

REINHOLD ENVIRONMENTAL Ltd.



**2014 APC Round Table
& Expo Presentation**

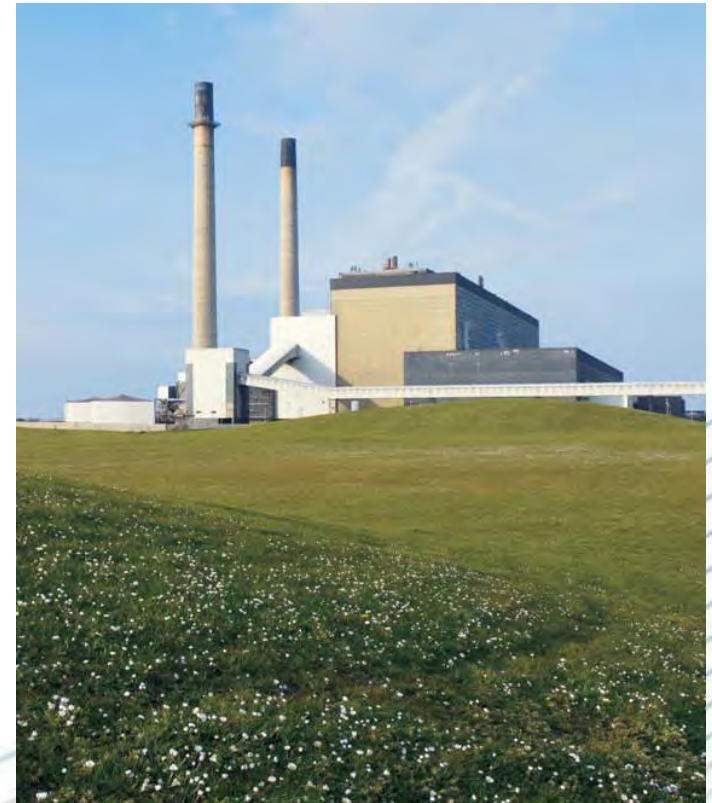
July 14-15, 2014, in Louisville, KY / Hosted by LG&E/KU

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Alternatives to Activated Carbon Injection

JOHN MEIER

Director of Marketing
Air Protection Technologies



Nalco Air Protection Technologies Portfolio

Goals:

- Reduce Hg Emission below Compliance Levels
- Minimize Capital Requirements
- Minimize Client Operating Costs



Hg Speciation Control
MerControl® 7895

Dry Scrubber Additive
MerControl® 6012

Hg Sorbents

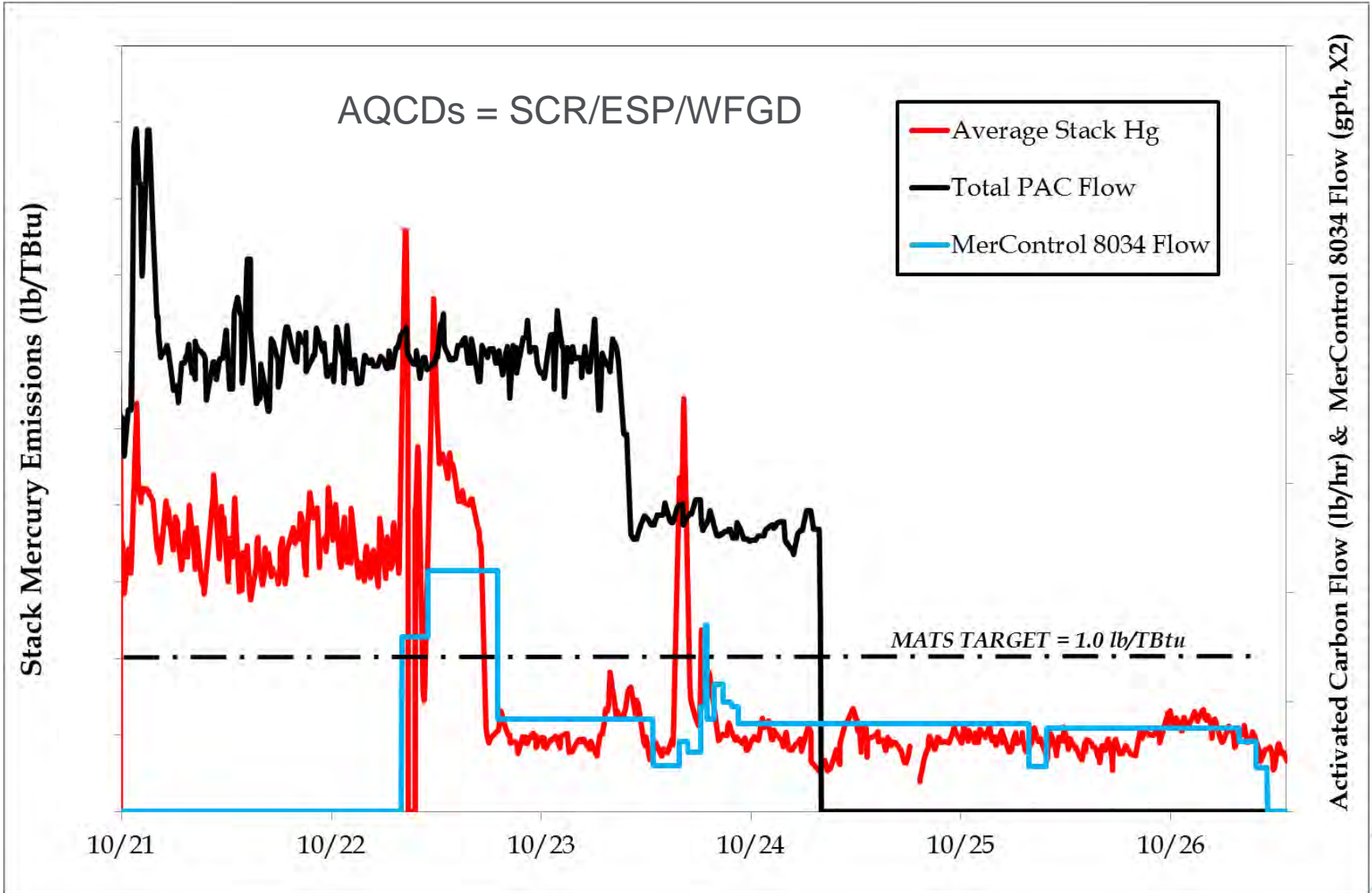
Wet Scrubber Additives
MerControl® 8034
MerControl® 8034 Plus

