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

EUEC 2009
Phoenix, AZ

Steven Derenne, We Energies

February 2, 2009

TOXECON™ - 270 MW Demonstration

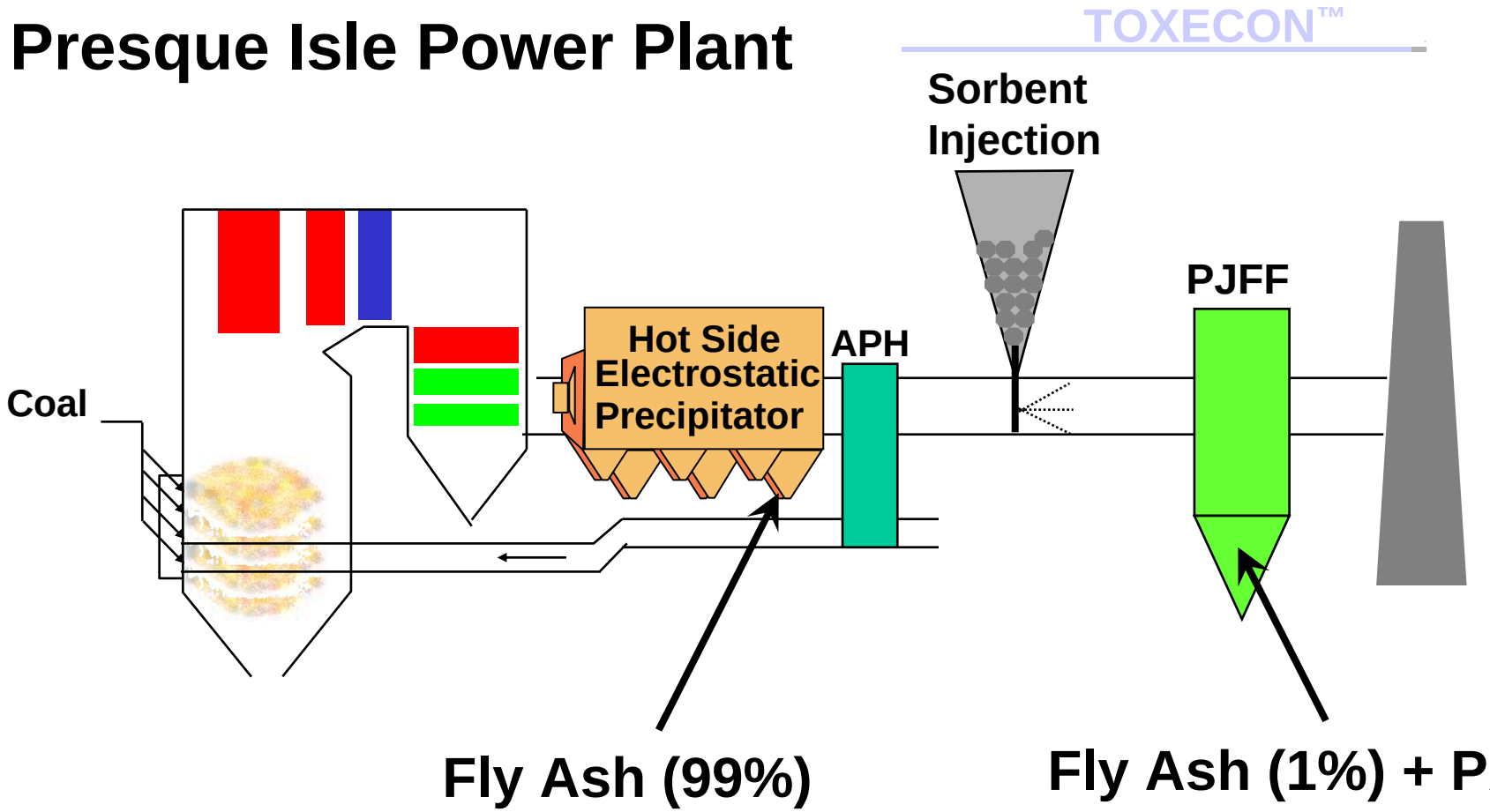
- Presque Isle Power Plant, Marquette MI
  - Units 7-9
  - PRB Coals
- $53.3M
  - $24.9M DOE
  - $28.5M We Energies

