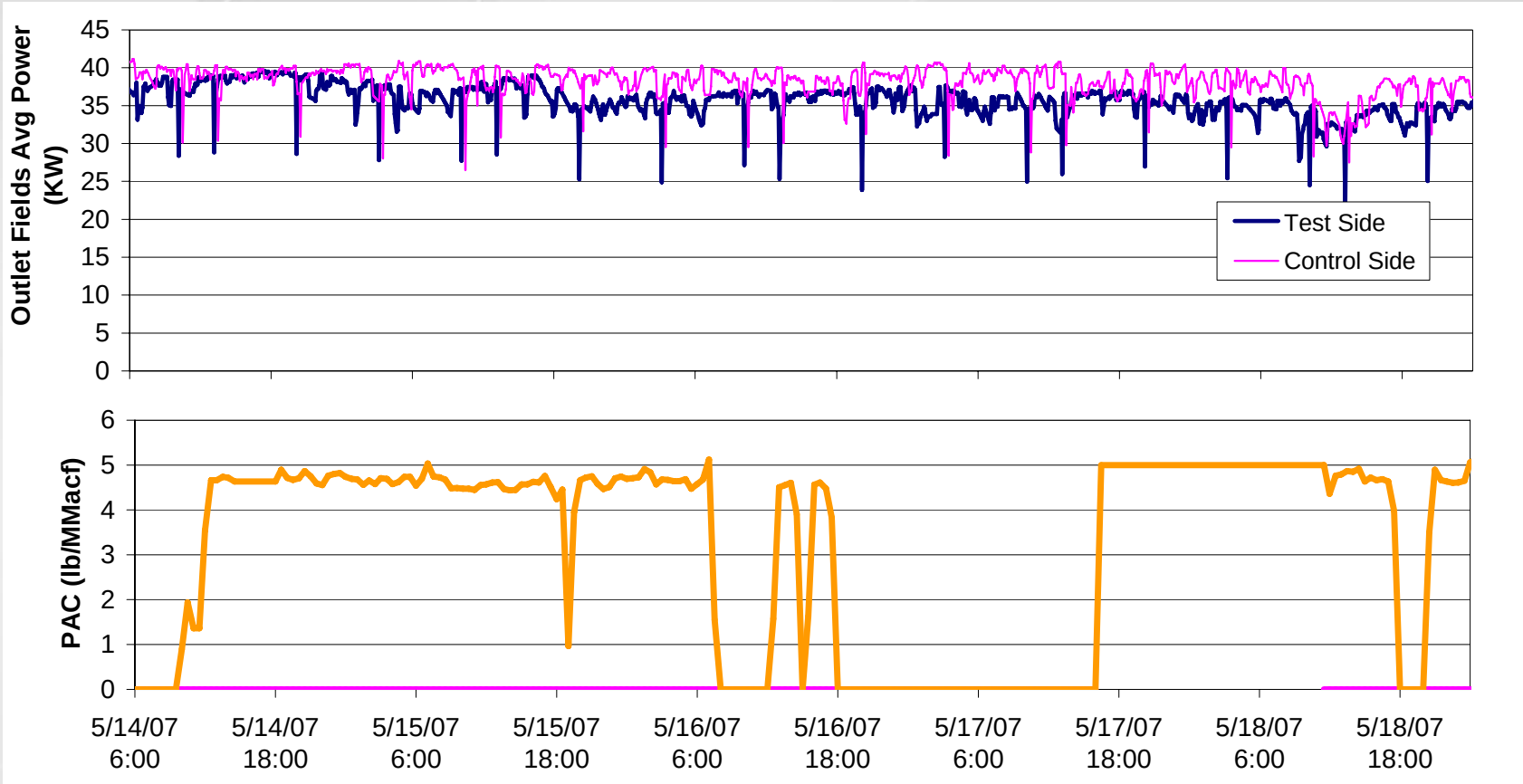