Plant Effluent Hg Control
Nalmet® 1689
Nalmet® 1691

← Integrated Air/Water Offering →

.....Provides Our Clients With Cost Effective, Sustainable Results

MerControl 8034 versus ACI Pre-ESP



Hg Capture via SDA and FF

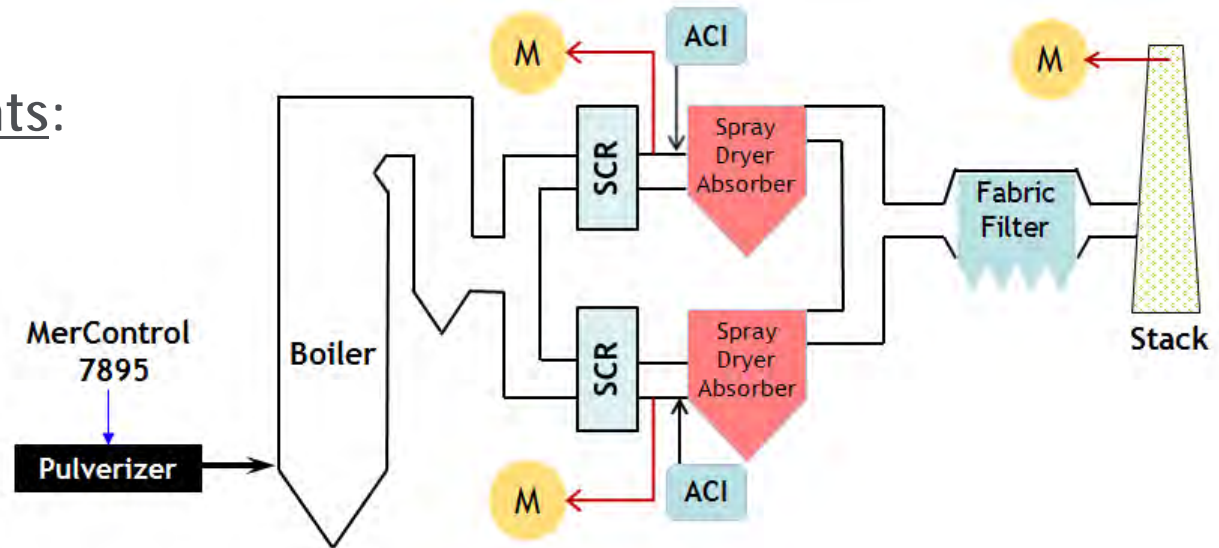
Site Description:

- Chlorine* = 24 ± 14 ppm
- Mercury* = 0.115 ± 0.020 ppm
- Full Load = 580-MWg
- Boiler Type = supercritical PC boiler
- Fuel = Low-sulfur PRB coal
- AQCDs = low-NO_x burners, SCR, SDA, FF

Goal: Mercury emissions less than 1.0 lb /TBtu at minimal cost.

Hg Measurements:

CMM, OHM and carbon traps at locations indicated at right by



¹Air Heater Inlet to Stack

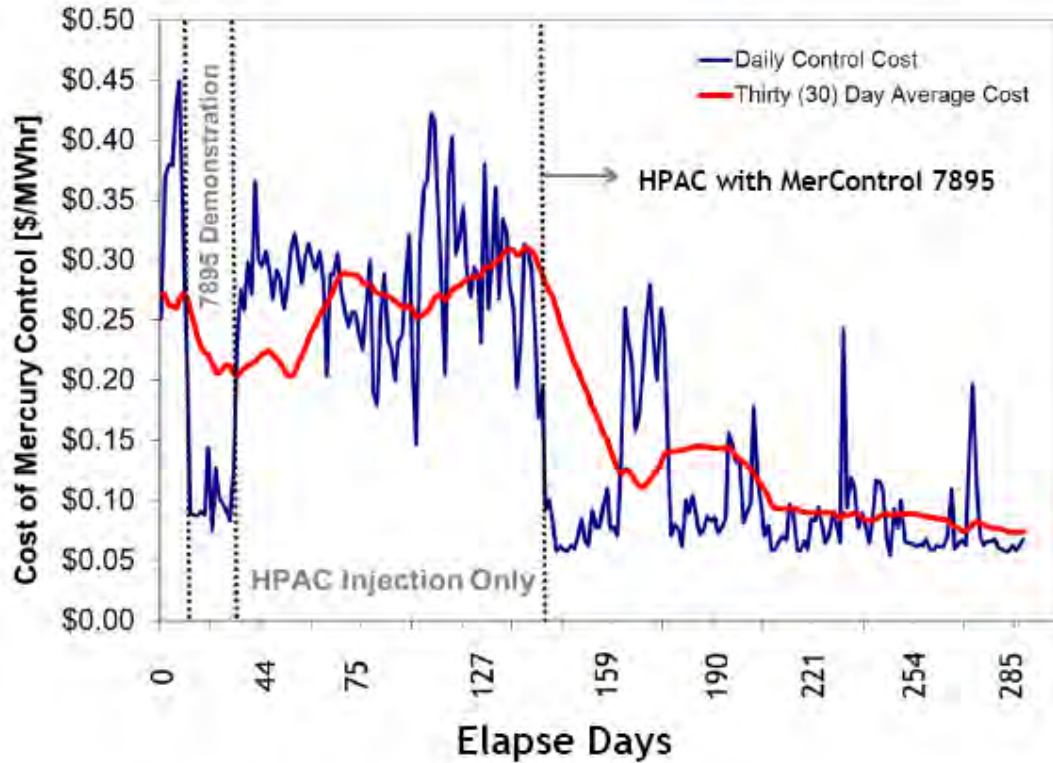
MerControl 7895 Technology

MerControl 7895 = Boiler Additive or BA



- Meter addition to coal pulverizers.
- Simple application equipment.
- Low capital cost.

Optimized Cost of Hg Emission Control



Condition	HPAC (lb/MMacf)	BA (ppmw)	\$/yr
HPAC only	1.65		\$1.45MM
HPAC+BA	0.25	28	\$0.36MM
Savings			\$1.09MM

(based on annualized used & 83% Hg capture.)

HPAC alone Hg control was about \$0.30/MWhr.

Optimized strategy for Hg control approached \$0.07/MWhr.

- **Cost reduction of >75% with Hg emission compliance.**
- **Annual saving of \$1.0-1.7MM realized.**

Mercury Emission Control Technologies

▲ MerControl® 7895

▲ MerControl® 8034

▲ MerControl® 8034 Plus



Mercury Emission Control for WFGD

MerControl 8034 and MerControl 8034 Plus

What is re-emission?

- ▲ Oxidized mercury (Hg) is soluble in water (4.8g/L at 68°F) and therefore can be removed from flue gas by a WFGD
- ▲ However, oxidized Hg can be reduced to elemental Hg within the WFGD. Elemental Hg is only slightly solubility in water (0.056 mg/L at 68°F). The result is lower Hg capture efficiency.

MerControl 8034 & 8034 Plus

- ▲ Reduces mercury re-emission up to 100%
- ▲ Consistently outperforms competitive technologies
- ▲ Reduces stack emissions without compromising gypsum quality
- ▲ Patented technology