Project Goals

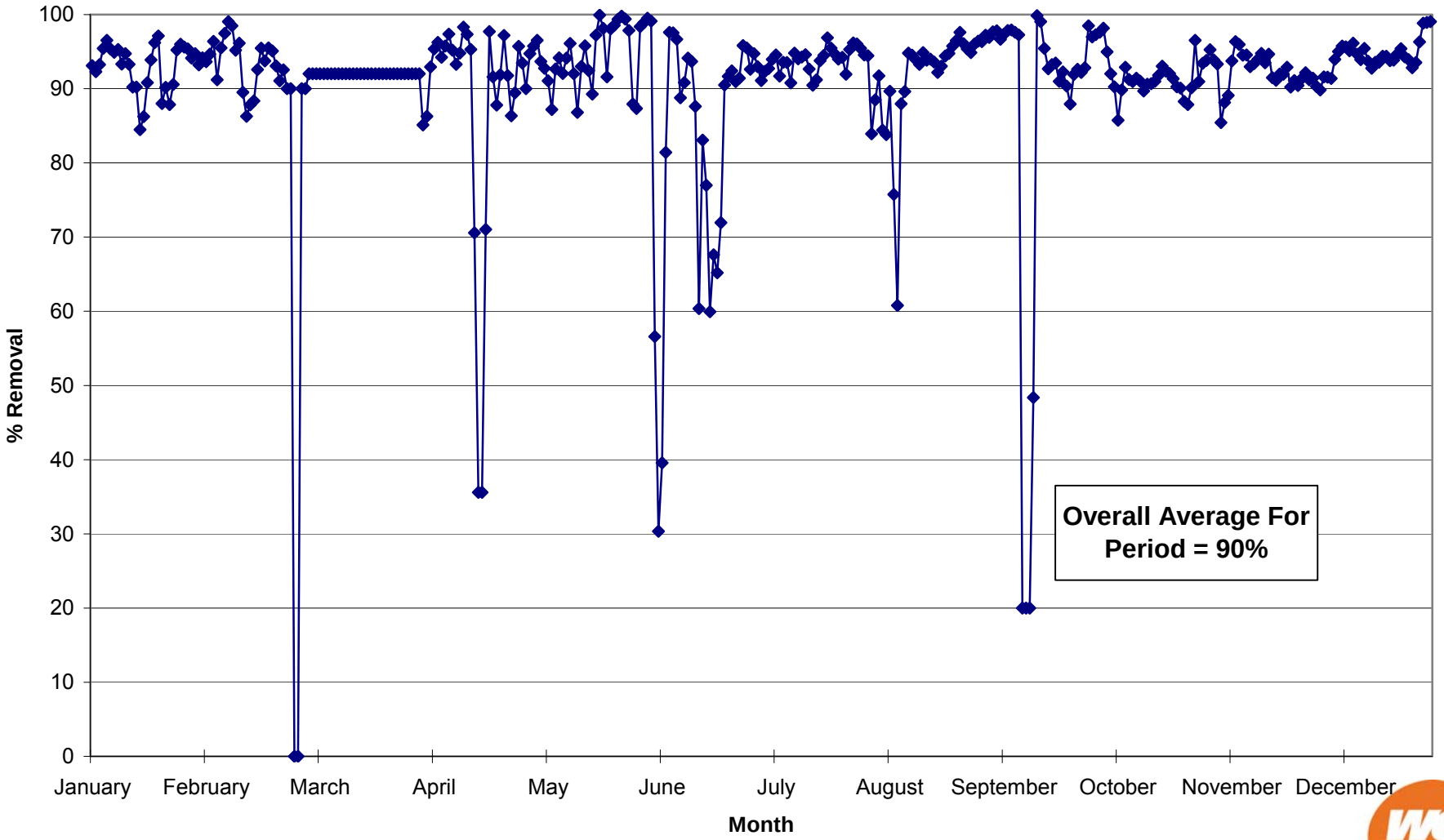
- 90% Hg - Continuous
- 70% SO_2 - Short- term
- 30% NO_X – Short-term
- Mercury Recovery – Ash Recycle

