Mercury Compliance Monitoring in 2015 and Beyond

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Clean Air Engineering

March 28, 2013

Overview

Mercury Monitoring

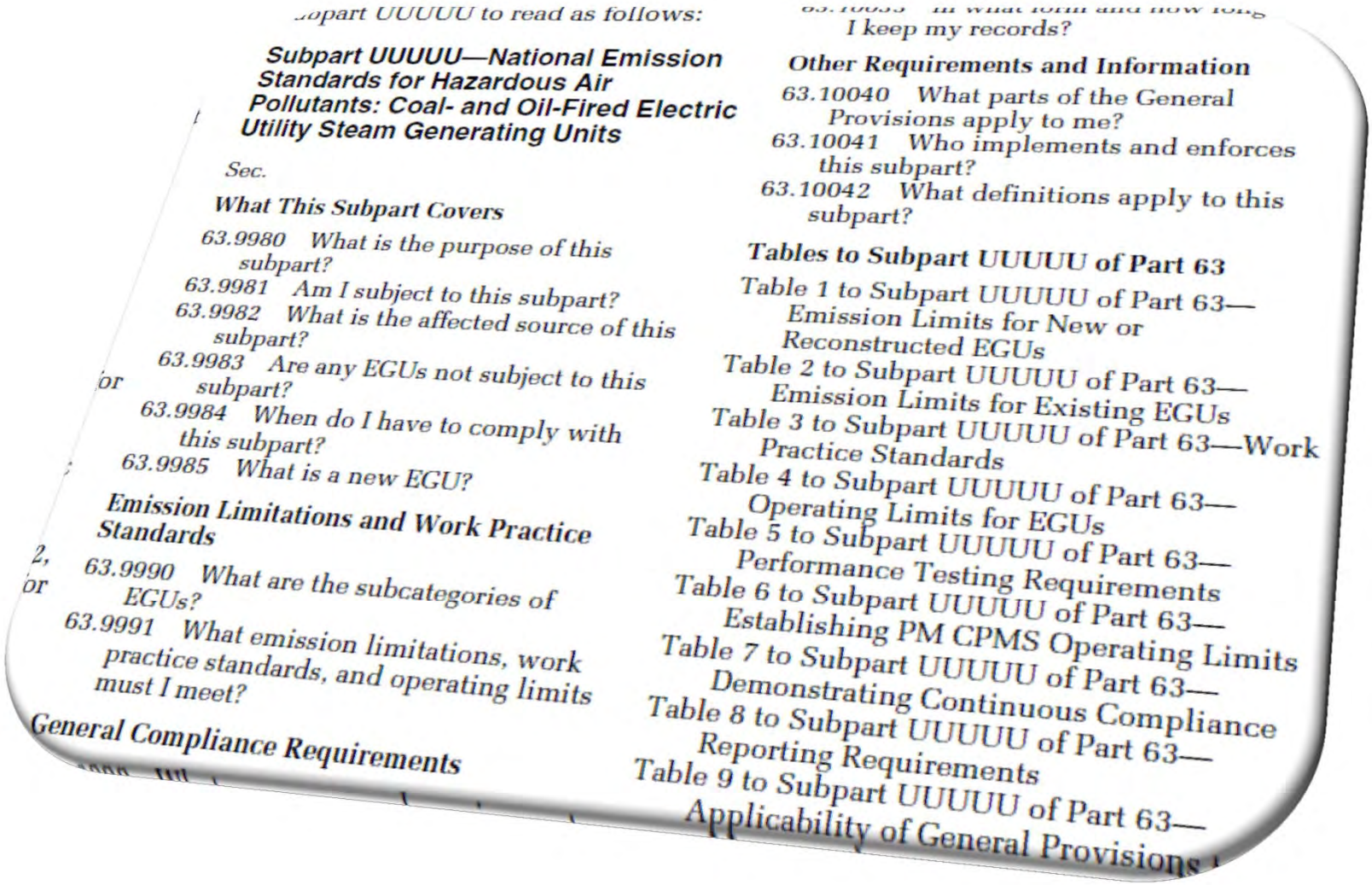
- Regulatory drivers
- Technology Overview
- Pros and Cons
- Alternative Hybrid Approach

Acknowledgements

Tim Rodak
Jim Wright
CleanAir

Joseph Siperstein
Ohio Lumex Corporation

Regulatory Drivers



...opart UUUUU to read as follows:

Subpart UUUUU—National Emission Standards for Hazardous Air Pollutants: Coal- and Oil-Fired Electric Utility Steam Generating Units

Sec.

What This Subpart Covers

63.9980 What is the purpose of this subpart?
63.9981 Am I subject to this subpart?
63.9982 What is the affected source of this subpart?
63.9983 Are any EGUs not subject to this subpart?
63.9984 When do I have to comply with this subpart?
63.9985 What is a new EGU?

Emission Limitations and Work Practice Standards

63.9990 What are the subcategories of EGUs?
63.9991 What emission limitations, work practice standards, and operating limits must I meet?

General Compliance Requirements

...I keep my records?

Other Requirements and Information

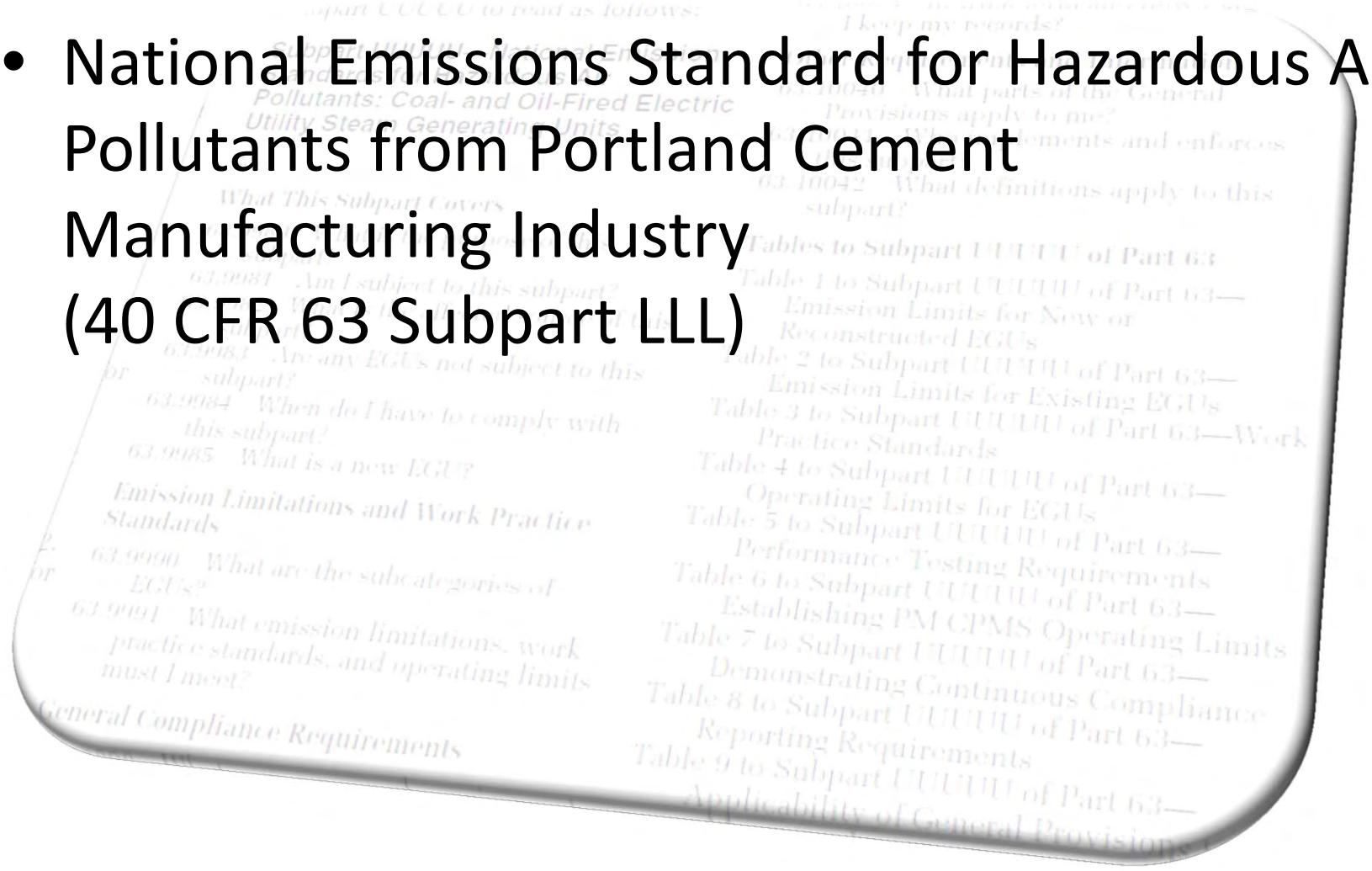
63.10040 What parts of the General Provisions apply to me?
63.10041 Who implements and enforces this subpart?
63.10042 What definitions apply to this subpart?