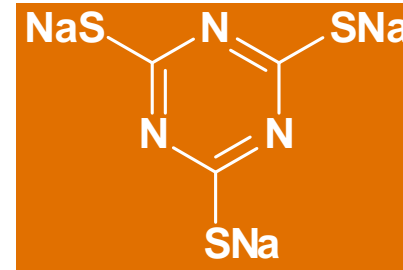
Structure of Some Mercury Chelants



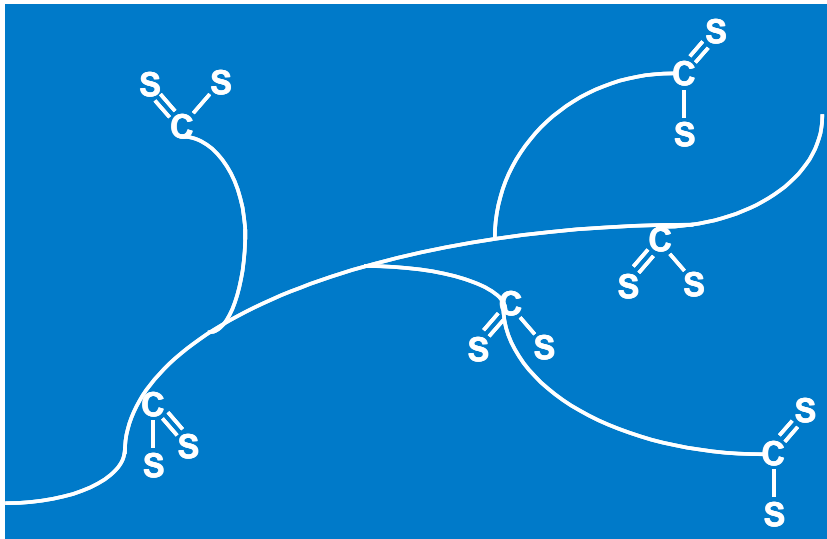
**Dimethyl dithiocarbamate
(DTC)**



**NaHS
Sodium
Hydrosulfide**



**1,3,5-triazine-2,4,6(1H,3H,5H)-trithione
Trimercaptotriazine (TMT)**



MerControl 8034 Technology
(poly-dithiocarbamate)
Patented Technology

*Reduces scrubber liquor soluble mercury
to less than 500 ppt.*

MerControl Product Comparison

	8034 Plus	8034
Stability- Appearance	Extended (> 1 yr)	Short (< 6 mo.)
Composition	No chlorides	Contains chlorides
Hazard Class/Packing Group	Non-hazardous	8/III
Aquatic Toxicity (EPA)	Practically Nontoxic	Slightly Toxic
Toxicity - German WGK	1	3
National Fire Protection Act (H/F/R)	1 1 0	2 1 0
Toxicity - Rainbow Trout - LC ₅₀	211 mg/L	74 mg/L
Toxicity – Daphnia magna - LC ₅₀	165 mg/L	73 mg/L
Freezing point	14 F (-10C)	-5F (-15C)

The higher the LC₅₀ number, the less toxic the chemical;

MerControl 8034 Plus is designed with performance and environmental impact in mind.

EPA Toxicity Categories for Aquatic Organisms:	
LC50 (ppm)	Toxicity Category
< 0.1	Very highly toxic
> 0.1 - 1	Highly Toxic
> 1 - 10	Moderately toxic
> 10 - 100	Slightly toxic
> 100	Practically nontoxic

MerControl 8034 Plus: Very Low Toxicity

Mammalian Testing

- ▲ Significantly less toxic and lower environmental impact than competitive technologies
- ▲ MSDS NFPA Rating = 1 1 0
- ▲ Non-irritating to skin
- ▲ Non-mutagenic

Substance/Structure	Acute Oral	Eye Skin Corrosion/ Irritation	Mutagenicity
Nalco's New Technology 8034 Plus	> 2,000 mg/kg	Skin- Non-irritating Eye- Non-irritating	Negative Ames
TMT	>2,000 mg/kg	Skin-Slightly Irritating Eye- Irritating	Negative Ames
Na ₂ S	LD ₅₀ - 254 mg/kg	Skin- Corrosive Eye- Corrosive	Negative Ames
DMDTC	LD ₅₀ - > 2,000 mg/kg	Skin-Severely irritating Eye-Severely Irritating	Positive Ames

Colors represent EPA defined toxicity categories

- Red = highly toxic
- Yellow = moderate to slightly toxic
- Green = practically non-toxic



MerControl 8034 Technology



Simple Application Equipment, Low Capital Cost

Injection and Sampling Points



Basin Injection



**Recirculation
Line Injection**



Sampling Stream

Application Control Strategy

Nalco Monitor and Control Skid

- Temporary installation in minutes.
- 24/7 monitoring and control
- Data logging and retrieval
- Plant specific design control
- Minimally intrusive to plant operations
- Auto alarms and secure remote access
- Automated control of application rate

Already successfully used at several full-scale demonstrations. Facilitates feed back mercury re-emission control. Patent pending.



Nalco APT Controller



Data Download from enVision

The screenshot displays the enVision web interface within a Windows Internet Explorer browser. The browser's address bar shows the URL: https://envision.nalco.com/_layouts/envision/SystemDetails.aspx?Tab=Details&ID=157008. The page title is "Nalco - System Details".

The interface features a navigation menu at the top with options: Discover, Survey, Propose, Setup, Manage, Report, Support, and nApp Store. The main content area is titled "System Details" and includes a breadcrumb trail: Home > System Summary > System Details.

The system being monitored is identified as "NALCO CO - NAPERVILLE, IL - Nalco-APT-Controller V6: APT201371086 [71086]". A "Connectivity" icon is visible in the top right corner.

The "Summary" tab is active, showing four gauges for system status:

- Temp (°F): 129.59
- pH: 5.27
- ORP: 173.75
- Combined Load: 51.85

The "Controllers" section displays a controller image and the following information:

- (Serial No.) 71086
- (Boilers)
- Download

The "Process Flow Diagram" section contains a table with the following structure:

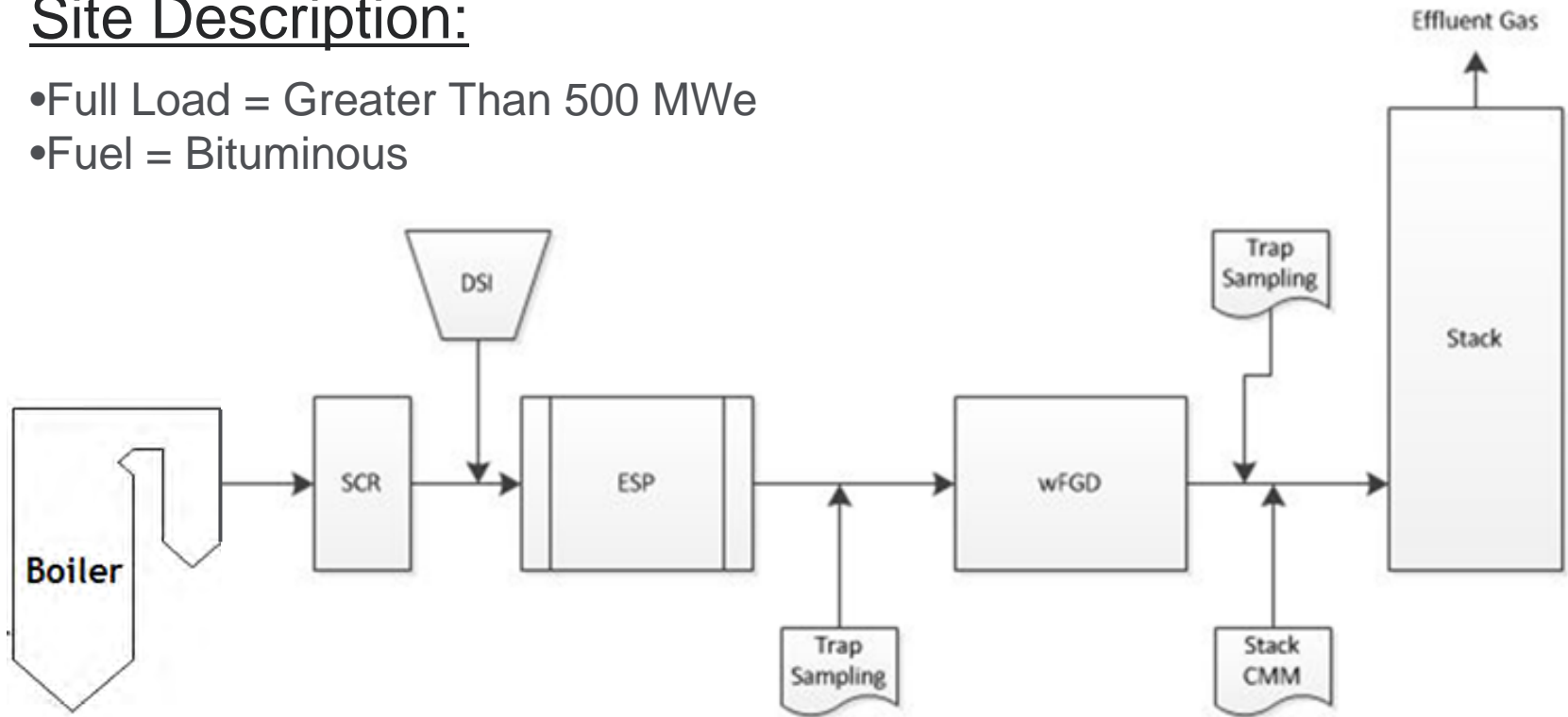
Date	Name	Modified By
No records to display		

