REINHOLD ENVIRONMENTAL Ltd.

2014 APC Round Table & Expo Presentation

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

SMART MATS COMPLIANCE STRATEGIES PANEL DISCUSSION

Reinhold APC Conference

Louisville, KY

July 15, 2014

- Panel Moderators:
  - Connie Senior – ADA Environmental Solutions
  - Ed Healy – Southern Company
- Panel Members:
  - Mary Zando – AEP
  - Grant Hilbers – DTE
  - Greg Betenson – PacifiCorp
  - Haley Turner – LG&E-KU
  - Andrea Taylor - TVA

Data Centered Decision Making

- What information did you use to make your decisions for MATS compliance?
  - What testing campaigns did you undertake to determine your MATS program?
  - Were there any surprises?
  - What was most useful?
  - If you had to do it over again, would you do it differently?
  - How confident are you that your MATS strategy will achieve the requirements?

How to Ensure MATS Compliance

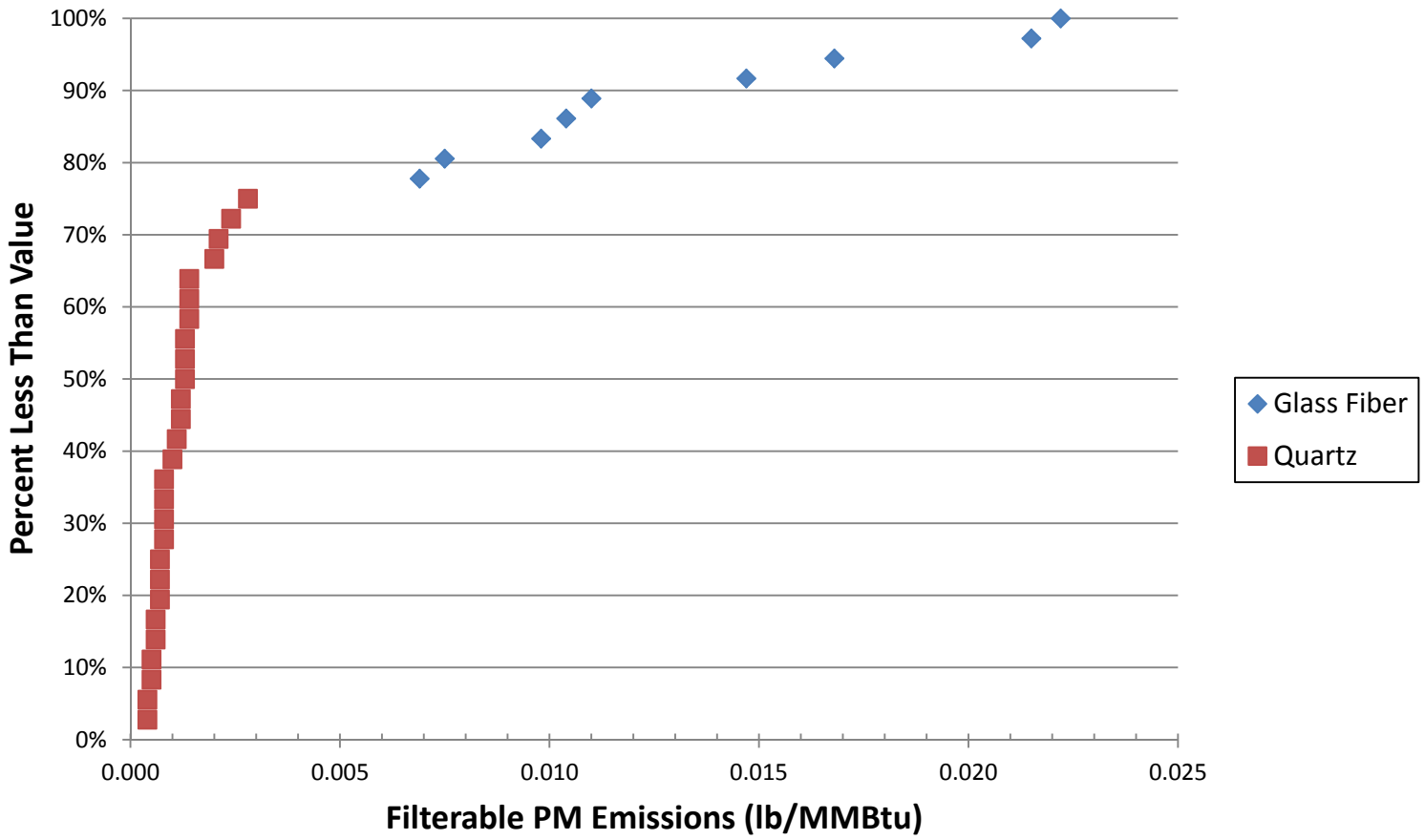
- Once MATS compliance arrives, what kind of data will you use to be in compliance year-round?
  - CEMS vs. Sorbent Traps (real-time vs. batch)?
  - Process monitors vs. Compliance monitors?
  - Quarterly Stack Tests vs. CEMS – how will this restrict unit operations?
  - How will do you demonstrate compliance?
  - What about multiple units on common control device?
  - What about the use of process control monitors vs. compliance reporting monitors?

Optimization of Compliance vs. Cost

- What information will you need to minimize compliance costs?
  - How do you plan to maintain process control of MATS equipment between quarterly stack tests? (Hg feedback for ACI control; HCl feedback for DSI control; SO_3 feedback for HLI control; PM feedback?)
  - How will fuel changes impact your compliance costs and how will these be integrated into the compliance strategy?
  - Once underway, how will the operator respond to changes in conditions?
  - What do you consider to be optimum in terms of cost vs. performance?

