Preliminary Performance Testing Results from the Greenidge Multi-Pollutant Control Project

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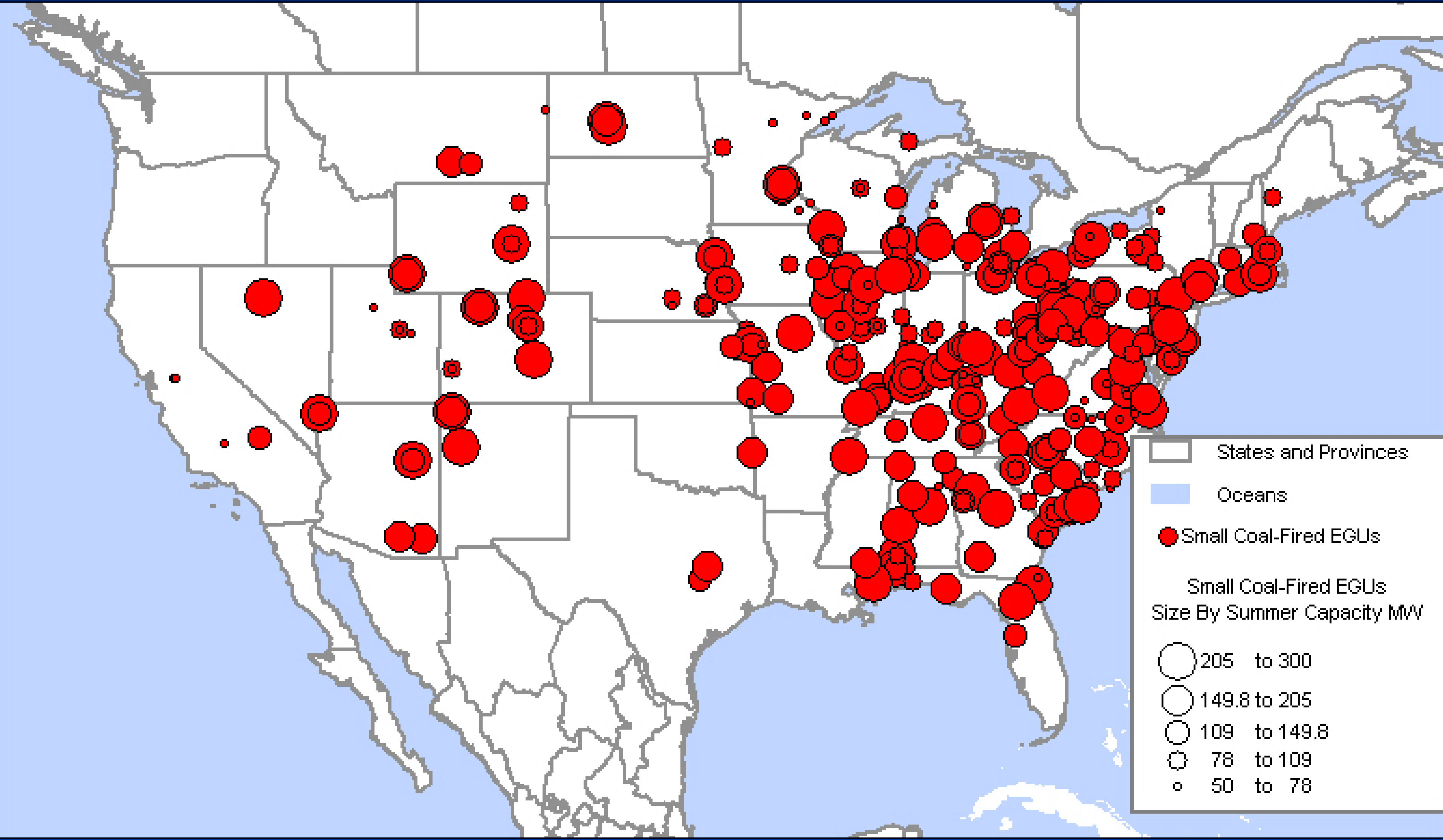
Greenidge Multi-Pollutant Control Project

- Part of U.S. DOE’s Power Plant Improvement Initiative
- Participants
  - CONSOL Energy Inc. (administration, testing, reporting)
  - AES Greenidge LLC (host site, operations)
  - Babcock Power Environmental Inc. (EPC contractor)
- Funding
  - U.S. Department of Energy, National Energy Technology Laboratory
  - AES Greenidge LLC
- Goal: Demonstrate a multi-pollutant control system that can cost-effectively reduce emissions of NO_x, SO_2, mercury, acid gases (SO_3, HCl, HF), and particulate matter from smaller coal-fired EGUs

Existing U.S. Coal-Fired EGUs
50-300 MW_e



Existing U.S. Coal-Fired EGUs
50-300 MW_e

- ~ 440 units not equipped with FGD, SCR, or Hg control
  - Represent ~ 60 GW of installed capacity
  - Greater than 80% are located east of the Mississippi River
  - Most have not announced plans to retrofit
- Difficult to retrofit for deep emission reductions
  - Large capital costs
  - Space limitations
- Increasingly vulnerable to retirement or fuel switching because of progressively more stringent environmental regulations
  - CAIR, CAMR, CAVR, state regulations
- Need to commercialize technologies designed to meet the environmental compliance requirements of these units

AES Greenidge Unit 4
(Boiler 6)