The browser's status bar at the bottom indicates "Error on page." and "Local intranet | Protected Mode: Off".

Hg Capture via SCR and WFGD

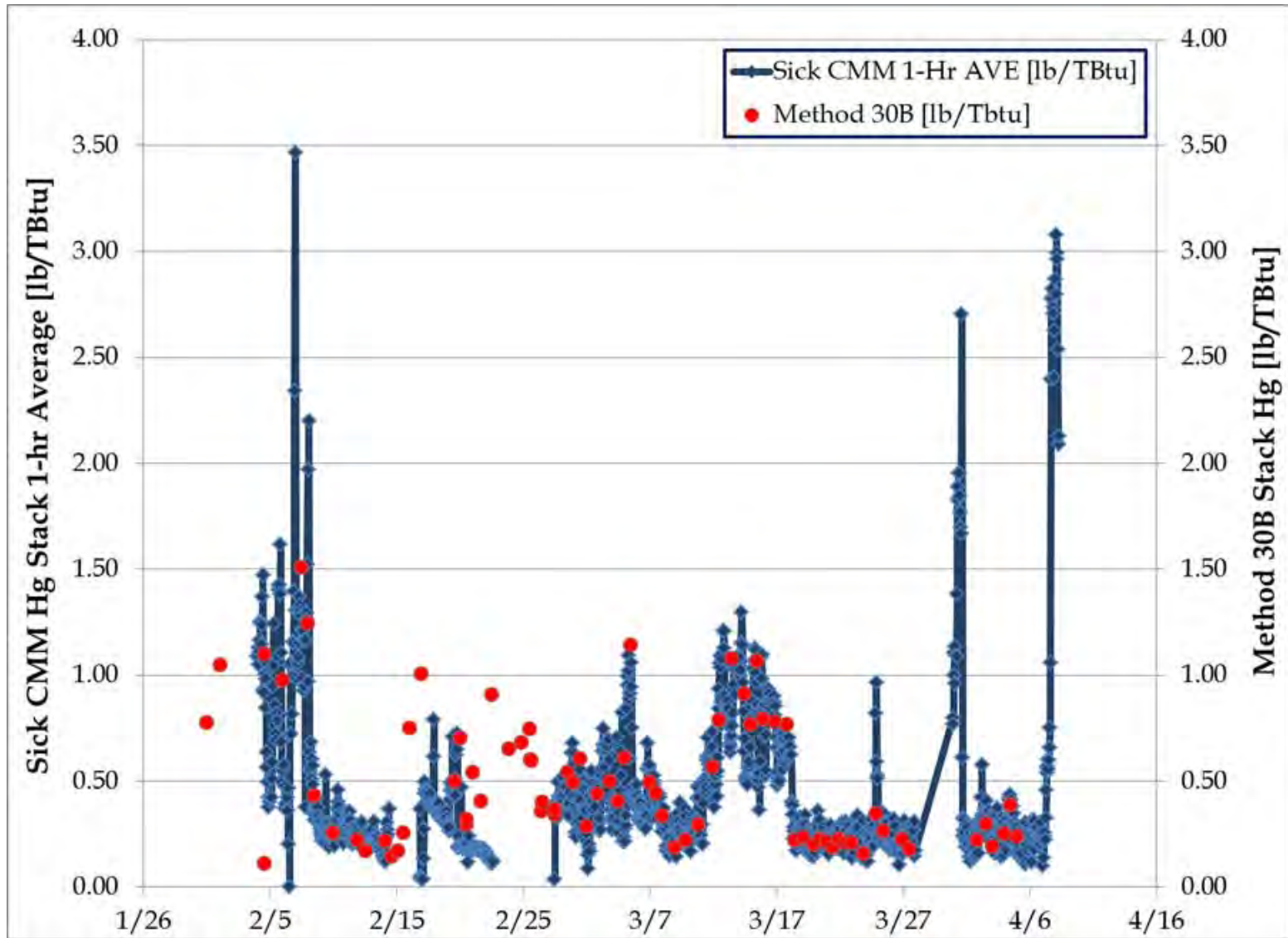
Site Description:

