McIlvaine Hot Topic Hour:

Full-scale Plant Trials of Novinda's non-carbon Mercury Capture Reagent

August 1, 2013

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Product Overview

- Non-carbon, mineral based product
- Facilitates Chemical Reaction vs. Adsorption (PAC)
- Powerful Oxidizer
- Preserves Beneficial Use of Fly Ash and Gypsum
- > 90% Mercury Removal
- SO_3-Tolerant
- Non Flammable
- Pricing Equivalent to Brominated Carbon
- 20 Million lb/year production capacity now on-line
- Packaging – Rail, Pneumatic Truck, Super Sacks

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SCR / CS-ESP / Wet FGD

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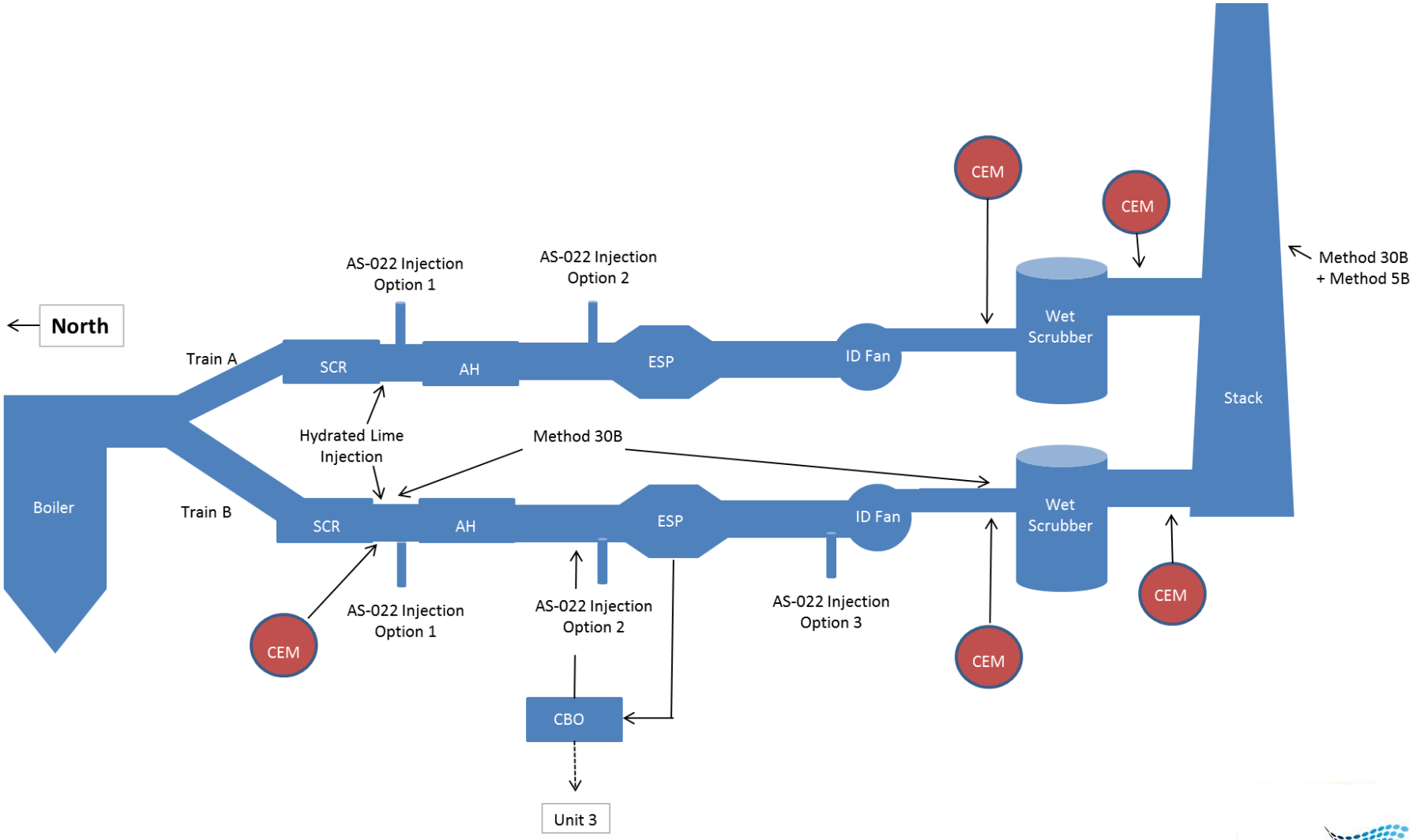
Plant Layout (SCR / CS-ESP / WS)