DATA CENTERED DECISION MAKING

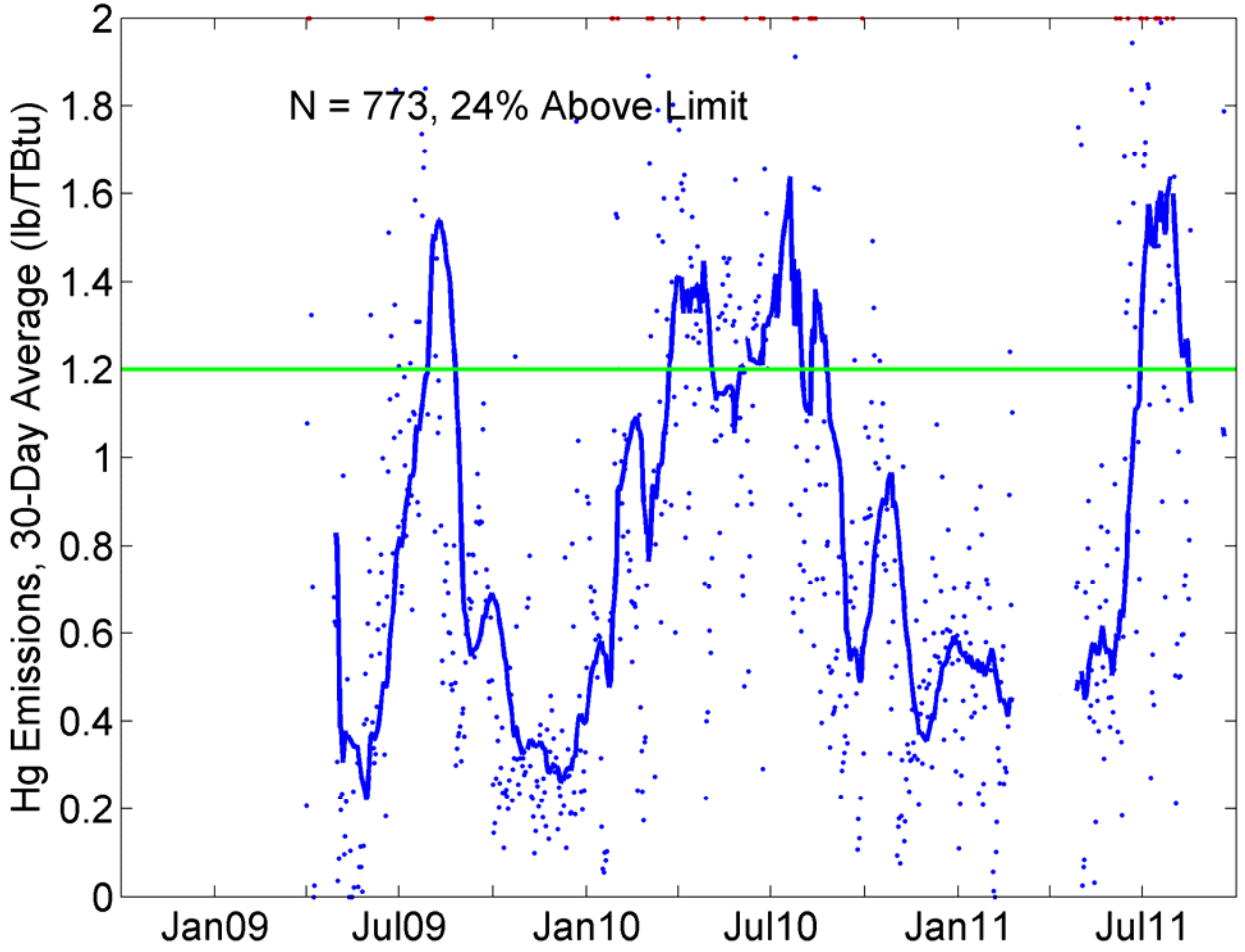
PM Emission Example



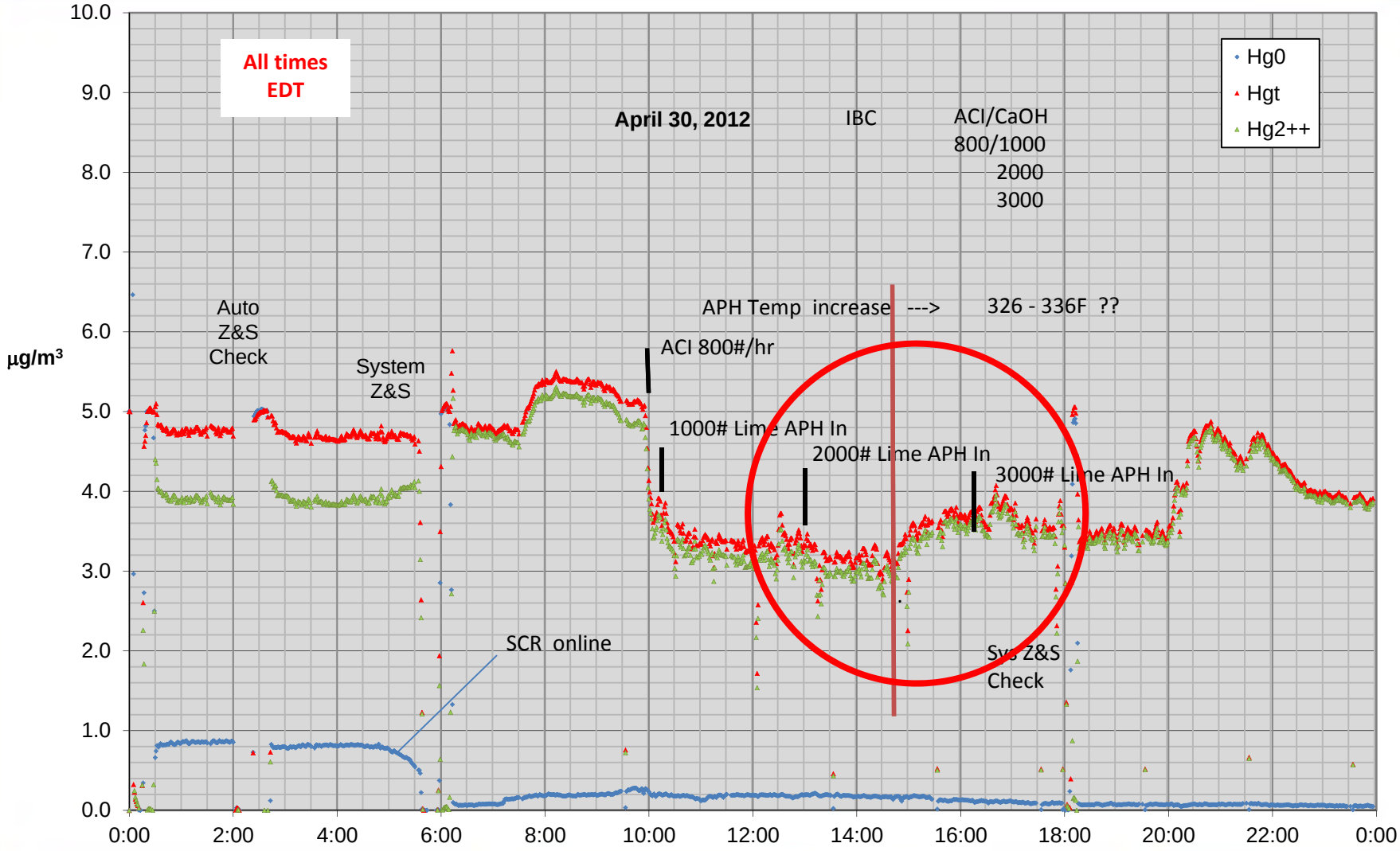
Mercury Emission Statistics

Plant	Basis	Period	N	Fraction > Limit	Mean	99th Percentile
Unit A	TBtu	30-d	402	0.25	0.82	1.87
Unit B	TBtu	30-d	773	0.24	0.83	1.59
Unit C	TBtu	30-d	926	0.26	0.92	1.90
Unit D	TBtu	30-d	917	0.33	0.97	1.62
Unit E	TBtu	30-d	1003	0.18	0.89	1.87
Unit F	TBtu	30-d	788	0.05	0.71	1.30
Unit G	TBtu	30-d	695	0.14	0.97	1.35

