Updates on the Performance of Selected Circulation Dry Scrubbers

Shiaw Tseng (stseng@graymont.com)

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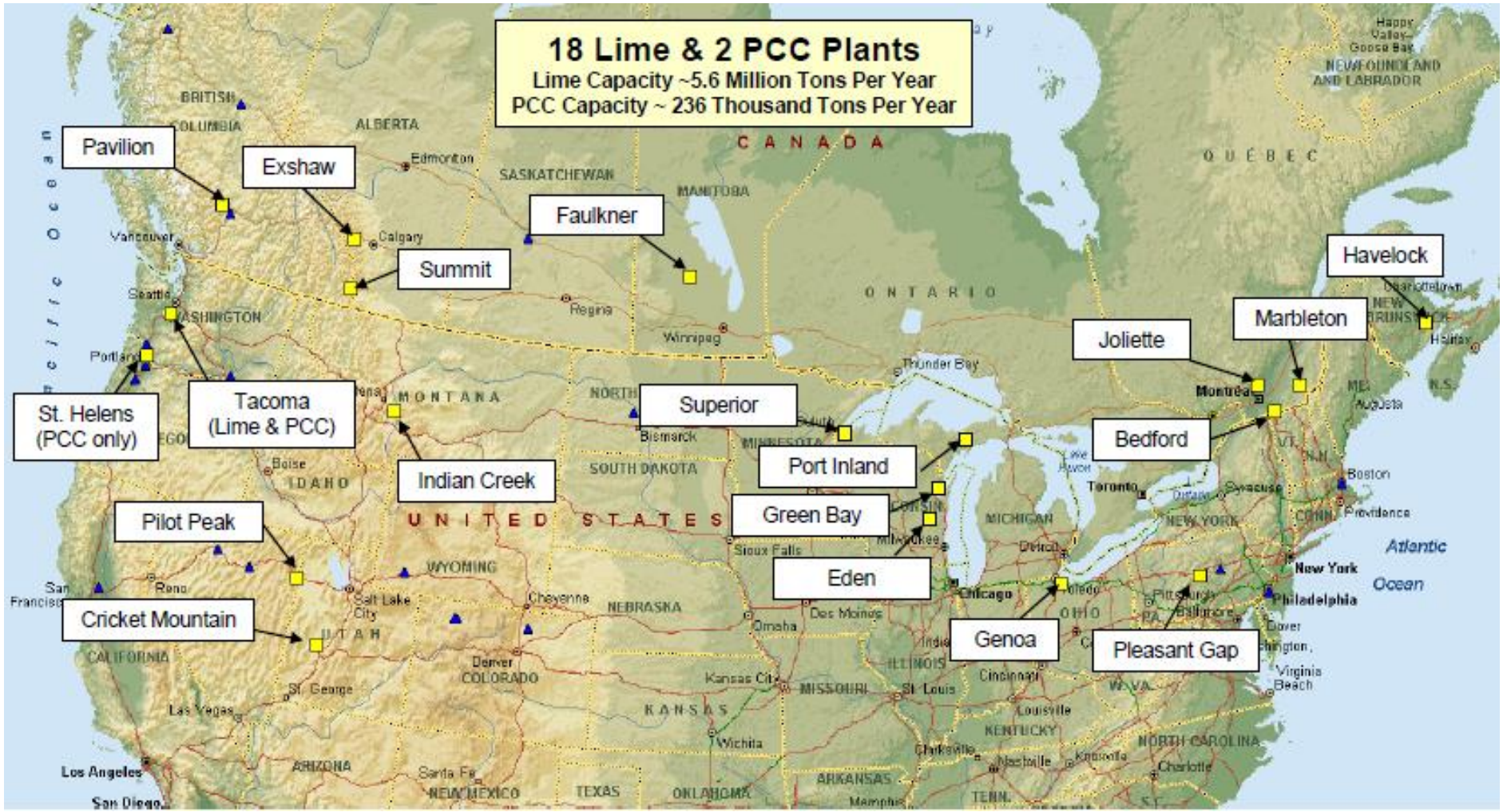
Outline

- Introduction
- Generic process flow diagrams of a circulation dry scrubbing (CDS) systems
- Locations of CDS installed at U.S. power plants
- Performance of CDS in
  - SO_2 removal
  - handling higher S coal
  - handling load swing
  - HAPs removal
- Conclusions

Graymont Lime Group Production and Terminal Facilities



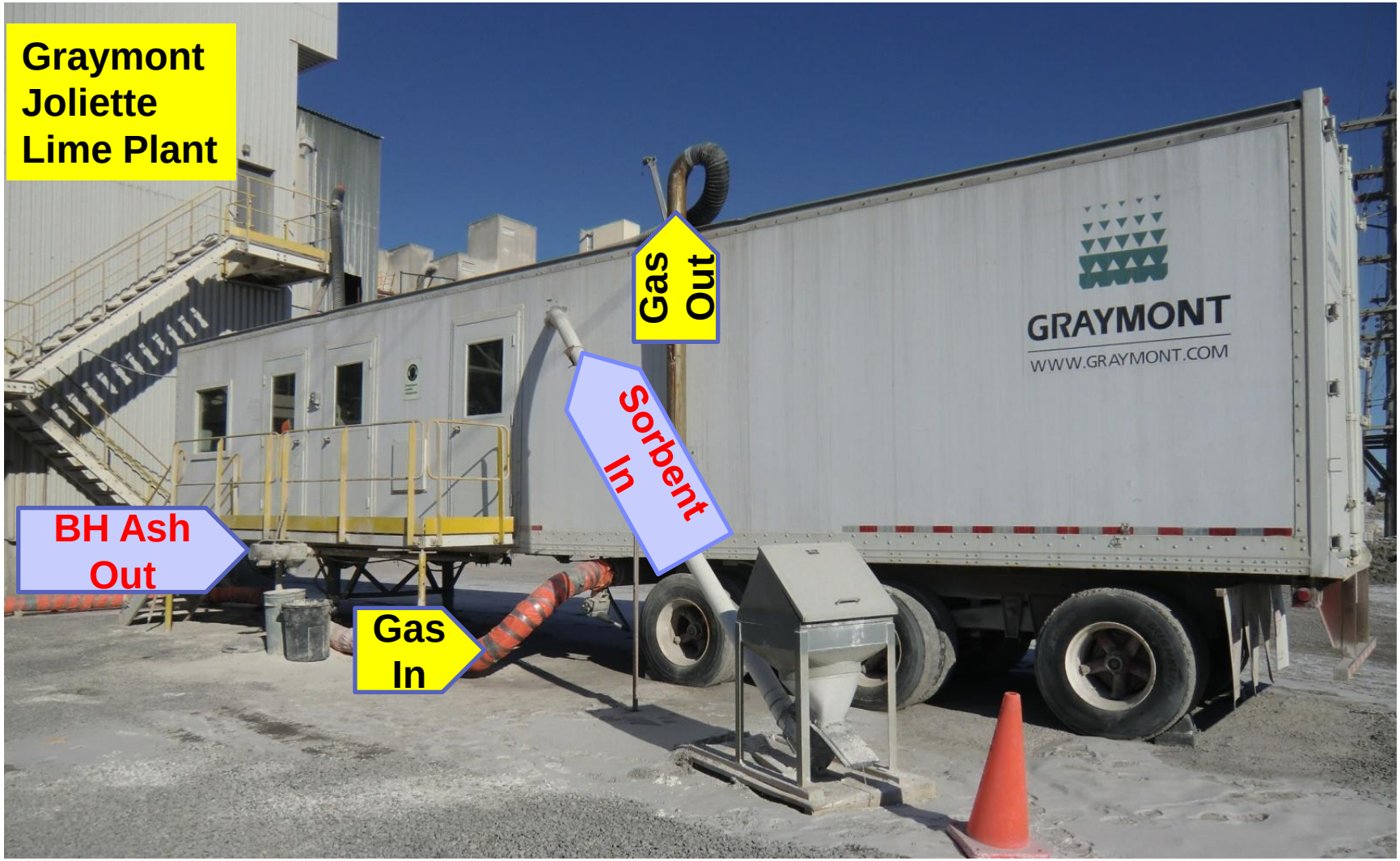
CDS at Graymont's Pleasant Gap Lime Plant