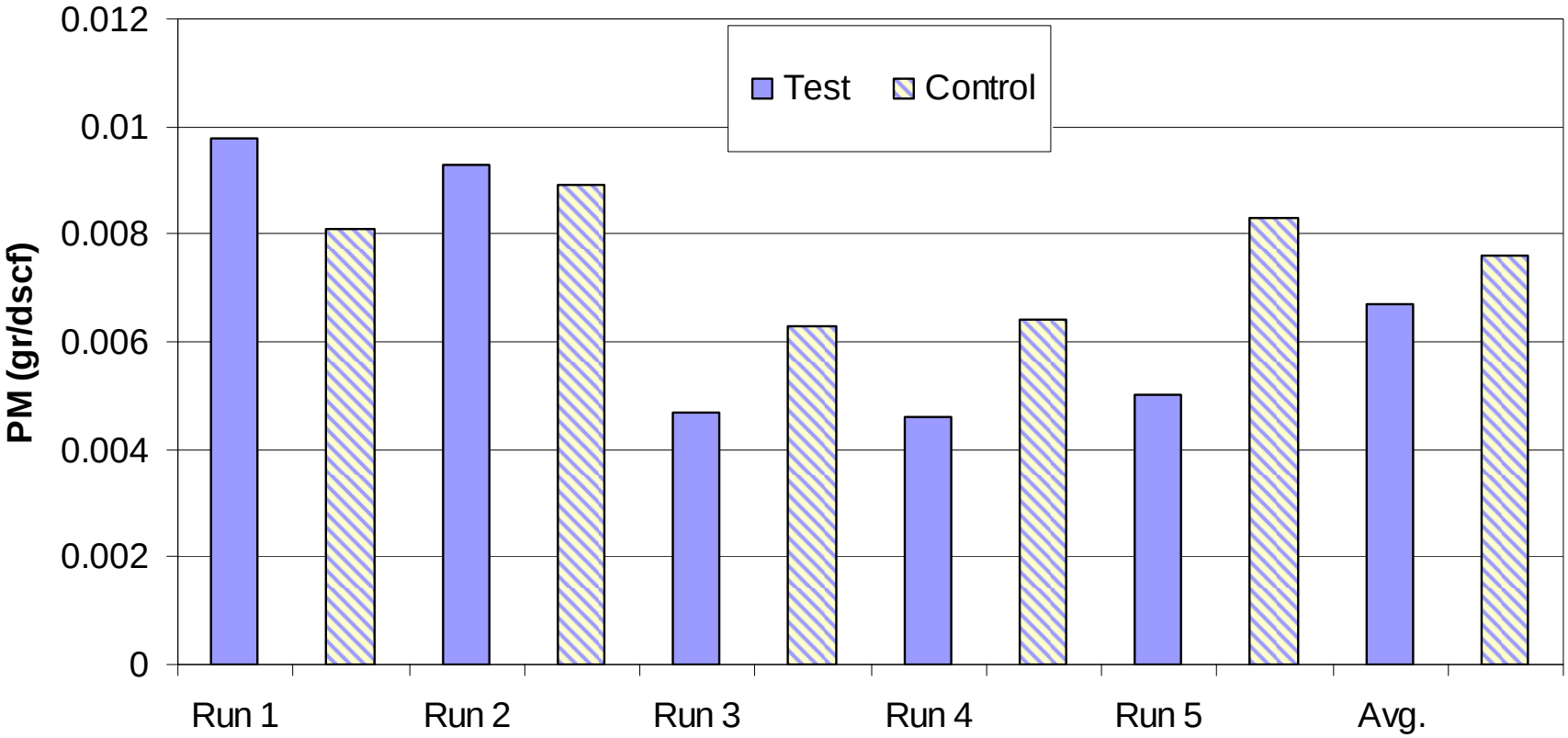
Test Results – Balance of Plant

