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

DOE/NETL 2007
Mercury Control Conference
Pittsburgh, PA

Steven Derenne

December 13, 2007

we energies

TOXECON™ - 270 MW Demonstration

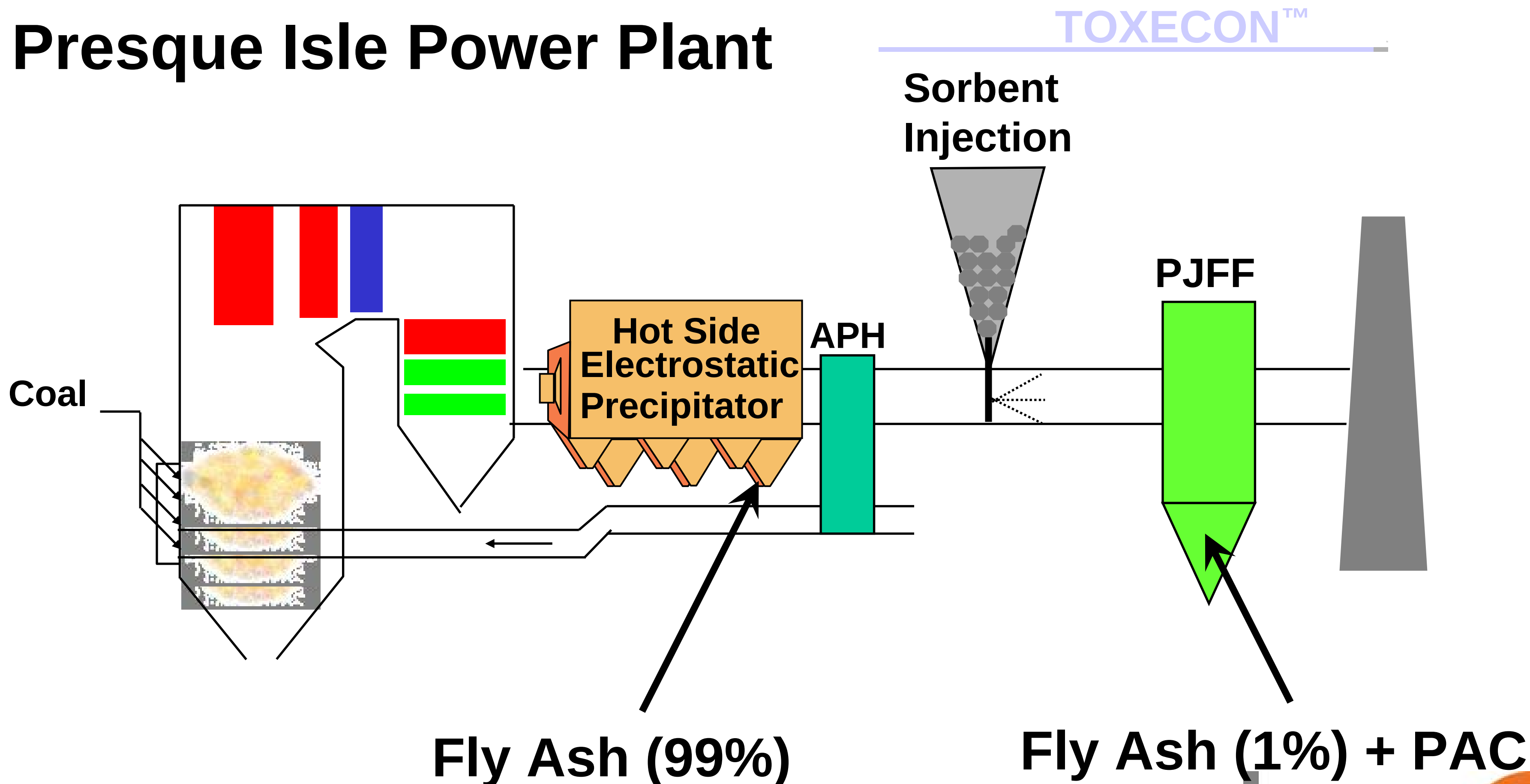
- Presque Isle Power Plant, Marquette MI
  - Units 7-9
  - PRB Coal from Antelope and Spring Creek Mines