Pleasant Gap, PA
Kiln #7
Type: Rotary
Capacity: 1,050 tpd lime
Power Plant: 3.5MW
Fuel: coal/petcoke

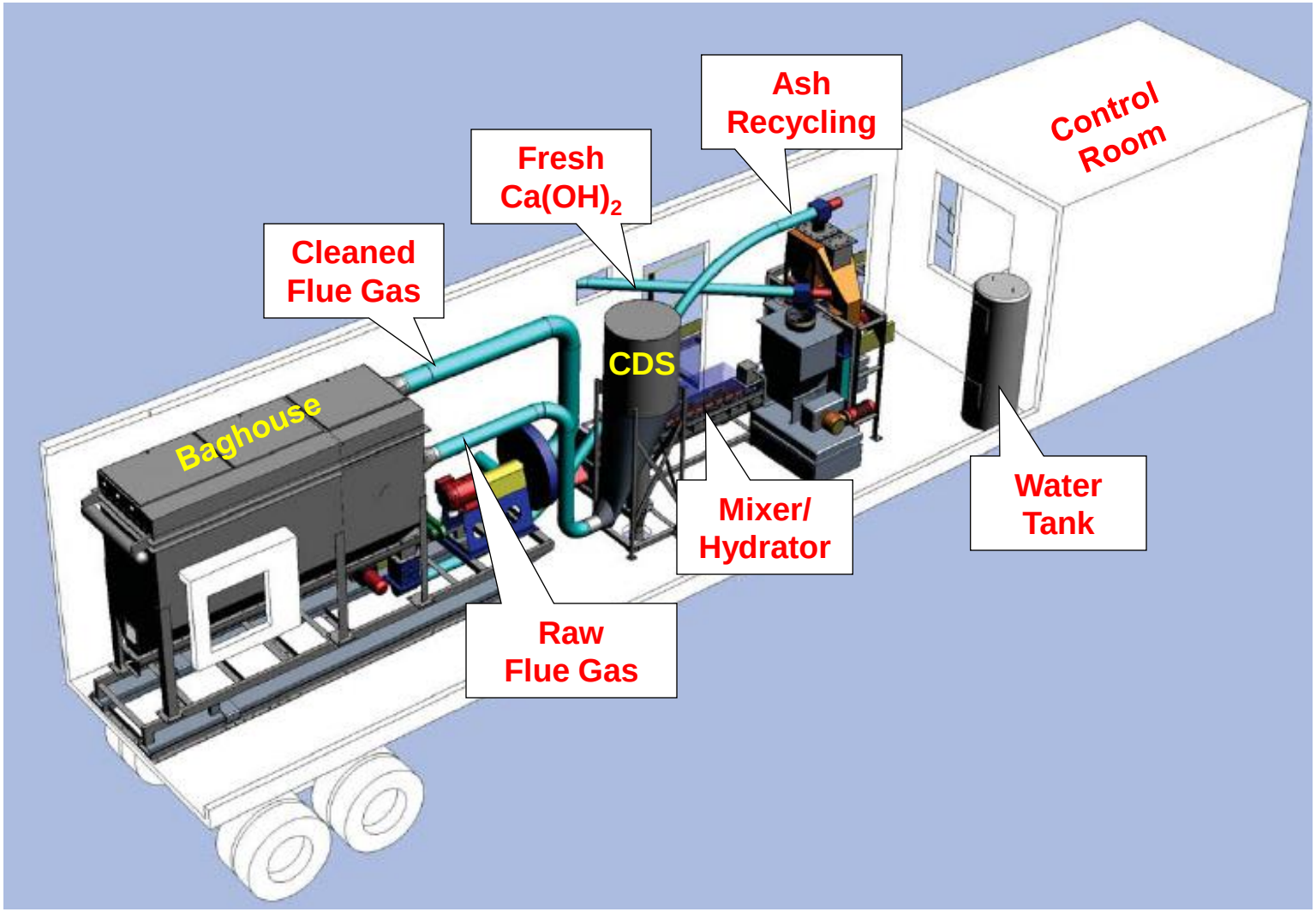
CDS Reactor: Solios
Engineering: Graymont
Startup: January 2008

CDS Performance:
for 3% sulfur coal
> 93% SO_2 Removal
(kiln outlet-to-stack)

