TOXECON™ Clean Coal Demonstration for Mercury and Multi-Pollutant Control

EUEC 2007

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Tucson, Arizona

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TOXECON™ – 270 MW Demonstration

- **Presque Isle Power Plant, Marquette MI**
  - **Units 7-9**
  - **PRB Coal from Antelope and Spring Creek Mines**
- **$53.3M**
  - **$24.9M DOE**
  - **$28.5M We Energies**
- **90% Hg Control**
- **70% SO_2 Control***
- **30% NO_X Control***

*** Potential**

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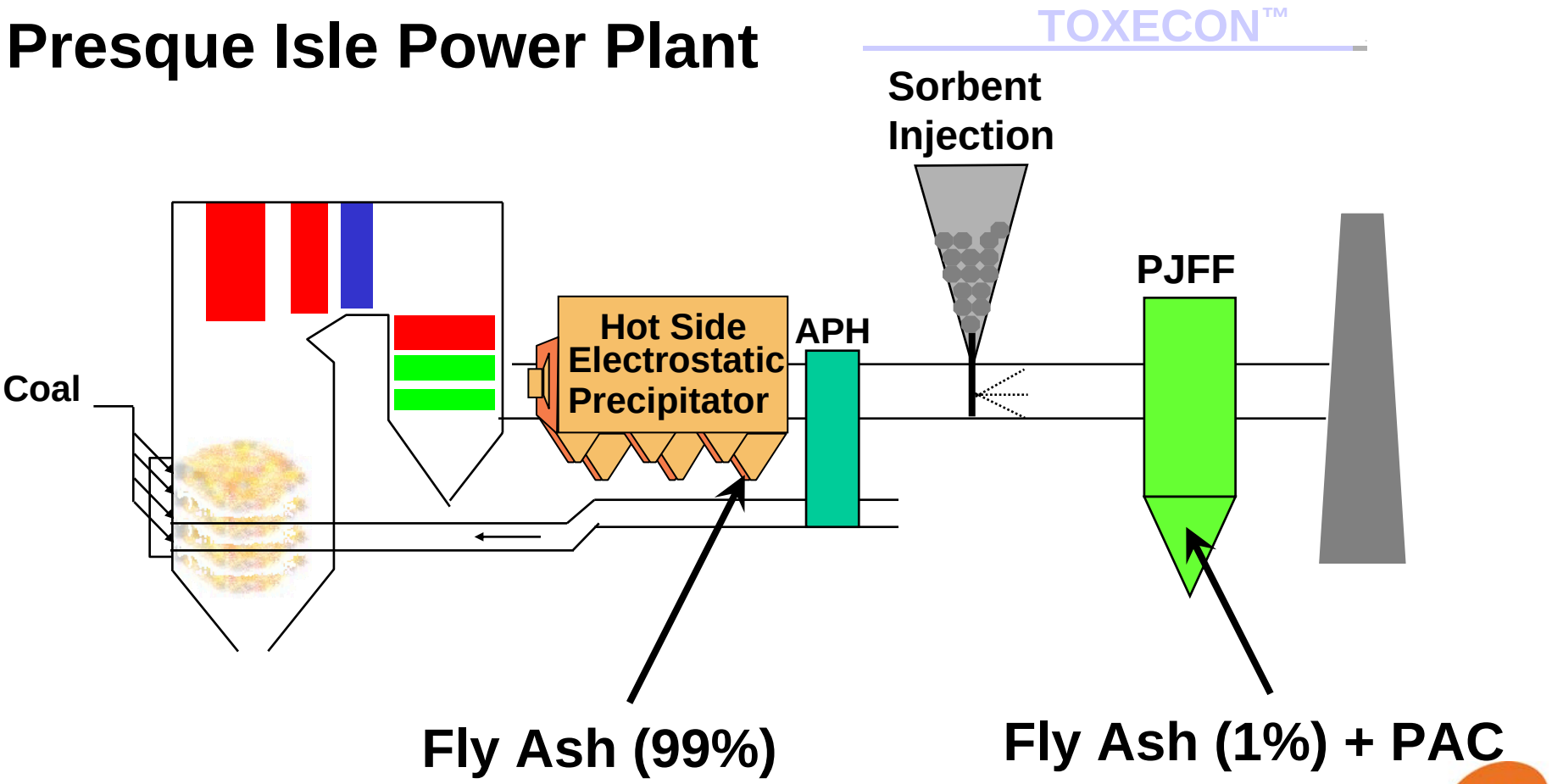
TOXECON™ Configuration