- $53.3M
  - $24.9M DOE
  - $28.5M We Energies
- 90% Hg Control
- 70% SO_2 Control
- 30% NO_X Control

we energies

TOXECON™ Configuration

Presque Isle Power Plant



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

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

we energies

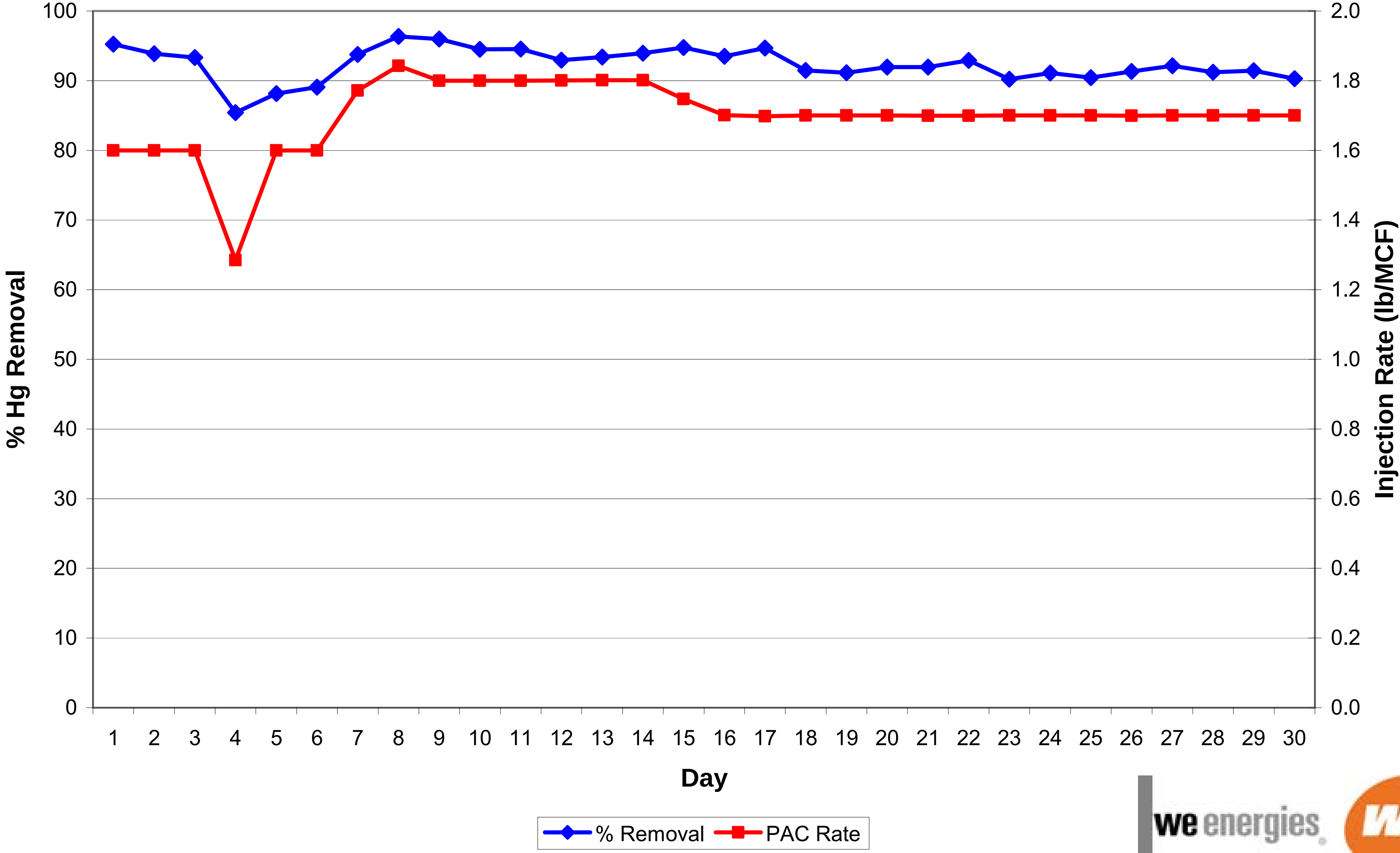
Schedule Overview

Date	Activity
2/13/06 - 2/17/06	Baseline Testing
2/20/06 - 3/2/06	Round 1 Parametric Testing
8/20/06 - 11/11/06	Round 2 Parametric Testing
11/12/06 - 1/15/07	Re-Testing and Transition to Long Term Performance
1/15/07 - 2/28/09	Evaluate Long Term Performance
6/18/07 – 6/29/07	RATA Testing
7/30/07 – 8/18/07	SO2/NOx Reduction Testing
12/17/07 – 2/29/08	CO Monitor Evaluation