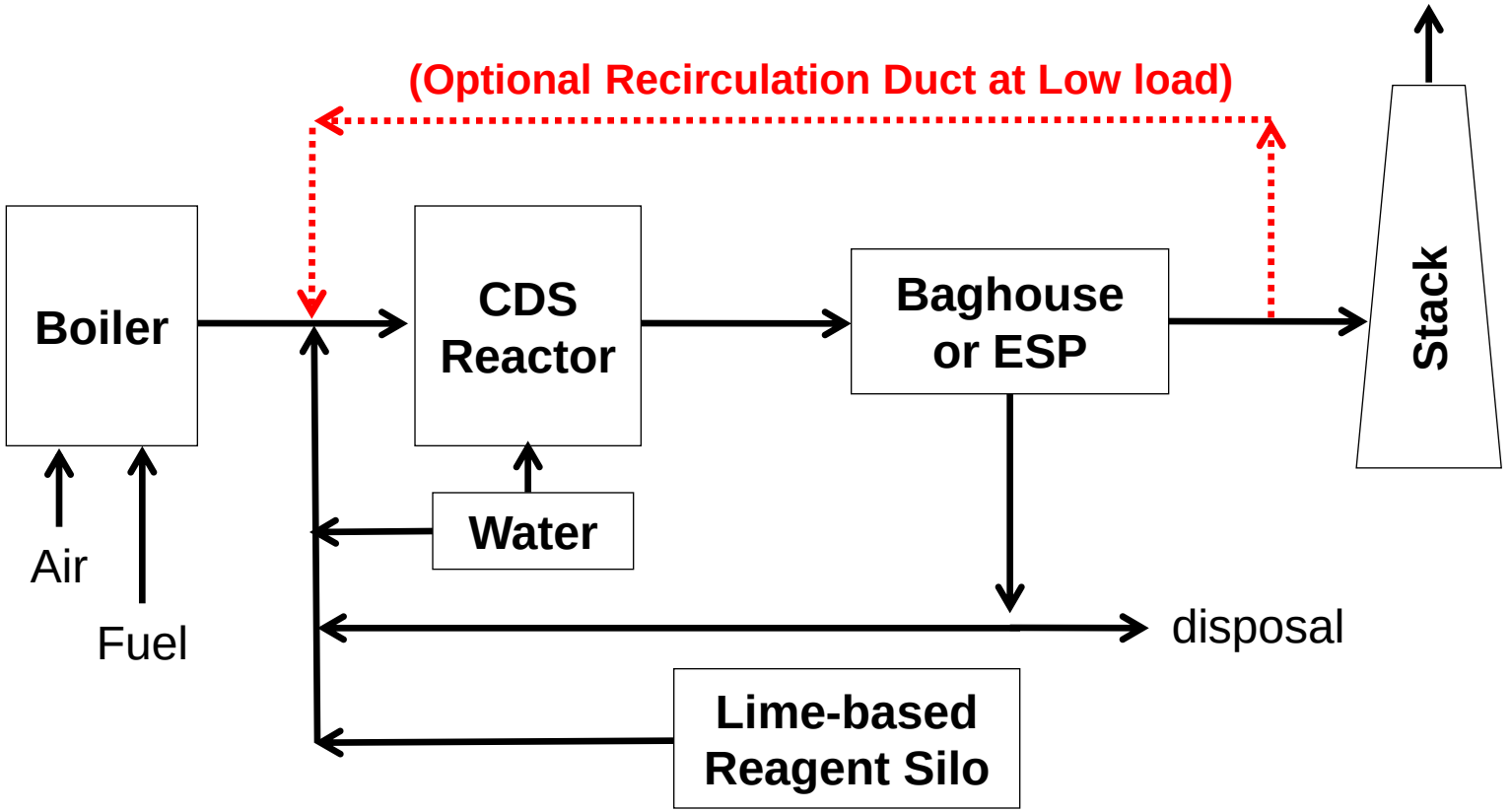
Graymont's Portable CDS Unit



Graymont's Portable CDS Unit



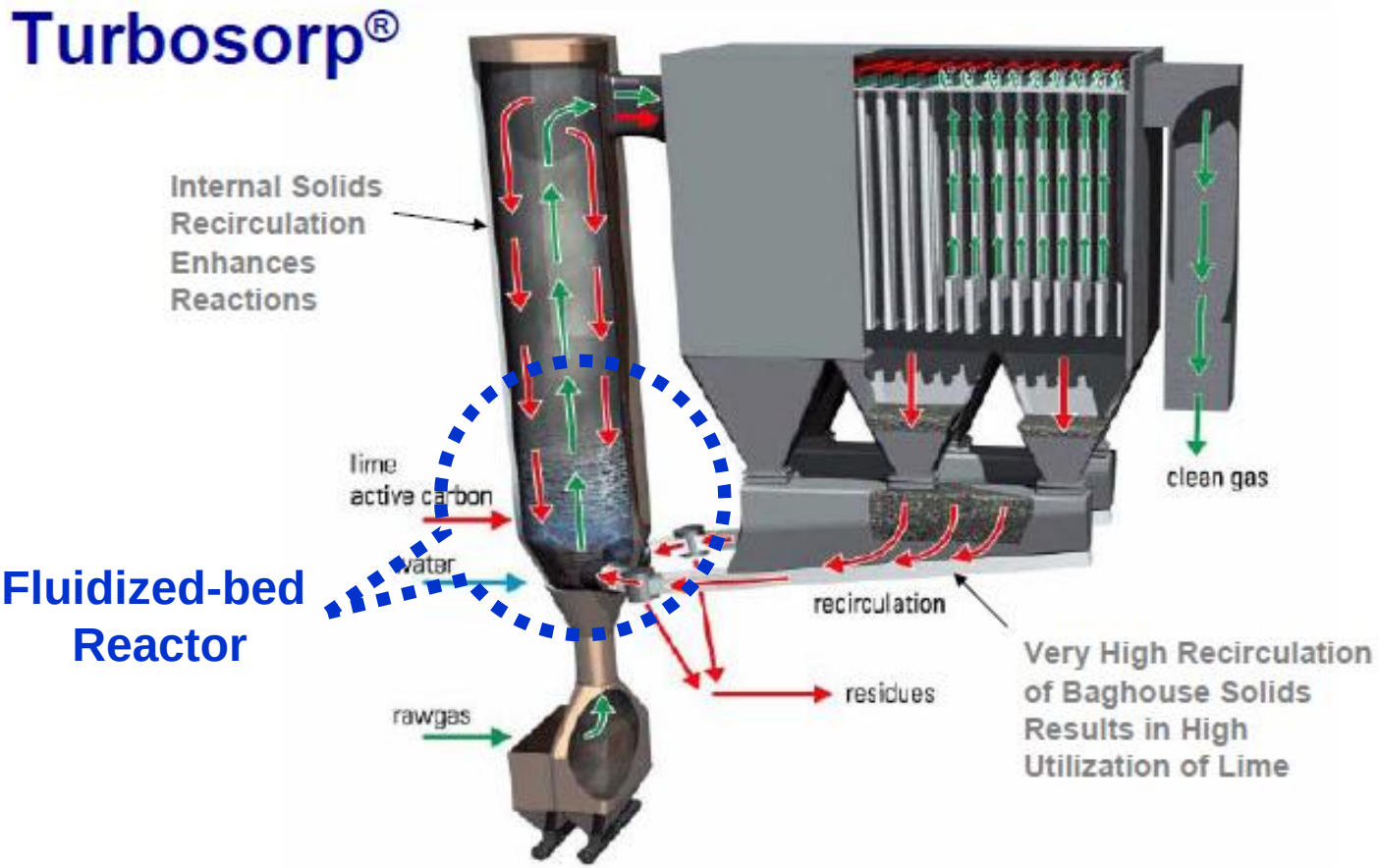
Generic Process Flow Diagram of a CDS System



System Advantages:

- **Recirculation of ash provides high lime efficacy**
- **No spray nozzles/atomizers & no circulation pumps keep capital and O&M costs low**

Lurgi Type of CDS Reactor



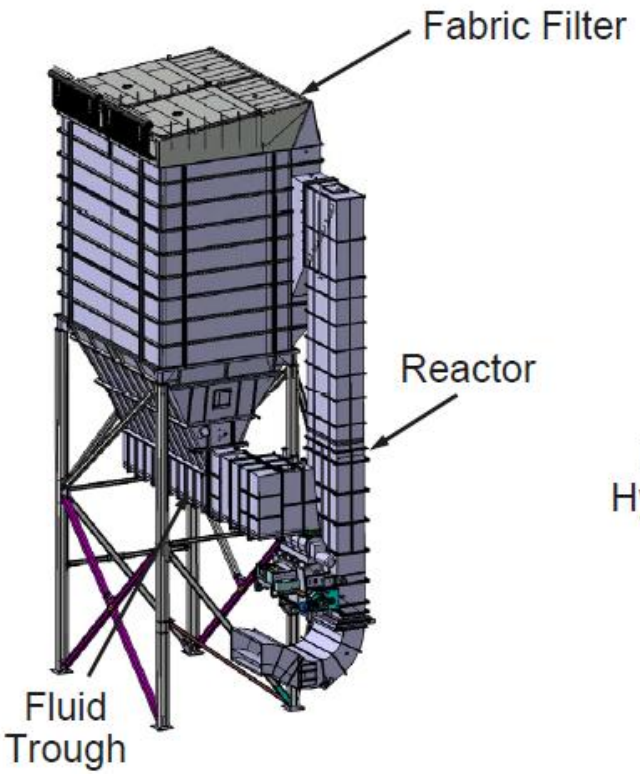
Vendors:

ANDRITZ
Babcock Power
Babcock & Wilcox
Foster Wheeler
FL Smidth
Clyde Bergemann
KC Cottrell
Marsulex
Dustex
Redecom

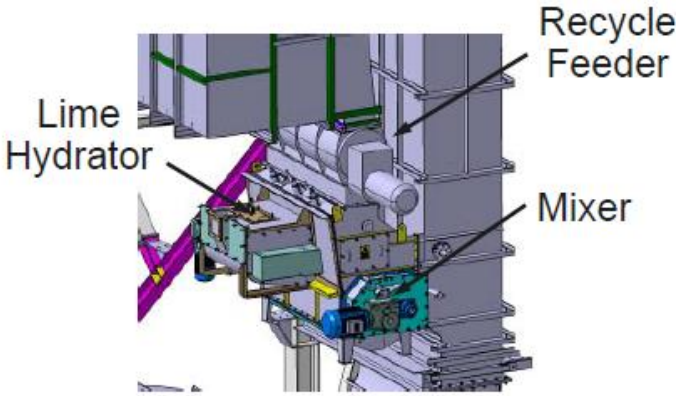
Key: (1) Fly ash, hydrated lime & recycled ash are suspended and fluidized.
(2) A flue gas re-circulation duct is required when operated at reduced load.