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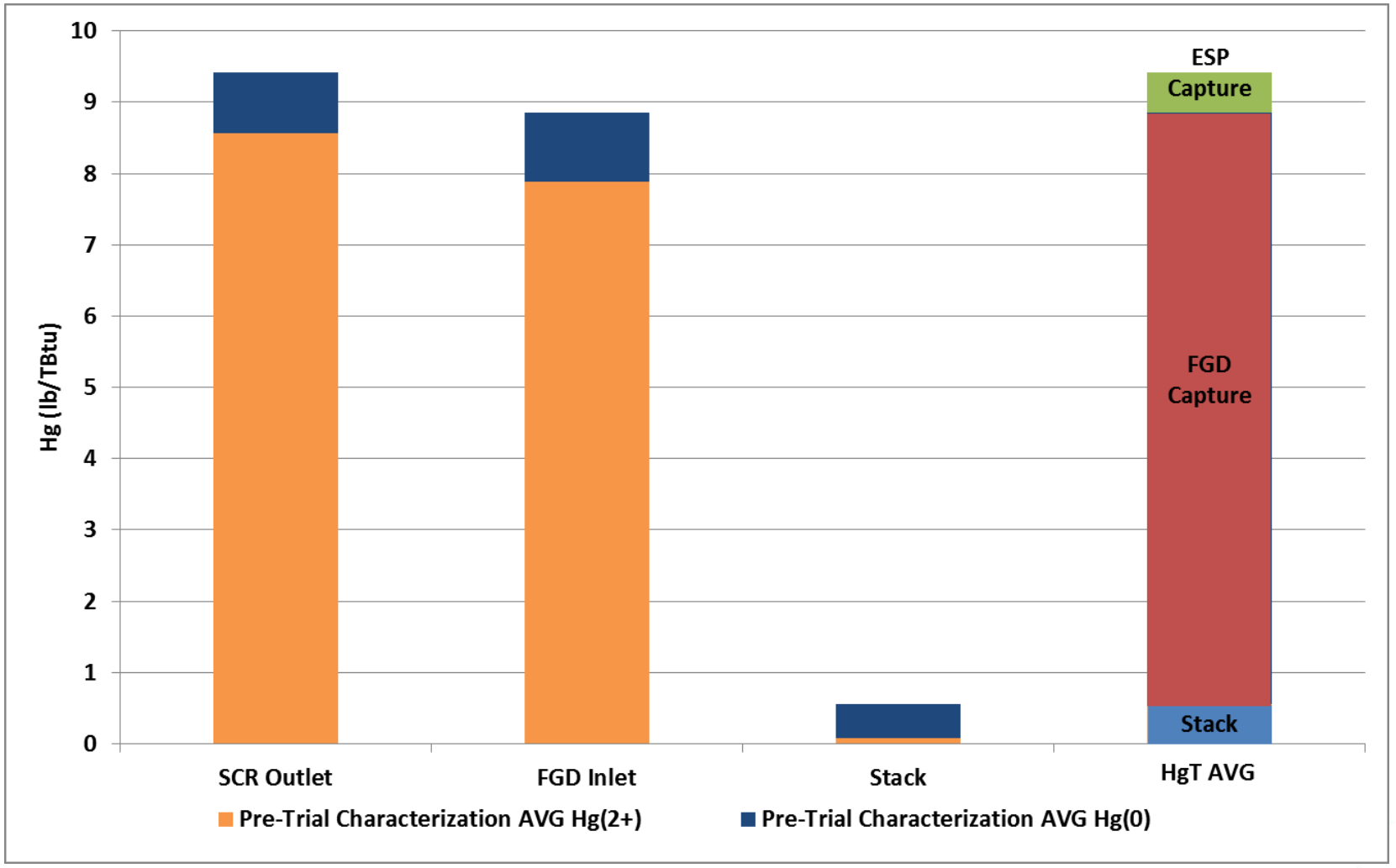
Pre-Trial Characterization: Hg Speciation