Tables to Subpart UUUUU of Part 63

Table 1 to Subpart UUUUU of Part 63—Emission Limits for New or Reconstructed EGUs
Table 2 to Subpart UUUUU of Part 63—Emission Limits for Existing EGUs
Table 3 to Subpart UUUUU of Part 63—Work Practice Standards
Table 4 to Subpart UUUUU of Part 63—Operating Limits for EGUs
Table 5 to Subpart UUUUU of Part 63—Performance Testing Requirements
Table 6 to Subpart UUUUU of Part 63—Establishing PM CPMS Operating Limits
Table 7 to Subpart UUUUU of Part 63—Demonstrating Continuous Compliance
Table 8 to Subpart UUUUU of Part 63—Reporting Requirements
Table 9 to Subpart UUUUU of Part 63—Applicability of General Provisions

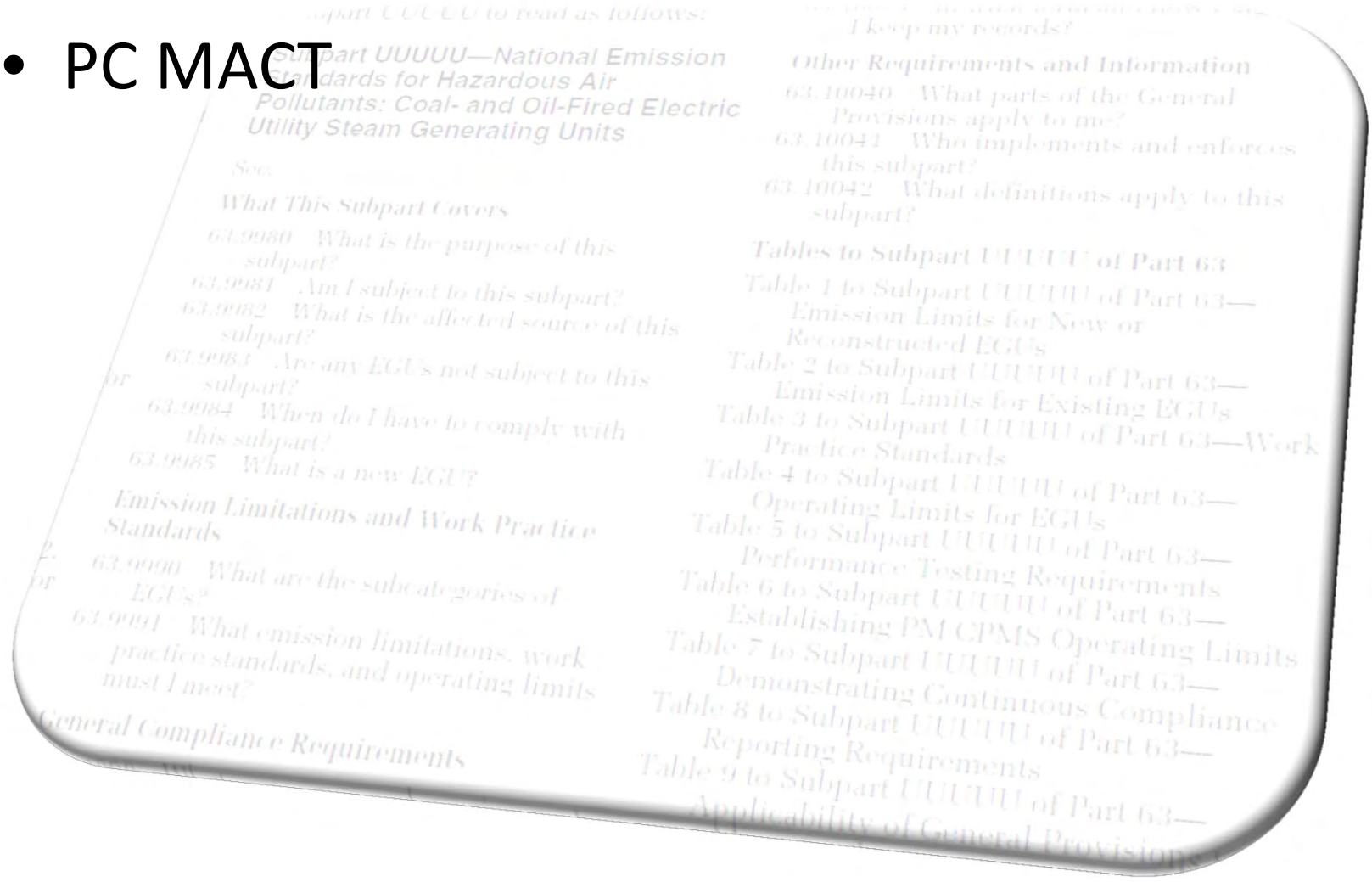
Regulatory Drivers

- National Emissions Standard for Hazardous Air Pollutants from Portland Cement Manufacturing Industry (40 CFR 63 Subpart LLL)