Presque Isle Power Plant



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ADA-ES ACI System at We Energies Presque Isle (270MW) TOXECON™

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PIPP Baghouse Design

- Pulse-Jet Fabric Filter
  - Supplied by Wheelabrator
  - On-line cleaning
  - Ability for off-line cleaning
- Air-To-Cloth Ratio
  - 5.5 ft/min (gross)
  - 1,080,000 acfm
- 10 Compartments
  - 648 bags/compartment
  - PPS fabric

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Schedule – Baseline and Parametric

Date	Activity
2/13/06 – 2/17/06	Baseline Testing • Two CEMs sampling from inlet and outlet of baghouse • Stack sampling (Ontario Hydro Method, Method 17 for particulate, Appendix K Sorbent Trap Method, Method 26A for halogens)
2/20/06 – 3/2/06	Round 1 Parametric Testing • Injection concentrations • CEMs, ash and coal sampling
8/20/06 – 11/11/06	Round 2 Parametric Testing • Injection concentrations • Sorbents • CEMs, ash and coal sampling
11/12/06 – 1/15/07	Re-Testing and Transition to Long Term Performance
1/15/07 –7/2/07	Evaluate Long Term Performance

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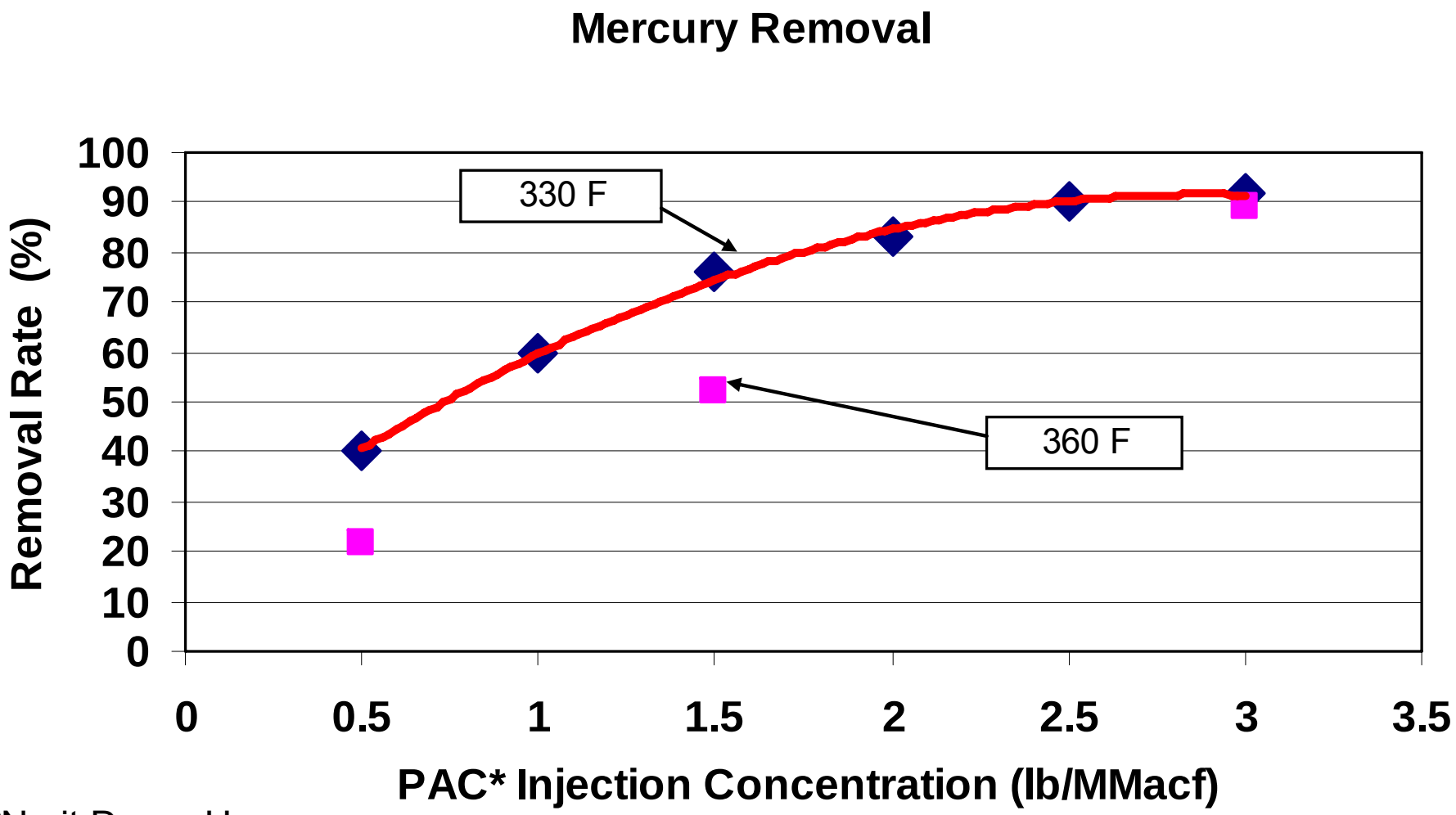
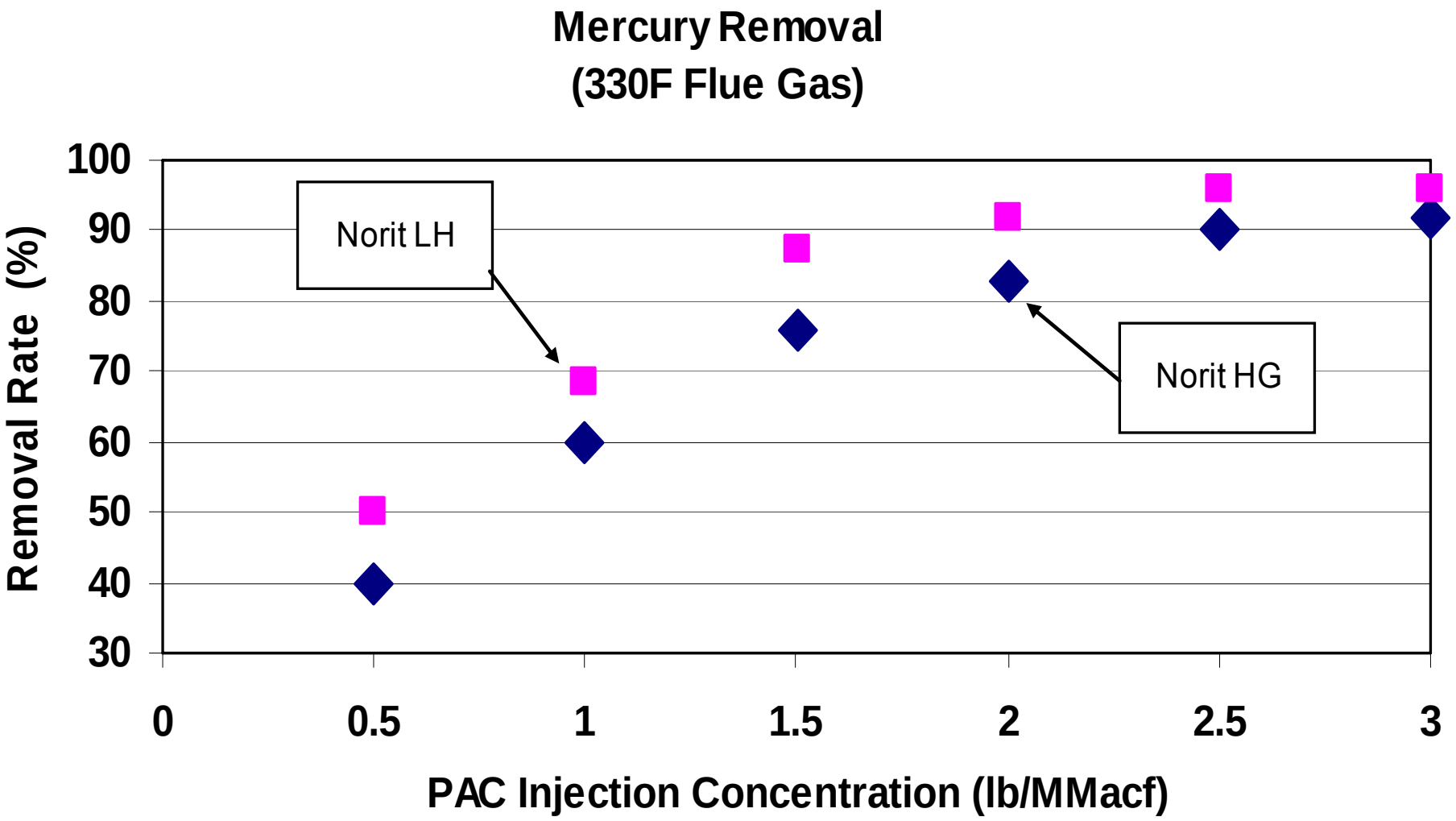
Preliminary Mercury Removal Results