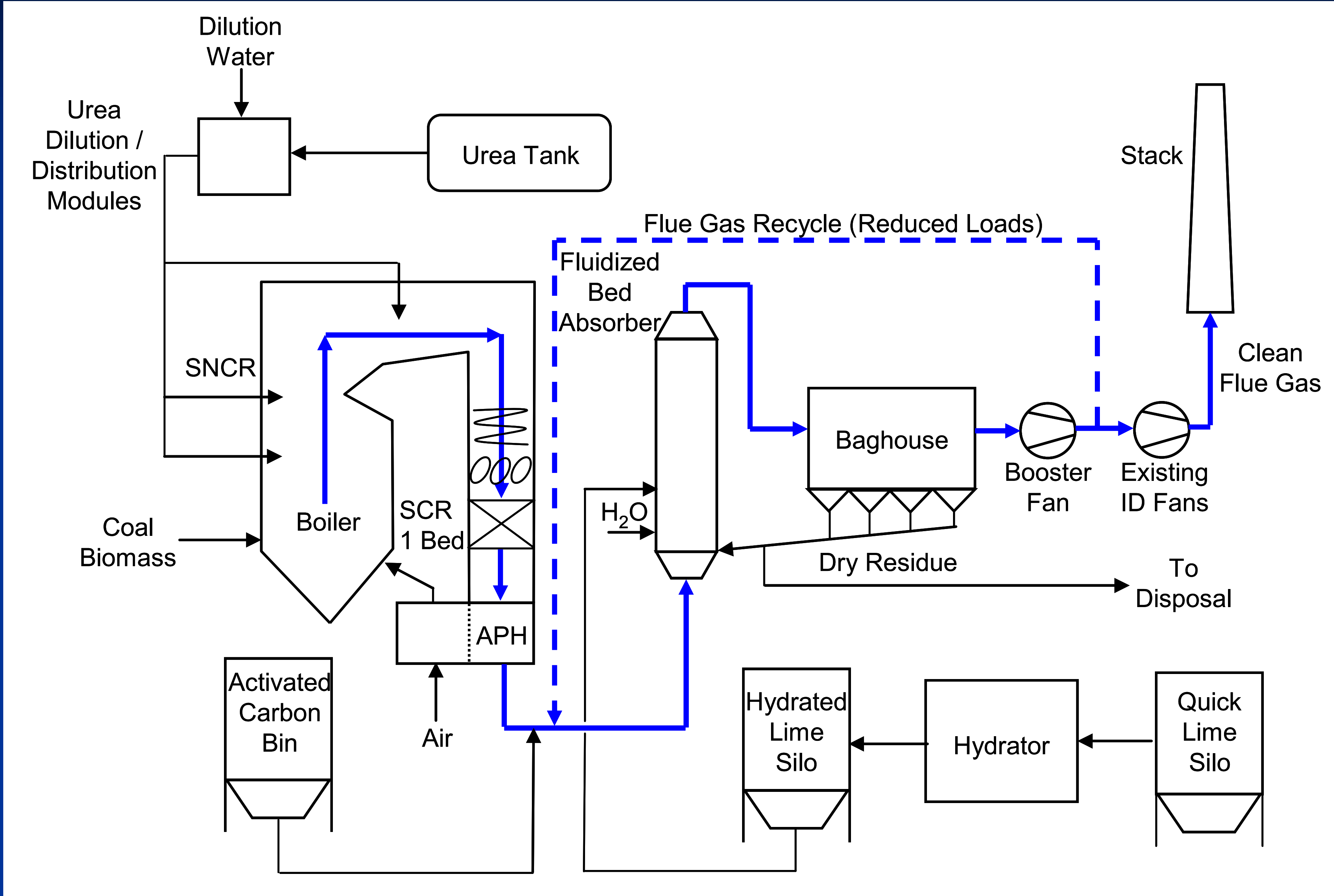
- Dresden, NY
- Commissioned in 1953
- 107 MW_e reheat unit
- Boiler:
  - Combustion Engineering tangentially-fired, balanced draft
  - 780,000 lb/h steam flow at 1465 psig and 1005 ^oF

- Fuel:
  - Eastern U.S. bituminous coal
  - Biomass (waste wood) – up to 10% heat input
- Existing emission controls:
  - Overfire air (natural gas reburn not in use)
  - ESP
  - No FGD - mid-sulfur coal to meet permit limit of 3.8 lb SO_2/MMBtu

Design Objectives

- Deep emission reductions
- Low capital costs
- Small space requirements
- Applicability to high-sulfur coals
- Low maintenance requirements
- Operational flexibility