TOXECON™ Configuration

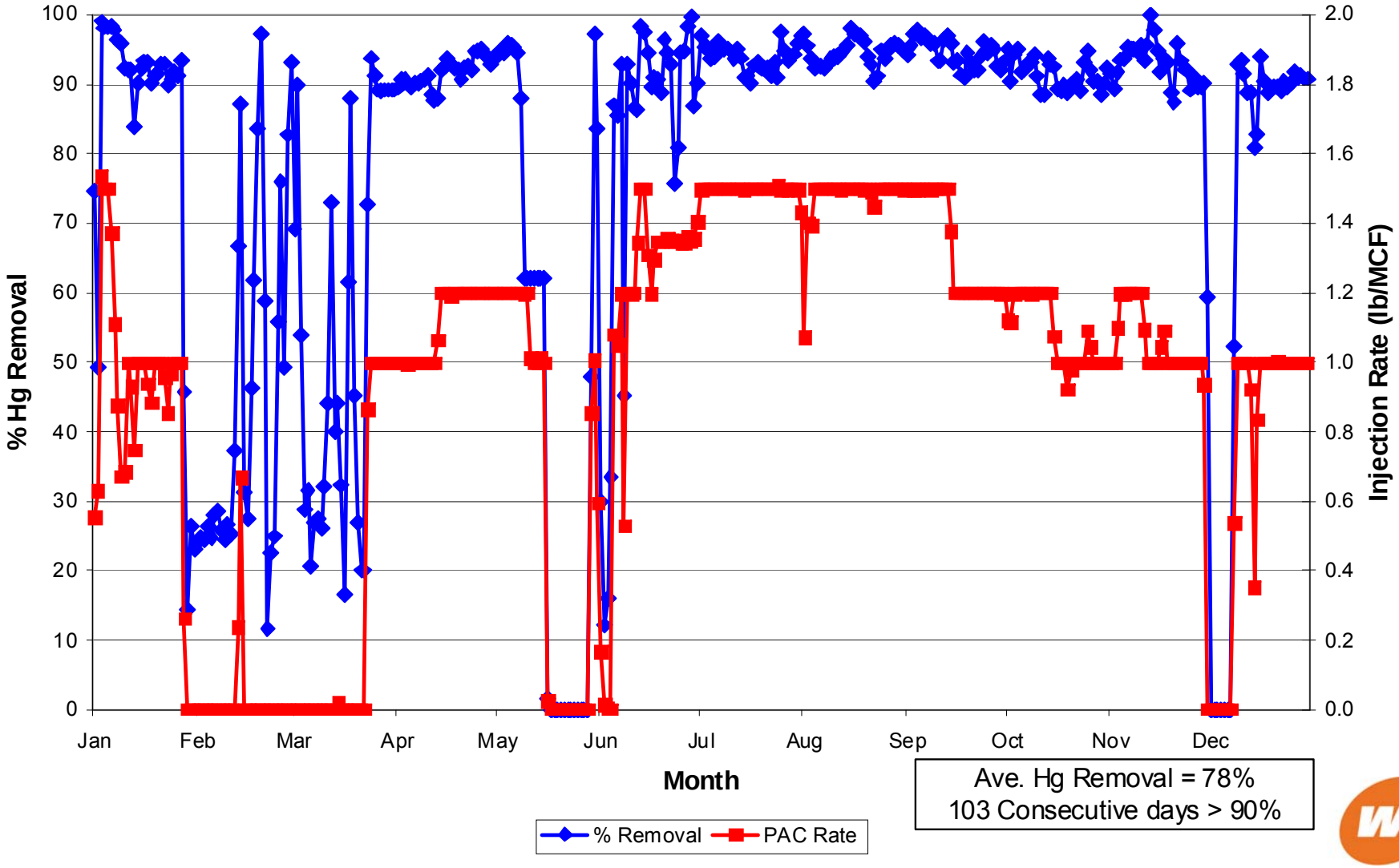
Presque Isle Power Plant



Mercury Removal
2007 Daily Averages



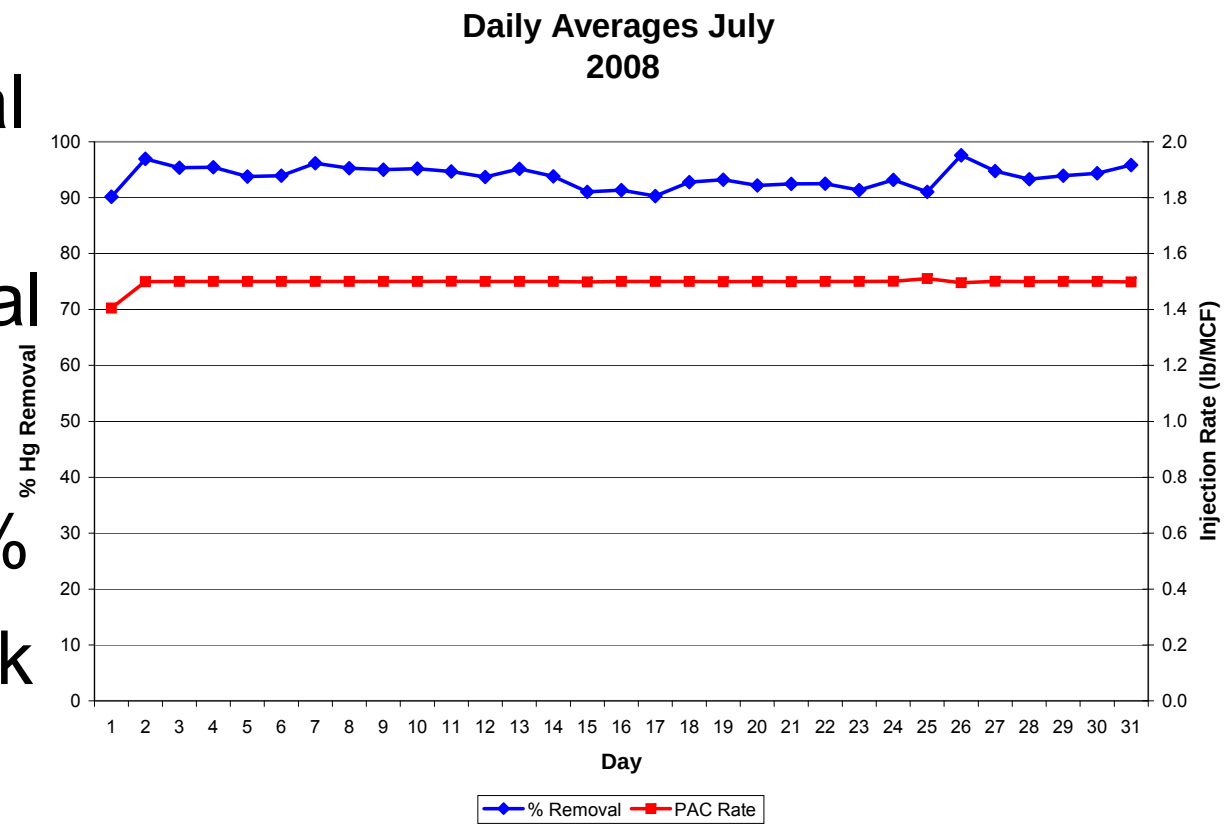
Daily Averages For 2008



Ave. Hg Removal = 78%