Regulatory Drivers

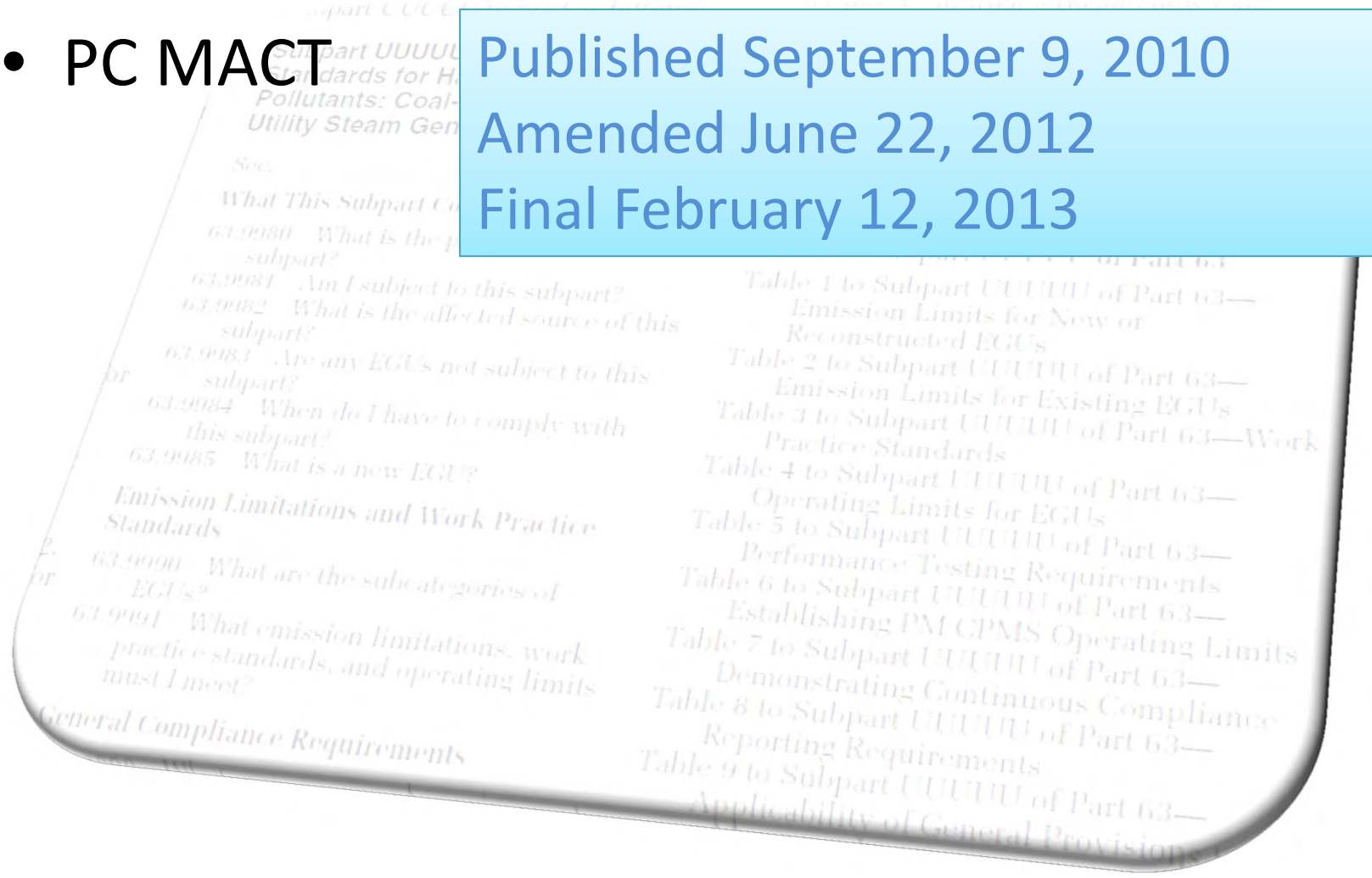
- PC MACT



Regulatory Drivers

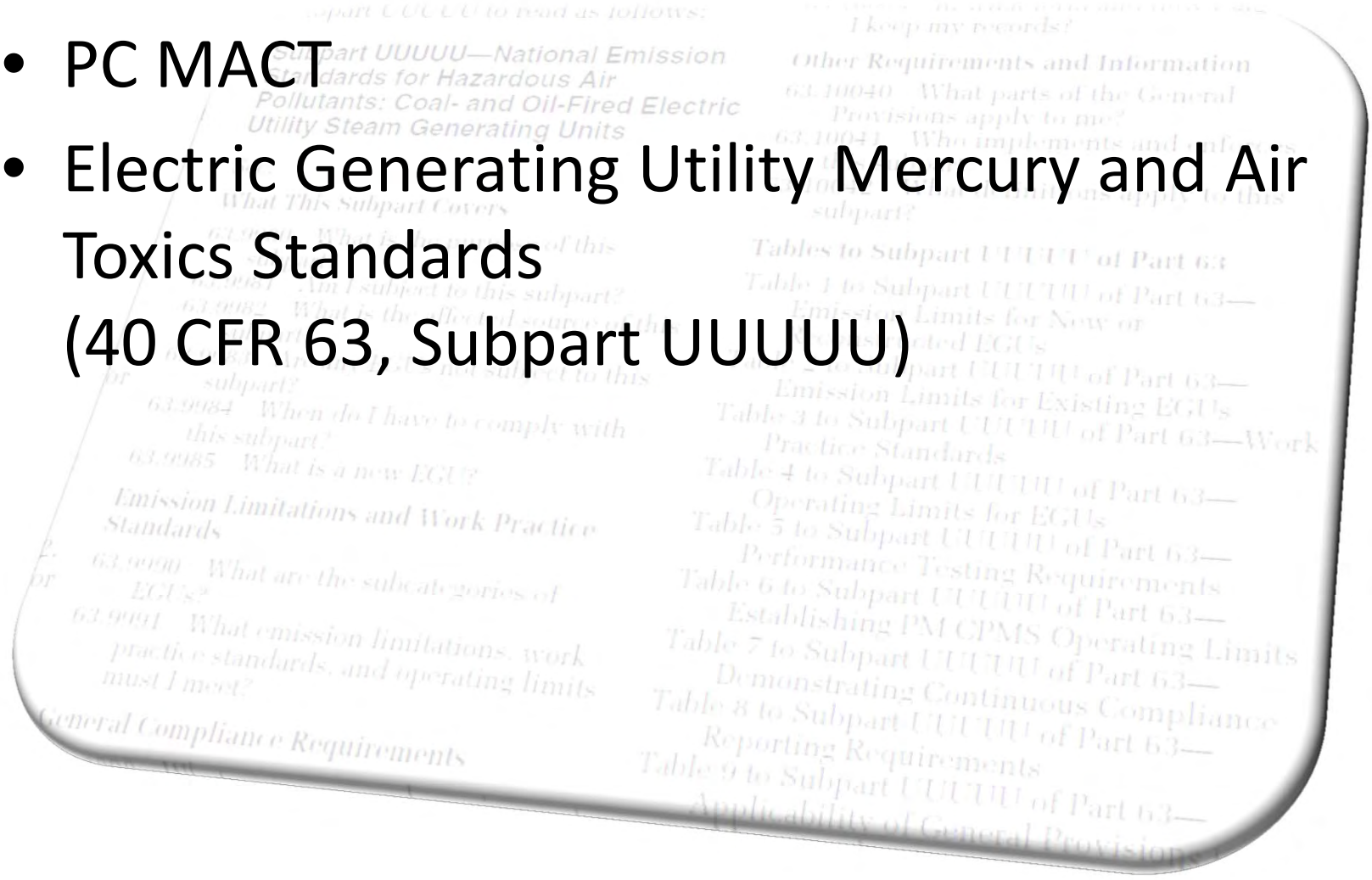
- PC MACT

Published September 9, 2010
Amended June 22, 2012
Final February 12, 2013



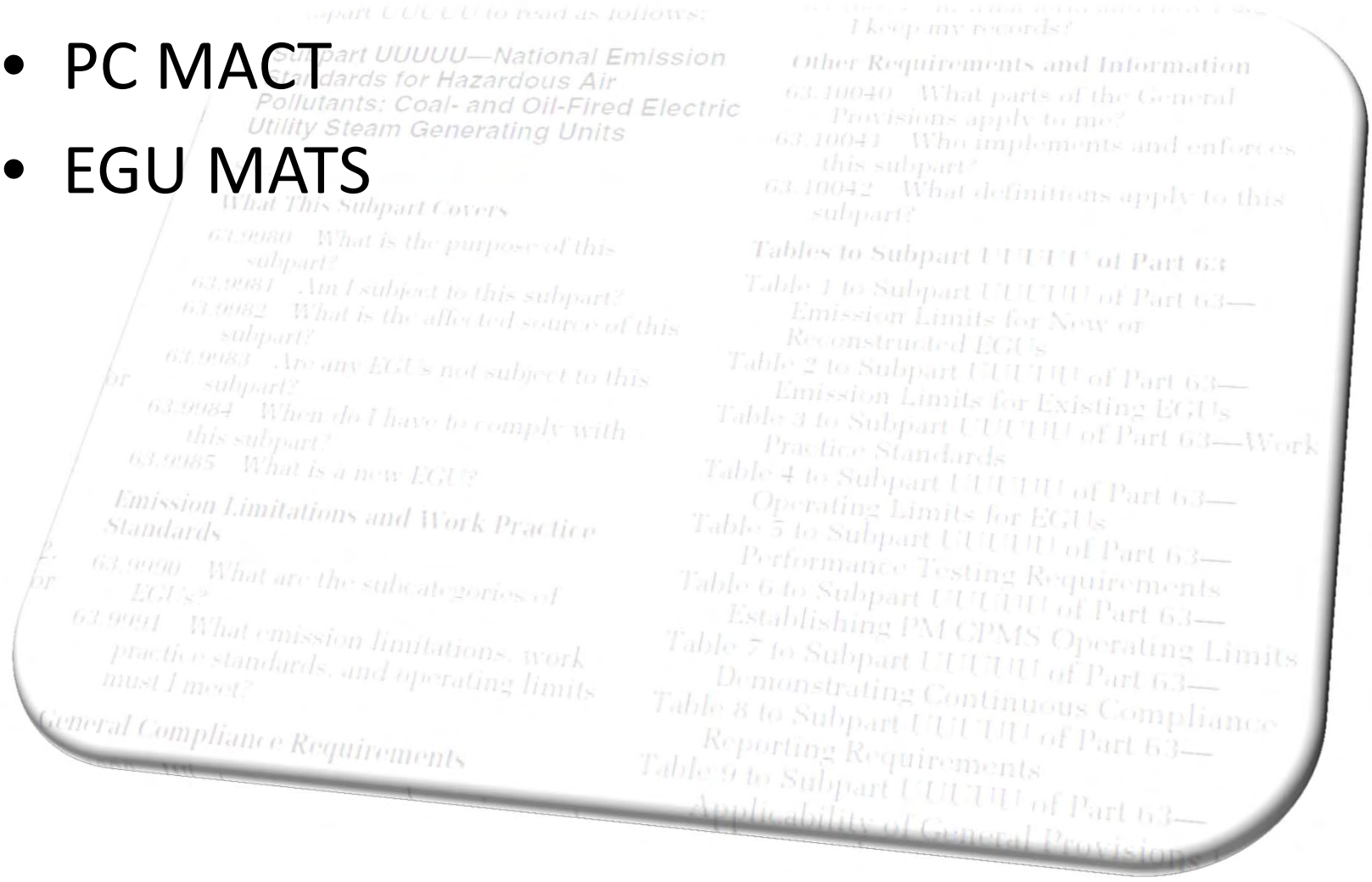
Regulatory Drivers

- PC MACT
- Electric Generating Utility Mercury and Air Toxics Standards
  (40 CFR 63, Subpart UUUUU)



Regulatory Drivers

- PC MACT
- EGU MATS



Regulatory Drivers

- PC MACT
- EGU MATS

Published February 16, 2012
Final April 16, 2012
Reconsideration July, 27, 2012
Proposed Updates November 16, 2012
Final (?) March, 2013

Compliance Dates

PC MACT
- September 9, 2015

MATS
- April 16, 2015

PC MACT Emission Limits

Existing Kilns: ≈ 12 µg/m^3

New Kilns: ≈ 5 µg/m^3

MATS Hg Emission Limits

Existing Plants: ≈ 1.4 µg/m^3

New Plants: ≈ ~~0.024 µg/m^3~~

≈ 0.36 µg/m^3

Monitoring Options

- Continuous Mercury Monitoring System (CMMS)
- Sorbent Trap Mercury Monitoring System (STMMS)