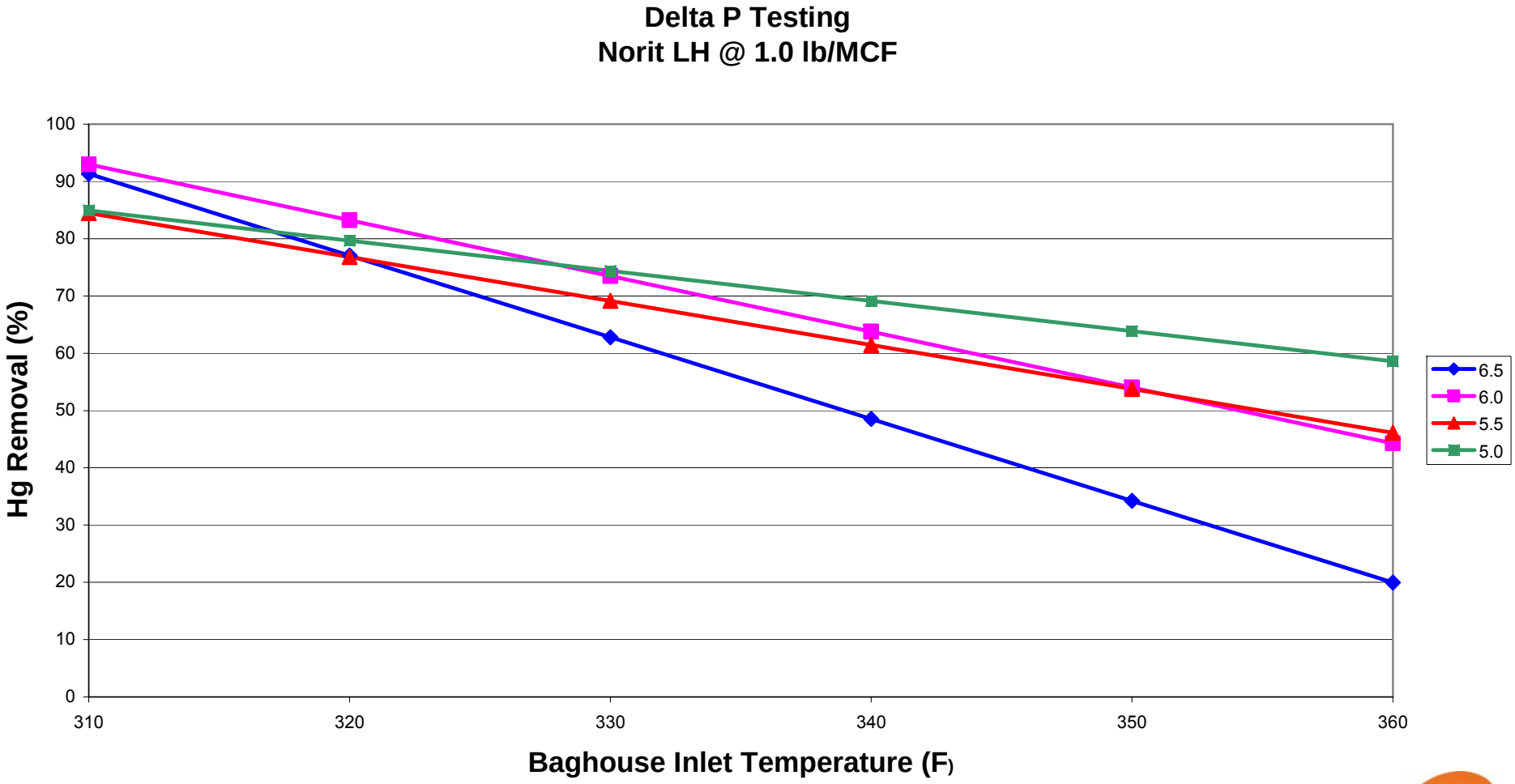


*Norit Darco Hg

Preliminary Mercury Removal Results



Effect of Baghouse ΔP



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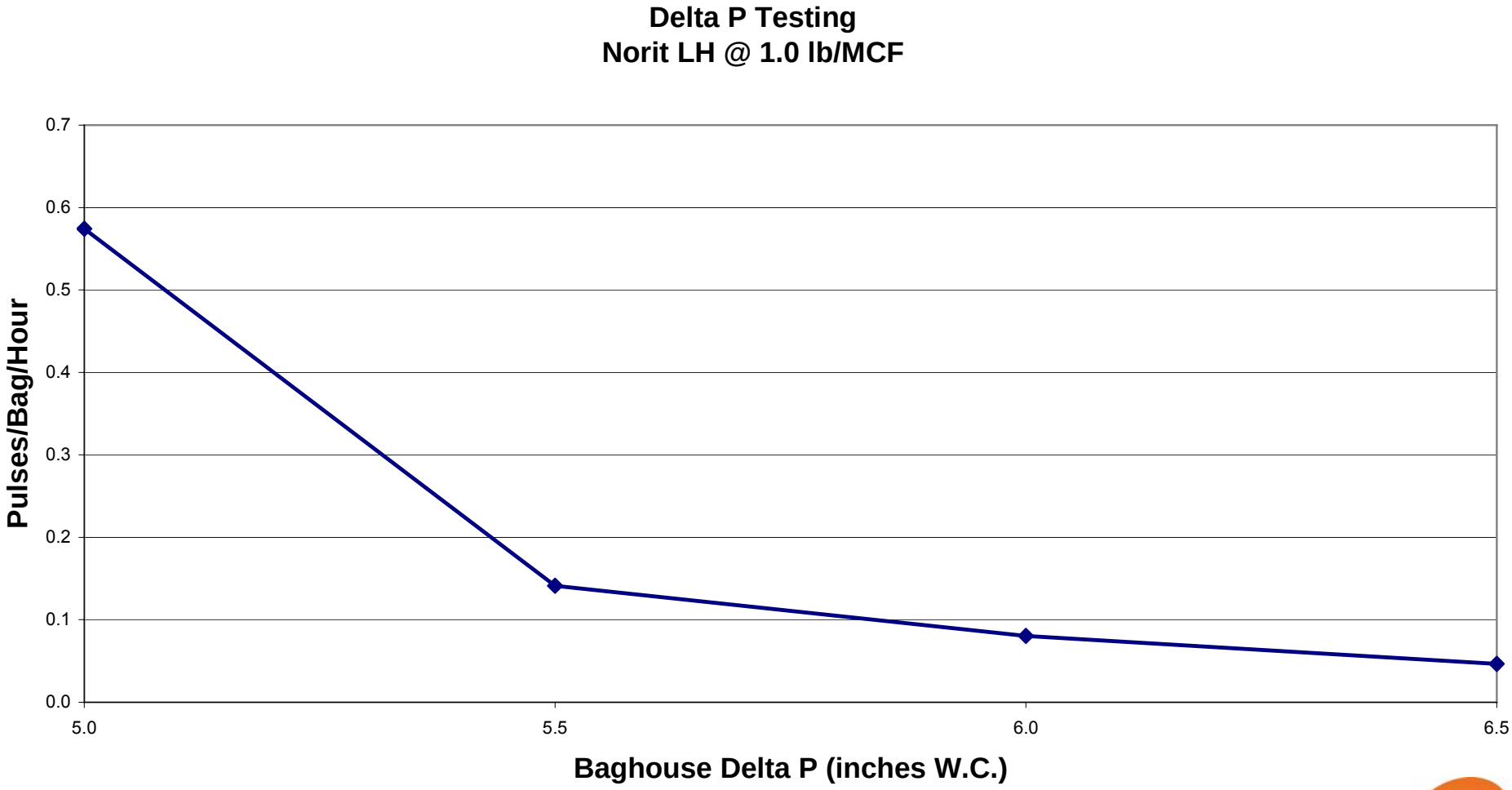
Effect of Baghouse ΔP



Economics

	$/MWH	
PAC	0.33	
Fan Power	0.27	
Bag Replacement	0.09	
Ash/PAC Disposal	0.03	
Annual Scheduled Maintenance	0.02	
Miscellaneous	0.07	
TOTAL	**0.81**	
Annual mercury removed	82	pounds
Average cost (variable only)	16,000	$/lb

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Economics

- Capital Costs
  - $34.4 million, 270 MW
  - $128/kw
- O&M Costs
  - $0.81/MWH
- Hg Removal (variable only)
  - $16,000/lb

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Balance of Plant Issues

- Smoldering PAC/ash in hoppers
- Material Handling
- Bag cage separation
- Condensation at startup

Problem with Overheating PAC

- Hot burning embers found in all compartments two weeks after the start of carbon injection
- Baghouse isolated to cool ash and clean out hoppers
- While extinguishing burning embers, unintentionally created additional flames in two compartments
  - 117 bags were failed in Compartment #4
  - 83 bags were failed in Compartment #3