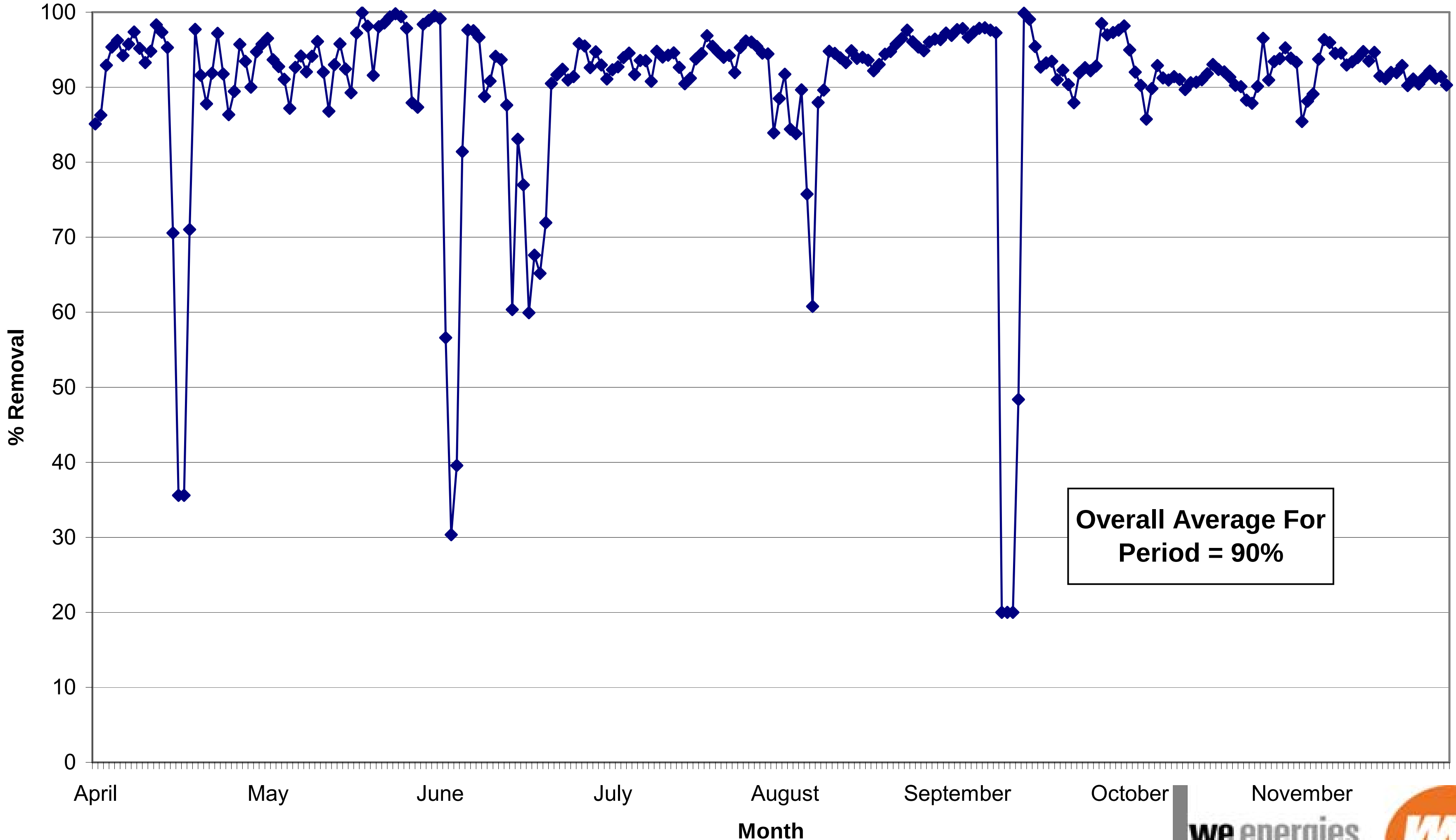
Current Operating Parameters

- Norit HG, 1.7 lb/MCF
- Baghouse Delta P set point
  - 3 units in service = 6.5” W.C.
  - 2 units in service = 4.6” W.C.
  - 1 unit in service = 2.3” W.C.
- Default cleaning timer
  - 3 units in service = 1 hour
  - 2 units in service = 2 hours
  - 1 unit in service = 4 hours
- Ash pulled every 4 hours
- Ash hopper heaters < 300F wall temperature