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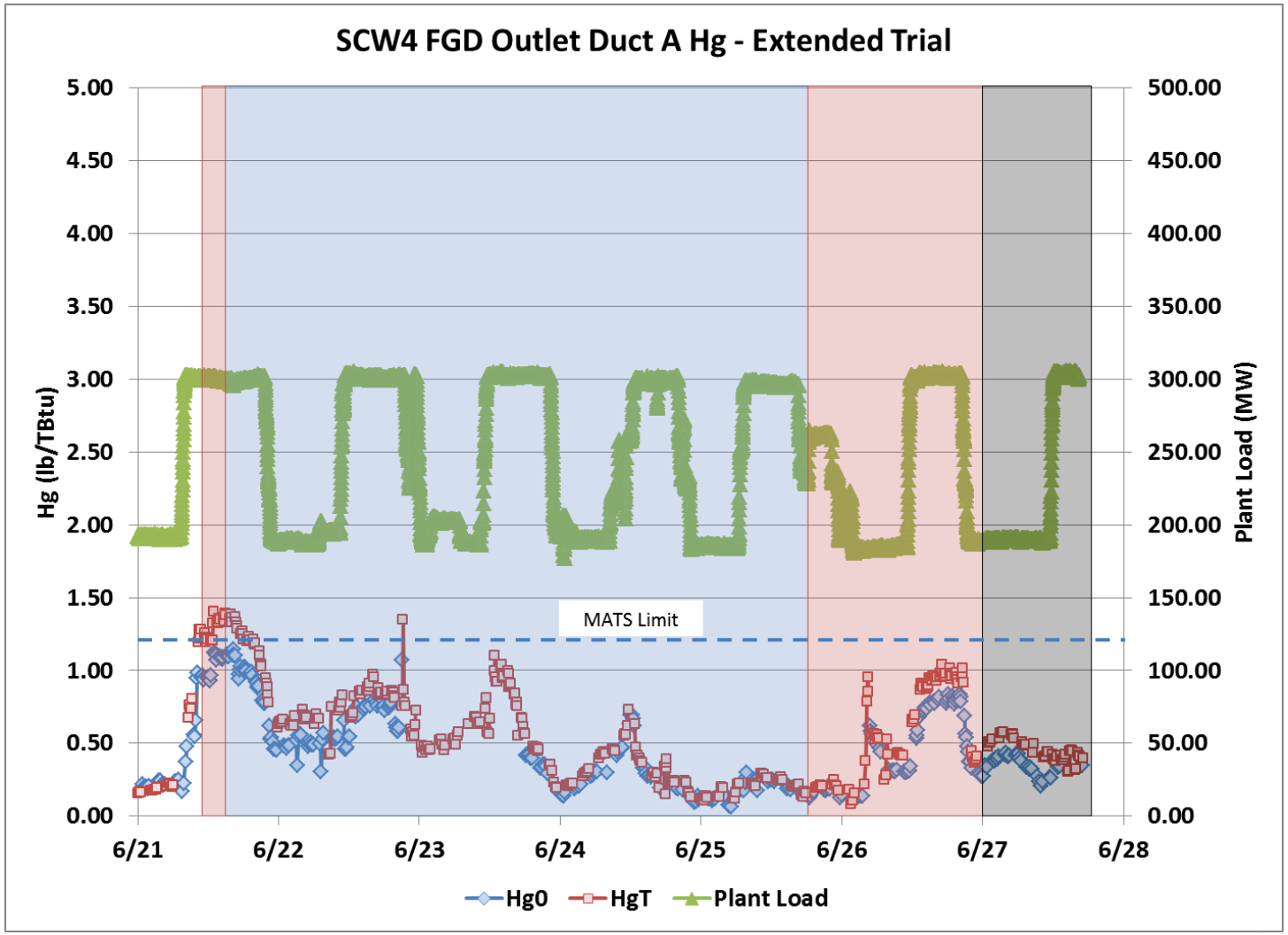
Typical CEMS Data – FGD Outlet