103 Consecutive days > 90%

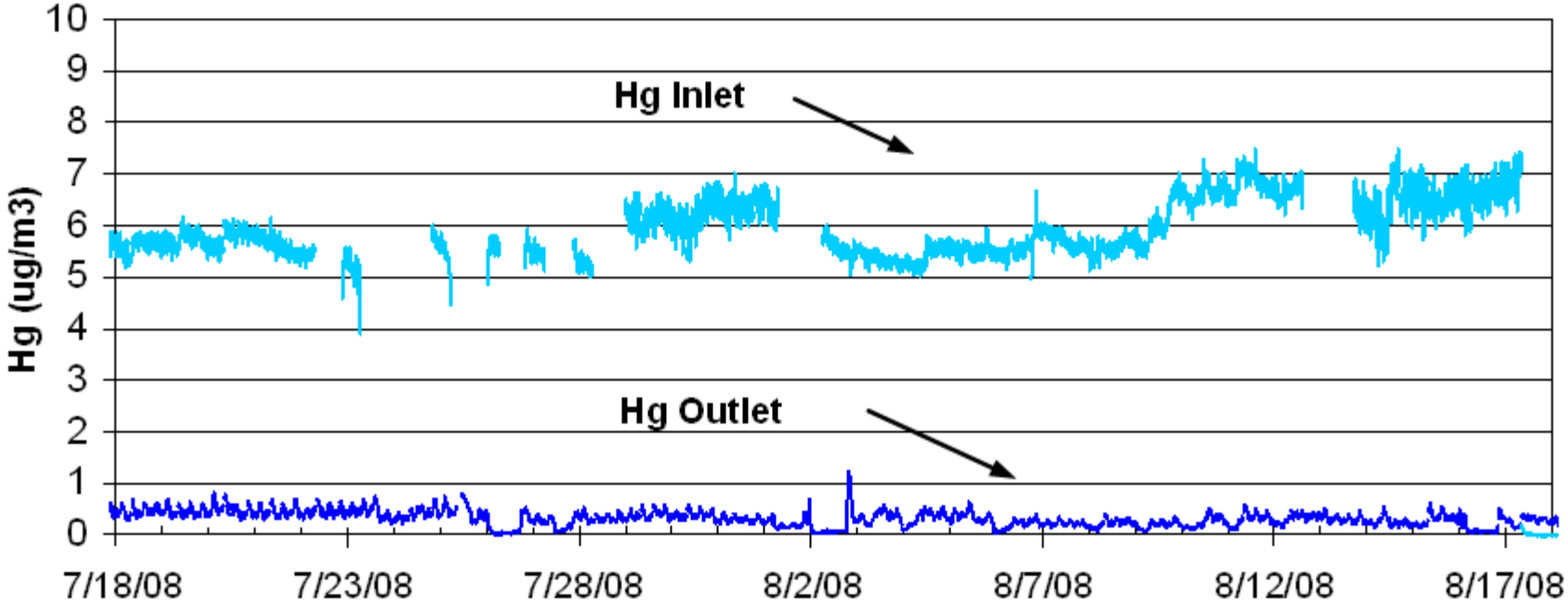
Typical Mercury Emissions

- July 2008 actual operation
- Mercury removal across the baghouse averaged 93.7%
- Mercury at stack outlet