- Opacity
  - Some opacity spikes measured during last field rapping while operating at reduced ESP power
  - Testing with full ESP power and varying the rapping sequence limited the particulate and opacity spikes for all sorbents tested
- Minimal other plant impacts
  - Potential fouling with ash handling valves

PAC Injection and ESP Power



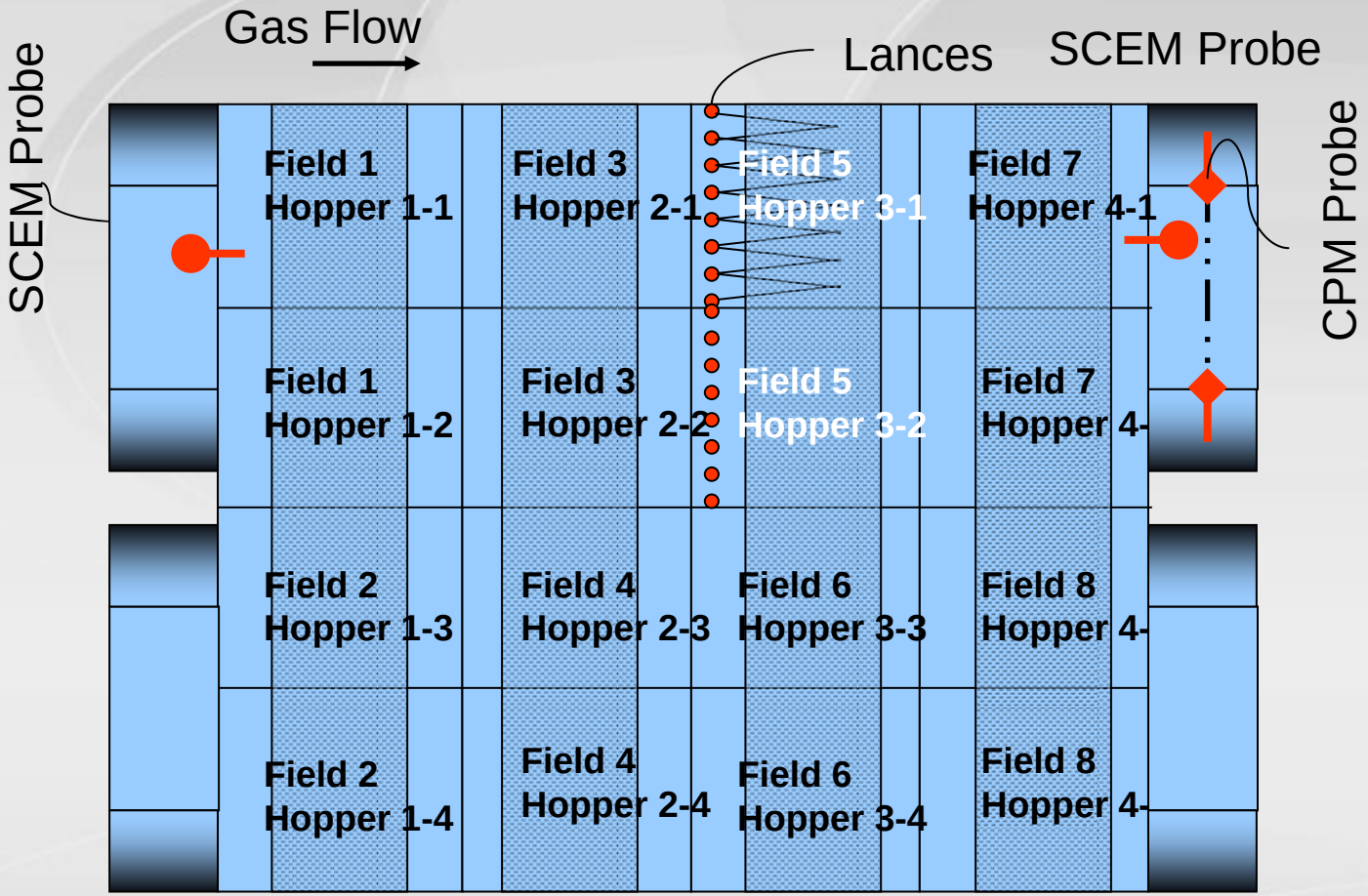
Results of February 2007 PM Tests



Fall 2007 Testing

- EPRI/Entergy Supported
- Test 1/2 of B ESP or 1/8 of Unit
  - Install 24 more lances
  - Modify manifold arrangement and carrier line sizes
- Conduct PM measurements on Control and Test sides
- Goals
  - Obtain 90% mercury removal at high load and low load conditions
  - Assess impact of PAC injection on PM emissions

Fall 2007 Testing



Testing 1/8 of unit - 1/2 of B ESP

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Preliminary Economics for Independence

Mercury Removal Rate	85%*
Brominated PAC Injection rate for above removal	5 lb/MMacf (960 lbs/hr)
Native Mercury Removal	10 – 15%
Stack Flow	3.2M acfm
Average Coal Mercury Concentration	5.5 lb/ TBtu
Mercury Removed	643 lb/ yr
20 Year Levelized Cost	$ 7.8M **
20 Year Levelized $/lb Mercury Removed	$ 12.0K **

* Includes baseline removal.

** Includes loss of ash sales and disposal fees.

Capital Cost Estimate:$5.15/kW
O&M Cost Estimate: 1.03 mills/KW-hr

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Contacts

- **Tom Campbell**, ADA-ES Manager of DOE Demonstrations
  Project Engineer responsible for site activities at Independence 2005-2007
  Tomc@adaes.com

- **Sharon Sjostrom**, ADA-ES VP Technology
  Current DOE Project Manager
  Sharons@adaes.com

- **Cam Martin**, ADA-ES Director of Engineering
  Responsible for Commercial Applications
  Camm@adaes.com

(303) 734-1727

ADA-ES