CMMS

Performance Specification 12A

Procedure 5 (Part 60, Appendix F) – PC MACT

Appendix A to Subpart UUUUU – MATS

CMMS

Performance Specification 12A

Procedure 5 (Part 60, Appendix F) – PC MACT

Appendix A to Subpart UUUUU – MATS

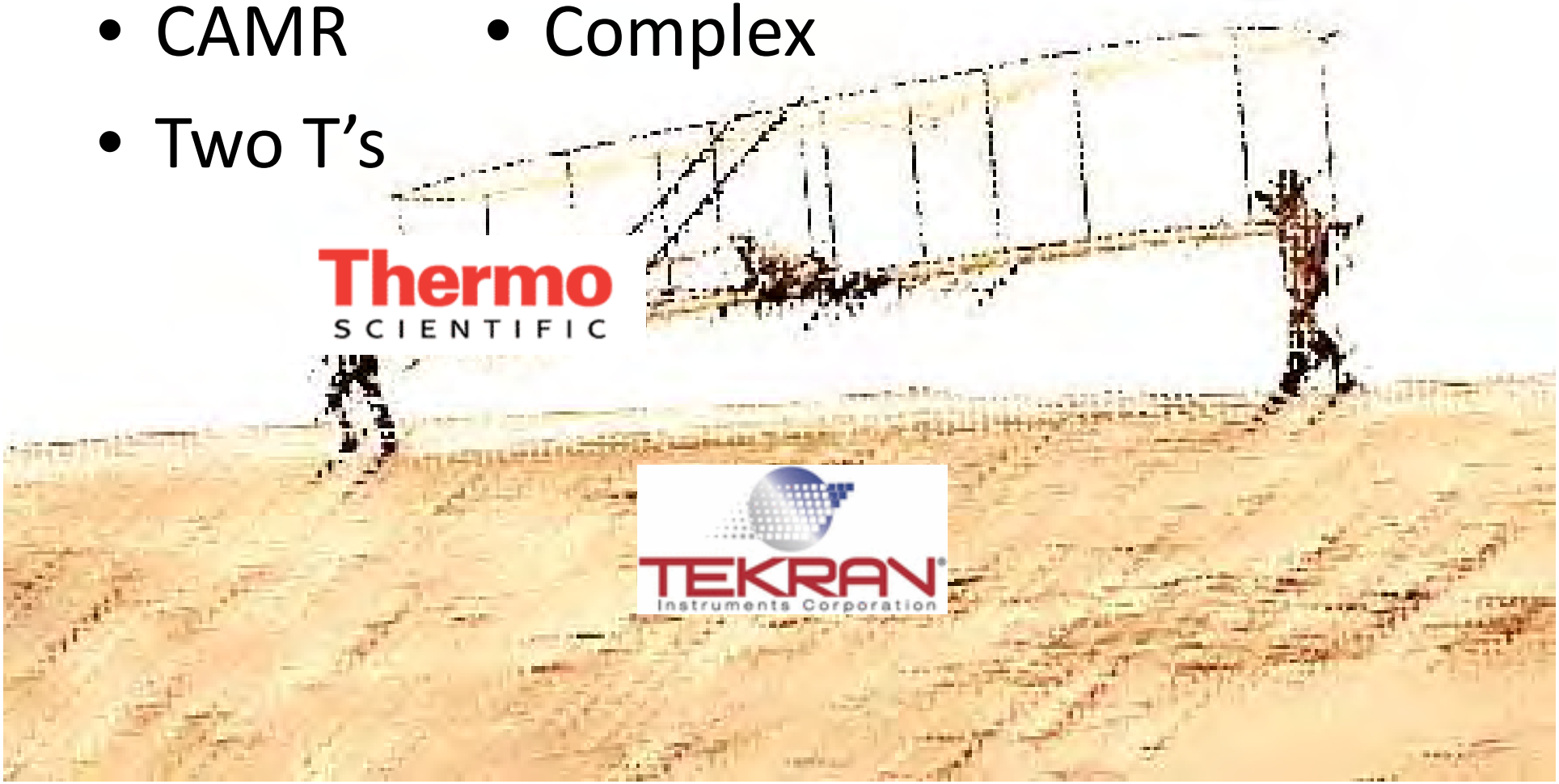
- Real-time data
- Daily calibration error tests
- Weekly system integrity checks
- Quarterly Linearity checks
- Annual RATA

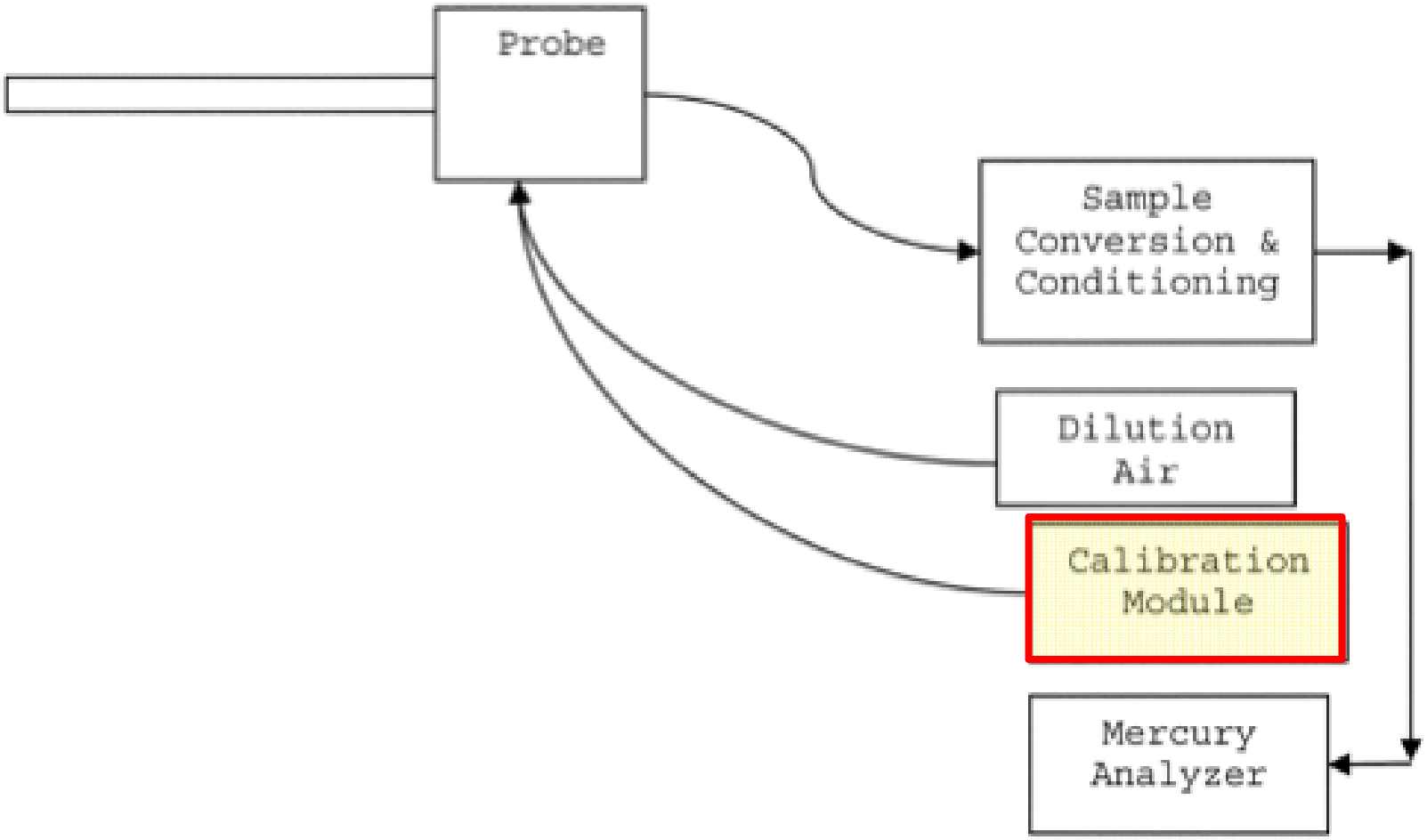
The History of CMMS

- 2003
- CAMR
- Two T's

- Expensive
- Complex

- Sensitivity?