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Extended Test Conditions

- 100 hrs continuous injection
  - AS-022 @ 400 lb/hr
  - Hydrated Lime @ 500 lb/hr
- 31.5 hrs continuous injection
  - AS-022 @ 220 lb/hr
  - Hydrated Lime @ 500 lb/hr
- 17 hrs continuous injection
  - AS-022 @ 220 lb/hr
  - Hydrated Lime off

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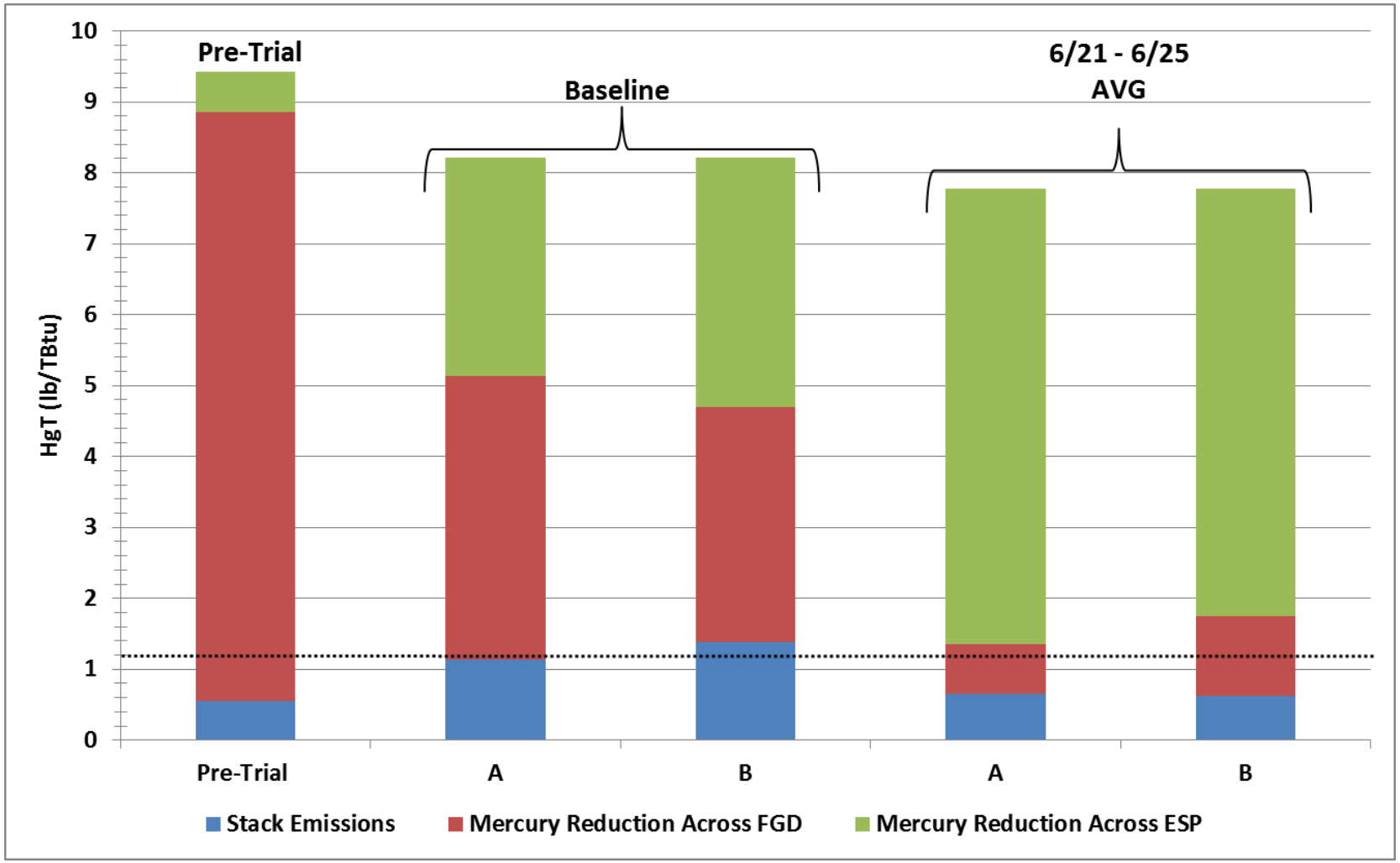
100 Hr Continuous Injection Results