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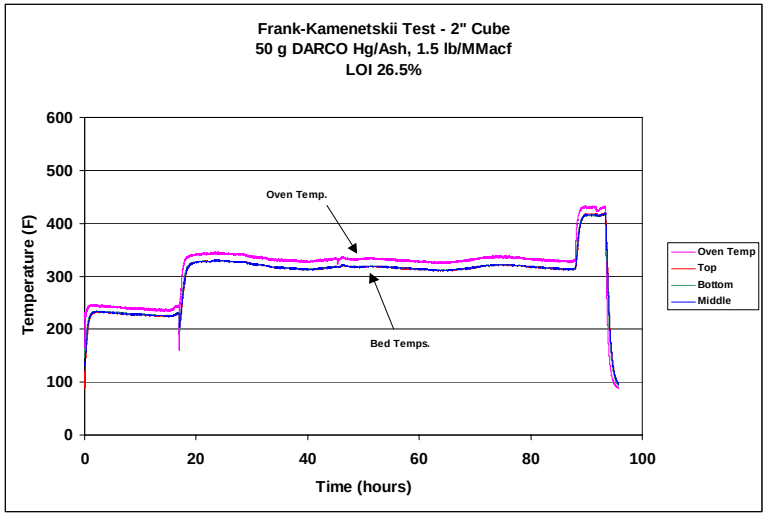
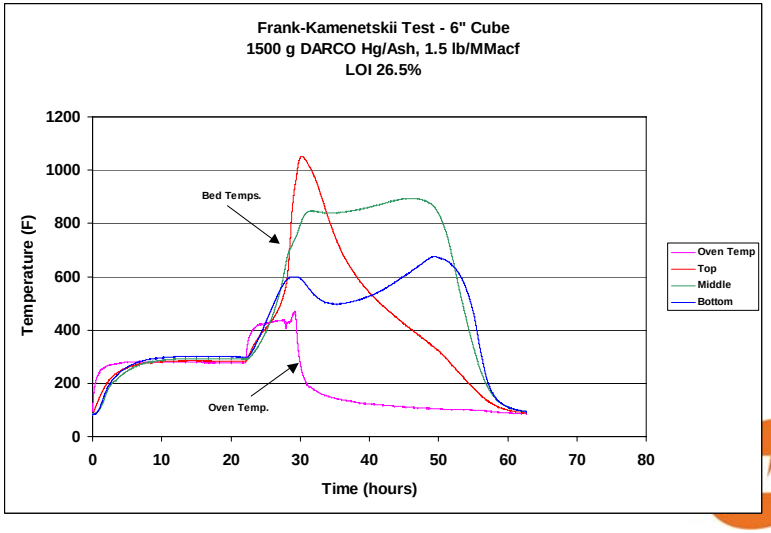
Burned Bag

Mechanism for Spontaneous Combustion

- **Laboratory tests confirm spontaneous combustion follows Frank-Kamenetskii Model**
- **Key Factors**
  - **Bed size**
  - **Temperature surrounding bed**
  - **LOI**
  - **Type of LOI (high vs. low surface area)**
  - **Gas oxygen concentration**





Material Handling Issues

- Ash Silo Unloading
- Ash Hopper Unloading

Cage Separation

- Bottom half of cage was found to be laying in bottom of bag
- Large percentage of bags
- Two problems:
  - Faulty spot welds on lower retaining ring
  - Improper position of locking slider on upper cage
- Warranty issue covered by WAPC

Demonstrated 90% Hg Removal

- From 12/2/06 to 1/19/07 Hg removal has been above 90%
- 48 consecutive days
- Norit Hg at 2.5 lb/MCF
- On 1/20/07 removal averaged 87.8%
- Testing continues to further optimize process economics

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What We Learned So Far

- Carbon injection effectively removes mercury
- Standard activated carbon is sensitive to temperature at low injection concentrations
- Bag cleaning based on ΔP and time reduces temperature sensitivity
- PAC/ash mixture can ignite with sufficient time and quantities at temperatures above 400 °F
- PAC/ash mixture is “sticky” and hoppers tend to “rat-hole”
- Normal ash unloading equipment is not effective when handling PAC/ash mixtures

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Design Recommendations

- Minimize PAC/ash storage in baghouse hoppers
  - Evacuate hoppers often
  - Prevent material build-up
- Control hopper temperatures
  - Eliminate or minimize use of hopper heaters
  - Controls should provide narrow band
- Install additional thermocouples or CO monitor for early detection of fires

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Conclusions

- CCPI demonstrations provide key support for the commercialization of new technologies
- Preliminary full-scale testing essential for establishing design basis and reducing risk
- First commercial mercury control system is now operational
  - Still some significant issues to resolve
  - The industry is closely watching this project

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