Source: Douglas J. Roll et al., Follow-on Turbosorp® Testing Results from the Greenidge Multi-Pollutant Control Project, Power-Gen International 2007, New Orleans, LA

Transport-Reactor Type of CDS System



Key Components
- Fabric filter
- Reactor
- Recycle Feeder
- Mixer
- Hydrator
- Fluid trough



Vendors:

ALSTOM Power - NID
Hitachi/Solios – EAD
Solios

Key: (1) Fly ash, hydrated lime & recycled ash flow with the flue gas (no venturi).
(2) Modular design (45 – 90 MW)

Source: Lawrence Gatton, Next Generation NID for PC Market, Coal-Gen, August 17019, 2011

Locations of CDS Installed at U.S. Power Plants

Operating CDS - PC Boiler **Operating CDS - CFB Boiler** **CDS Under Construction**

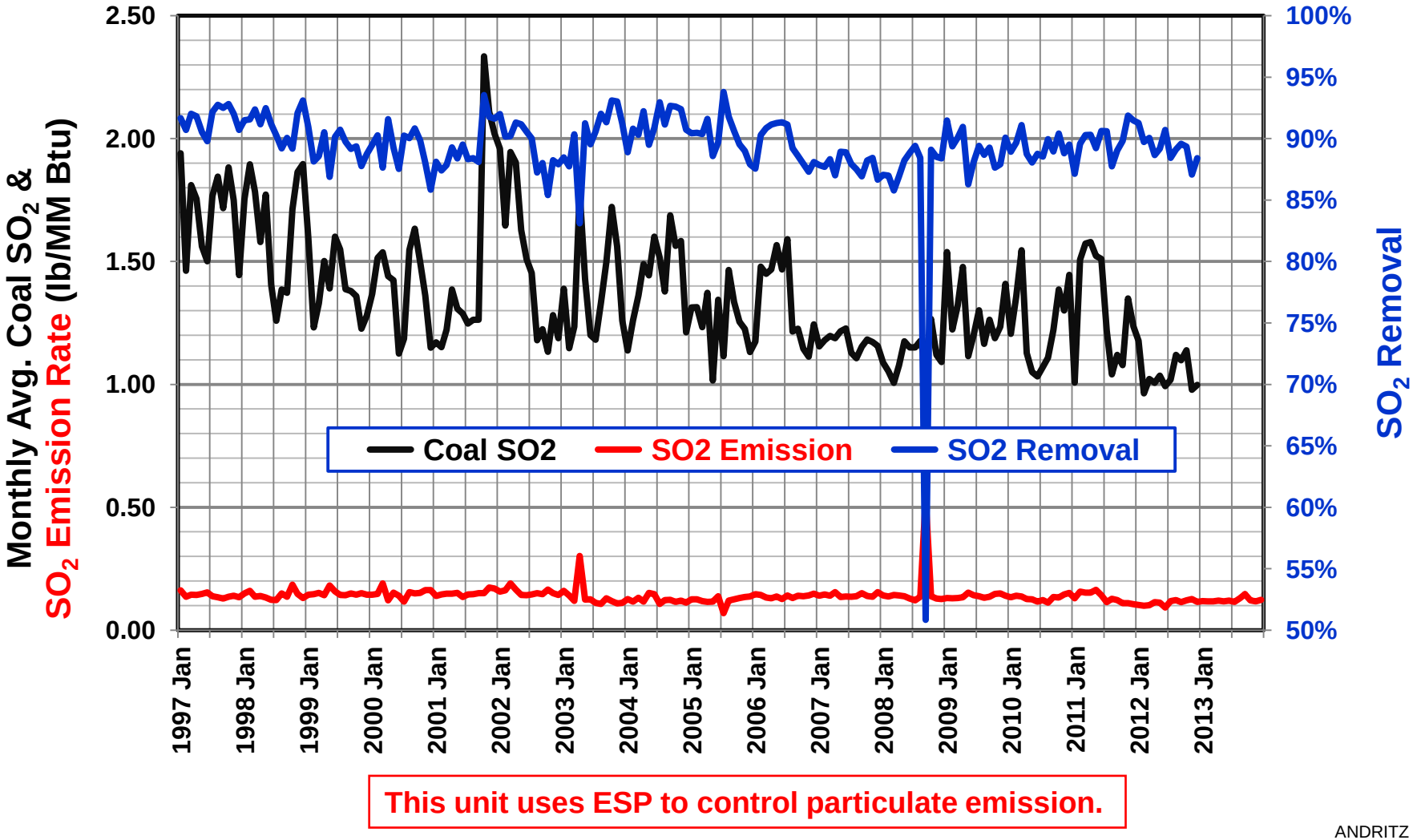
- **Units range from 58 to 690 MW**
- **Fuel sources range in sulfur content**

Larger Units Need Multiple CDS Reactor Vessels

- For the following NID systems:
  - Indian River Unit 4 (440 MW) : 8 J-tube reactors
  - Brayton Point Unit 3 (670MW): 8 J-tube reactors
  - Homer City Units 1 and 2 (690 MW each): 10 J-tube reactors for each unit
  - Boswell Unit 4 (558 MW): 8 J-tube reactors
  - Flint Creek Unit 1 (558 MW): 8 J-tube reactors

- The following Lurgi types of CDS systems are built with 2 parallel reactor vessels
  - Big Stone Unit 1 (500 MW)
  - Edgewater Unit 5 (460 MW)
  - Michigan City Unit 12 (540 MW)

Neil Simpson II Station - Unit 1 (WY, PC / 100 MW / 1995)



This unit uses ESP to control particulate emission.