Unit Specific Mercury Emissions

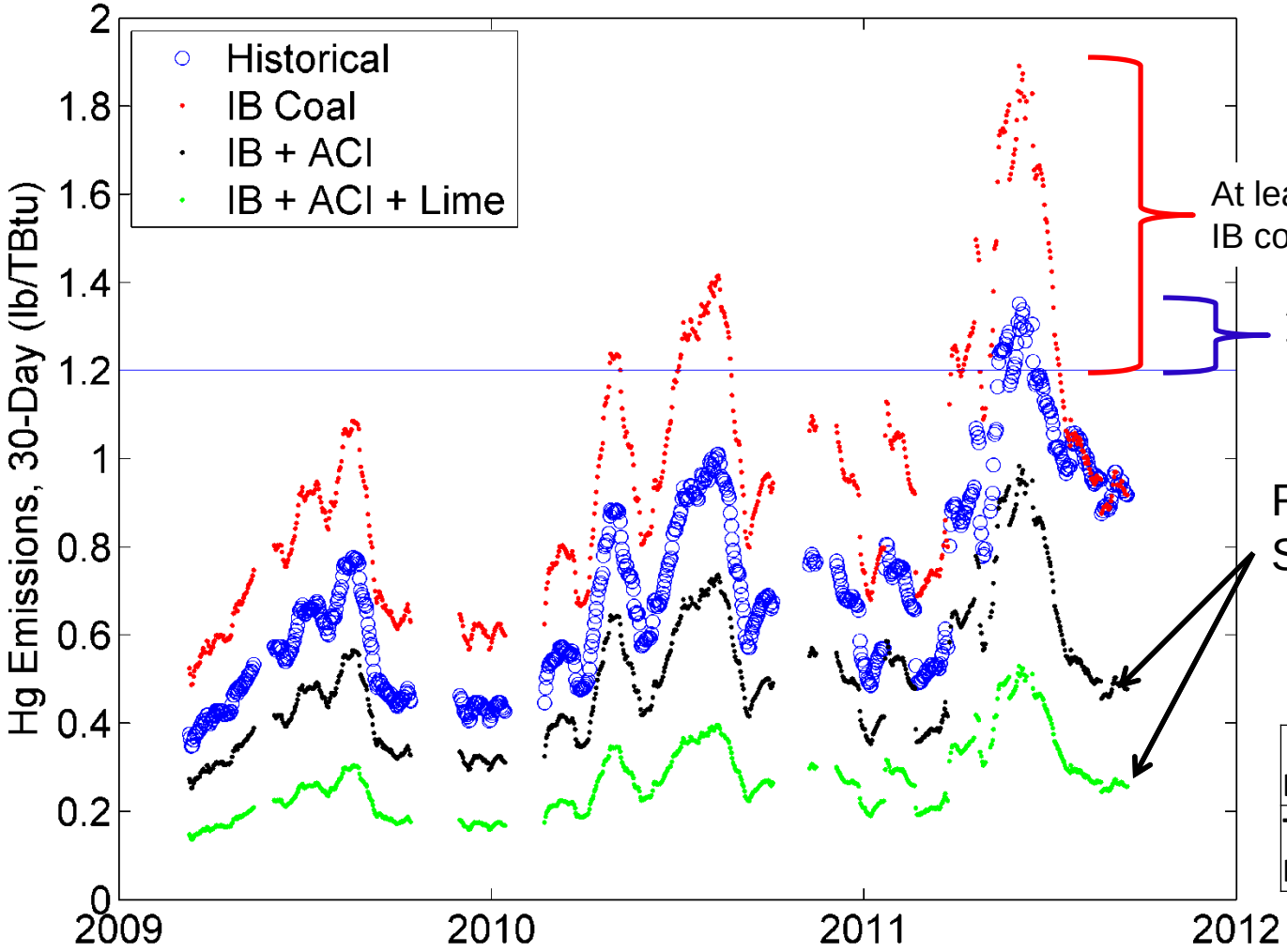


Mercury Removal & Temperature



ENSURING MATS COMPLIANCE

Mercury Compliance Assessment



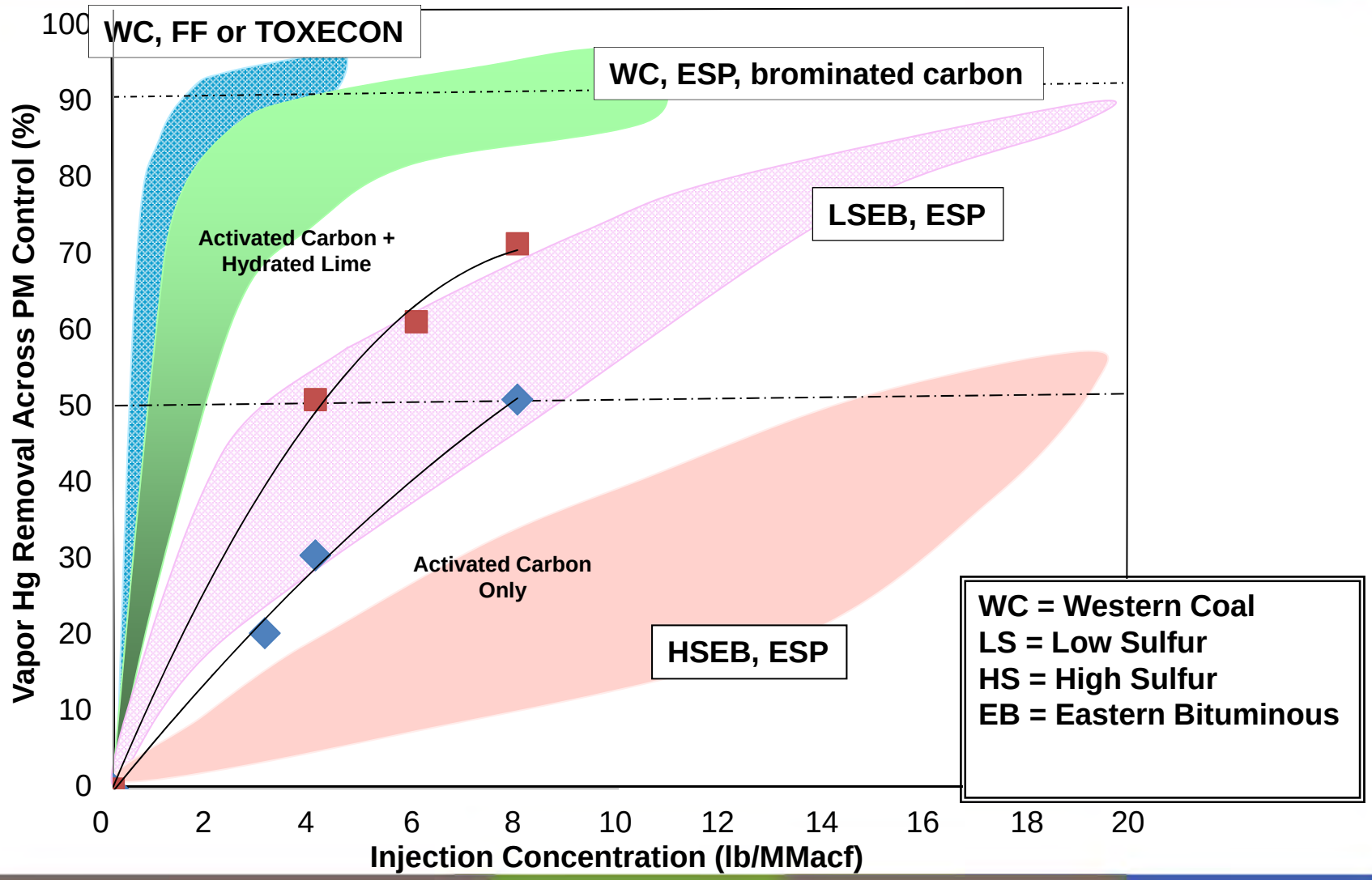
At least 37% reduction for IB coal

At least 11% reduction for historical emissions

Recommended Strategy

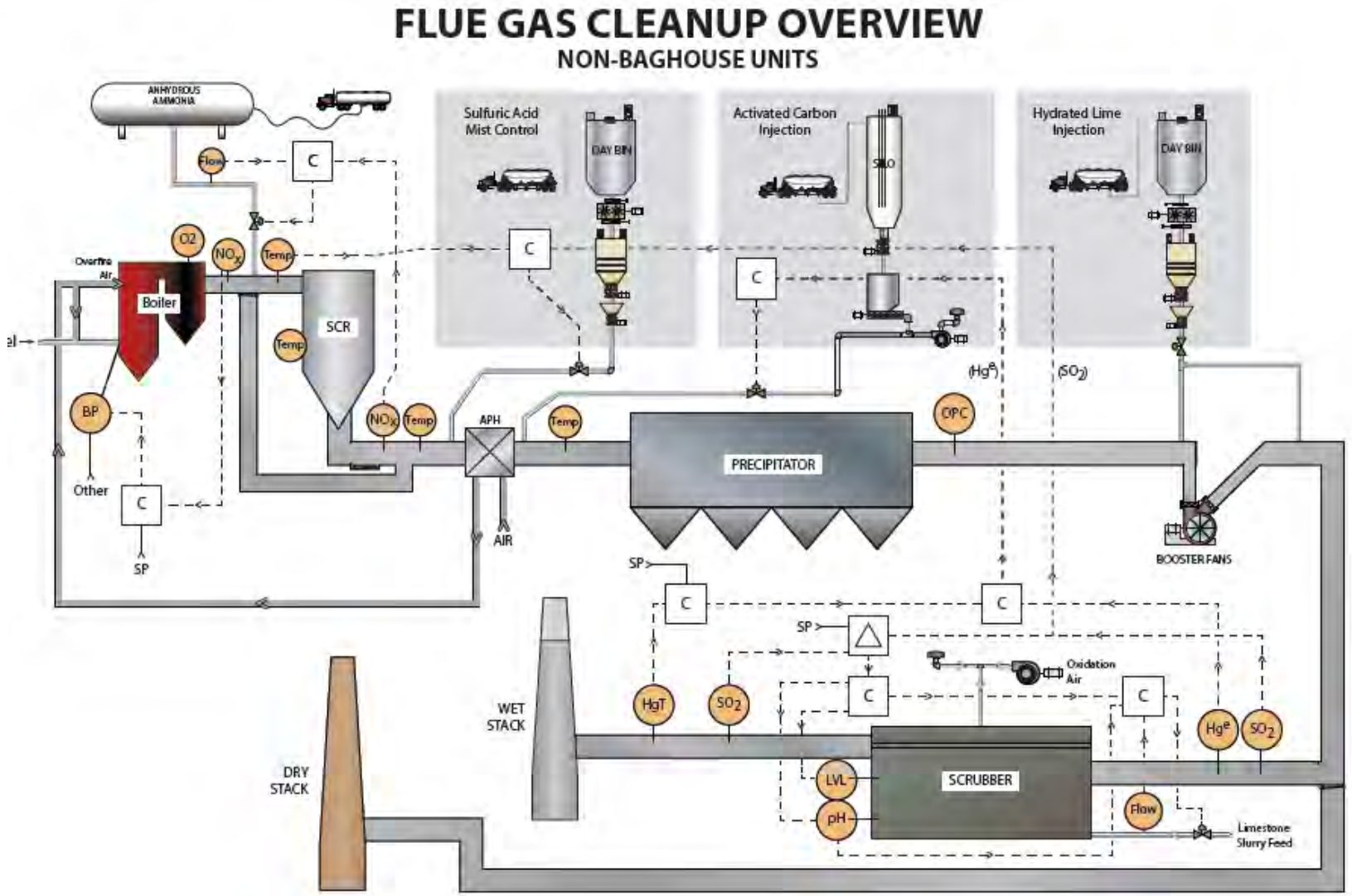
	Days > 1.2	Days > 1.0
Historical	3%	11%
Theoretical IB Coal	20%	38%

Operating Margin



OPTIMIZATION

Hg CEMS Equipment as Process Monitor



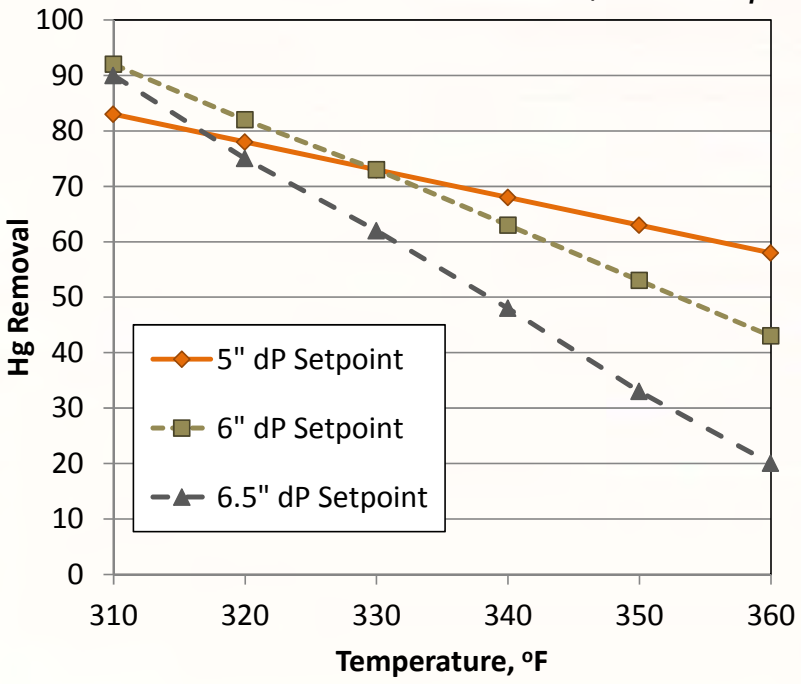
What information did you use to make your decisions for MATS compliance?