AS-022 @ 400 lb/hr + Lime @ 500 lb/hr



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Continuous Injection Comparisons

Case	SCR Outlet	ESP Removal	WFGD Removal	Stack Emission
Pre-Trial Characterization (Method 30B)	9.42	0.56	8.31	0.55
Baseline: No Injection	8.21	3.30	3.66	1.26
AS-022 @ 400 lb/hr Hydrated Lime @ 500 lb/hr	8.70	7.13	1.08	0.49
AS-022 @ 220 lb/hr Hydrated Lime @ 500 lb/hr	8.99	6.75	1.29	0.95
AS-022 @ 220 lb/hr Hydrated Lime Off	9.04	5.79	2.51	0.74

Note: All Hg Concentrations in lb/TBtu

Green Indicates Hg level below MATS limit of 1.2 lb/TBtu

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Summary

- Air Heater Inlet Injection Location proved most efficient in parametric testing.
- Lime provided performance enhancement.
- Configuration for extended trial
  - AS-022 Injection at Air Heater Inlet @ 400 lb/hr
  - Hydrated Lime @ 500 lb/hr
- MATS compliance for Hg capture satisfied during extended trial.
- Gypsum quality maintained during trial
- Majority of Hg capture moved from WFGD to ESP.
- Equilibrium in a WFGD requires several days to be established.