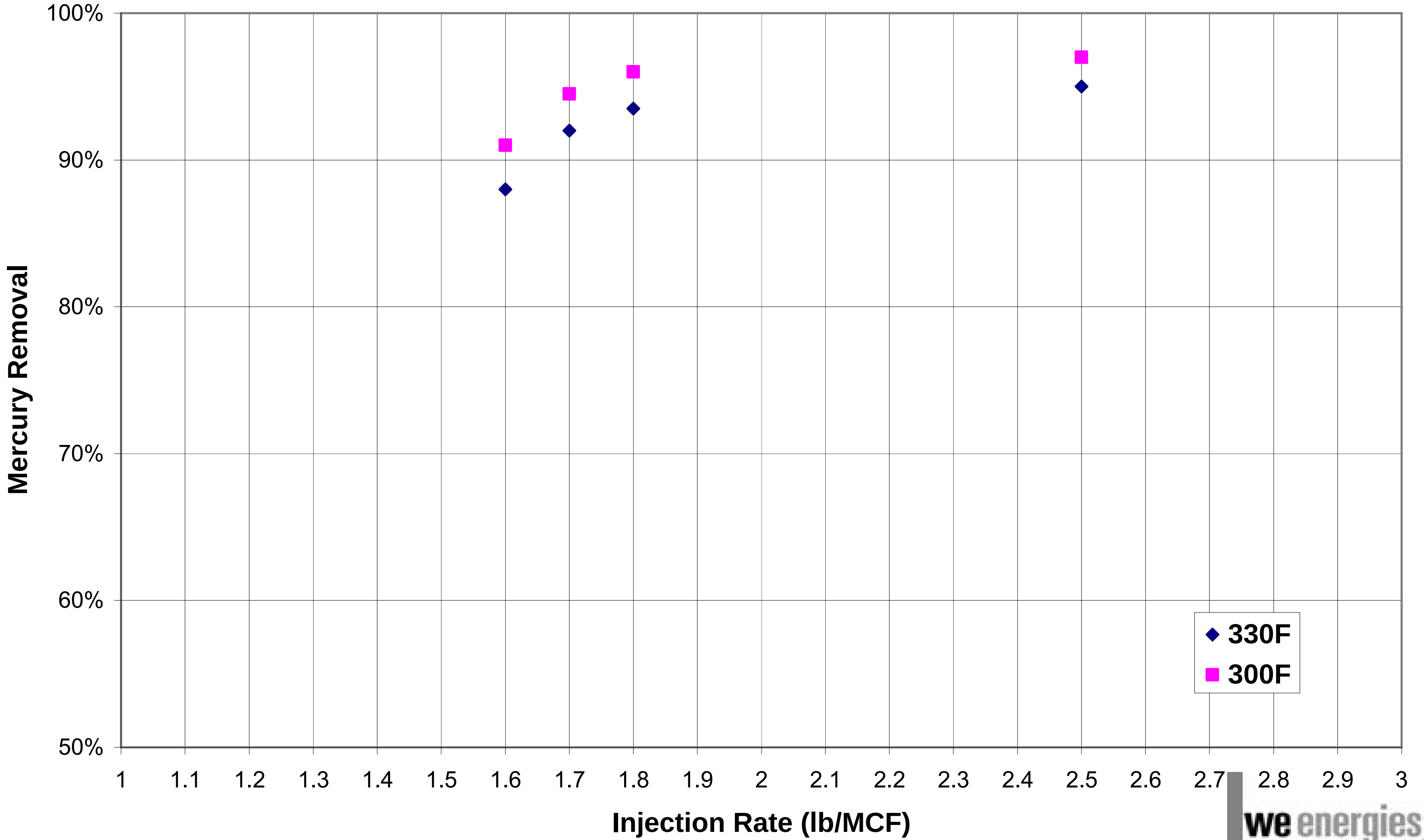
Daily Averages November 2007



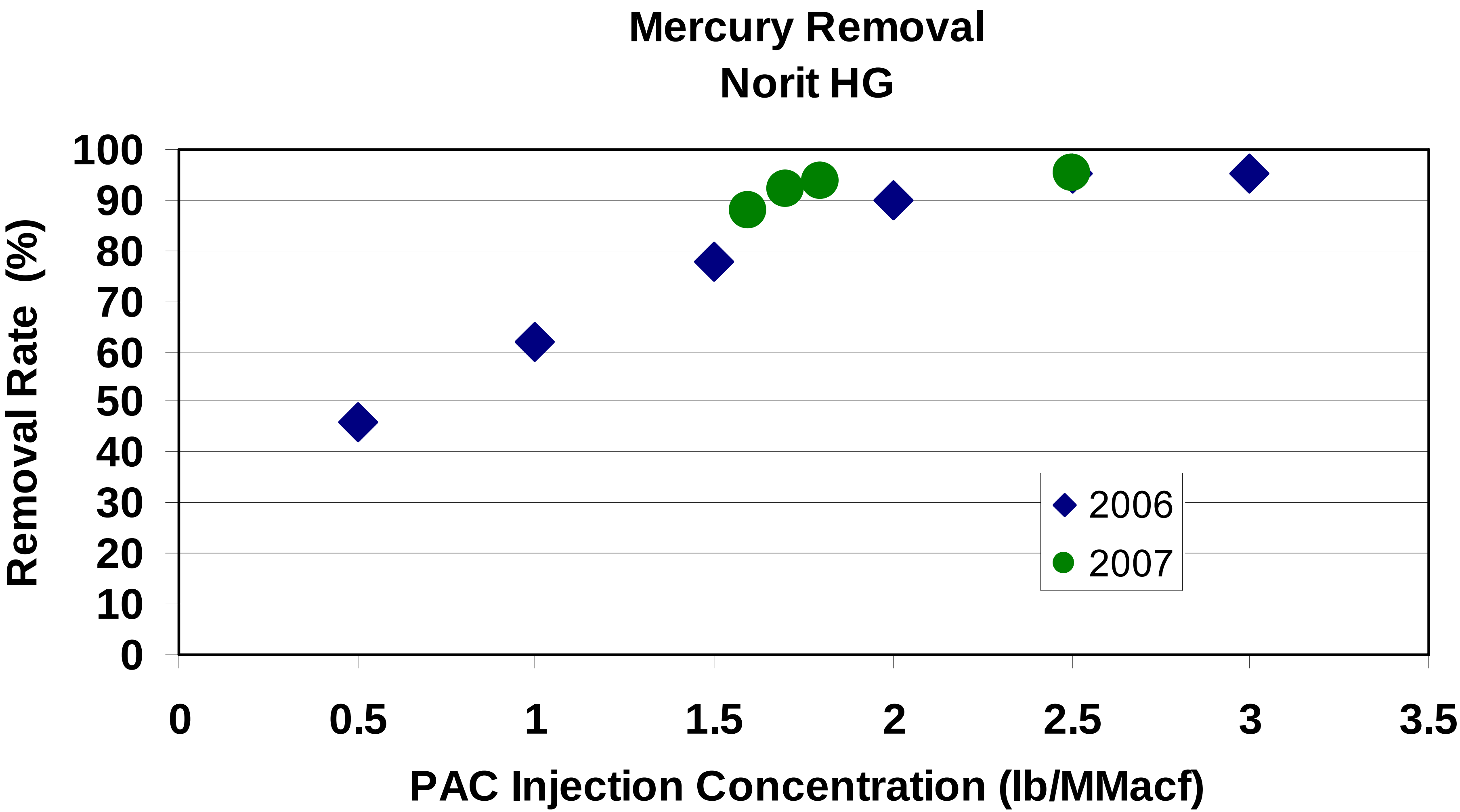
Mercury Removal
Daily Averages



TOXECON Mercury Removal
Norit HG
Corrected For BH Inlet Temperature



Mercury Removal Results



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	114	pounds
Average cost (variable only)	11,000	$/lb

Economics – Cont.