- Many plants have generated short-term parametric test data on sorbent injection and/or halogen addition
  - Allows you to test many conditions in a short time
  - Care exercised in extrapolating short-term parametric results to different conditions and different boilers
- Temperature
- SO_3 concentration
- Mixing and residence time

Parametric Testing:
Be Careful Extrapolating Data from One Unit to Another

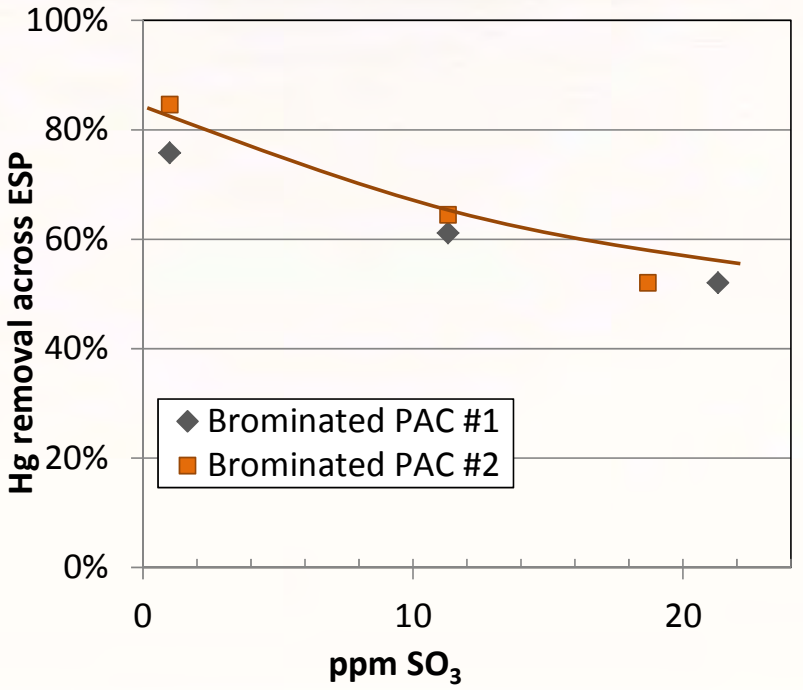
- Effect of temperature
- Effect of SO_3 at the particulate control device

Source: Derenne and Stewart, Final Report



Presque Isle TOXECON fabric filter, 1 lb/MMacf Darco Hg sorbent

Source: Pollack, AQV

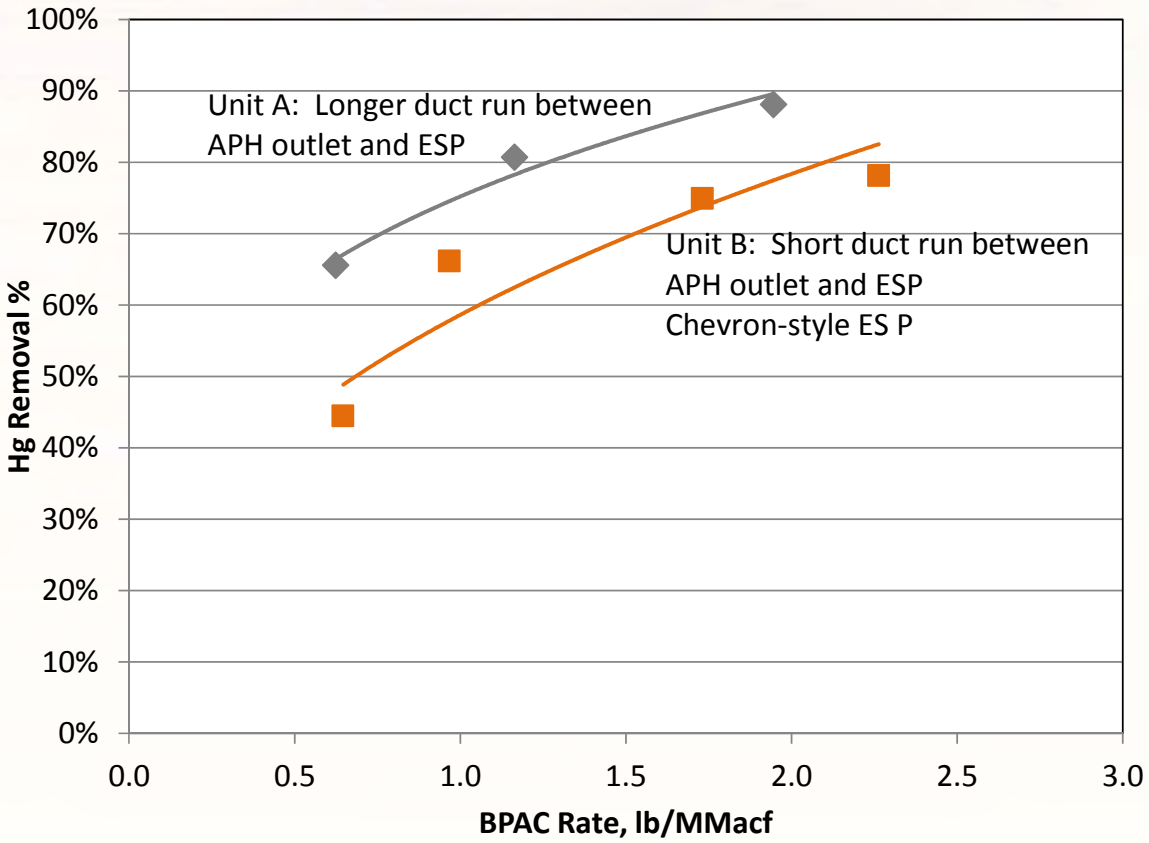


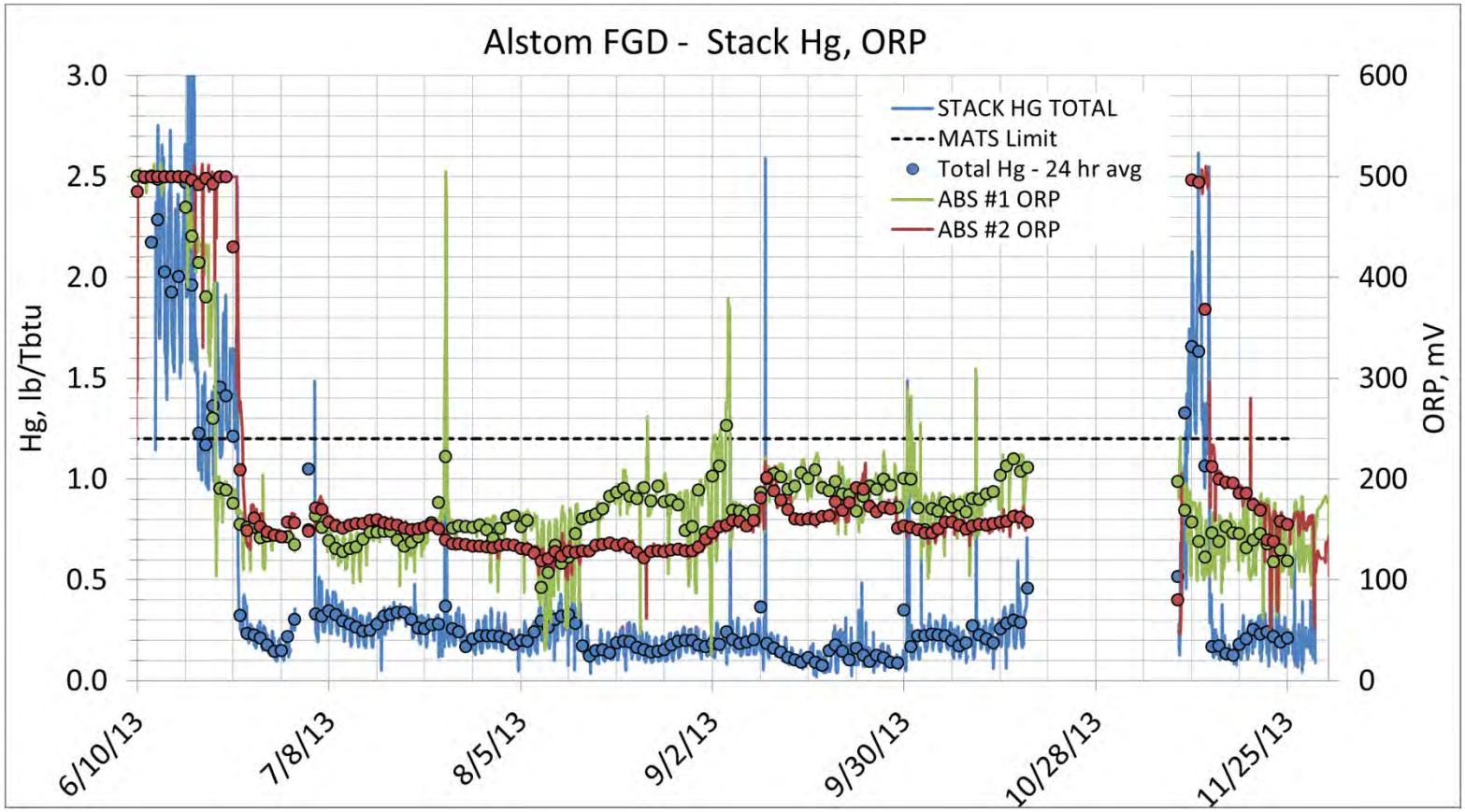
MRC Results: 10 lb/MMacf, injection upstream of APH; APH outlet: 300 F