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SDA / PJ-BH
CDS / CS-ESP

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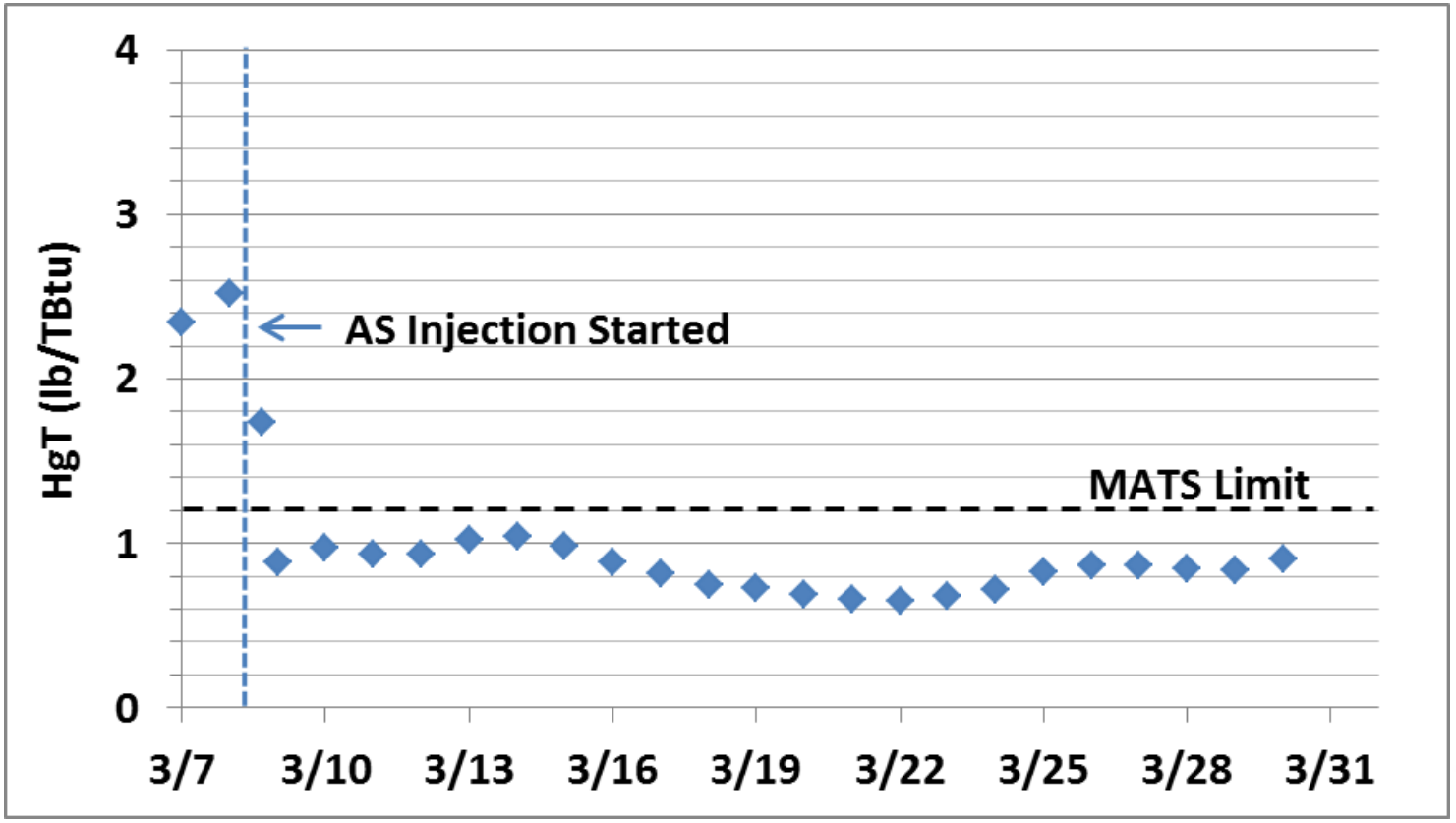
PRB 750MW: SCR / SDA / PJBH (AS-022)

Typical Operation: Daily Load Cycling
Injection Ratio: 0.6 lb/mmacf (average)