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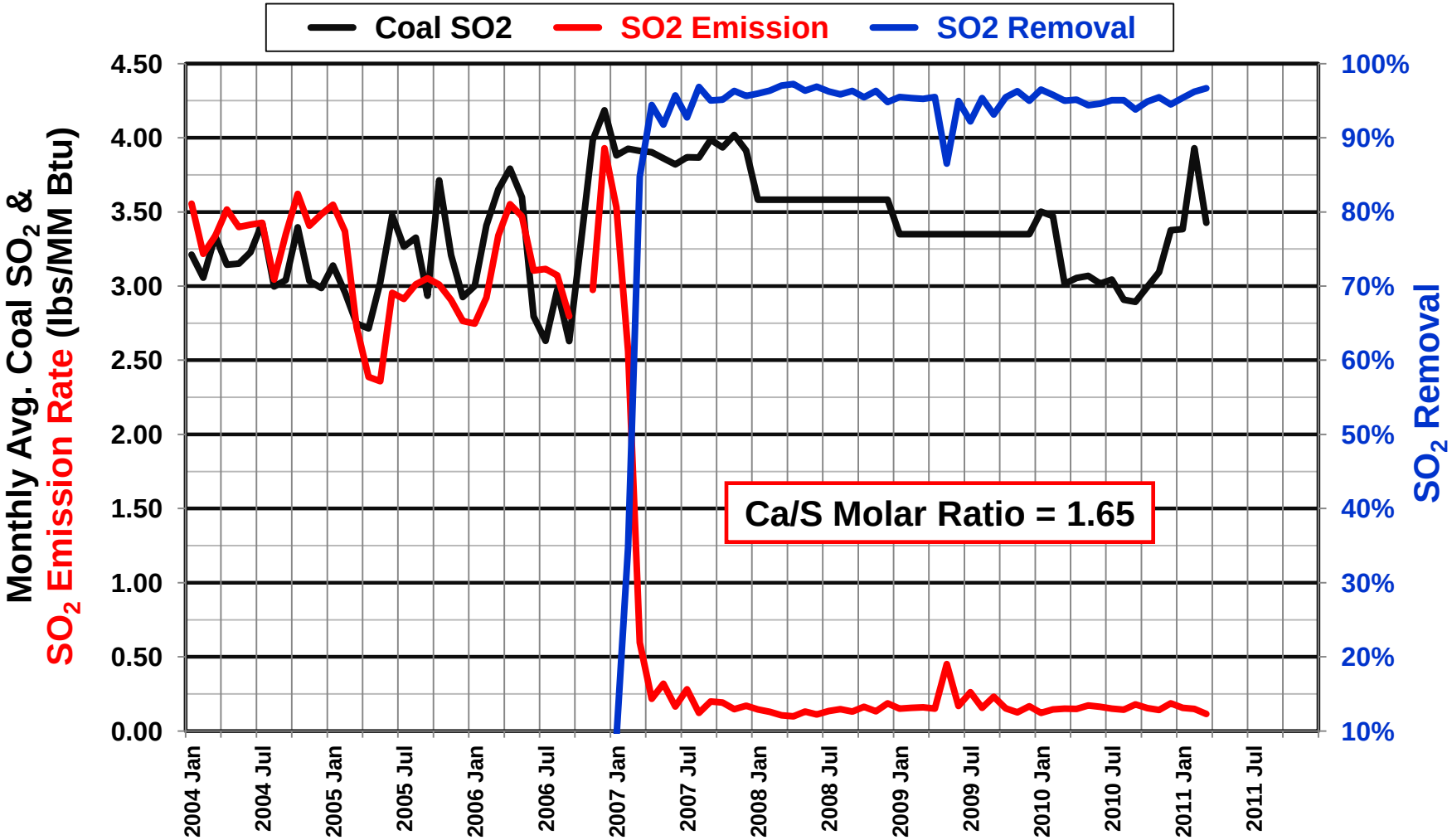
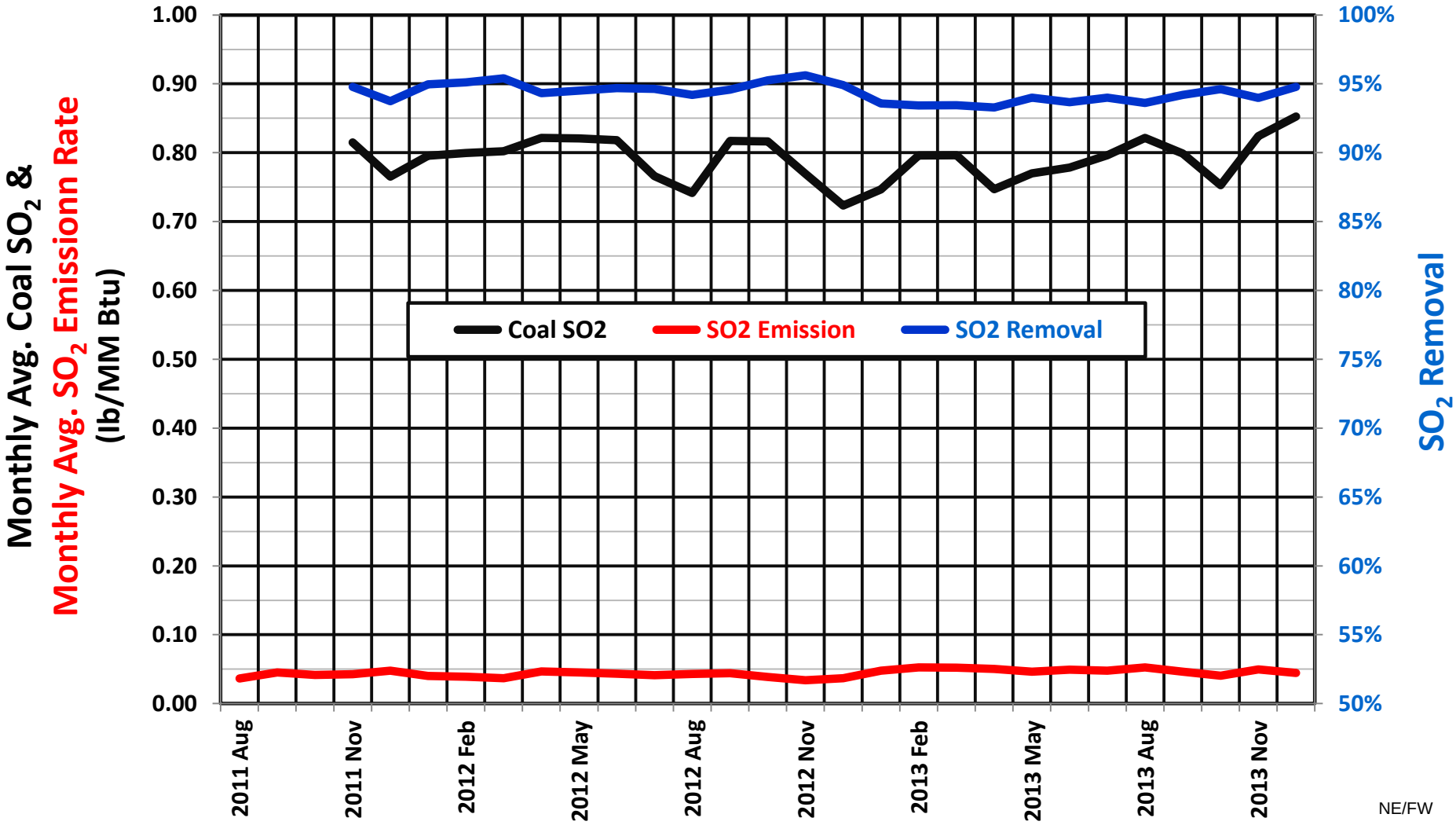
AES Greenidge Station - Unit 4 (NY, PC / 115MW / 2007)



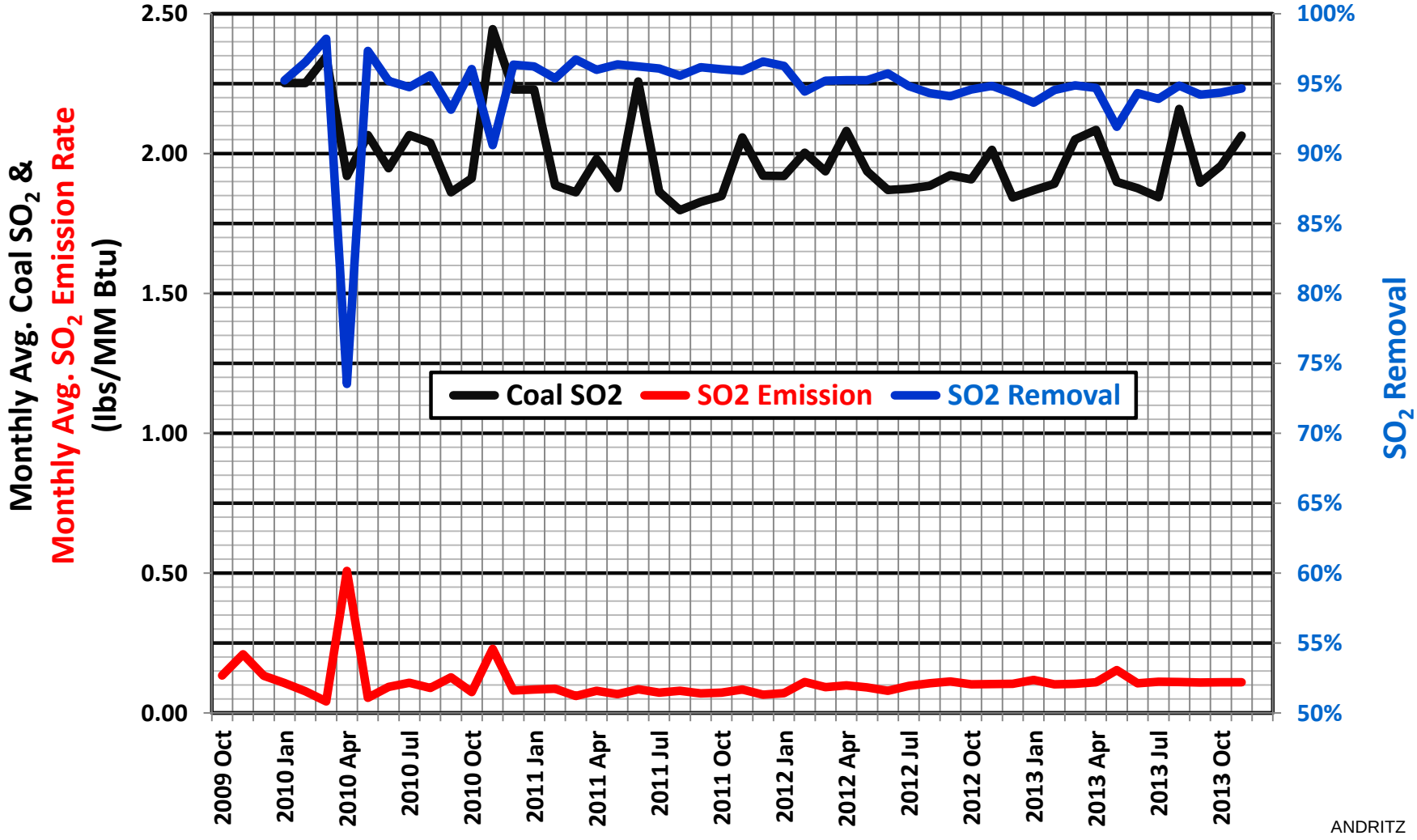
Babcock Power

Dry Fork Station - Unit 1 (WY, PC / 425MW / 2011)