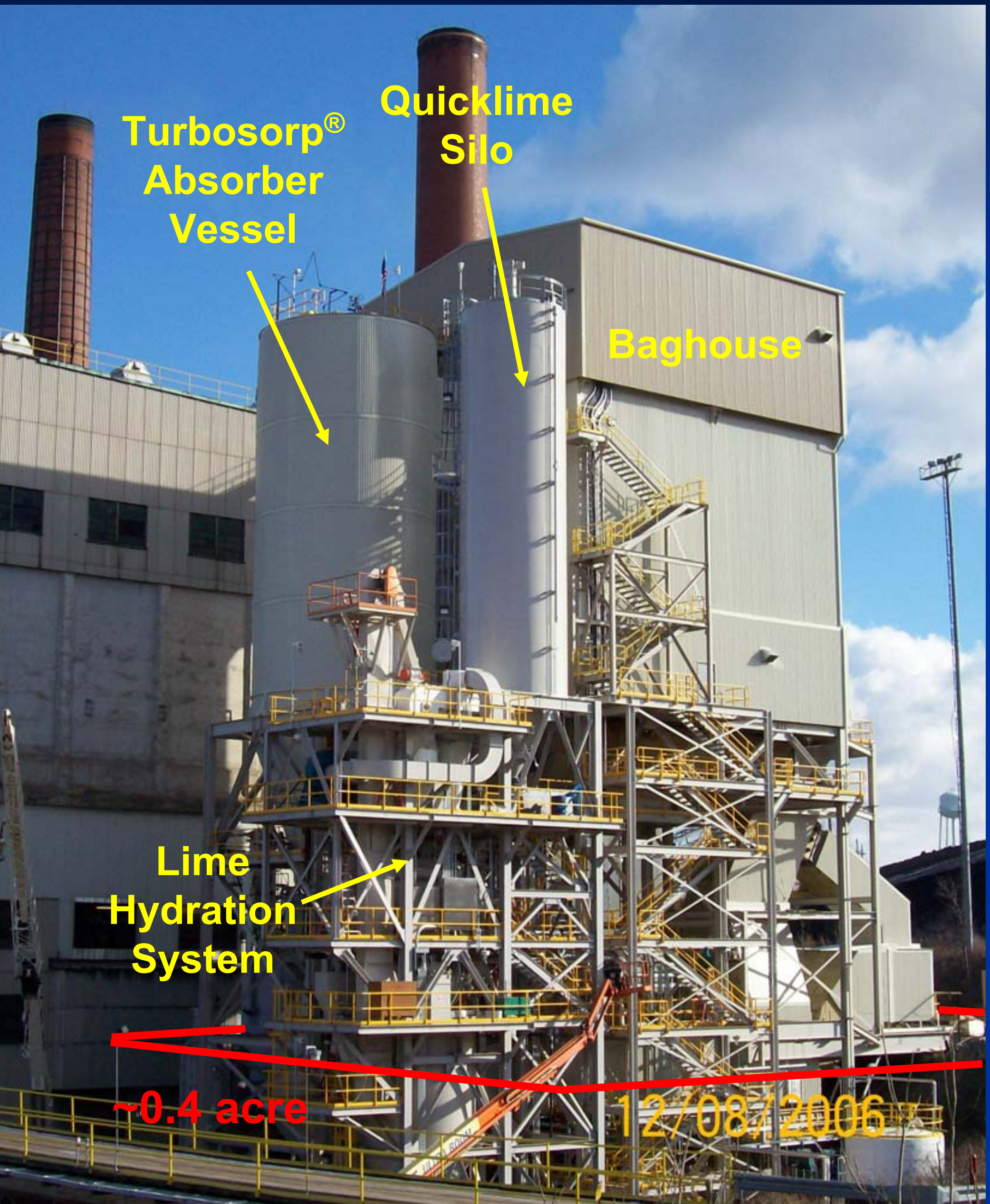
Multi-Pollutant Control Process



Hybrid NO_x Control

- Combustion Modifications
  - Replace coal, combustion air, and overfire air nozzles
  - Reduce NO_x to 0.25 lb/MMBtu
- SNCR
  - Three zones of urea injection
  - Provide NH_3 slip for SCR
  - Reduce NO_x by ~ 42.5% (to 0.144 lb/MMBtu)
- SCR
  - Single catalyst bed (1.3 m)
  - Cross section = 45' x 14'
  - Fed by NH_3 slip from SNCR
  - Reduce NO_x by > 30% (to ≤ 0.10 lb/MMBtu)

Turbosorp® System



- Completely dry
- Separate control of reagent, water, and recycled solid injection
- Applicable to high-S coal
- High solids recirculation
- 15-25% lower reagent consumption than SDA
- Carbon steel construction
- No wet stack
- Low maintenance requirements
  - Few moving parts
  - No slurries
  - No dewatering

Mercury Control

- System design favors high baseline Hg removal without activated carbon injection
  - Hg oxidation across in-duct SCR catalyst
  - Low temperature (~170 ^{o}F) in scrubber / baghouse
  - Ample gas / solids contact in scrubber / baghouse
  - Similar to SCR / SDA / FF with bituminous coal
    - Field sampling shows 90% Hg removal often achieved with no ACI

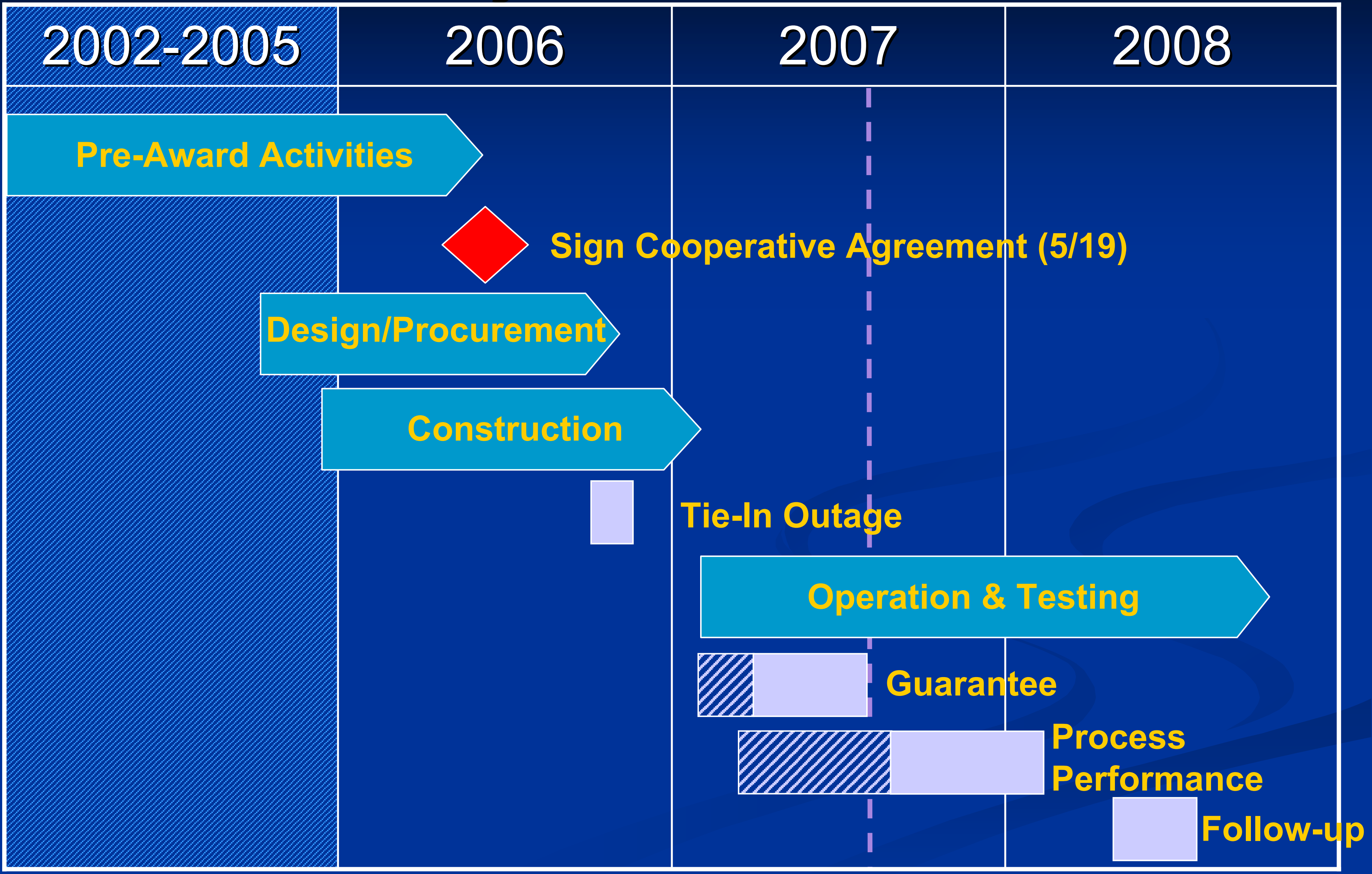
- To ensure ≥ 90% Hg removal, demonstration at AES Greenidge includes an activated carbon injection system
  - Turbosorp® system provides high carbon residence time
  - Projected activated carbon requirement: 0.0 – 3.5 lb/mmacf