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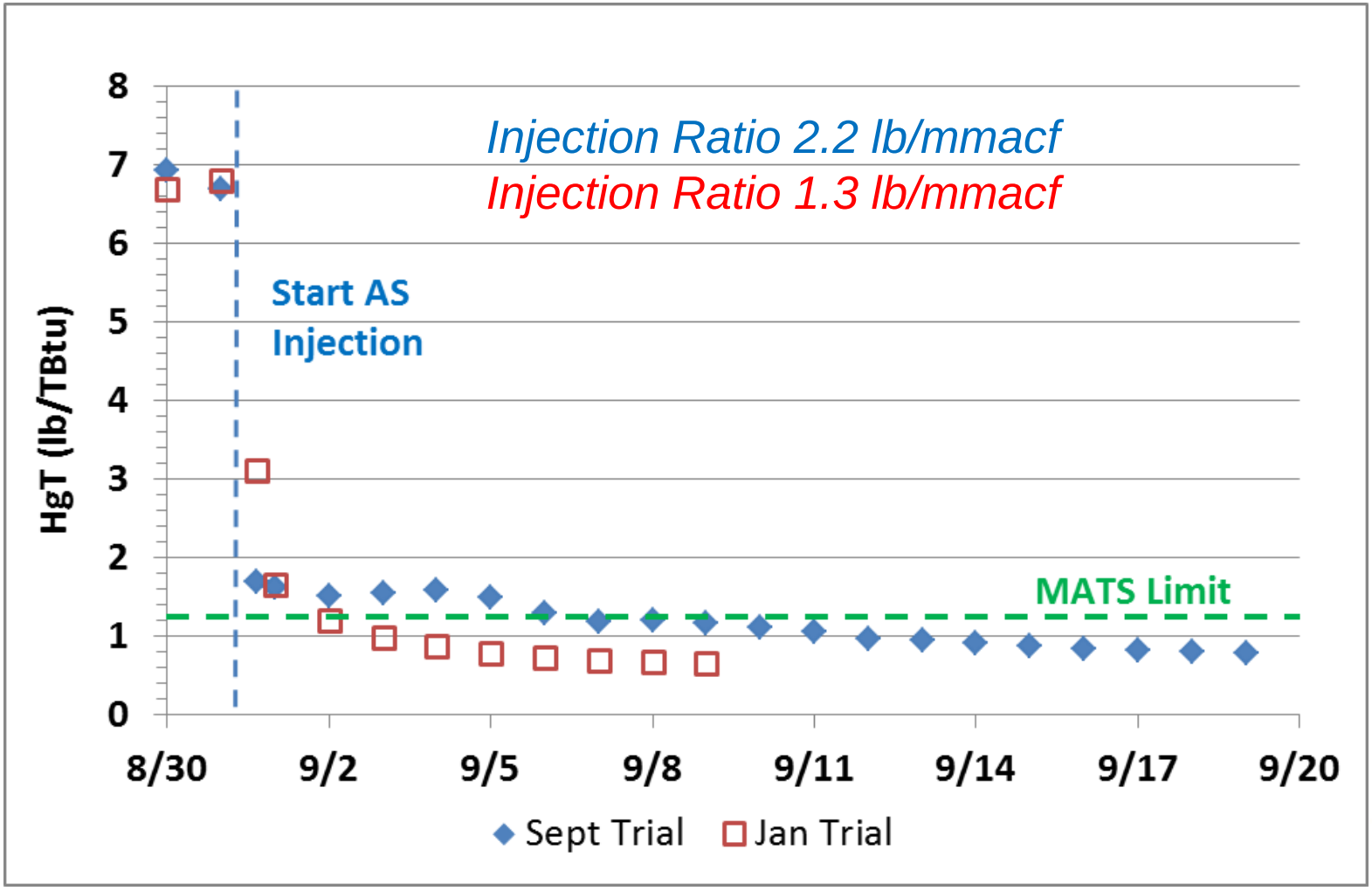
Wygen 2 Results- Cumulative Average