NE/FW

Sandow Station - Unit 5A (TX, CFB / 315MW / 2009)



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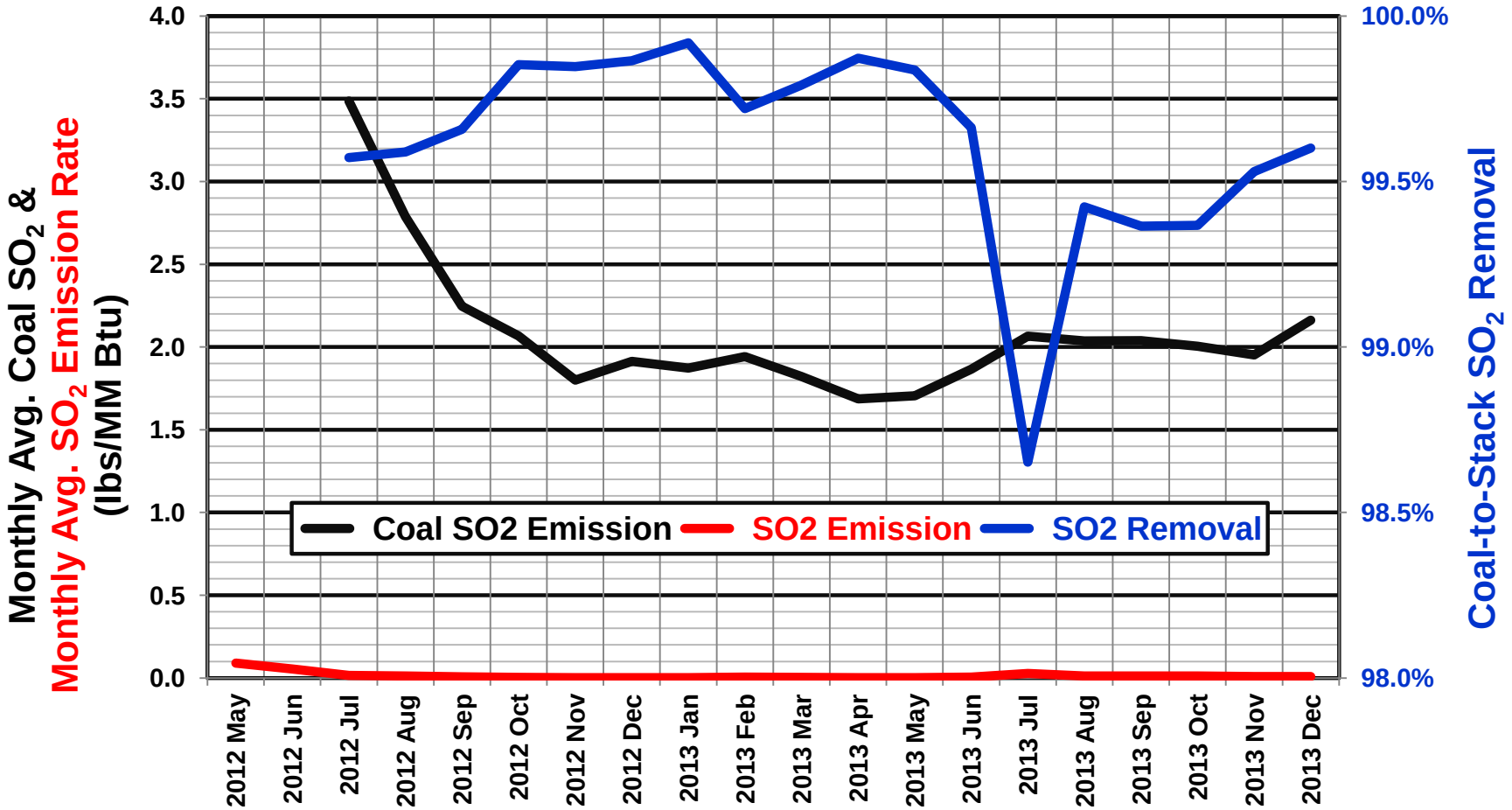
Virginia City Hybrid Energy Center – Unit 1 (VA, CFB / 300MW / 2012)



The average monthly SO_2 emission from Sep/2012 to Dec/2013 was 0.0076 lb/MMBtu.