Performance Targets

Fuel: 2-4% sulfur bituminous coal, up to 10% biomass

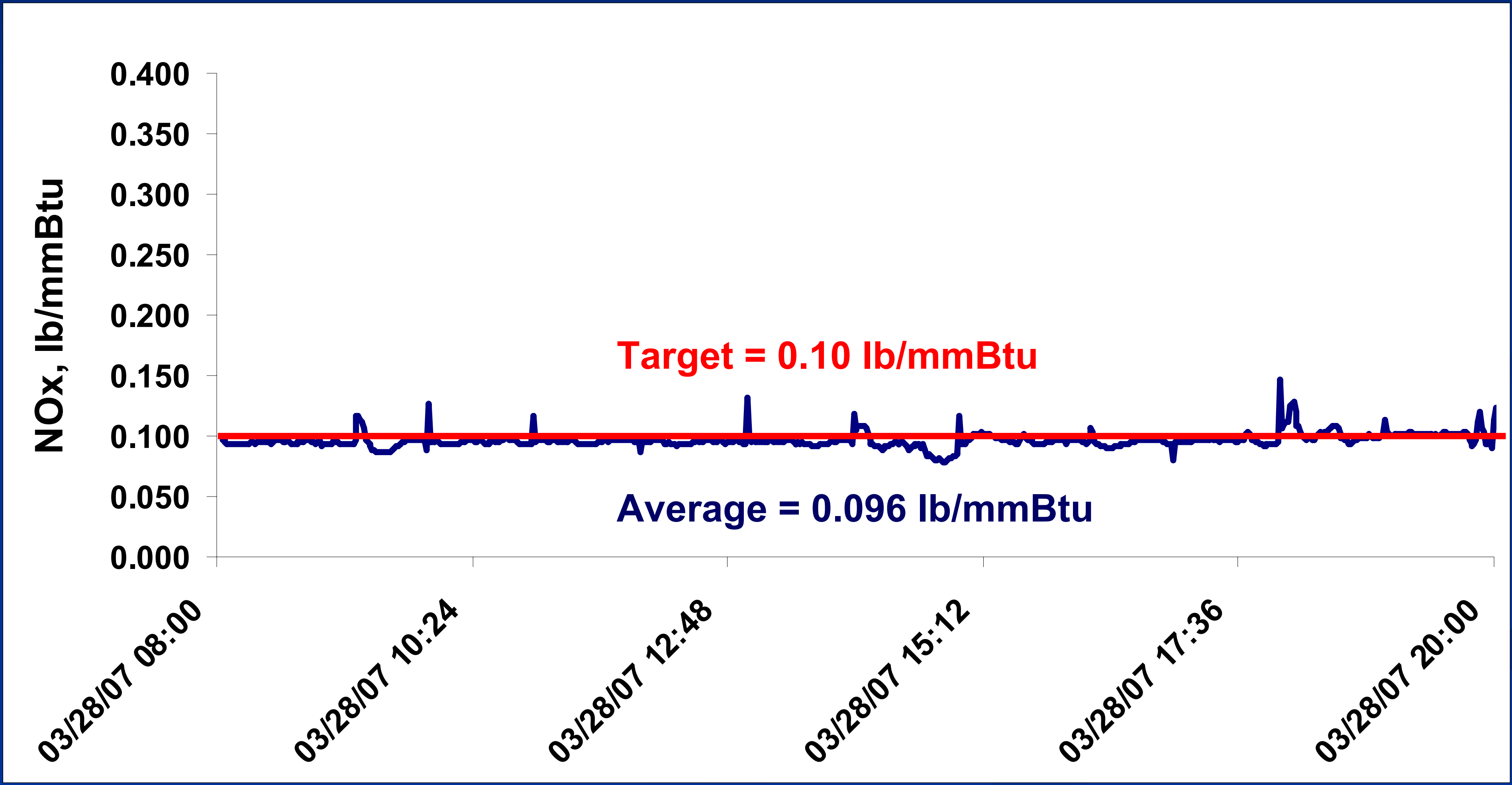
Parameter	Goal
NO_x	≤ 0.10 lb/mmBtu (full load)
SO_2	≥ 95% removal
Hg	≥ 90% removal
SO_3, HCl, HF	≥ 95% removal