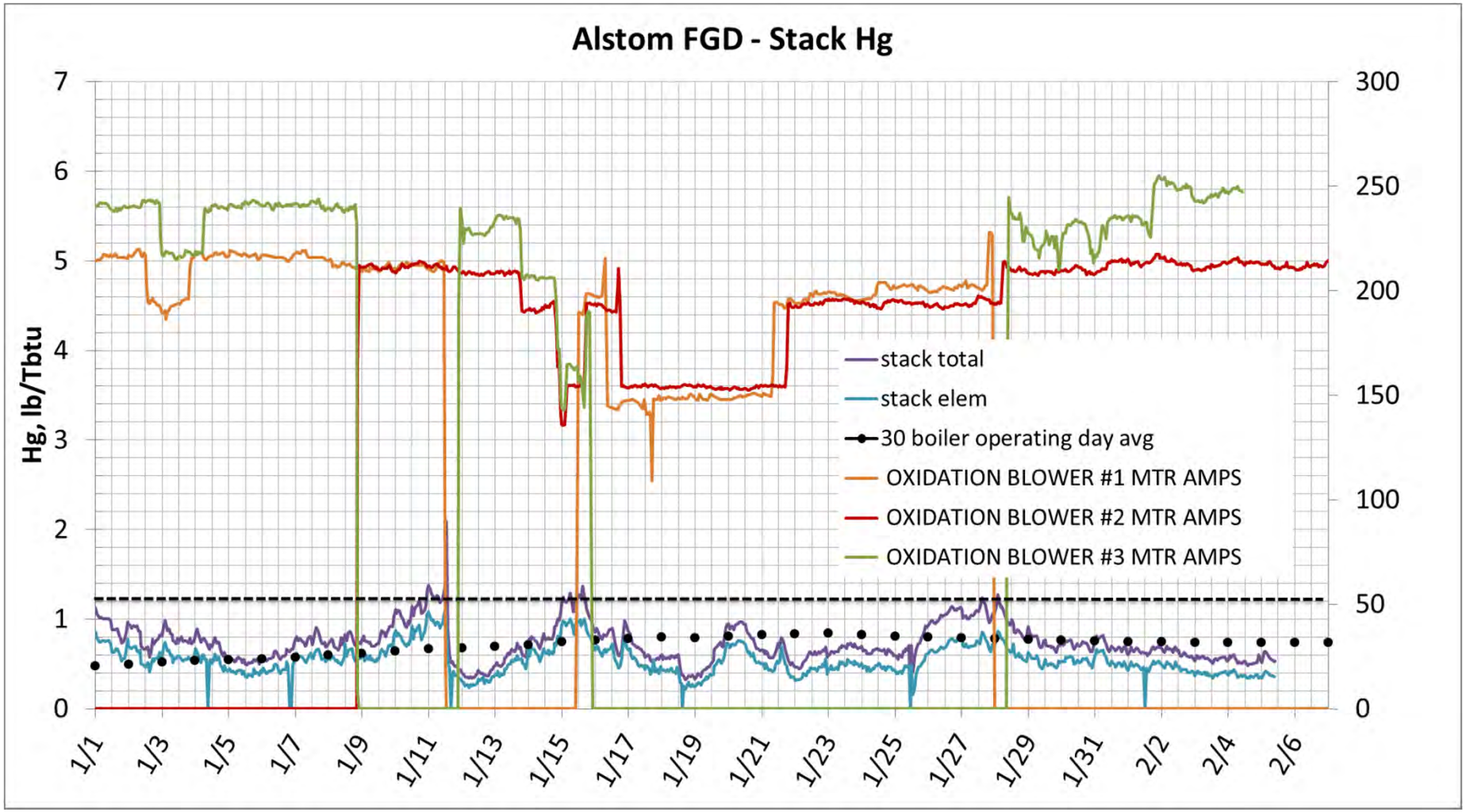
Parametric Testing:
Be Careful Extrapolating Data from One Unit to Another

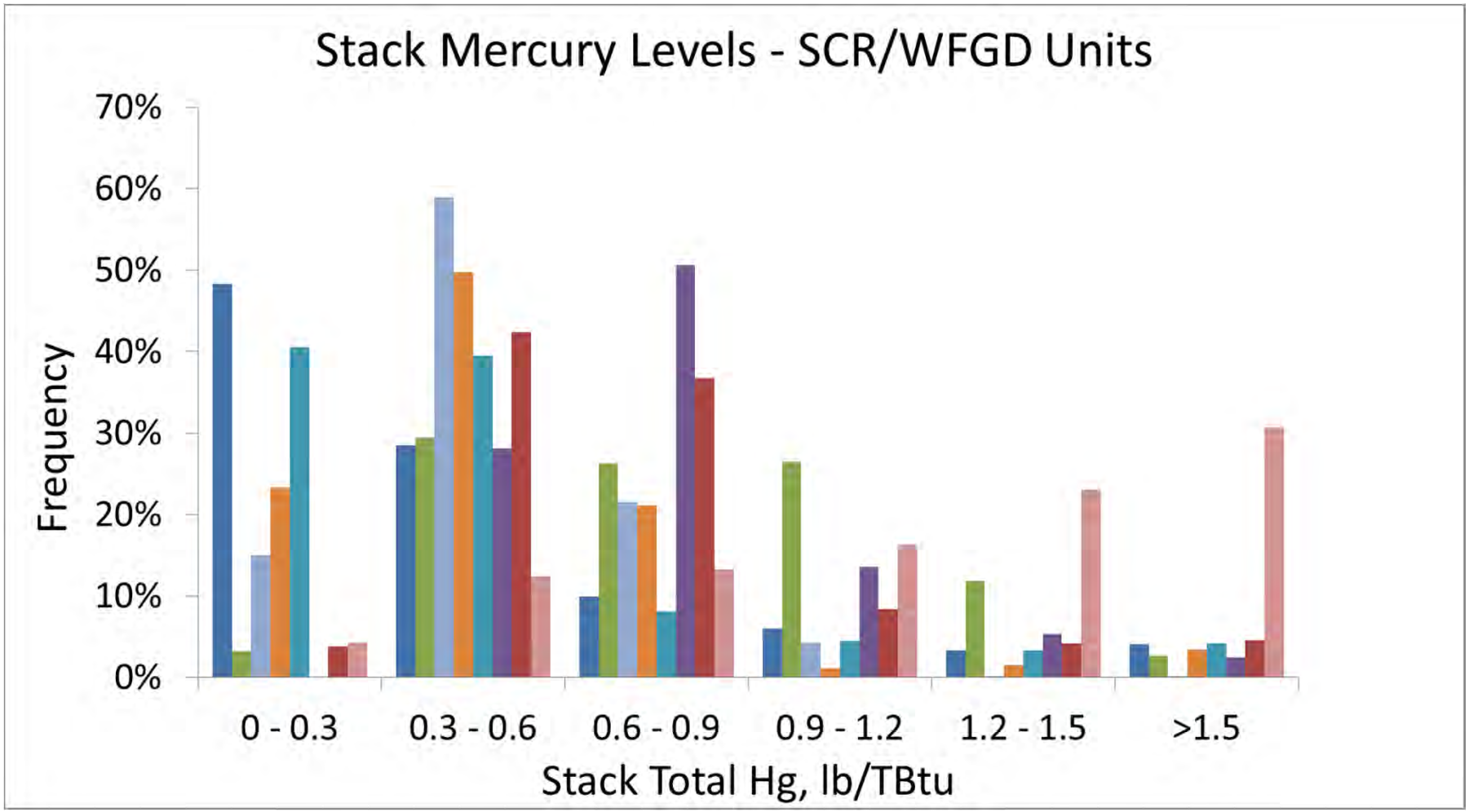
- Example: Both Units burn the same PRB coal
- Unit B has short residence time between APH outlet and ESP inlet AND Chevron-style inlets
- Unit A has longer duct residence time between APH outlet and ESP inlet
- Testing of brominated PAC on both units at 315-320 F