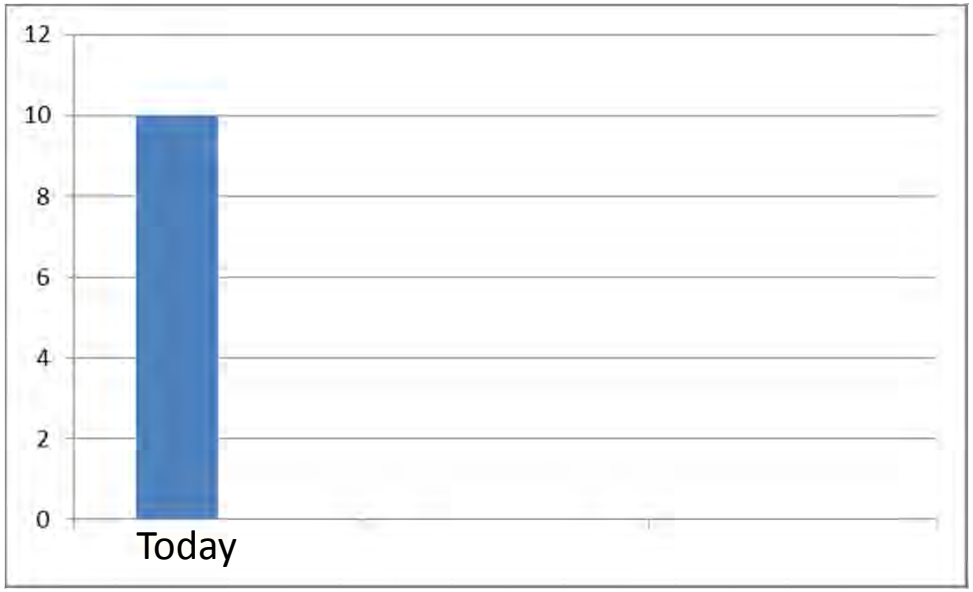




Source: USEPA

NIST Calibrators

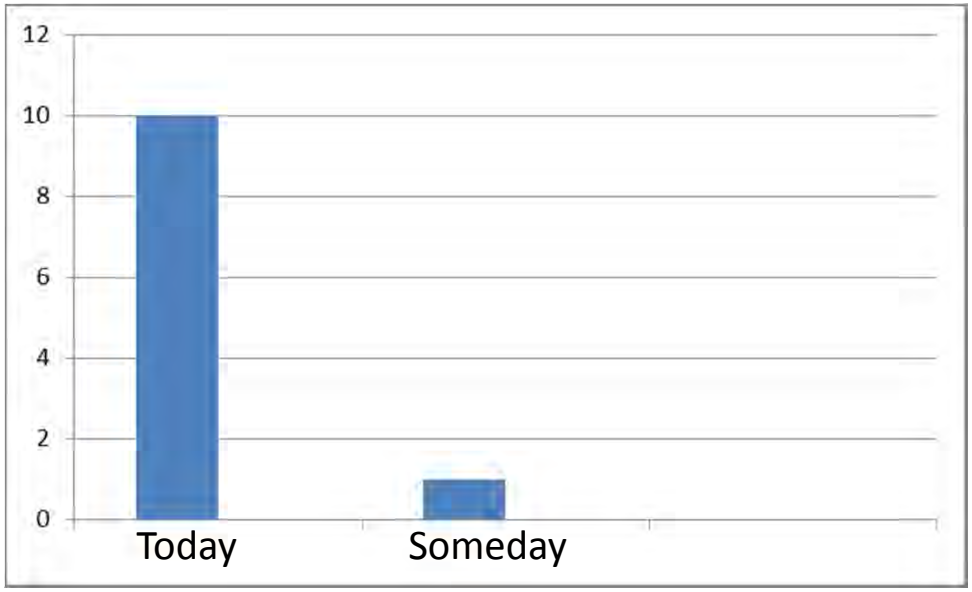
- Today
  0-10 µg/dscm
  low point of 2.7



Source: EPRI CEMS, 2012, Thermo Supergroup

NIST Calibrators

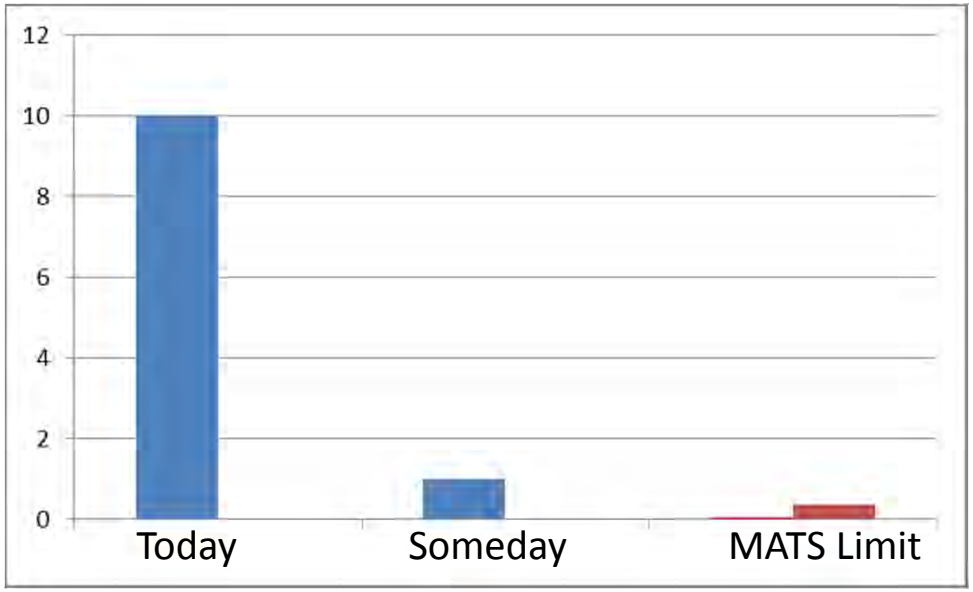
- Today
  0-10 µg/dscm
  low point of 2.7
- Someday
  0-1 µg/dscm
  low point of 0.2



Source: EPRI CEMS, 2012, Thermo Supergroup

NIST Calibrators

- Today
  0-10 µg/dscm
  low point of 2.7
- Someday
  0-1 µg/dscm
  low point of 0.2
- MATS Limit = 0.024-0.36



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The status of Hg CEMS

Getting better all the time…

✓More options

✓"Believable" to around 0.2 µg/dscm

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Getting better all the time…

✓More options

✓"Believable" to around 0.2 µg/dscm

- Still expensive
- Still complex

Calibration

Thermo SCIENTIFIC

TEKRAN Instruments Corporation

CEMTREX

OPSIS

SICK


STMMS
OHIO LUMEX
69238

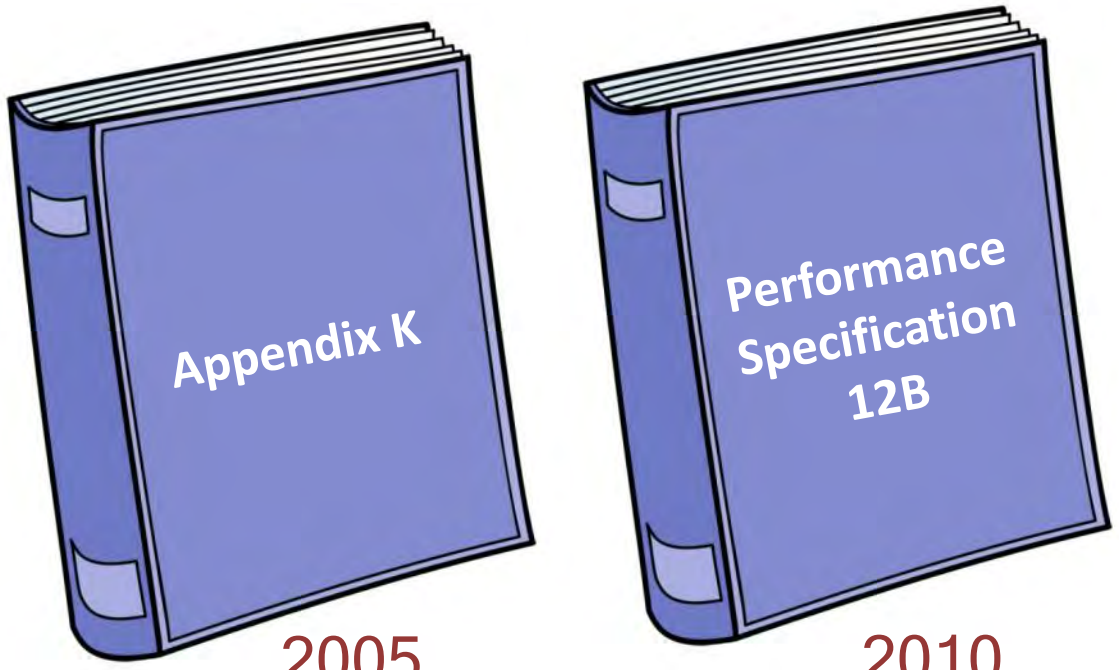
Performance Specification 12B – Specifications and Test Procedures For Monitoring Total Vapor Phase Mercury Emissions from Stationary Sources Using a Sorbent Trap Monitoring System