- Full Load = Greater Than 500 MWe
- Fuel = Bituminous

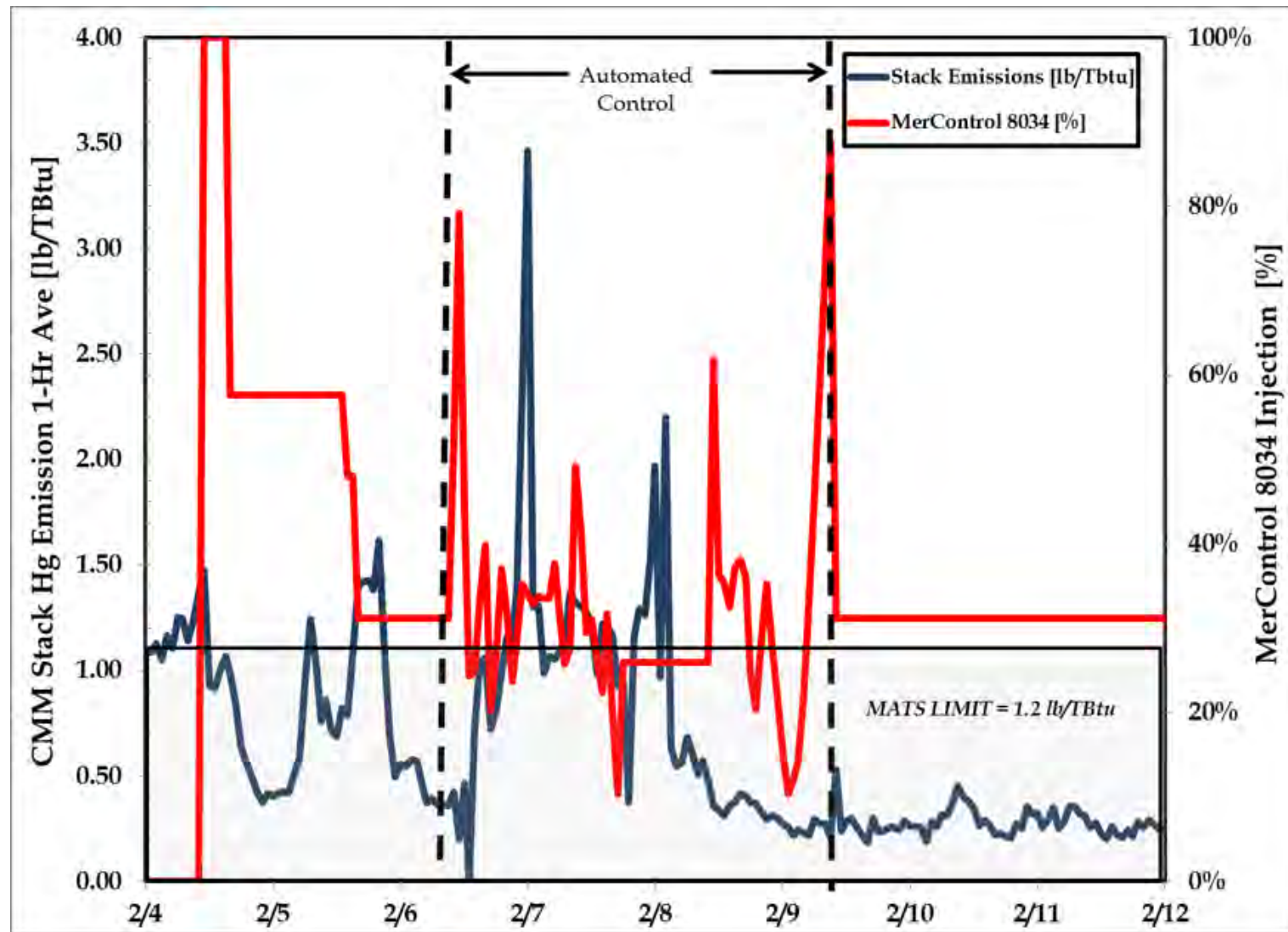


Goal: Reduce Hg re-emissions to meet MATS limit.