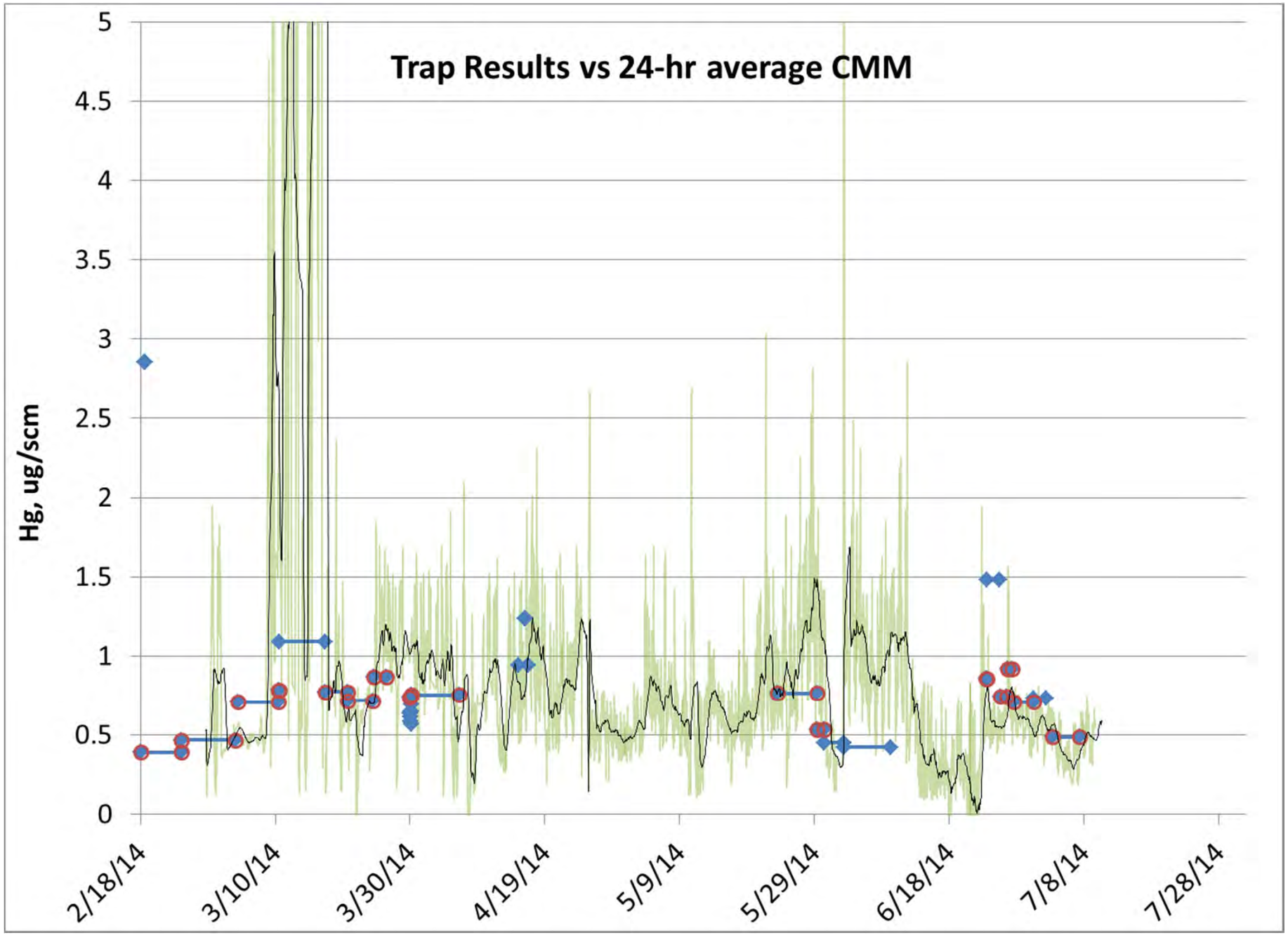
Two Units burning same PRB coal, brominated PAC, similar temperature




Alstom FGD - Stack Hg, ORP
Hg, lb/Tbtu
ORP, mV
3.0
2.5
2.0
1.5
1.0
0.5
0.0
600
500
400
300
200
100
0
6/10/13
7/8/13
8/5/13
9/2/13
9/30/13
10/28/13
11/25/13
STACK HG TOTAL
MATS Limit
Total Hg - 24 hr avg
ABS #1 ORP
ABS #2 ORP


Alstom FGD - Stack Hg
Hg, lb/Tbtu
7
6
5
4
3
2
1
0
300
250
200
150
100
50
0
1/1
1/3
1/5
1/7
1/9
1/11
1/13
1/15
1/17
1/19
1/21
1/23
1/25
1/27
1/29
1/31
2/2
2/4
2/6
stack total
stack elem
30 boiler operating day avg
OXIDATION BLOWER #1 MTR AMPS
OXIDATION BLOWER #2 MTR AMPS
OXIDATION BLOWER #3 MTR AMPS


Stack Mercury Levels - SCR/WFGD Units
70%
60%
50%
40%
30%
20%
10%
0%
Frequency
0 - 0.3
0.3 - 0.6
0.6 - 0.9
0.9 - 1.2
1.2 - 1.5
>1.5
Stack Total Hg, lb/TBtu


Trap Results vs 24-hr average CMM
Hg, ug/scm
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
2/18/14
3/10/14
3/30/14
4/19/14
5/9/14
5/29/14
6/18/14
7/8/14
7/28/14