  - 0.35 µg/m³
  - 0.007 lb/GWH



Typical Hg CEM Data

Thermo Fischer Scientific Mercury Freedom Systems



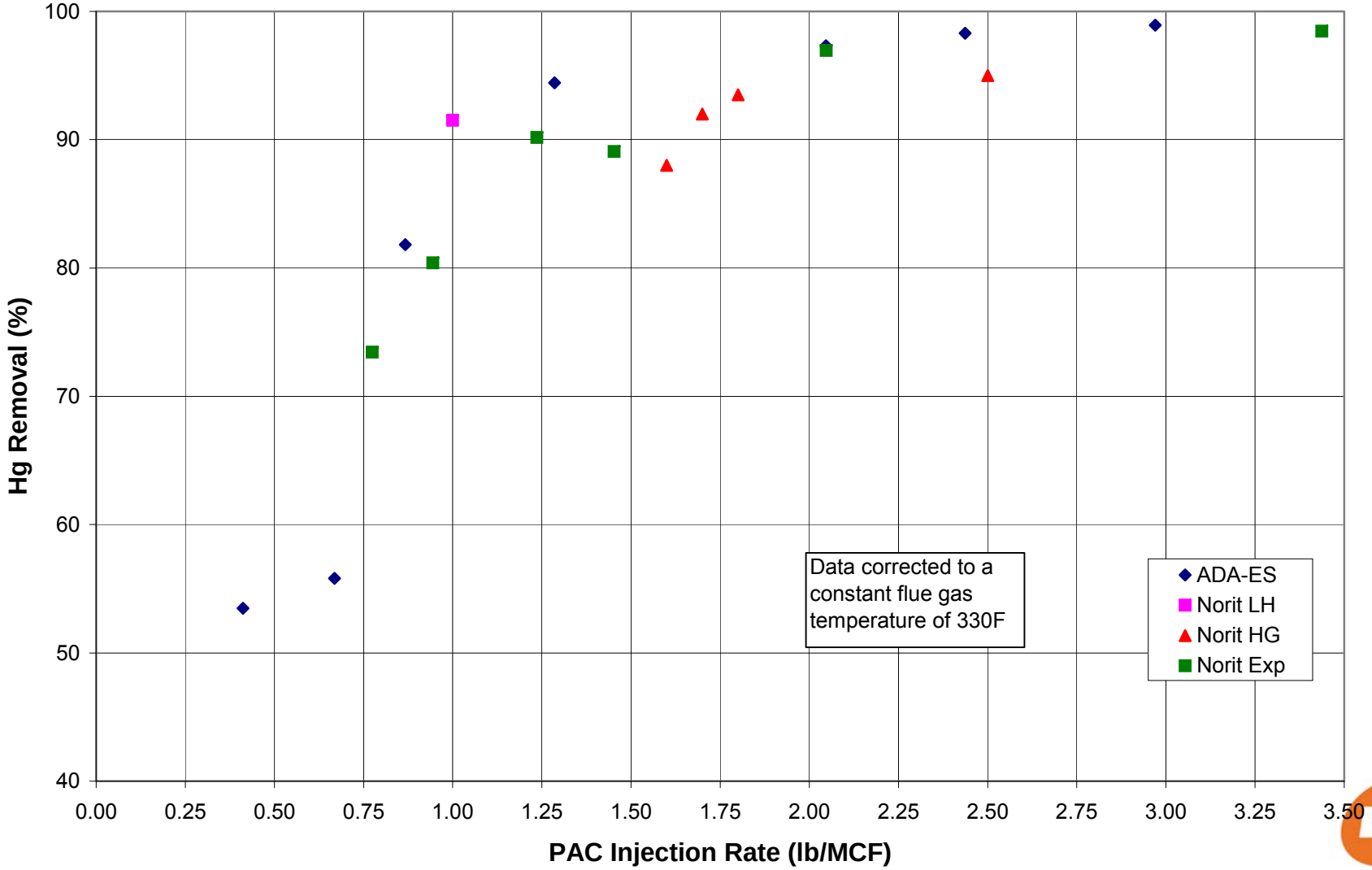
Current Operating Parameters to Achieve 90% Mercury Removal