Hg Measurement Validity

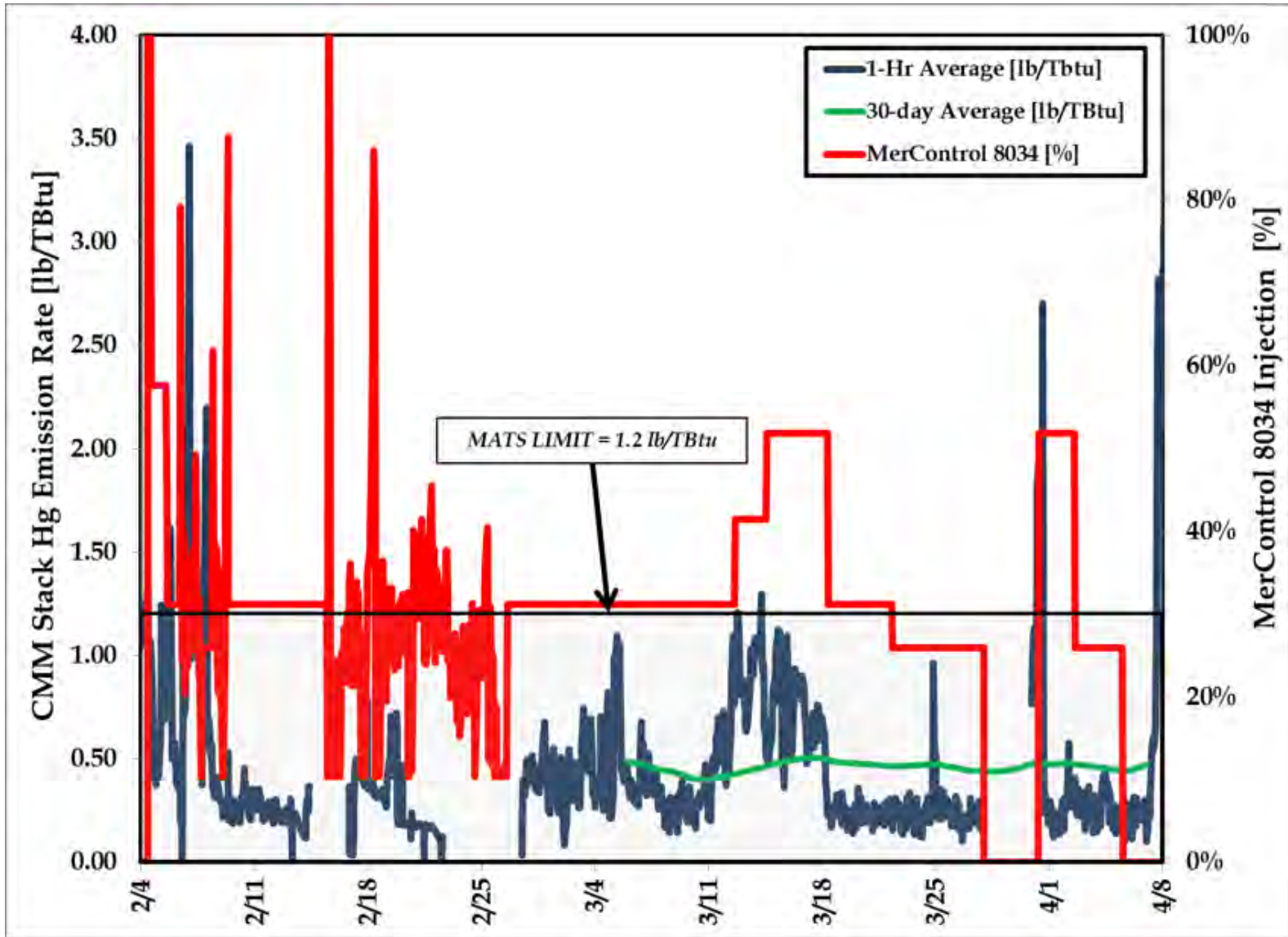


Initial MerControl 8034 Dosing

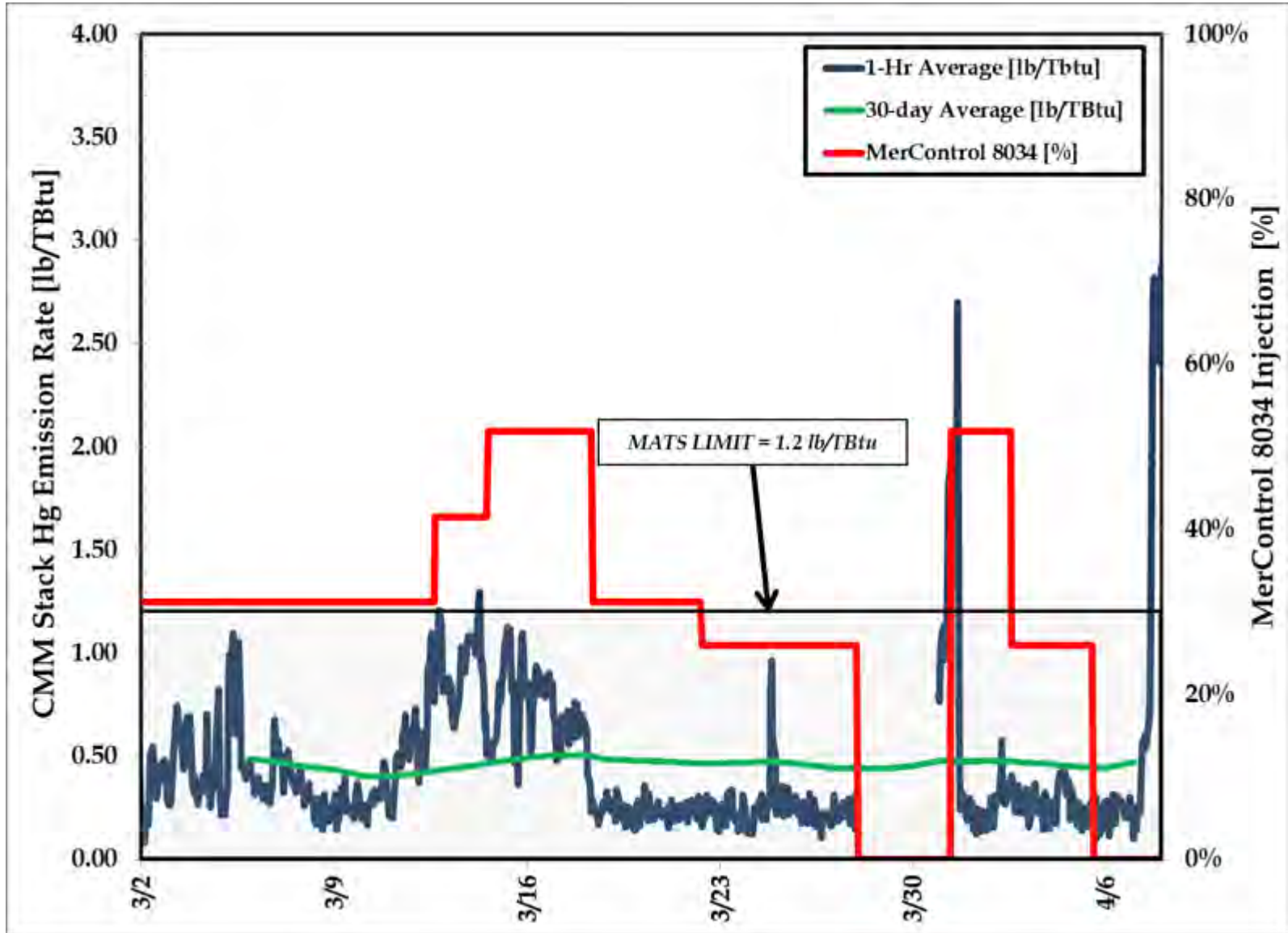




Demonstration Data



30-Day Rolling Average



30-Day Rolling Average with 8034

30-Day Rolling Average (3/6 through 4/5)*		
<i>Average</i>	0.46	lb/TBtu
<i>Max</i>	0.50	lb/TBtu
<i>Min</i>	0.40	lb/TBtu
<i>Standard Deviation</i>	0.02	lb/TBtu

* All data with MerControl 8034 Injection

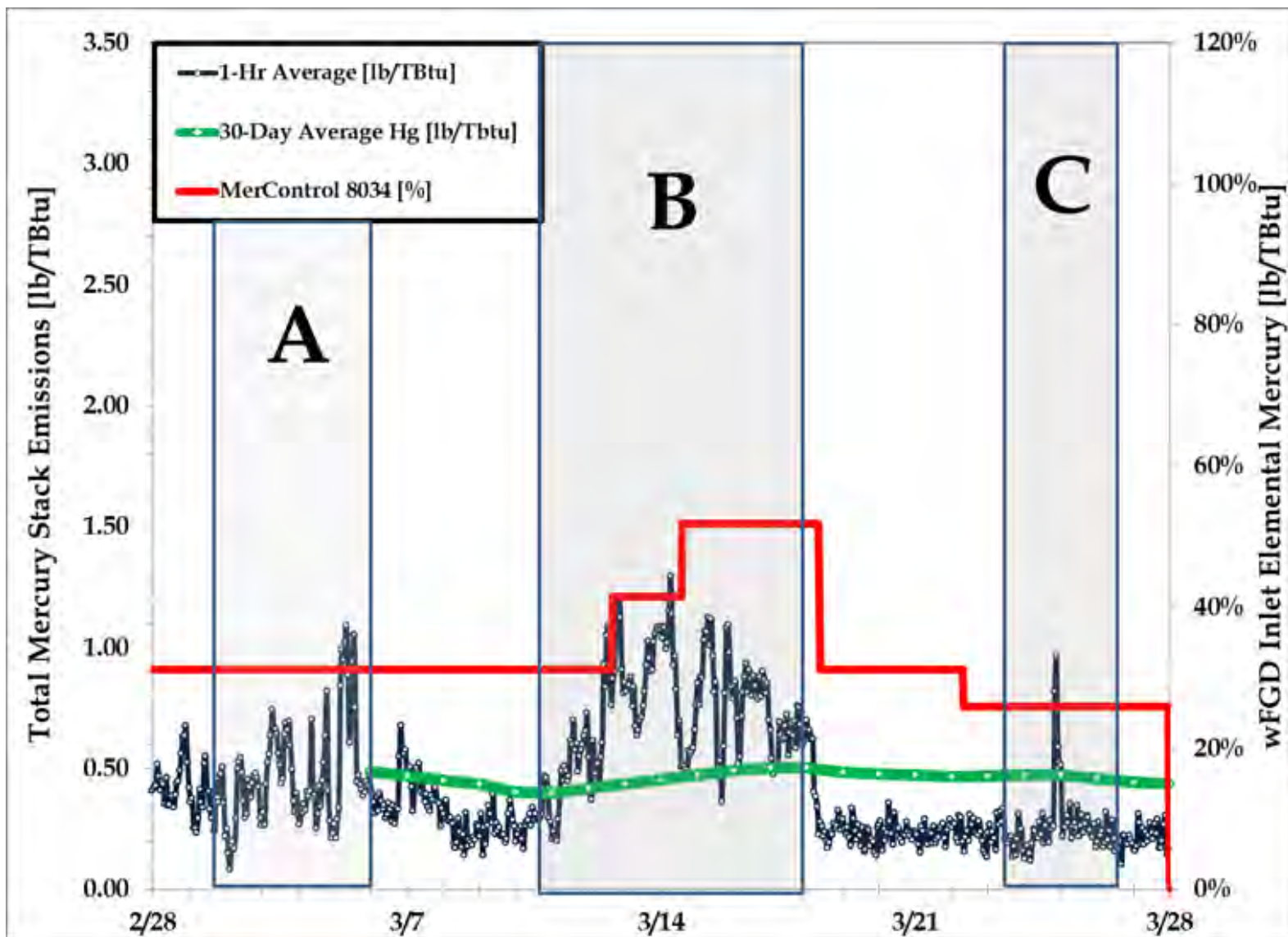
- ▲ Baseline Mercury Emission Rate = 1.20 ± 0.13 lb/TBtu
- ▲ 30-Day Rolling Average with 8034 = 0.46 ± 0.02 lb/TBtu