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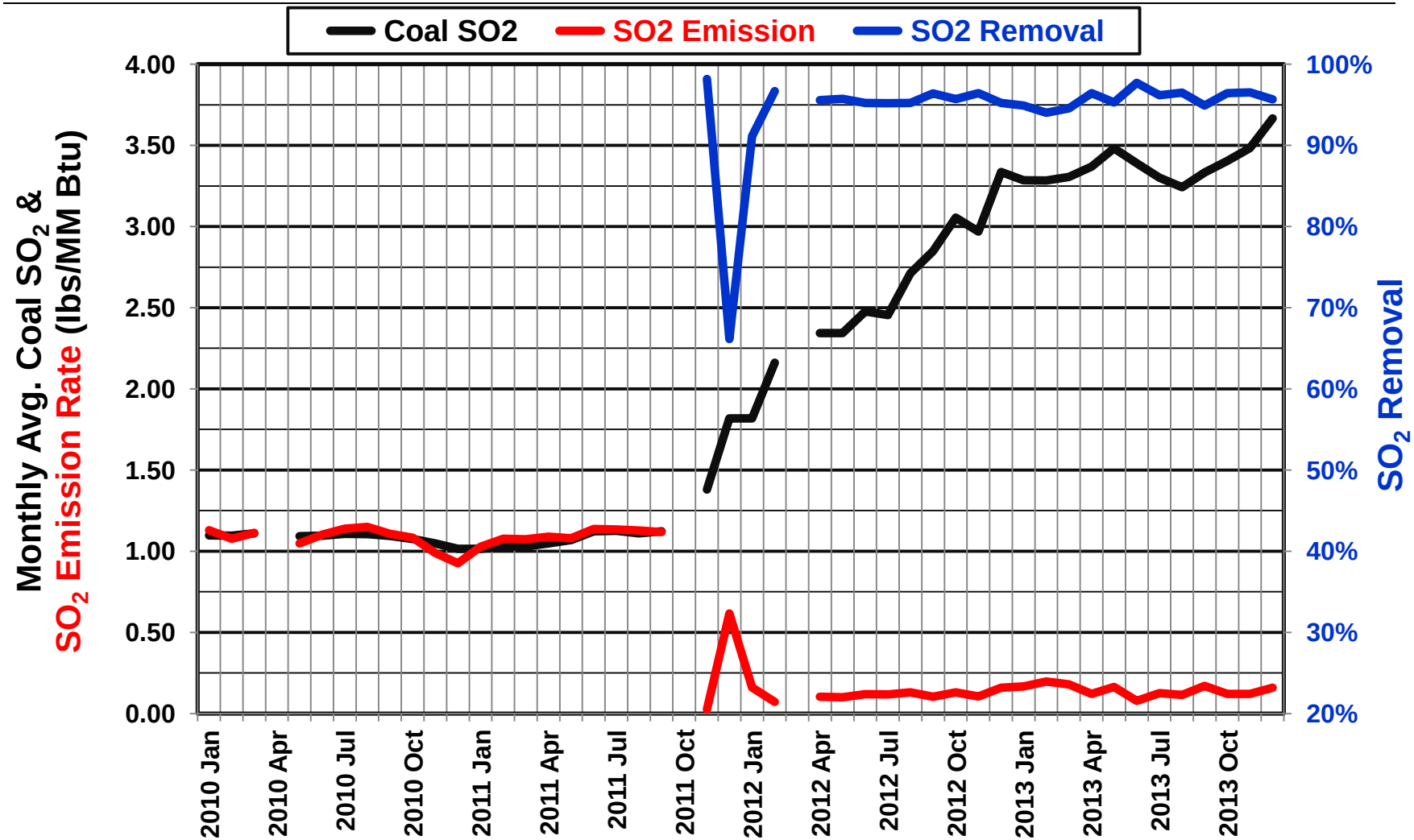
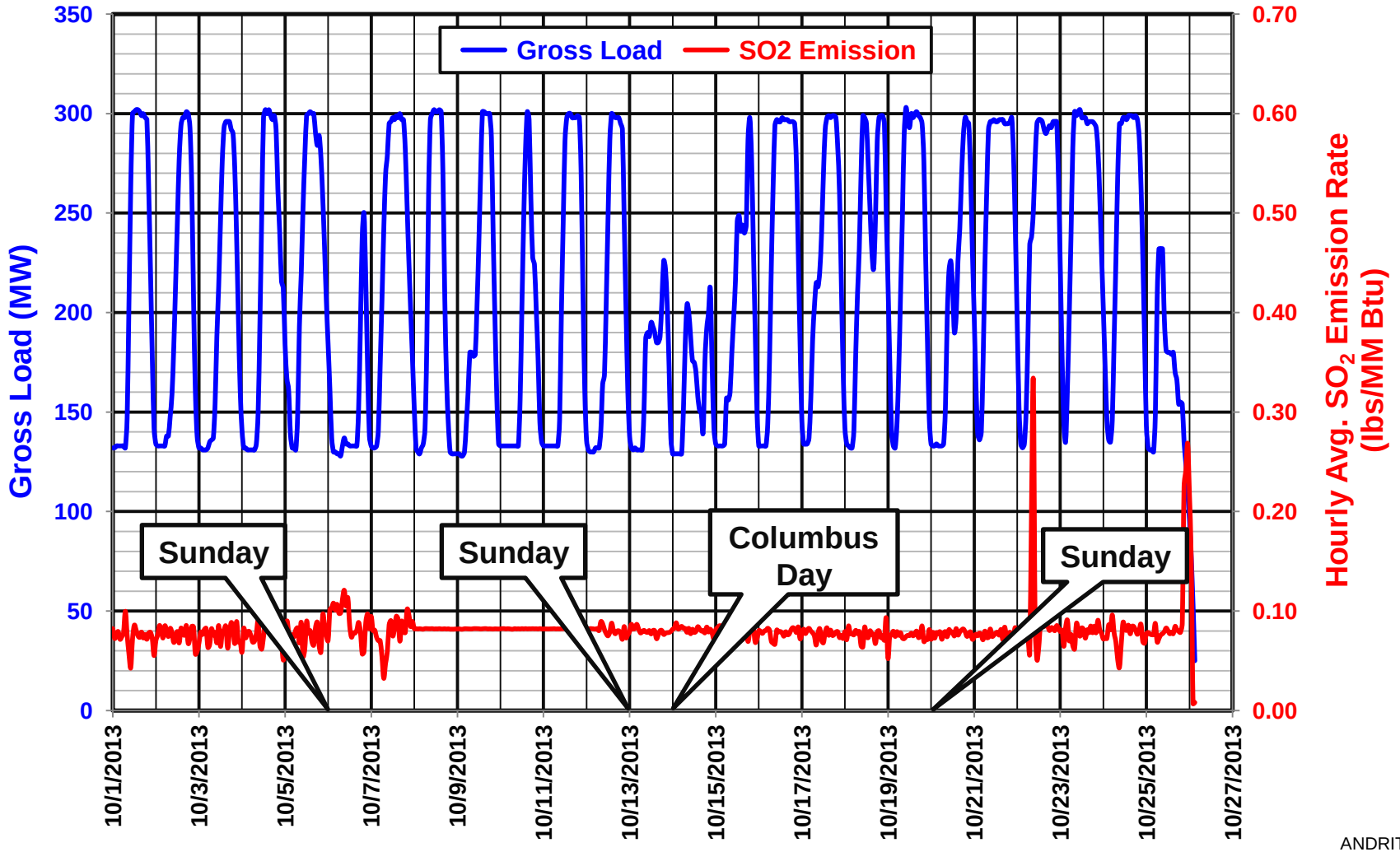
Indian River Station – Unit 4 (DE, PC / 440MW / 2012)



ALSTOM Power

John Twitty Station – Unit 2 (MO, PC / 300MW / 2011)



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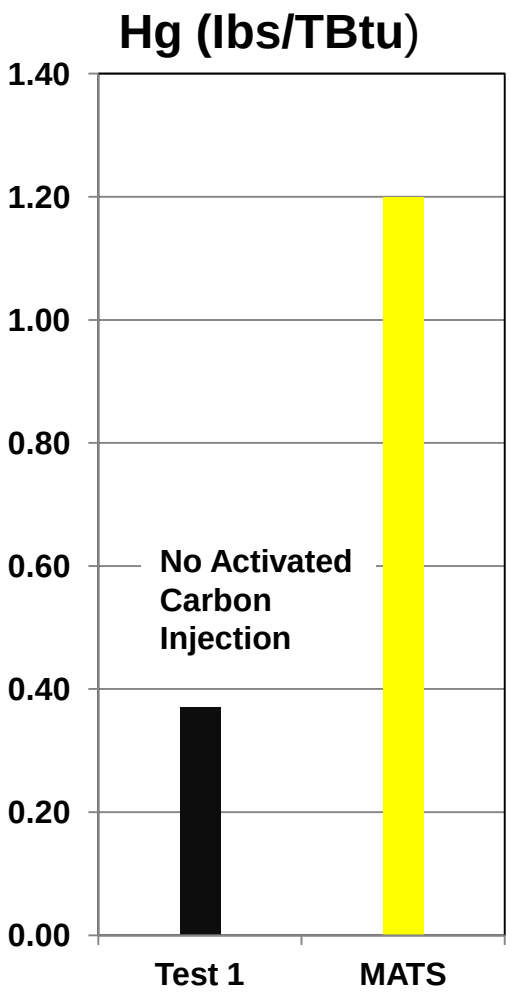
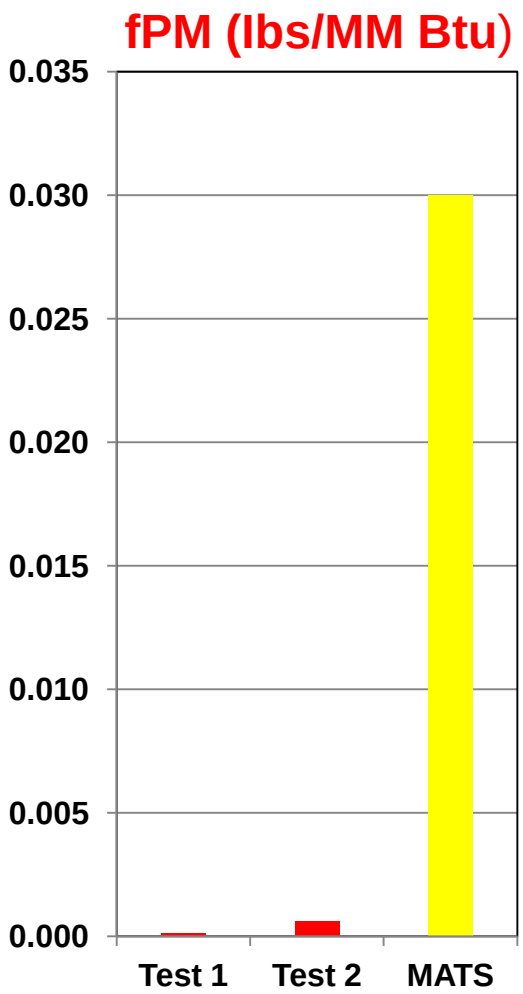
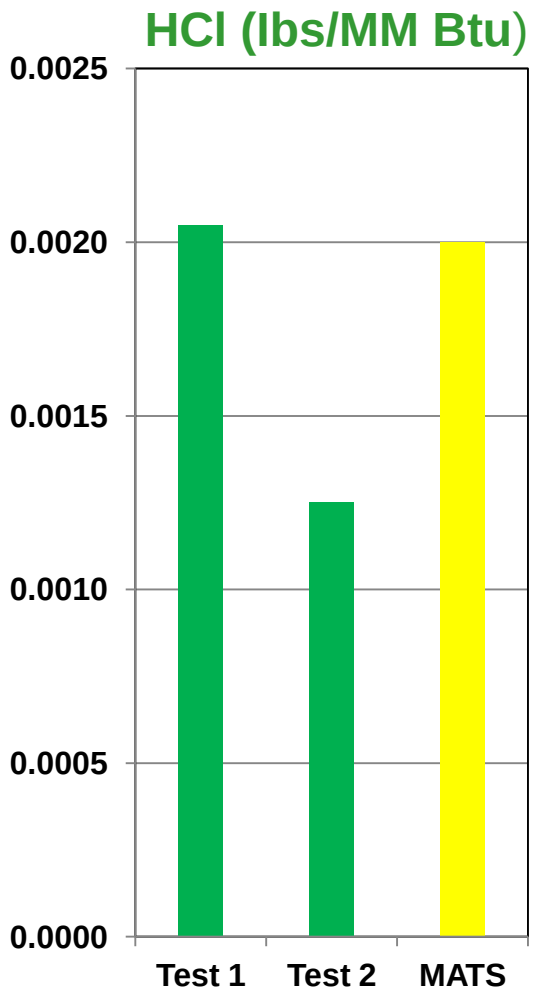
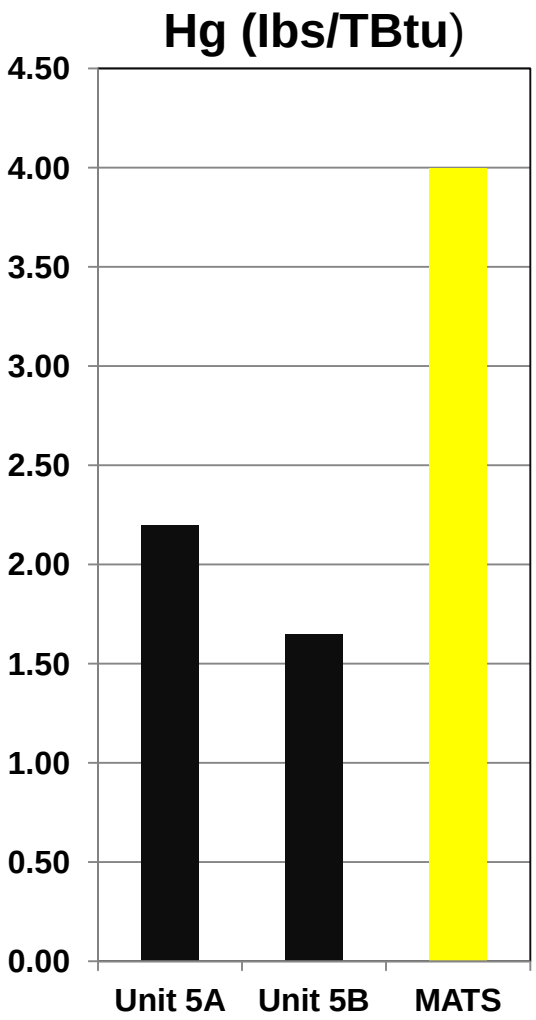
AES Greenidge – Results of Performance Tests