- Norit LH at 1.0 lb/MMacf
- Baghouse Cleaning On Time
  - 3 units in service = 0.2 p/b/h
  - 2 units in service = 0.4 p/b/h
  - 1 unit in service = 0.6 p/b/h
- Ash pulled every 4 hours
- Ash hopper heaters < 300 °F wall temperature

Alternative Sorbent Testing

- High carbon ash from bituminous coal units at Presque Isle
  - 40% mercury removal @ 10 lb/MMacf
  - Co-injected with Norit LH
    - Still required 1.5 lbs/MMacf of PAC for 90% removal
    - There was no improvement due to the ash.
  - Milled ash to reduce particle size
    - Did not improve capture
- Developmental PACs

Comparing PACs



Mercury Recovery – Ash Recycle

- Original project goal to demonstrate sorbent regeneration and recover 90% of mercury captured in the sorbent
  - 2 separate processes were developed and demonstrated with both exceeding 90% recovery
- Added goal to eliminate PAC/ash disposal in landfill
  - Developed and demonstrated processes to use PAC/ash in concrete

Reprocessing PAC

- Michigan Tech University
  - Microwave energy
  - Successful lab-scale demo
    - Removal of mercury
    - PAC/ash sorbent screening test
- United Environment & Energy
  - Thermal energy
  - Successful pilot-scale demo
    - Removal of mercury
    - Conversion to fertilizer
    - Greenhouse testing