Project Schedule



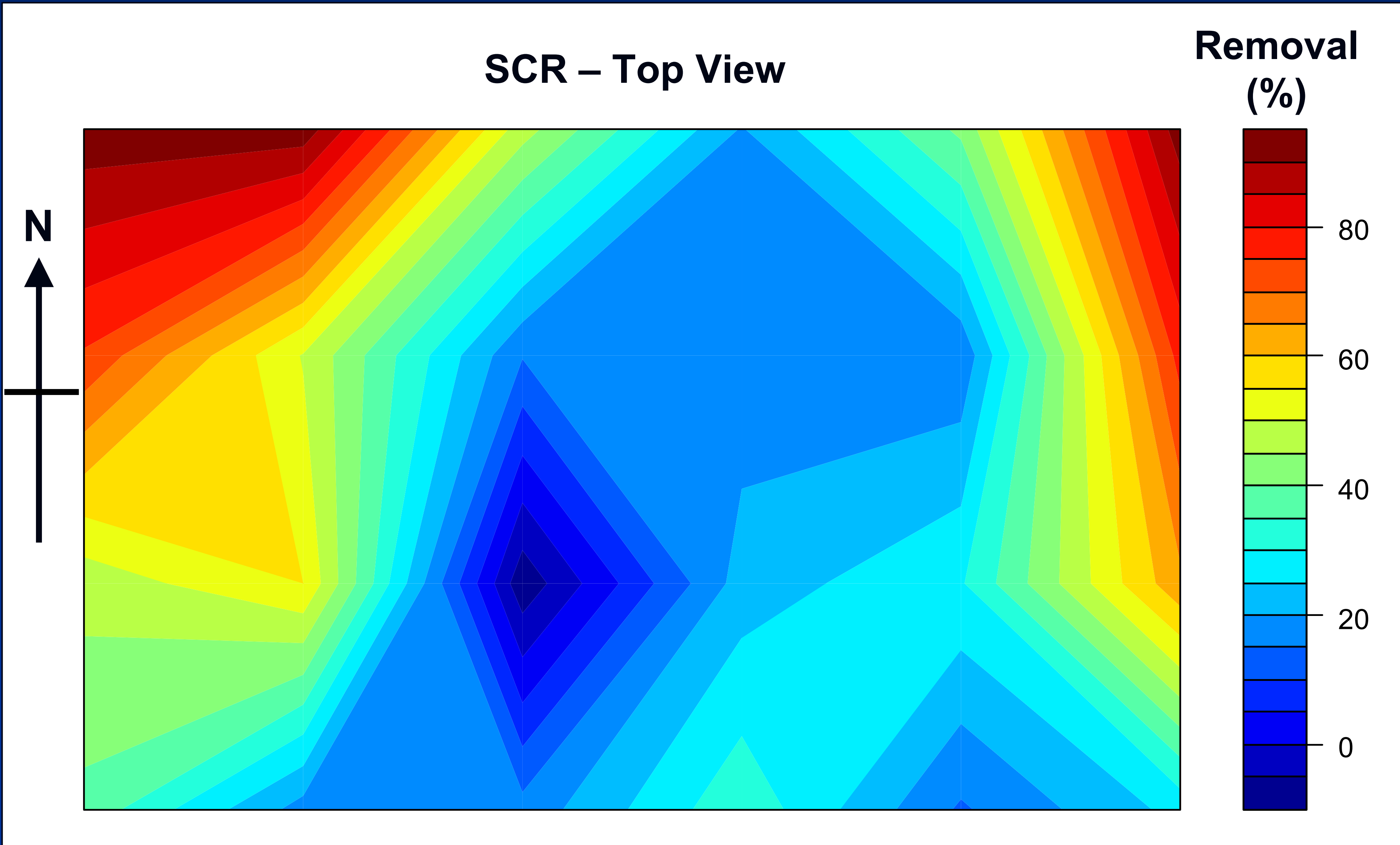
NO_x Emission Rate

March 28, 2007

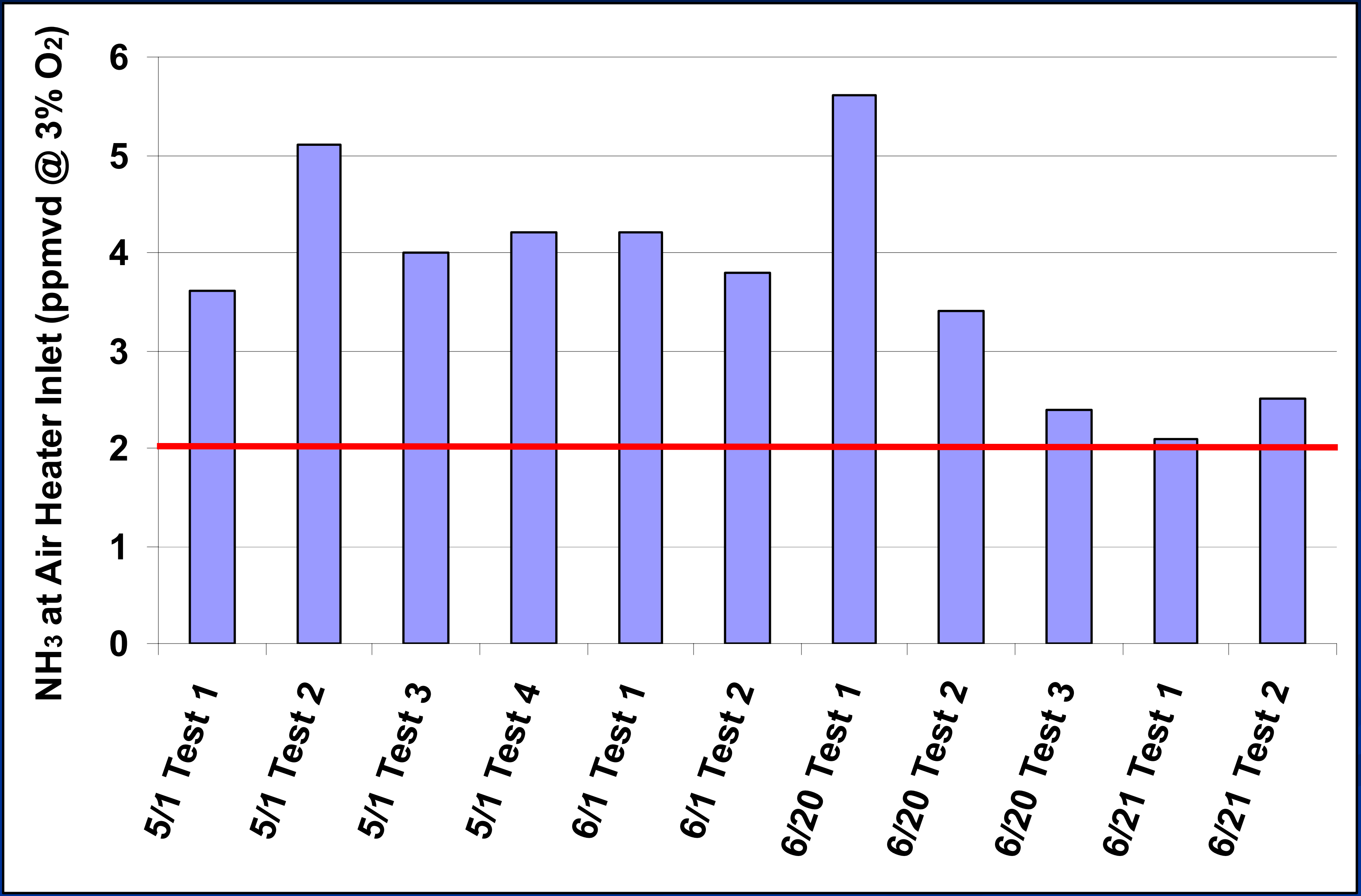


NO_x Removal Across SCR

March 28, 2007 – Three-Test Average