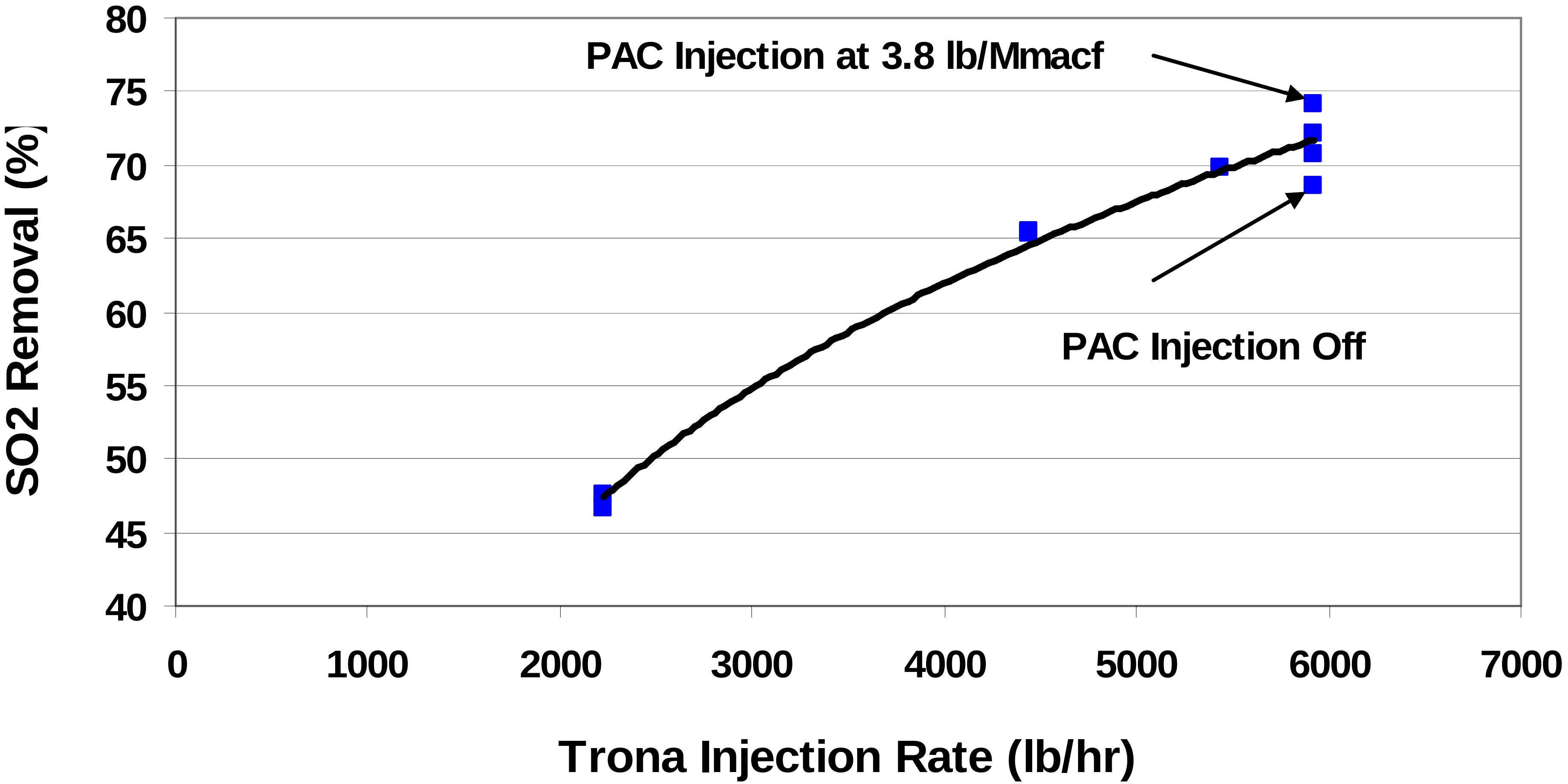
- Capital Costs (2005$)
  - $34.4 million, 270 MW
  - $128/kw
- O&M Costs (estimate)
  - $0.81/MWH
- Hg Removal - 82 pounds/year
  - $11,000/lb – Variable
  - $62,000/lb – All In