PAC / Ash Use in Concrete

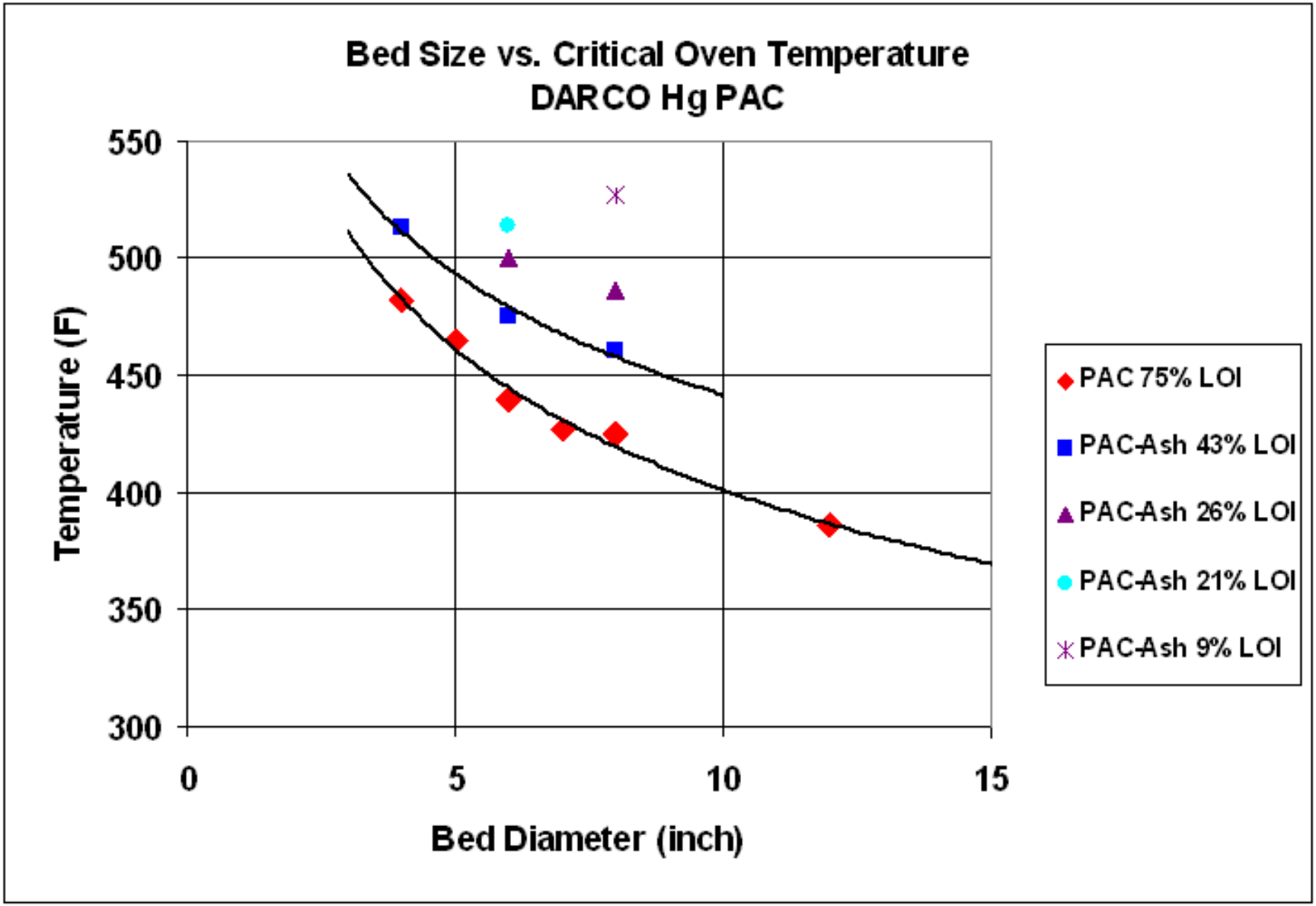
- Dallas based Miracon Technologies has developed a low-cost air entraining process that is minimally affected by activated carbon content
- Laboratory evaluation of concrete mixtures using the high PAC TOXECON ash at varying LOI levels
- Tests include
  - Compressive strength
  - Hardened air void analysis
  - Chloride permeability
- Lab and full scale tests were performed at Sky Ute Sand & Gravel in Farmington NM using the new air entraining process
- Based on promising lab- and full-scale results, a test pad 30’ x 60’ will be poured at PIPP using TOXECON ash and the new air entraining process

Balance of Plant Issues

- Spontaneous Combustion
- Ash/PAC Handling
- Duct Corrosion
- Bag Life

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
  - Minimize amount of PAC injected
- Test installation of hopper CO monitor was unsuccessful


Bed Size vs. Critical Oven Temperature
DARCO Hg PAC
550
500
450
400
350
300
Temperature (F)
0
5
10
15
Bed Diameter (inch)
PAC 75% LOI
PAC-Ash 43% LOI
PAC-Ash 26% LOI
PAC-Ash 21% LOI
PAC-Ash 9% LOI

Material Handling Issues

- Ash Silo Wet Unloader
  - Excessive dusting during startup has been an ongoing problem
  - Extensive modifications were required
  - Adding enclosure around truck loading station

Duct Corrosion

- Over 19% wall loss in localized areas
- Expansion joint frames
- Diverter damper seals
- Possible causes:
  - SO3 increase across baghouse?
  - Dead-ended ductwork under certain operating scenarios causing temperatures less than acid dew point?

Bag Life

- Lab testing indicates bags have reached end of life
- Had expected considerably longer life
- Complete set of replacement bags has been purchased
- No apparent actual bag failures
- Continuing to monitor

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 continues to provide operational experience

we-energies.com