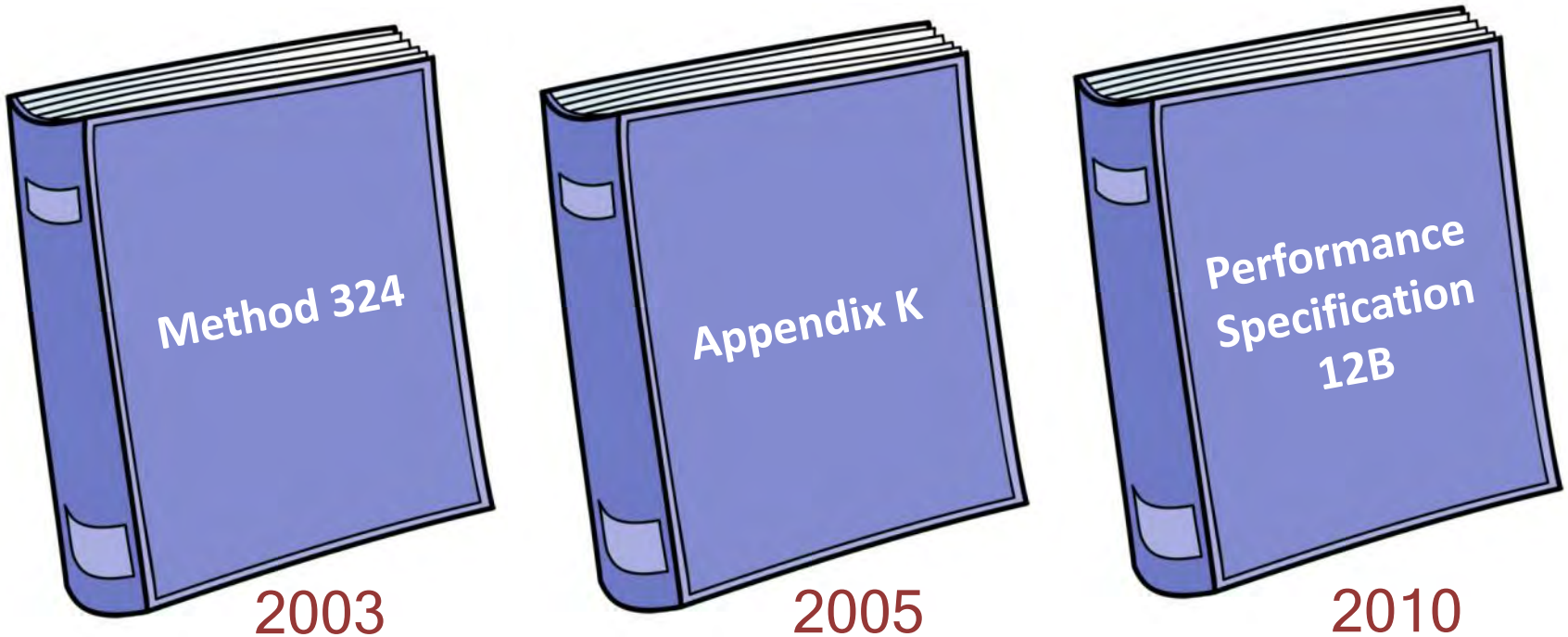
1.0 Scope and Application

The purpose of Performance Specification 12B (PS 12B) is to establish performance benchmarks for, and to evaluate the acceptability of, sorbent trap monitoring systems used to monitor total vapor-phase mercury (Hg) emissions in stationary source flue gas streams. These monitoring systems involve continuous repetitive in-stack sampling using paired sorbent media traps with periodic analysis of the time-integrated samples. Persons using PS 12B should have a thorough working knowledge of Methods 1, 2, 3, 4, 5 and 30B in appendices A-1 through A-3 and A-8 to this part.

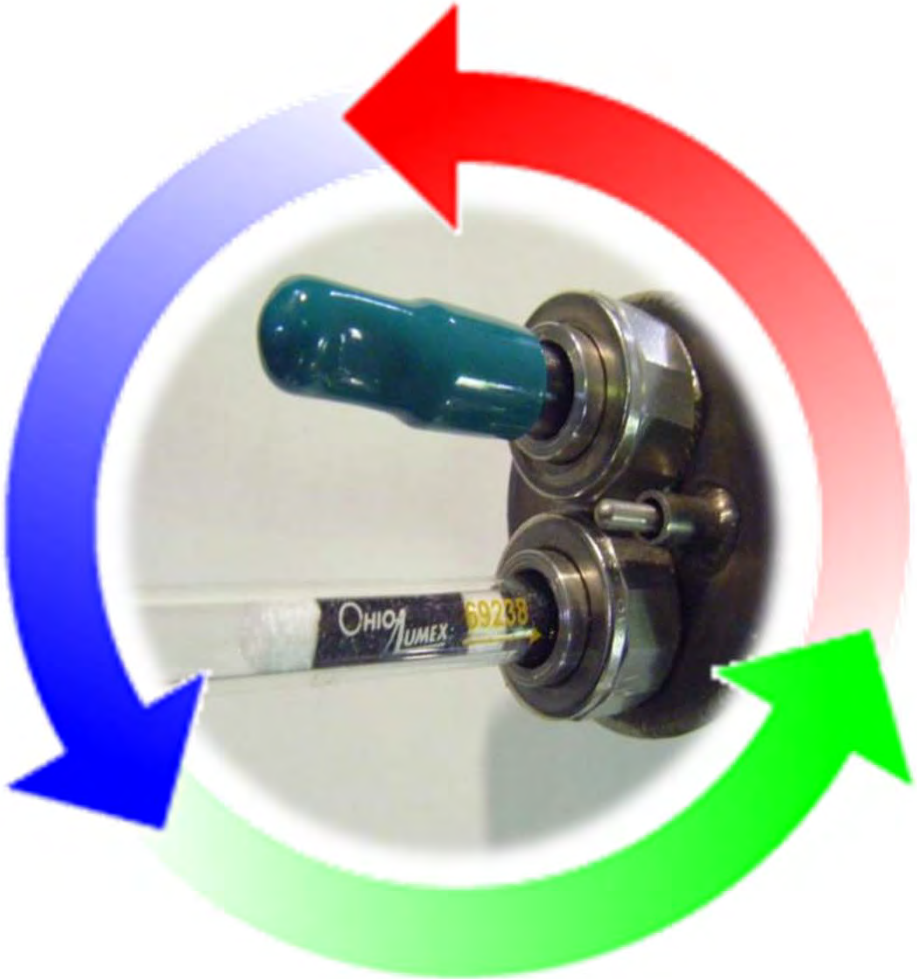
2010

PC MACT

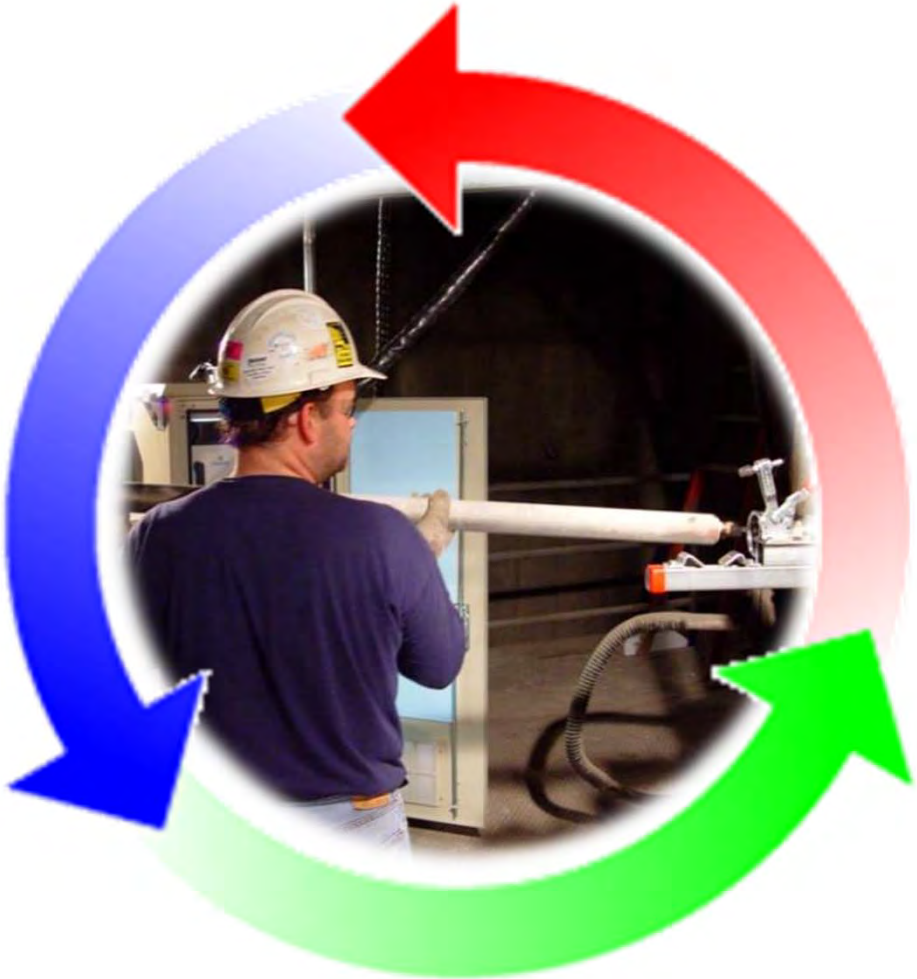

Appendix K
Performance Specification 12B
2005
CAMR
2010
PC MACT


Method 324
Appendix K
Performance Specification 12B
2003
EU MACT
2005
CAMR
2010
PC MACT