Trona Injection Testing

- Removal of 74% SO_2 was achieved at an NSR of 1.02 (5926 lb/hr)
- NO_x levels were not noticeably affected
- Mercury removal was adversely affected during trona injection
- Brown plume developed when PAC injection was turned off
- Baghouse cleaning frequency increased by a small amount

we energies

SO2 Removal Using Trona



Current Balance of Plant Issues

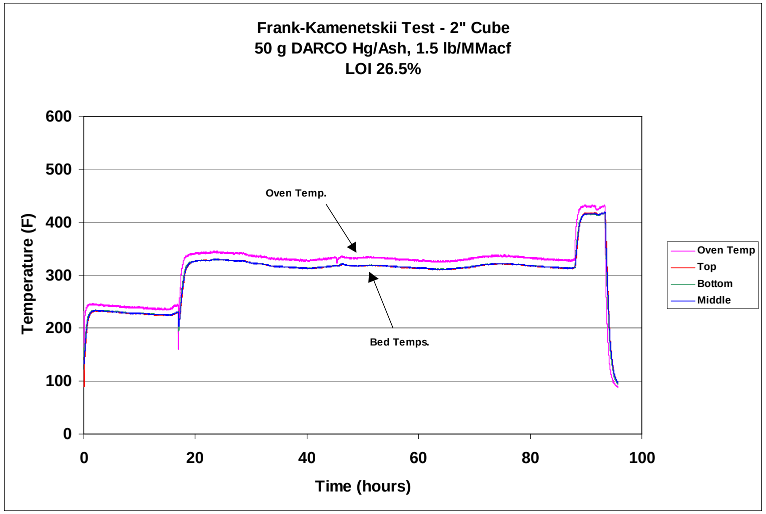
- Spontaneous Combustion
- Ash/PAC Handling

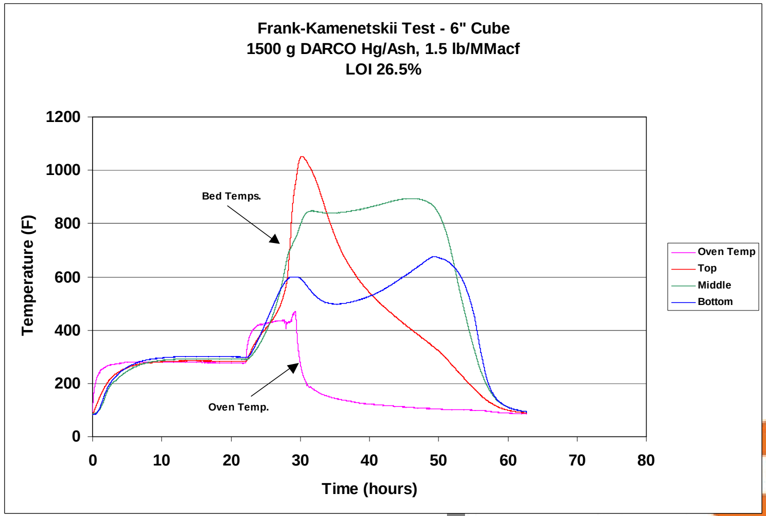
Spontaneous Combustion

- Operational changes have successfully prevented problems
  - Ensuring complete emptying of ash hoppers
  - Minimizing ash/PAC residence time (4 hours)
  - Lower set point on hopper heaters
- Adding test installation of hopper CO monitor