Regulated MATS Hg Scorecard

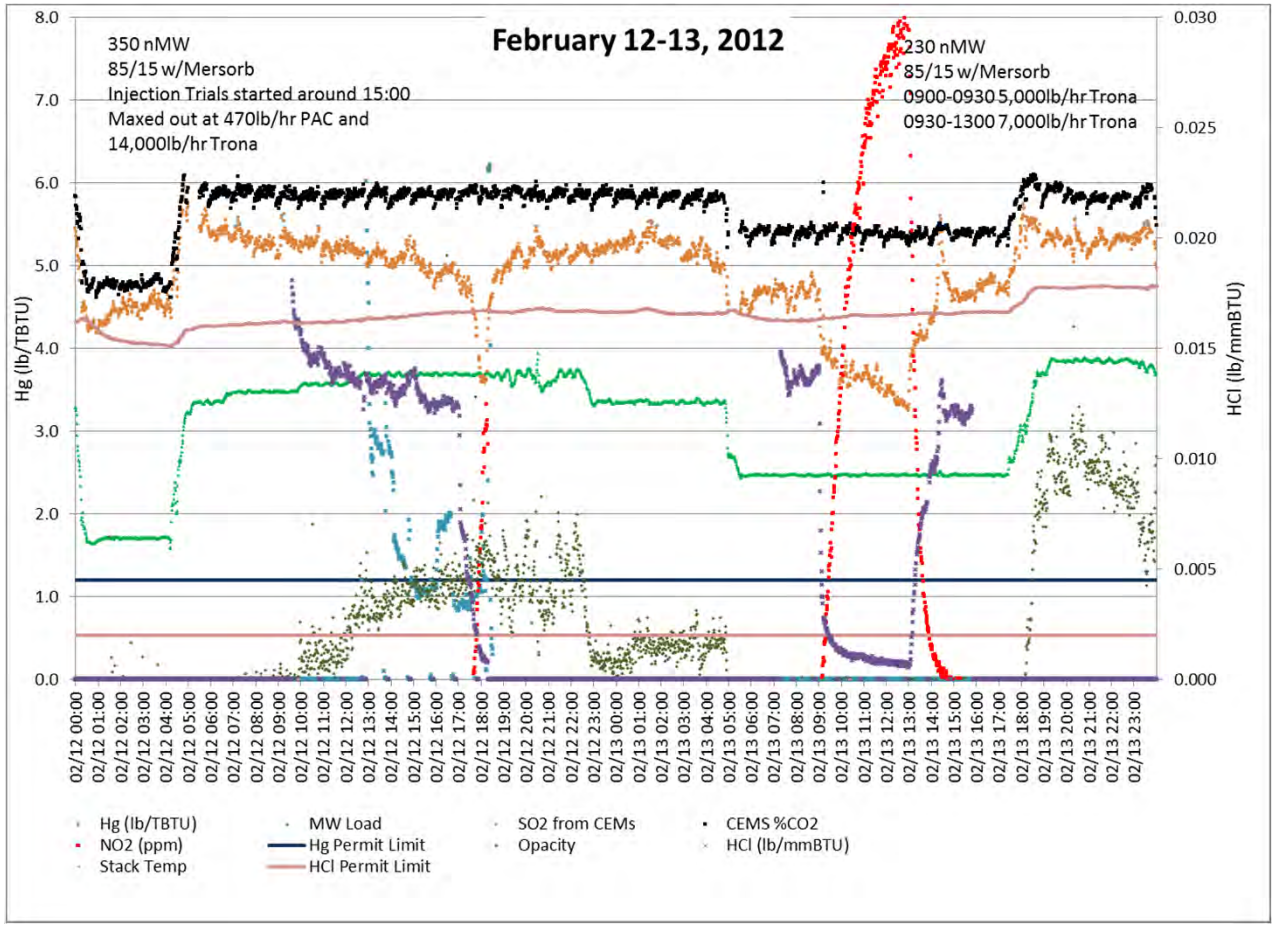
As of: 4/30/2014		Installed Continuous Hg Monitor	Applicable Hg limit	Continuous Hg Monitor			Sorbent Trap	Notes
				30 Boiler Day Average Hg[1]	Monitor Calibration Error >0.375 ug/m3	Hours > 1.0 lb/Tbtu in last 90 Days[3]	30 Boiler Day Average Hg[4]	
Plant	**Unit**		*lb/Tbtu*	*lb/Tbtu*	*days*	*%*	*lb/Tbtu*	
Units without ACI Installations								
Amos	1	Thermo	1.2	0.57	8	14%	-	Data from Thermo monitor
Amos	2	Lumex		0.74	-	27%	-	Data from Ohio Lumex temporary monitor.
Amos	3	Thermo		0.46	10	6%	-	Data from Thermo monitor
Mitchell	1	Thermo		-	17	-	-	Thermo monitor calibrations not acceptable to use data.
Mitchell	2	Lumex		1.05	-	51%	-	Data from Ohio Lumex temporary monitor.
Mountaineer	1	Thermo		0.30	6	7%	-	Data from Thermo monitor
Units with ACI Installations								
Rockport	1-2	Thermo	1.2	-	-	-	-	Monitor tube bundle failed. No monitor during data period.[2]
Turk	1	Thermo	1.7	0.87	-	18%	-	Thermo monitor used for data. Plant limit of 1.7 #/Tbtu until MATS (4/16/15).

Notes:

1. 30 Boiler day average is a close approximation to the MATS calculation method but is not exact. Data may be included from otside of the data period stated in the notes to complete the 30 boiler day average.
2. Data period for this scorecard is 3/30/2014 through 4/30/2014 (30 calendar days)
3. Turk is calculated on hours greater than 1.4 (#/Tbtu)
4. Turk sorbent trap data is taken from RegPerfect.

Key			
30 Boiler Day Average Hg[1]	Monitor Calibration Error >0.375 ug/m3	Hours > 1.0 lb/Tbtu in last 90 Days	30 Boiler Day Average Hg[4] (Turk Only)
lb/Tbtu	*days*	*%*	*lb/Tbtu*
0 - 1.0	<10	0 - 33	0 - 1.4

Smart MATS Compliance Strategies
Data Centered Decision Making



Smart MATS Compliance Strategies
Ensuring MATS Compliance

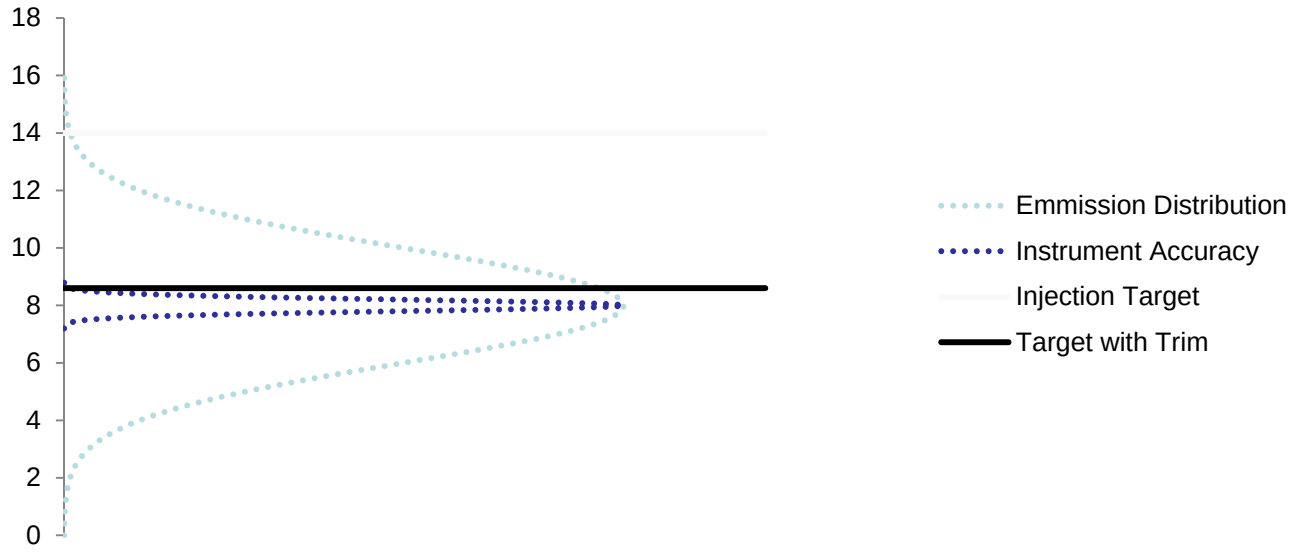
DTE Energy

- Solution selection based on multiple criteria:
  - Compliance Assurance
  - Reliability
  - Operational Flexibility
  - Total Cost

	Quarterly Stack Testing	Continuous Process Monitoring	Sorbent Traps	CEMs
Hg	NOT ALLOWED	NOT ALLOWED	Evaluate	Evaluate
HCl	Evaluate	Evaluate	NOT AVAILABLE	Evaluate
PM	Evaluate	Evaluate	NOT APPLICABLE	Evaluate

Smart MATS Compliance Strategies
Optimization of Compliance vs. Cost

- Minimize $ / MW
  - Develop injection curves for each blend
  - Trim Trona injection rate using HCL feedback
  - Trim Carbon injection rate using Hg feedback



PacifiCorp MATS Compliance Decision Process

- Field Tests at Wyoming PacifiCorp Plants
  - 2005 Alstom Mer-Cure at Dave Johnston 2 &3
  - 2010-11 Field Tests w/ADA-ES
    - Jim Bridger 2:
      - ESP w/SO3 Injection Wet Sodium FGD/ SCR to Follow: PAC's, CaBr2, ATI-2001, and Four Different WFGD Additives
    - Dave Johnston 1 & 3:
      - ESP Only: PAC Testing
      - SDA/FF: CaBr2 and PAC's

PacifiCorp MATS Compliance Decision Process

- Wyodak: 2012 SDA/FF, Amended Silicate Testing
- Naughton: 2013 ESP w/SO3 Injection + Sodium Wet FGD, B&W Hg Re-Emission Test

– Confidence in Our MATS Strategy

- Attempted to Install Multiple Hg Control Options to Provide Operation Flexibility Based on Brief Testing
- Expect Real Proof Will Be Commercial Experience After Performance Testing

MATS Compliance

- Certified Hg CEMS For Past 5 Years with Weekly Reports of 12 Plant Results
- “Stack Vision” Basis For All Air Emission Compliance w/PacifiCorp Environmental Services Providing Additional MATS Reporting Data

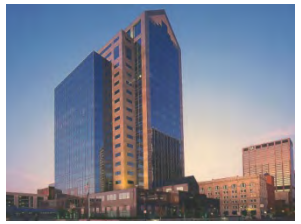
Optimization of Compliance Costs

- Hg CEMS, PI Data, SAP Costs, Spreadsheets Coupled with “Control Lever” Adjustments as Experience Gained and Process Conditions Change
- Staying Abreast of User Experience and New Technology Refinements and Developments
- Expect Continued Hg Process Control Advances as Industry Gains Experience