STMMS

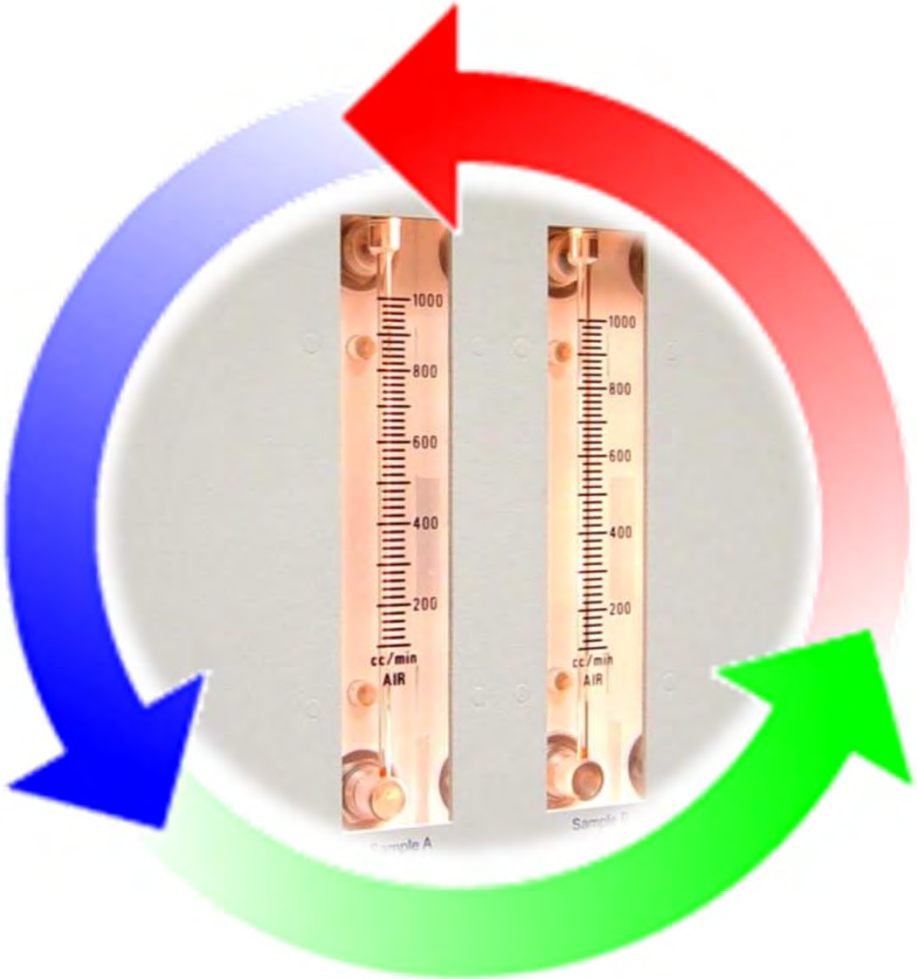


STMMS



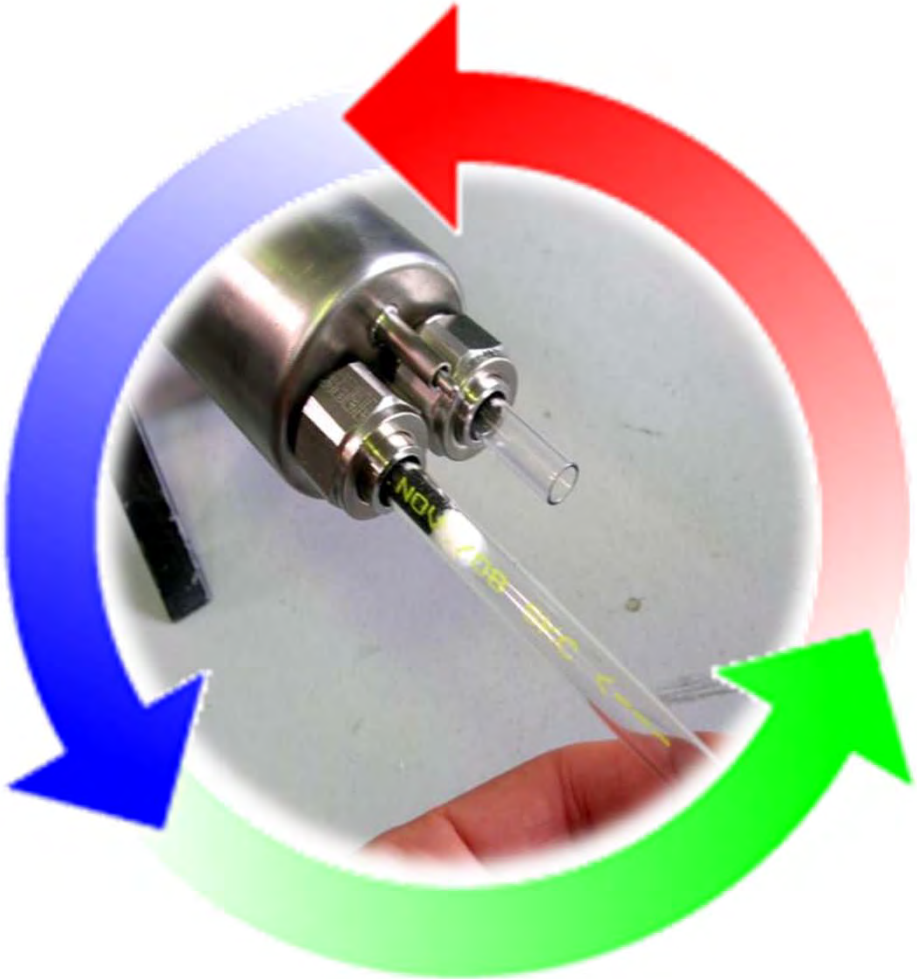
1. Capture mercury in-situ on a sorbent

STMMS



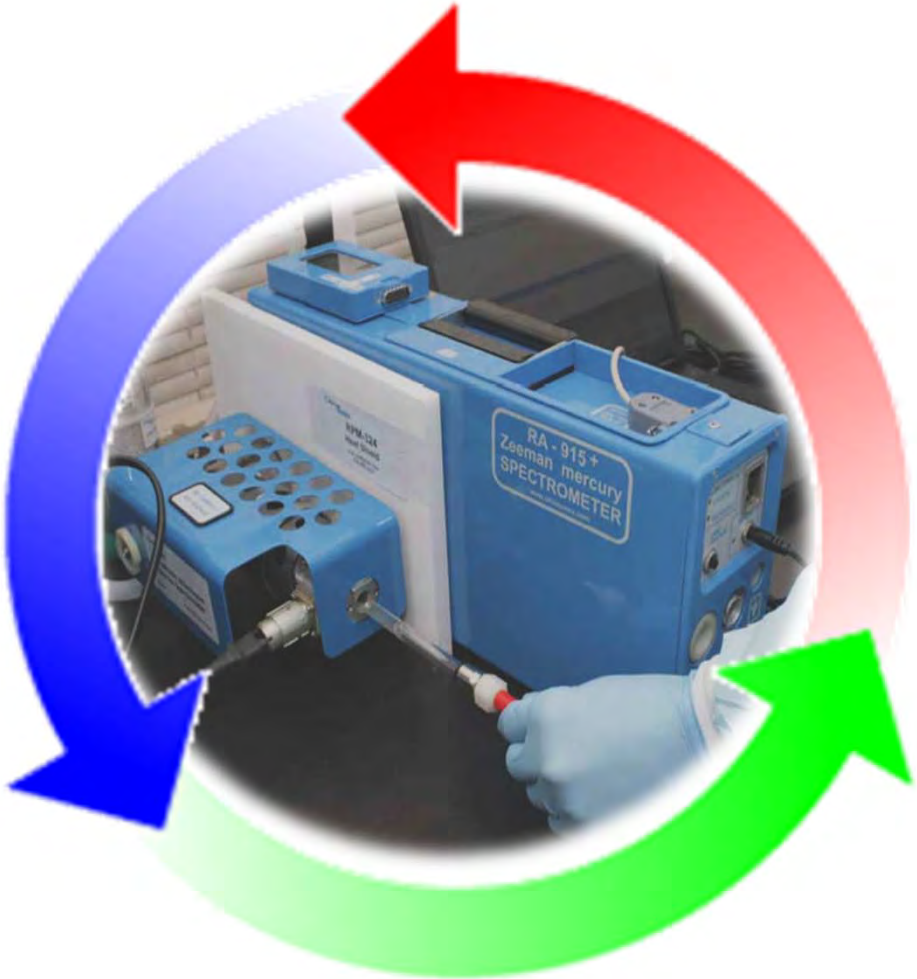
2. Sample over a period of several days

STMMS



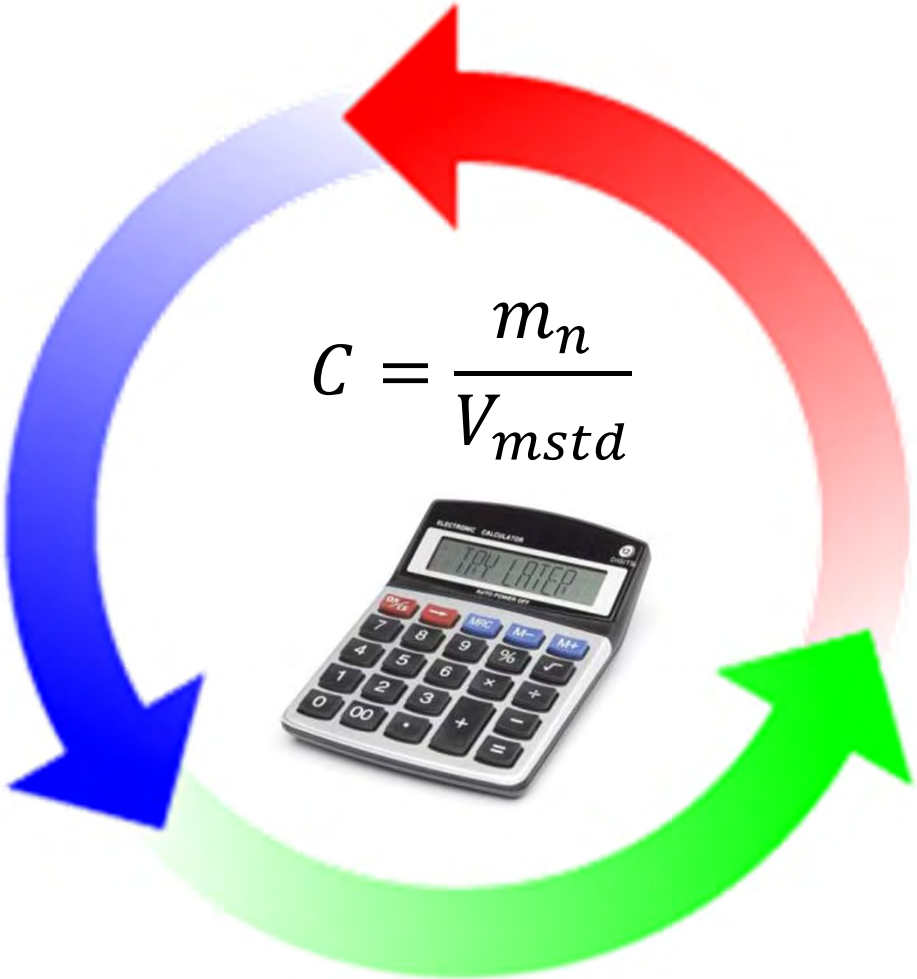
3. Recover traps and send to lab

STMMS



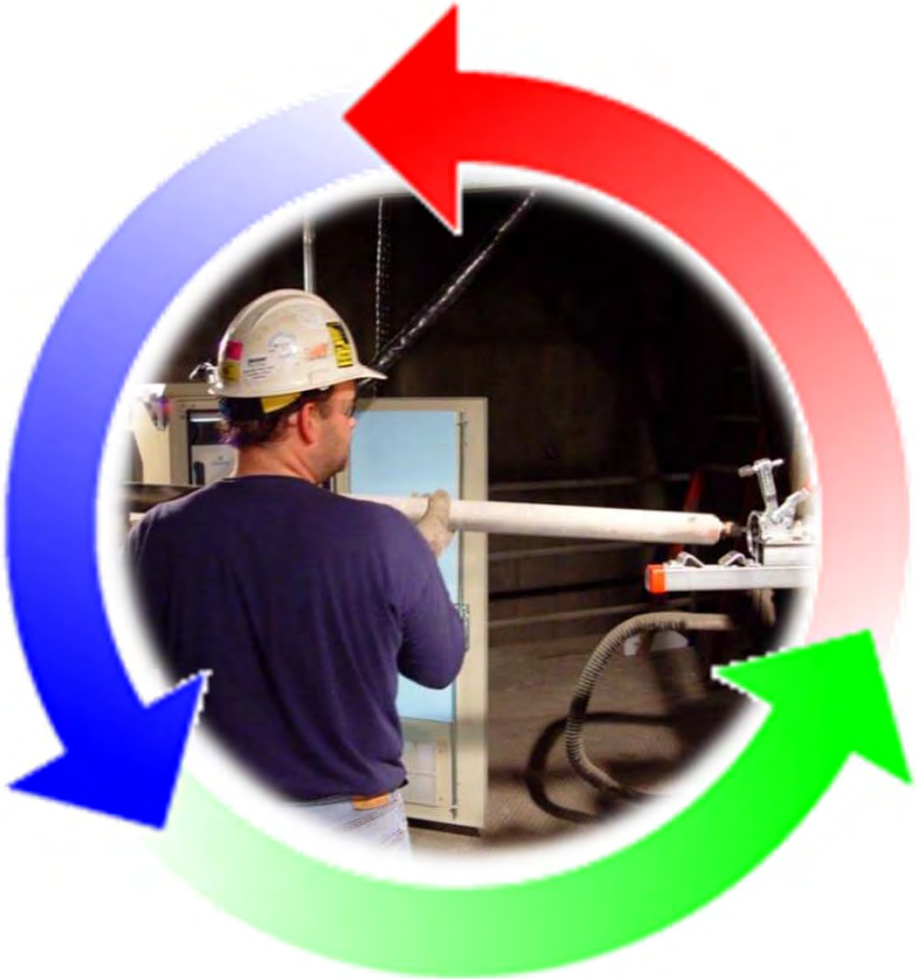