Mechanism for Spontaneous Combustion

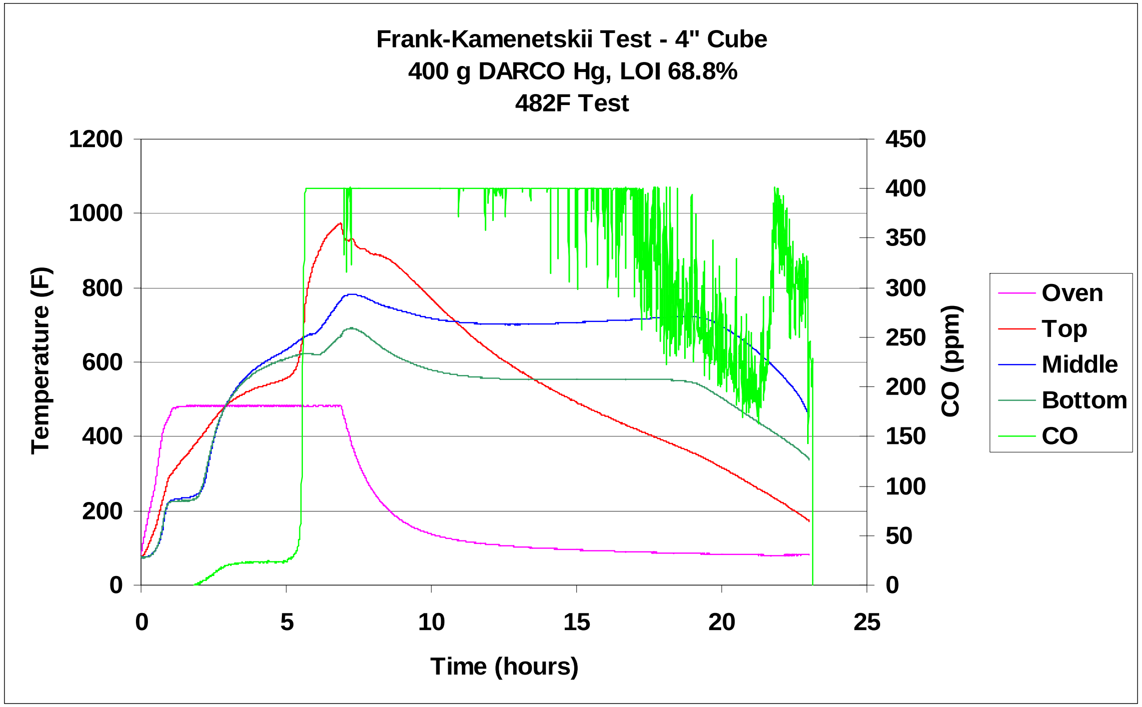
- Laboratory tests confirm spontaneous combustion follows Frank-Kamenetskii Model
- Key Factors
  - Bed size
  - Temperature surrounding bed
  - LOI
  - Type of LOI (high vs. low surface area)
  - Gas oxygen concentration





CO Provides Early Warning

- Adding test installation of hopper CO monitor
- Laboratory tests show significant CO production at the onset of auto-ignition



Material Handling Issues

- Ash Silo Vent Filter
  - Short bag life
  - Opacity from bag bleed-thru
  - Solutions being pursued
    - Alternate bag materials
    - Adjusting operating parameters

Material Handling Issues – Cont.

- Ash Silo Wet Unloader
  - Excessive dusting during startup
  - Extensive upgrades now produce acceptable product most of the time
  - Currently pursuing additional upgrades

CEMs

- Integrated with CEM DAS and Plant DCS

RATA Testing

- June 2007: Presque Isle
  - Ontario Hydro Method
  - Sorbent Trap
  - Instrumental Reference Method
- Passed high level (1.5 to 3.2 $\mu g/m^3$)
  - OH to CEM
  - STM to CEM
  - IRM to CEM
- Passed low level (0.48 to 0.93 $\mu g/m^3$)
  - STM to CEM
  - IRM to CEM

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 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”
- Special ash unloading equipment is needed when handling PAC/ash mixtures with high carbon %.

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
- Bag cleaning based on time.

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 provides operational experience
  - Still some significant issues to resolve
  - The industry is closely watching this project

we energies®

we®