Ammonia Slip



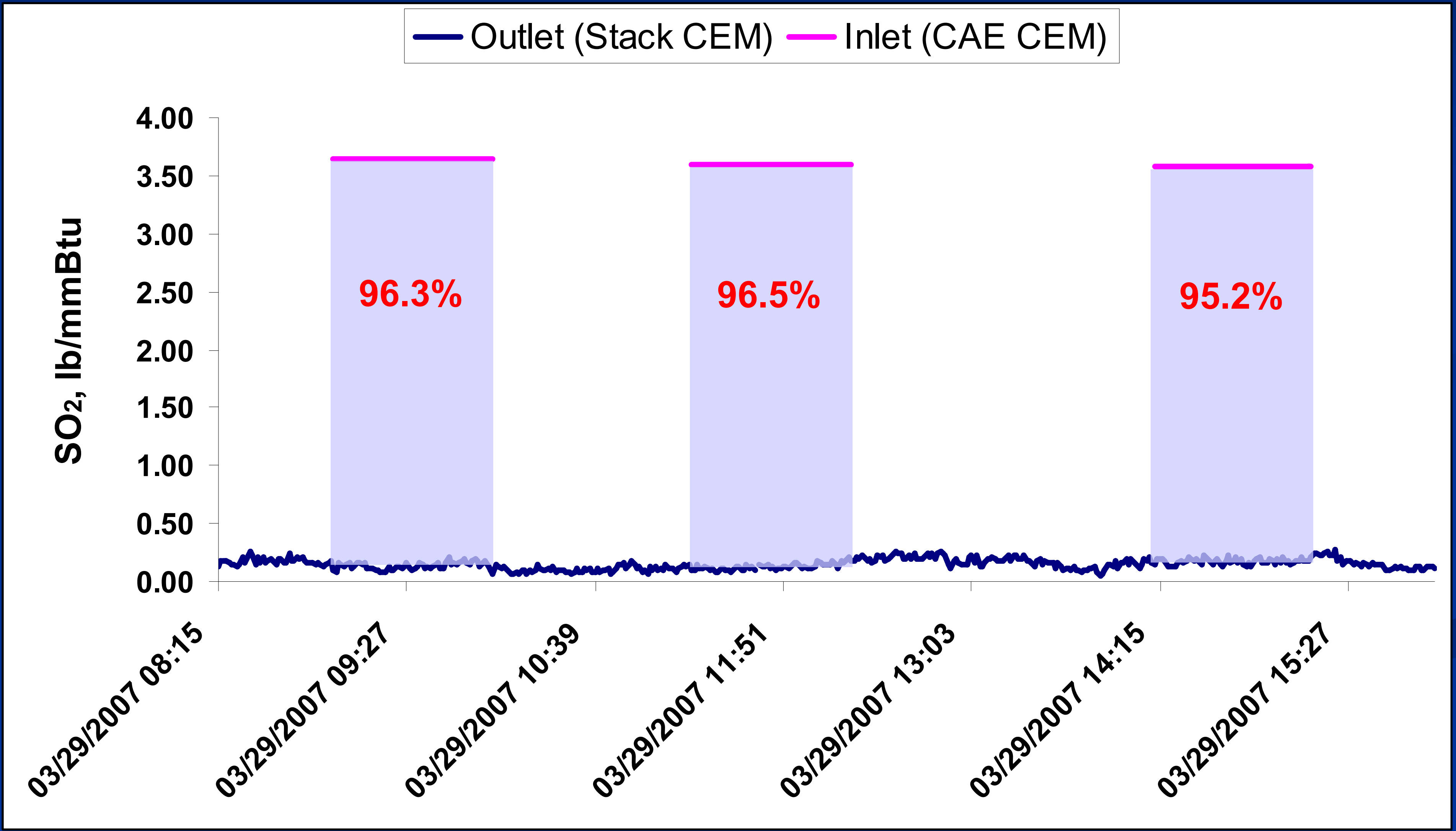
Large Particle Ash

Solution - May 2007

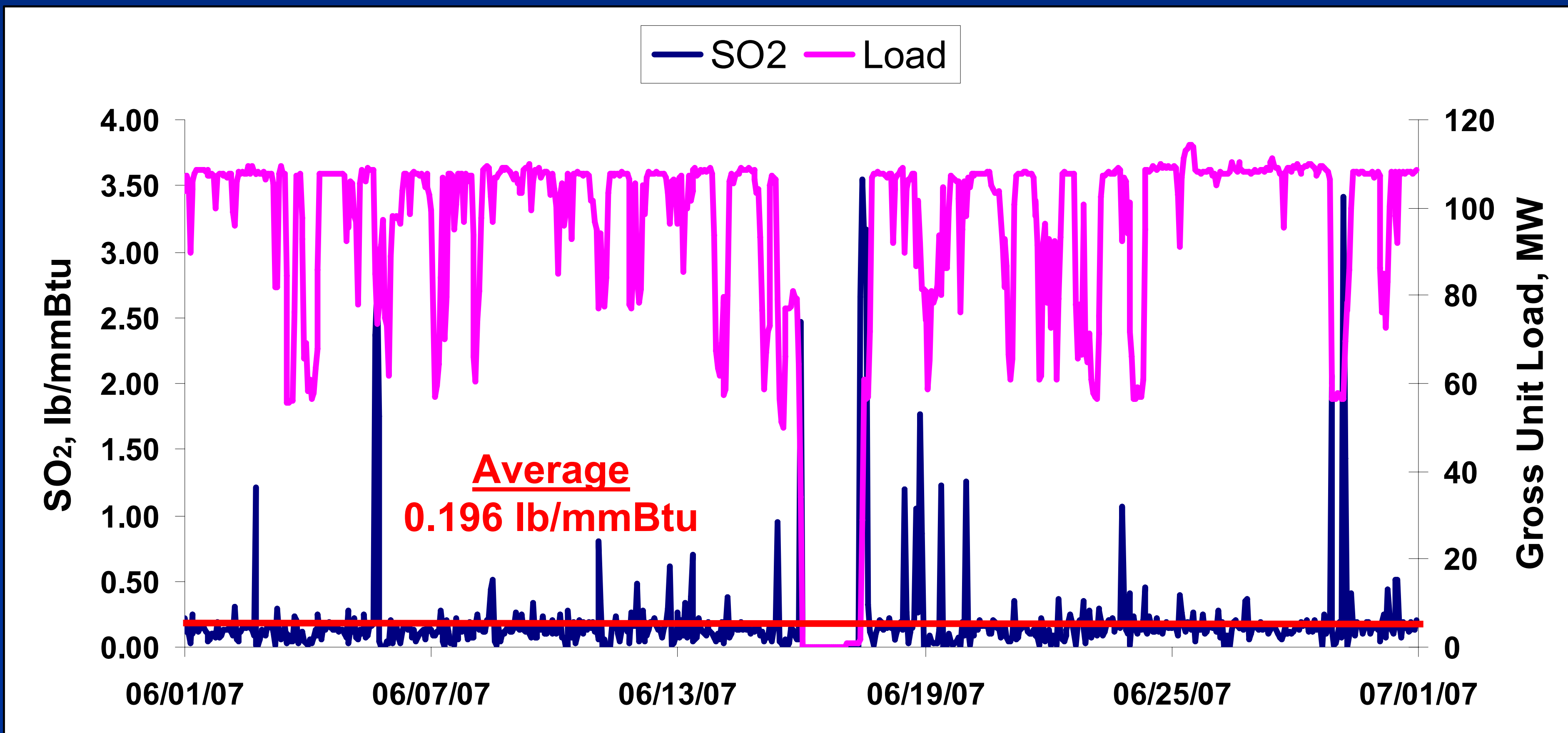
- Sloped screen above catalyst
- Soot blowers
- Vacuum ports