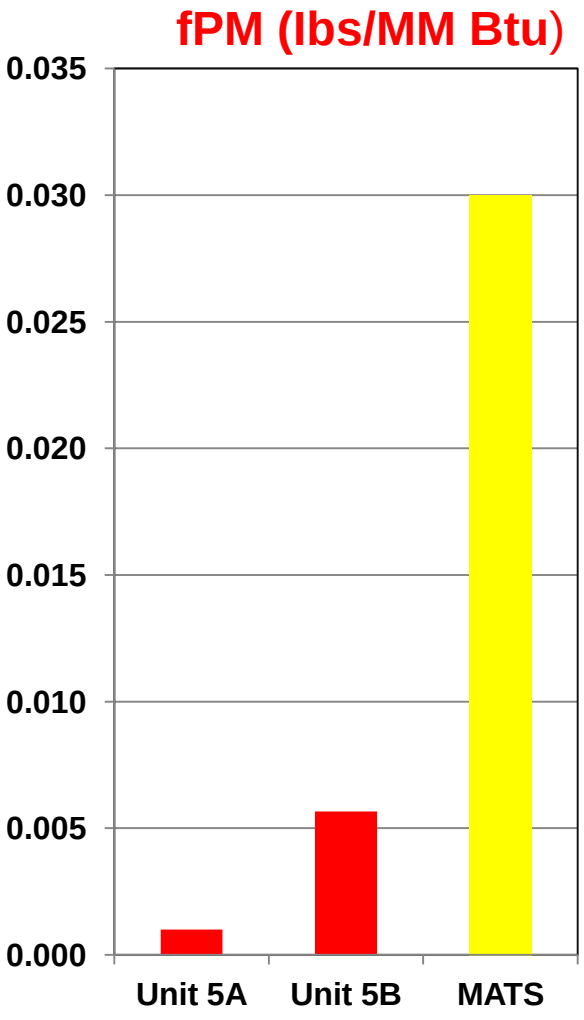


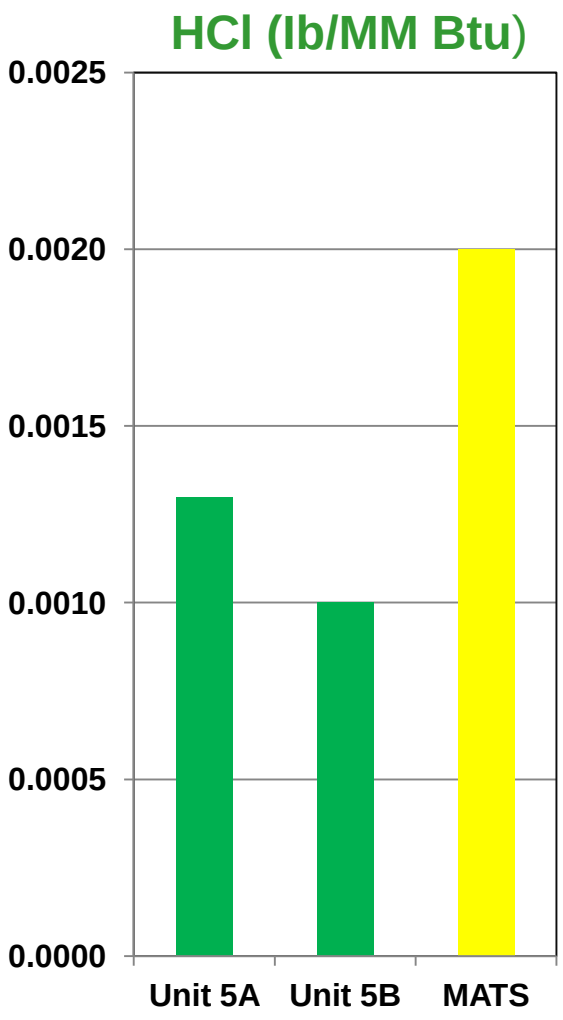




Sandow Station - Utility MACT ICR Data







Conclusions

- In the U.S. power industry, 4 lime-based circulation dry scrubbing (CDS) technologies have been installed in 12 PC boilers and 12 CFB boilers. Constructions are underway at 15 PC boilers.
- Multiple CDS reactor vessels can be placed in parallel to process flue gases from larger units.
- These CDS technologies are applied to solid fossil fueled electricity generating units with sizes ranging from 58 to 690 MW.
- These technologies are well proven, capable of handling solid fuels with various sulfur contents.
- Data obtained from AES Greenidge and Sandow No. 5 Stations showed that the emission limits of mercury, filterable particulate, and hydrogen chloride mandated under the Mercury and Air Toxics Standards were met.