PPL companies





Smart MATS Compliance Strategies

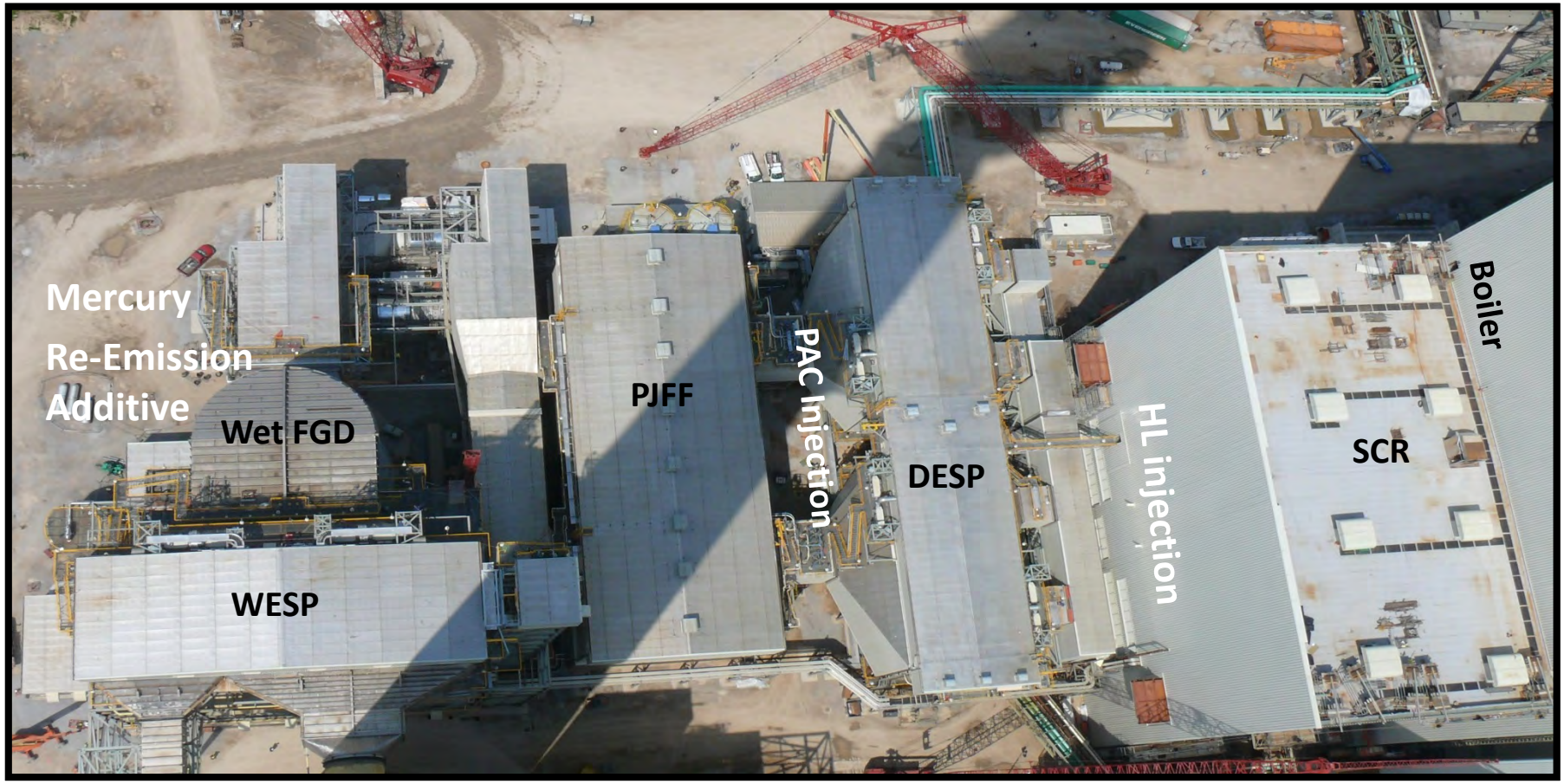
Haley Turner – Chemical Engineer
LG&E Trimble Station

LG&E KU Overview

- 13 coal fired units total
  — *4 locations*
- 1 existing PJFF and PAC
  — *Trimble County 2*
- 8 new PJFFs and PAC
- 3 DESPs being removed
- All same PJFF supplier

PPL companies

TC2 Air Quality Control System



PPL companies

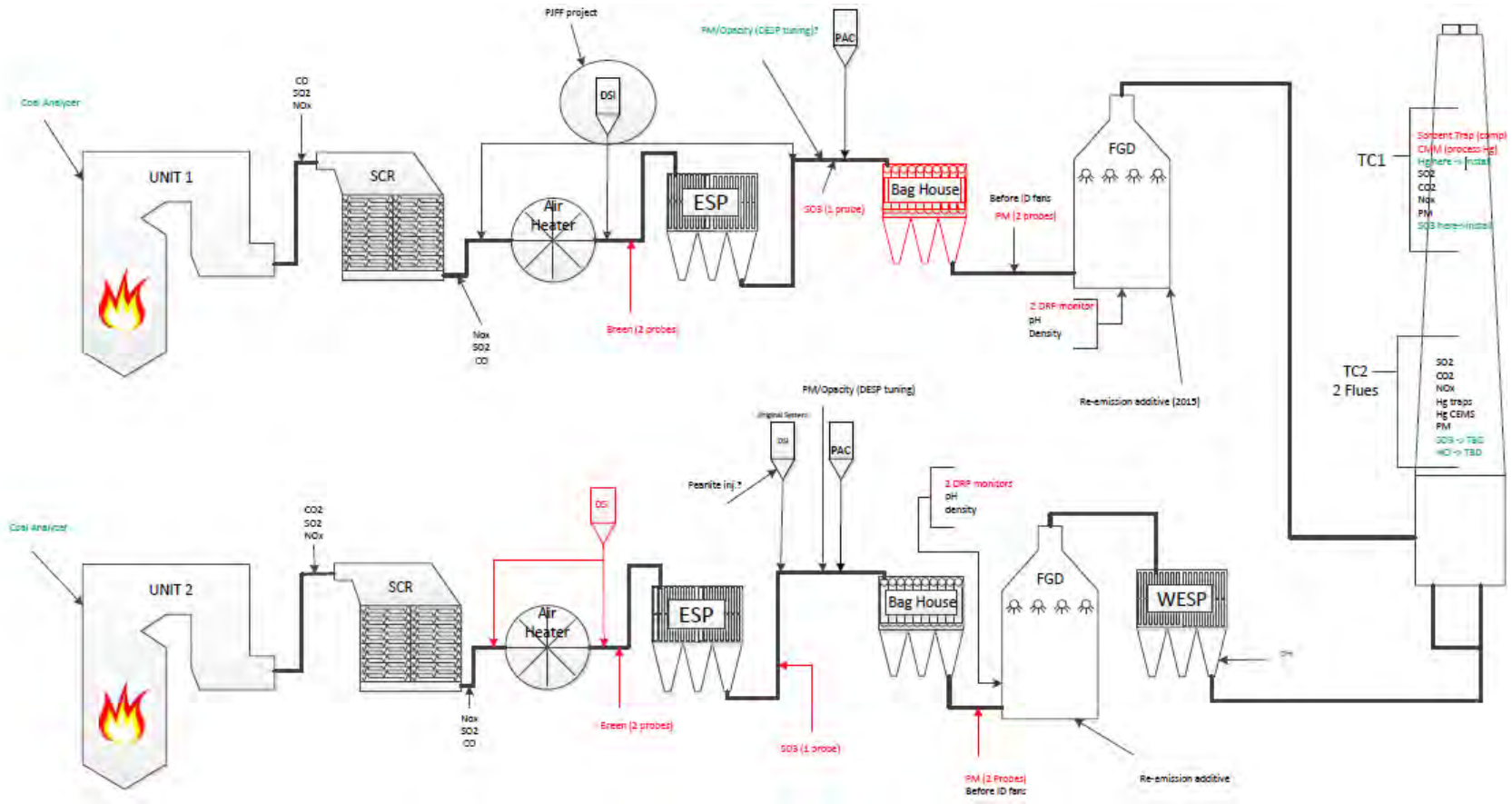
Anything can affect Everything

And the Effect can affect Anything

Hg Compliance and Control

- Fuel – S, Cl, Hg
- Burners – NOx, O_2, CO, air flow
- Temperature – oxidation, PAC effectiveness, bag material/coating
- SCR – NH_3, SO_3 conversion, Hg oxidation
- Air Heater – temperature, leakage, ABS, Hg oxidation
- Hydrated Lime – Cl consumption, SO_3 capture
- DESP – Ash loading, filter cake, hopper mixture
- PAC – effectiveness, hopper issues, re-emission issues
- PJFF – dP issues, permeability, maintenance
- FGD pH – re-emission, scaling, corrosion
- FGD density – re-emission, reactivity
- FGD turnover – re-emission, efficiency
- FGD ORP – re-emission, reactivity

Process Monitoring



PPL companies