SO_2 Removal Efficiency

March 29, 2007

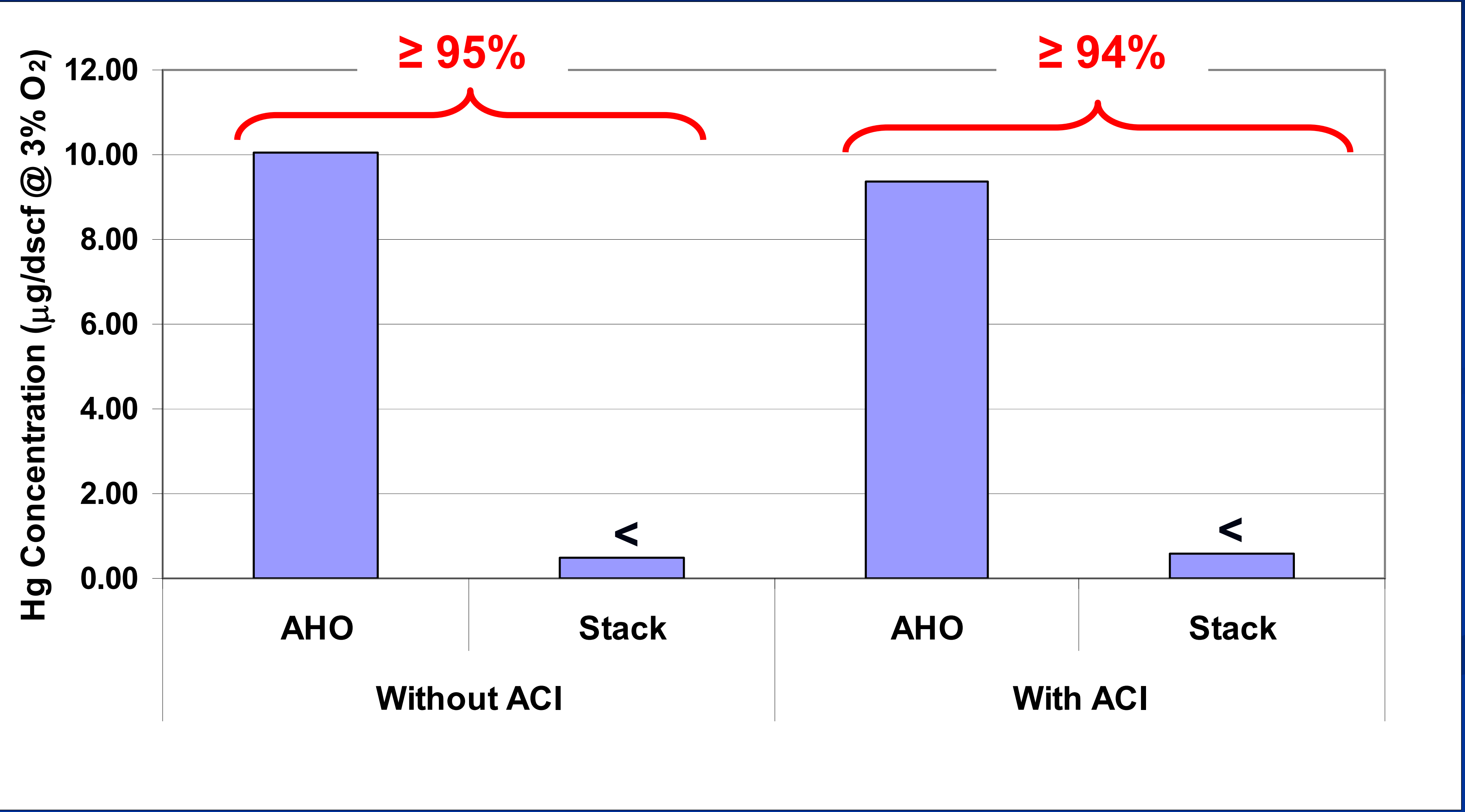


SO_2 Emissions
June 2007



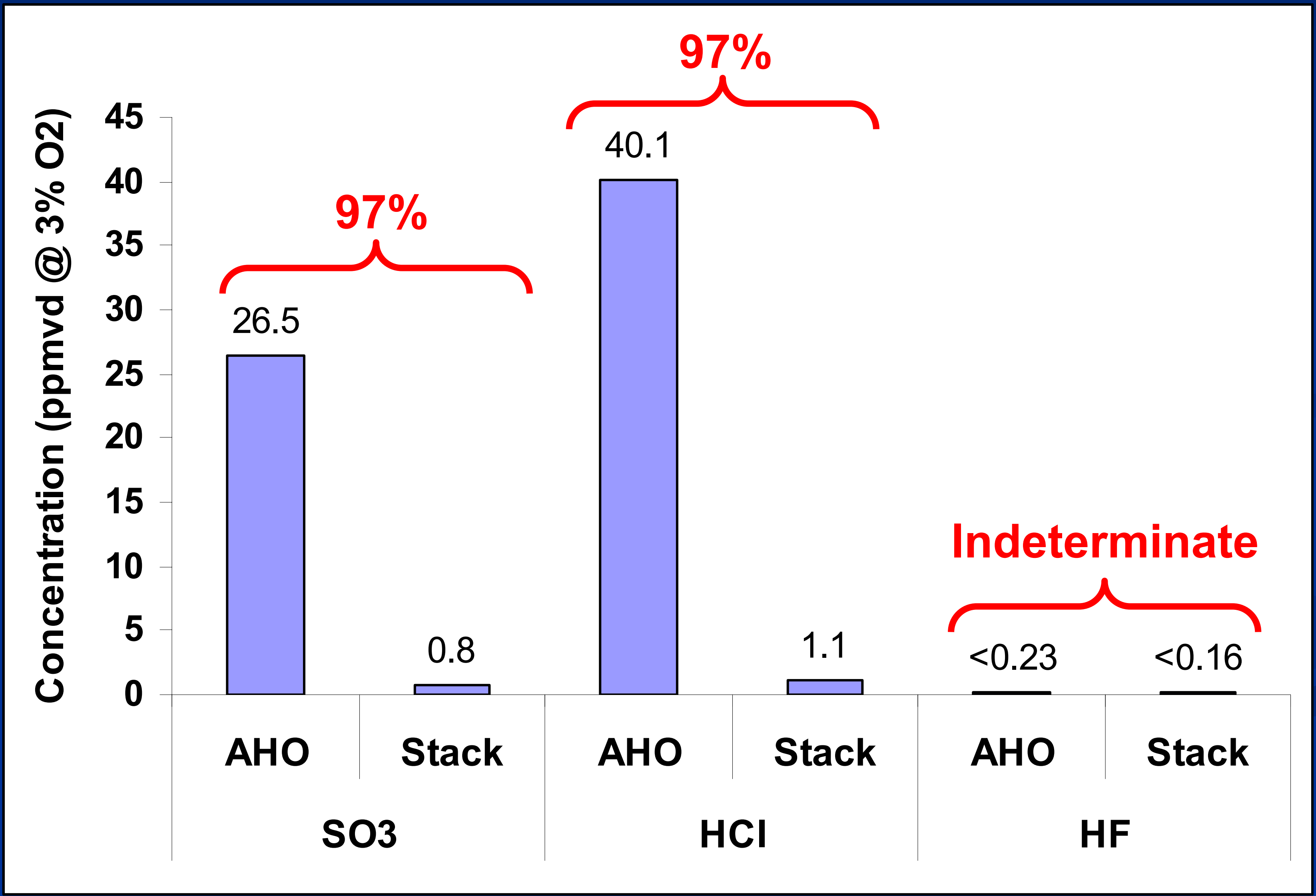
Mercury

March 28-30, 2007

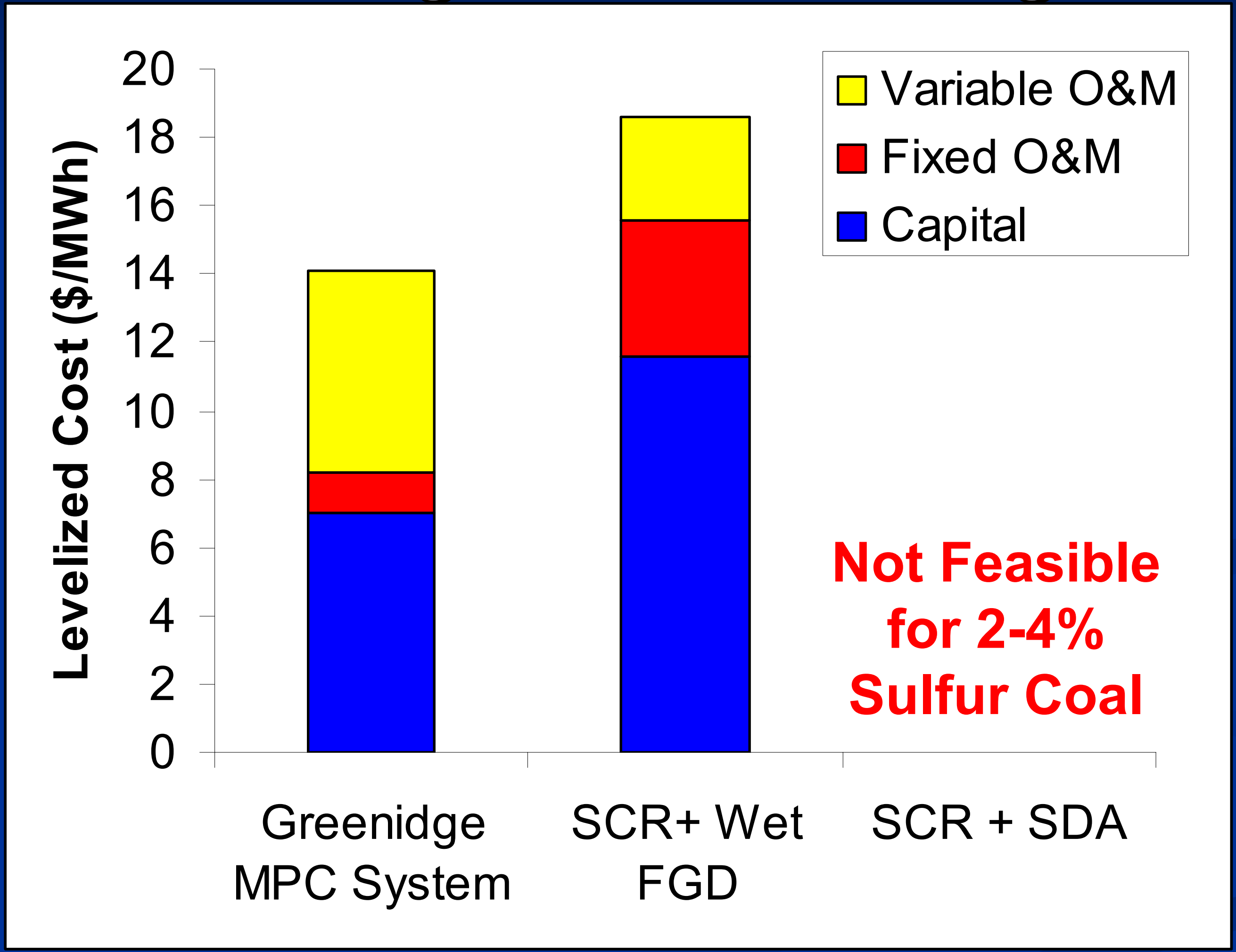


Acid Gases

May 2-4, 2007



Economics
AES Greenidge Unit 4 – Design Case



SCR + Wet FGD modeled using Integrated Environmental Control Model with technical assumptions from Greenidge design basis; both systems modeled using common set of economic assumptions

Summary

- Greenidge MPC process uniquely designed to meet needs of smaller coal-fired units
  - Deep emission reductions
  - Low capital costs
  - Small space requirements
  - Applicability to high-sulfur coals
  - Low maintenance requirements
  - Operational flexibility
- Preliminary performance testing results are encouraging
  - Demonstrated ability of system to achieve emission targets for NO_x, SO_2, Hg, and acid gases
  - Still optimizing NO_x control system, evaluating effects of higher-than-expected NH_3 slip
- Additional testing planned for September 2007 – June 2008

Disclaimer