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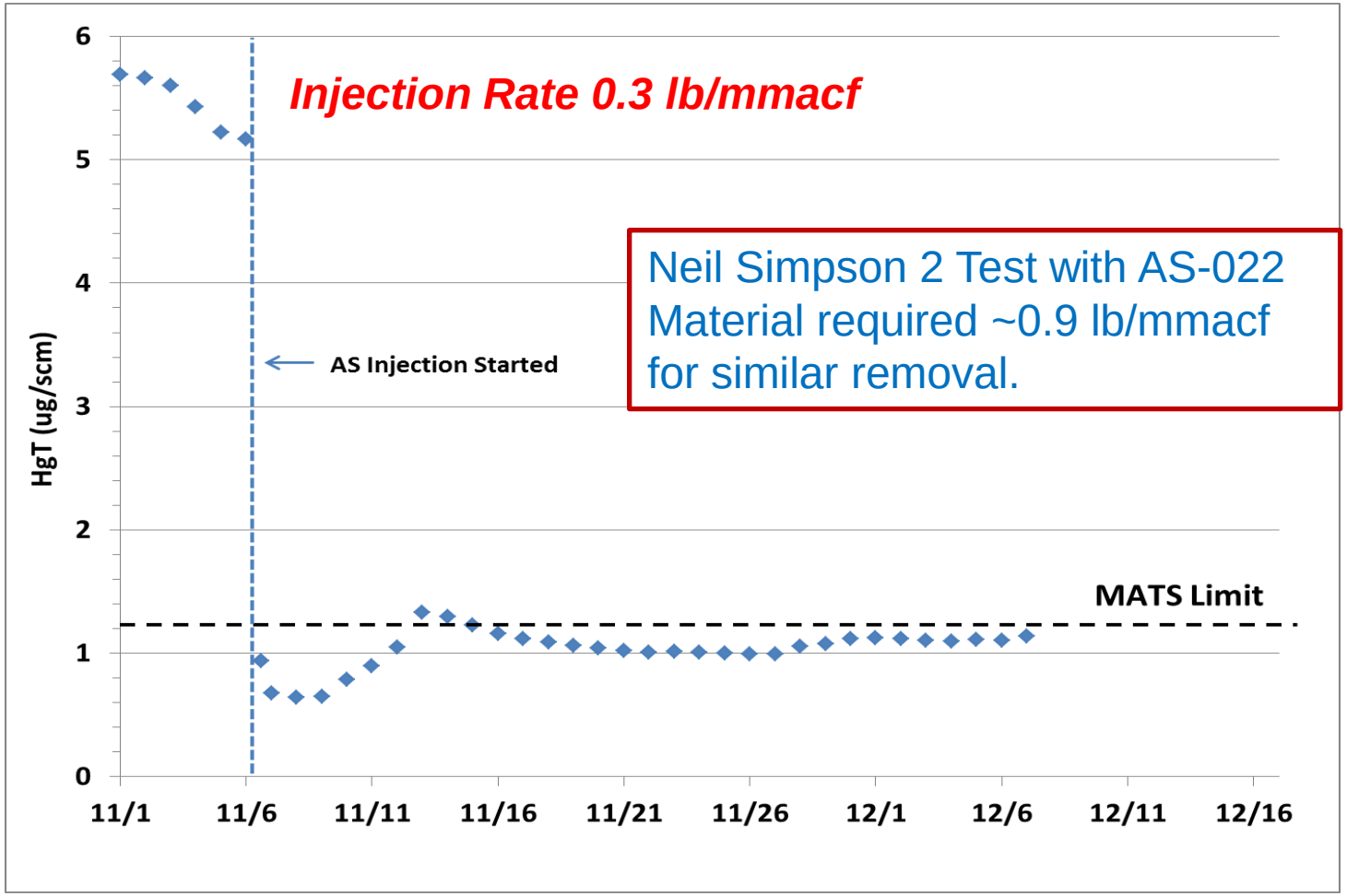
BHP Neil Simpson 2 Stack Hg CEM 30-day Cumulative Average with AS-HgX



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Cost Analysis – Pulse Jet Unit with AS-HgX

	Material Flow Rate	CaCl2 Injection Rate	Reduction	Cost
BrPAC with CaCl2	50 lbs/hr	400 ppm	83%	$62.70/hr
BrPAC	100 lbs/hr	0	83%	$75.00/hr
Amended Silicates	30 lbs/hr	0	90%	$30.00/hr

AS @ $1.00/lb
Brominated PAC @ $0.75/lb
$CaCl_2$ @ $1.50/gallon

Annual Savings Over:
BrPAC + CaCl2 - $286,452 (52%)
BrPAC - $394,200 (60%)

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Advantages of AS-HgX

- Innovative, non-carbon mercury control technology
- Available now in commercial quantities for full-scale plant trials or long-term supply contracts
- SO_3 tolerant up to 20 ppm
- Compatible with continued sale of Fly Ash and Gypsum
- Non-flammable
- Powerful, stand-alone oxidizer
- Improves capture of high-resistivity fly ash in a CS-ESP
- Significantly reduced feed versus Brominated PAC in dry-scrubbed configurations
- Cost competitive with Brominated PAC
- Reduced carbon footprint versus PAC and/or Brominated PAC

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Further Information:

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