MerControl 8034 Performance

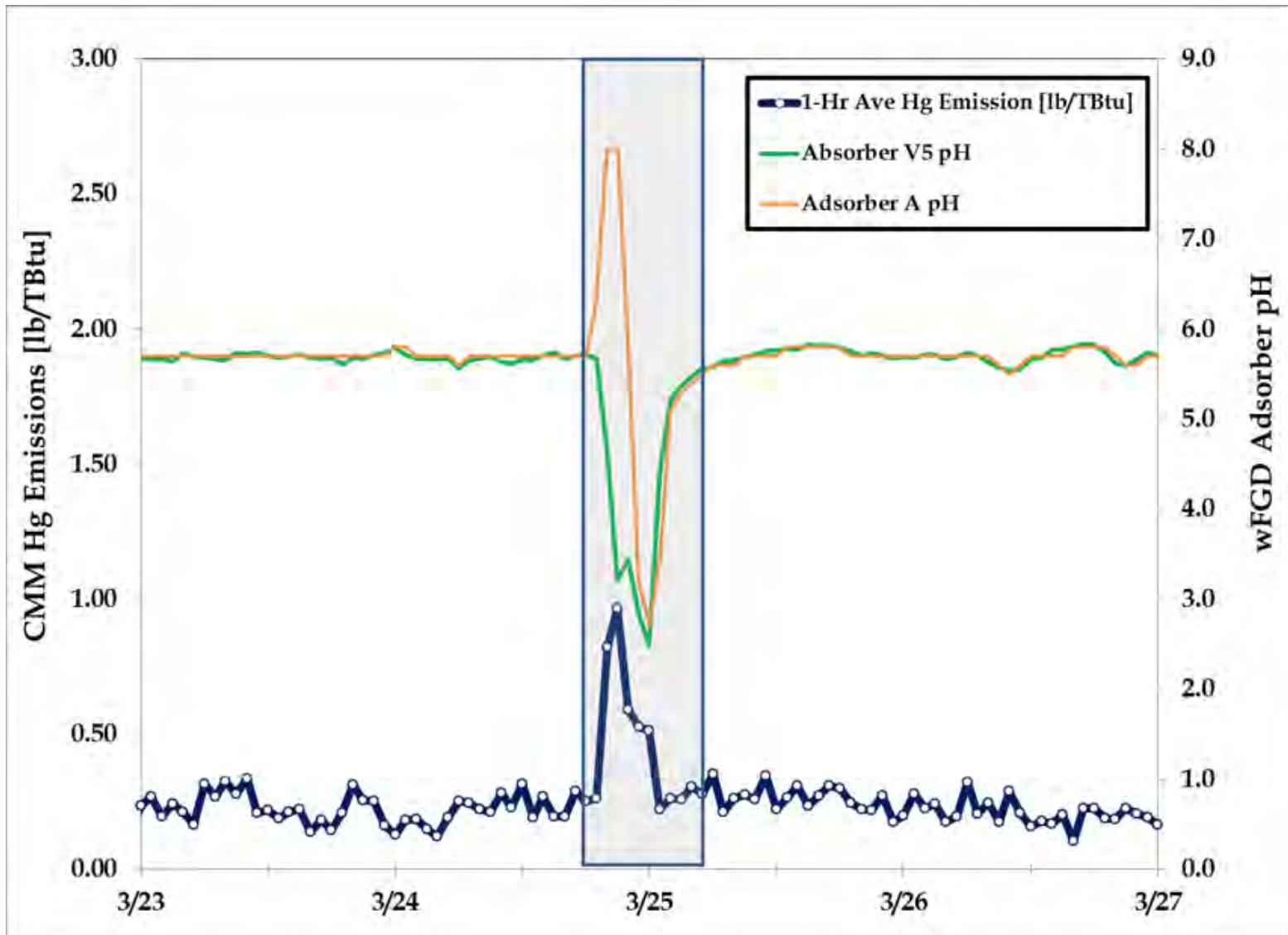
▲ Operational Impacts



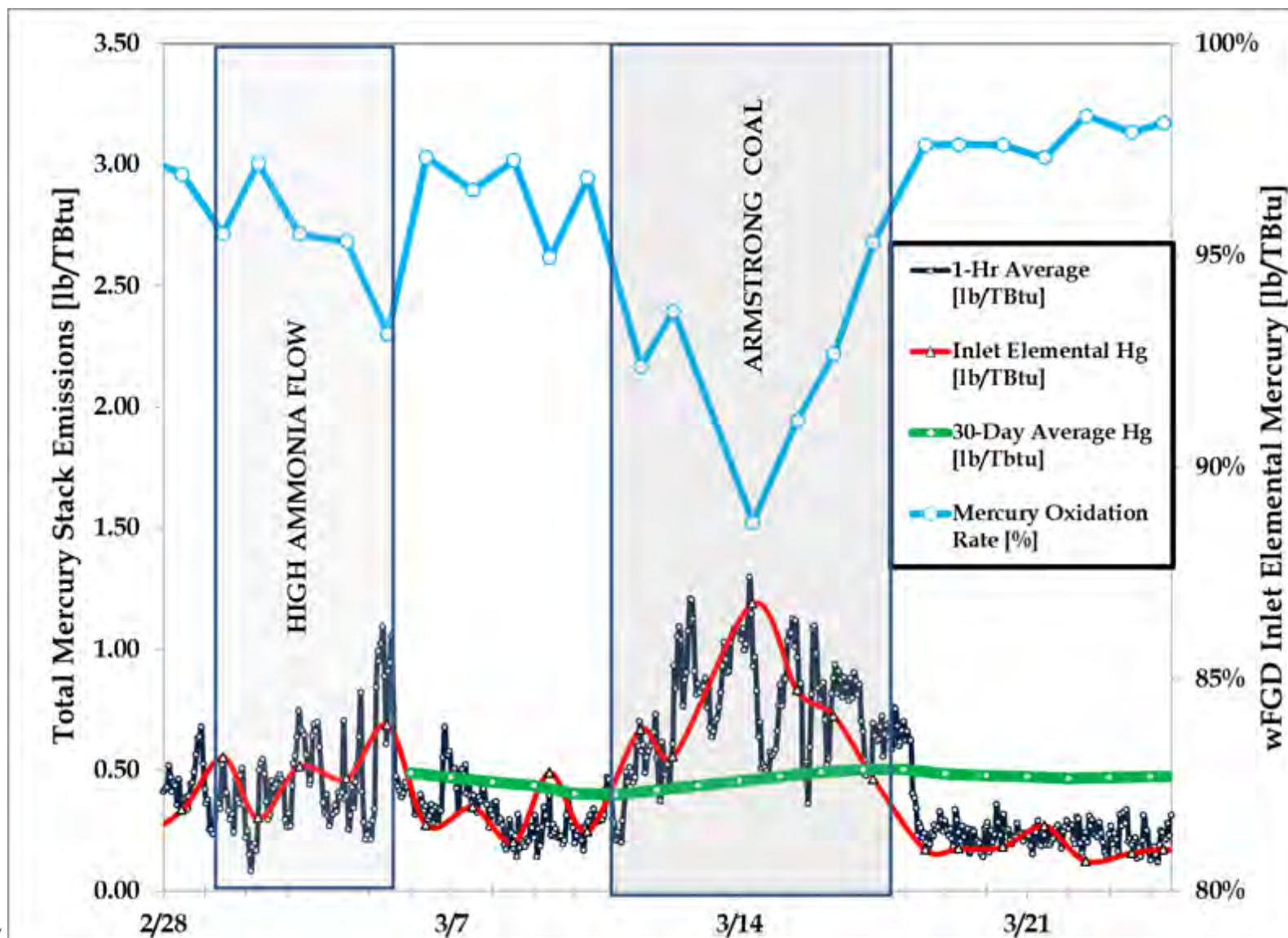
Emission Excursions



Scrubber pH



Mercury Oxidation



Hg Capture via SCR and WFGD

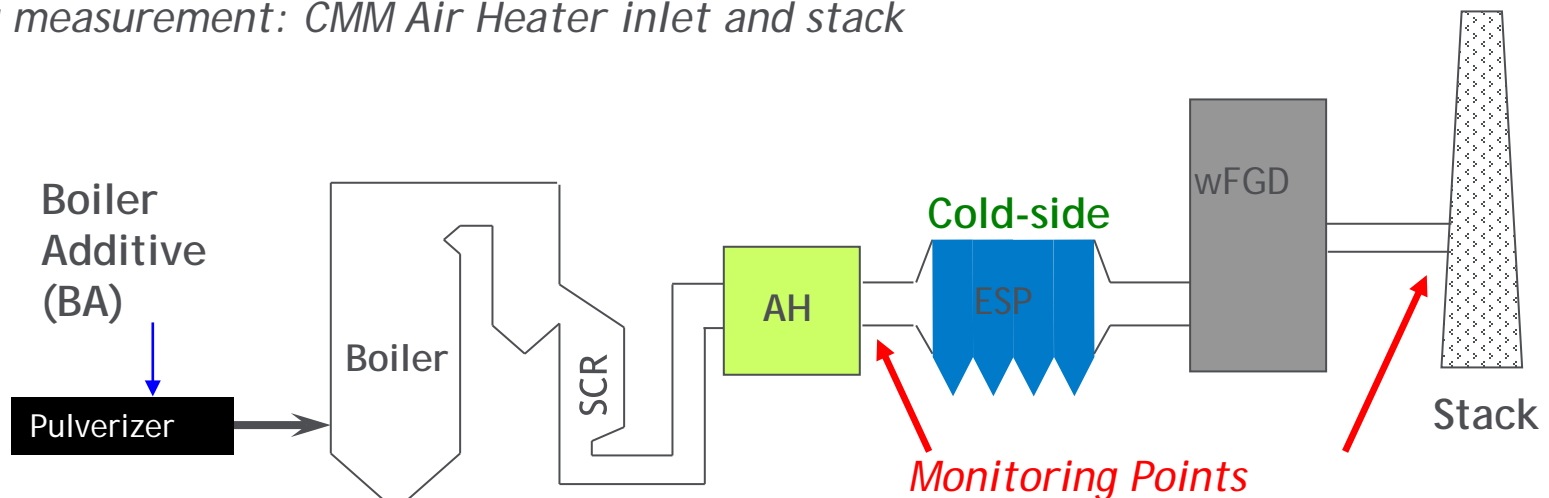
Site Description:

- Chlorine* = 1200 ppm (max = 1400)
- Mercury* = 0.05 ppm (max = 0.06)

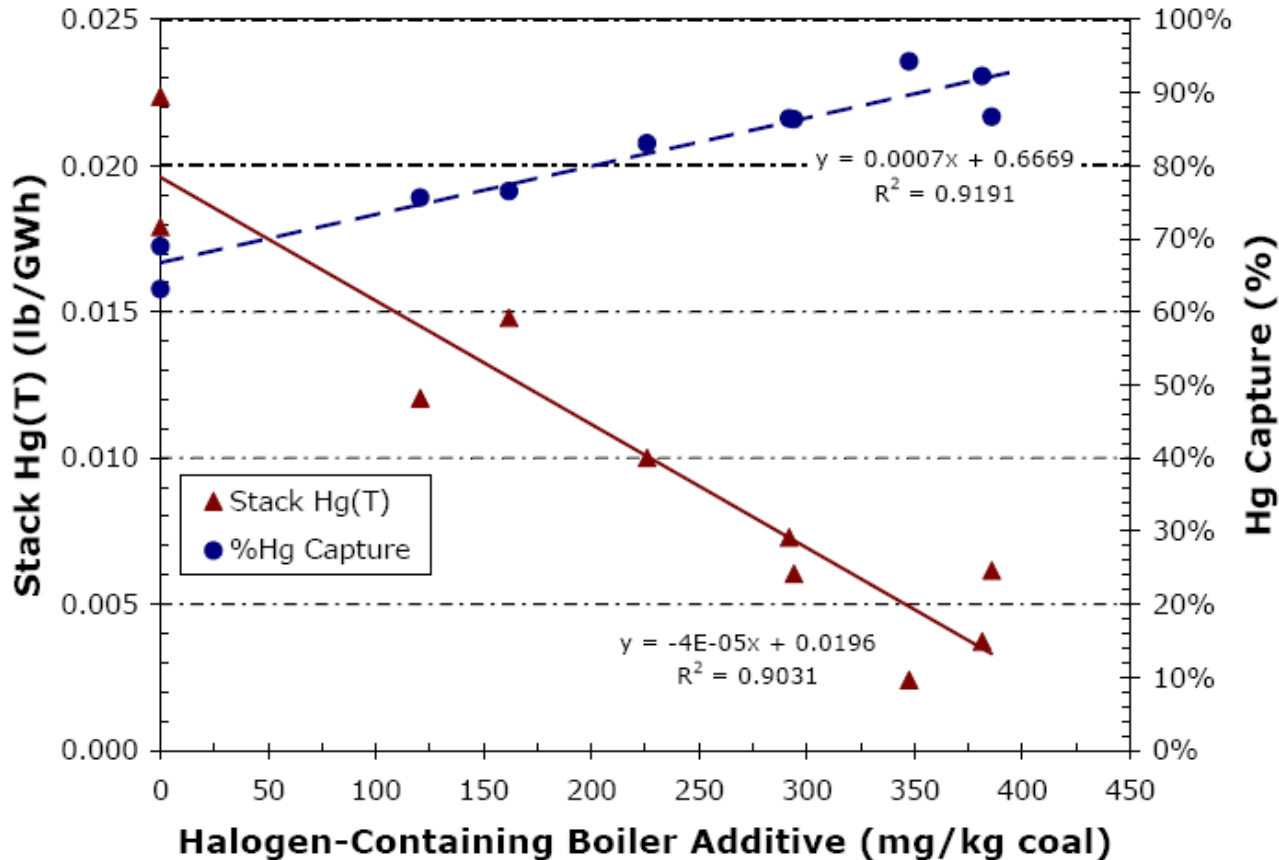
- Full Load = 192 MWe
- Boiler Type = PC, Corner Fired
- Fuel = High Chlorine Bituminous
- AQCDs = SCR, cold-side ESP and wFGD

Goal: Achieve 90% Hg Capture¹ *and* meet mercury water discharge regulations.

Hg measurement: CMM Air Heater inlet and stack



Mercury Emissions and Capture



Hg Capture %

$$\left(\frac{\text{Hg}^{\text{T}}_{\text{FGD inlet}}}{\text{Hg}^{\text{T}}_{\text{stack}}} \right) \times 100$$

Based on OHM measurements

➤ *Halogen-containing BA reduces Hg stack emissions.*

MerControl 8034 Summary

- ▲ MerControl 8034 application resulted in reduction of stack mercury emissions from 1.20 to 0.46 lb/TBtu.
- ▲ Scrubber solids analyzed and pass TCLP leaching test
- ▲ No effects observed on SO₂ capture
- ▲ No effects observed on normal plant operation
- ▲ Burning Armstrong Coal resulted in reduced mercury oxidation rates, and higher mercury emissions
- ▲ Significant deviation in scrubber pH resulted in emission excursion.

Questions

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