4. Analyze for total mercury collected

STMMS



5. Calculate emissions

STMMS



6. Repeat

STMMS Purpose – An Evolution

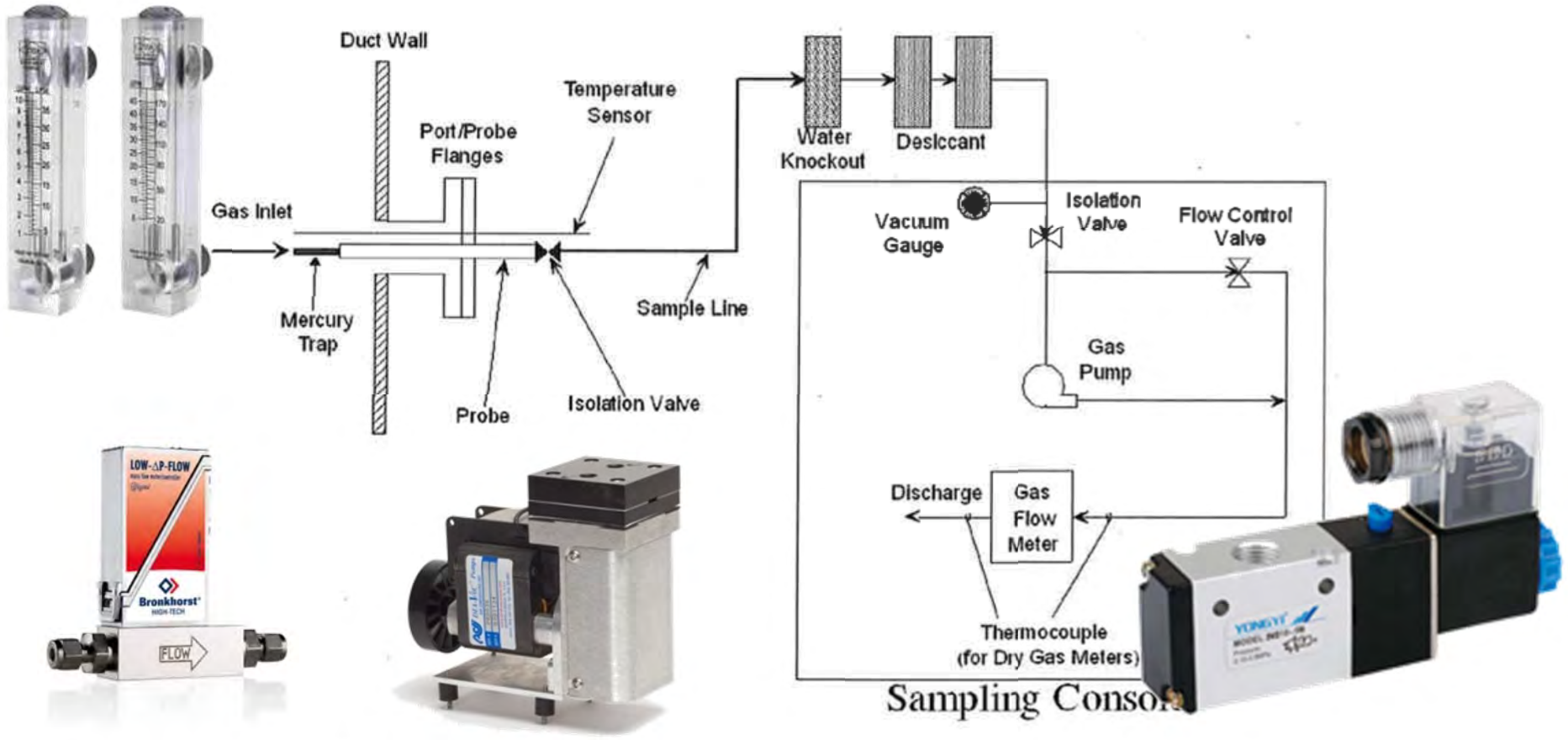
CMMS
Back-up

CMMS
Alternative

- Simplicity
- NIST-Traceability
- It works
- Cost-Effectiveness

Simplicity

Simple mechanical equipment



Simplicity

No on-site Hg calibration materials

Certification Requirements
CMMS versus STMMS

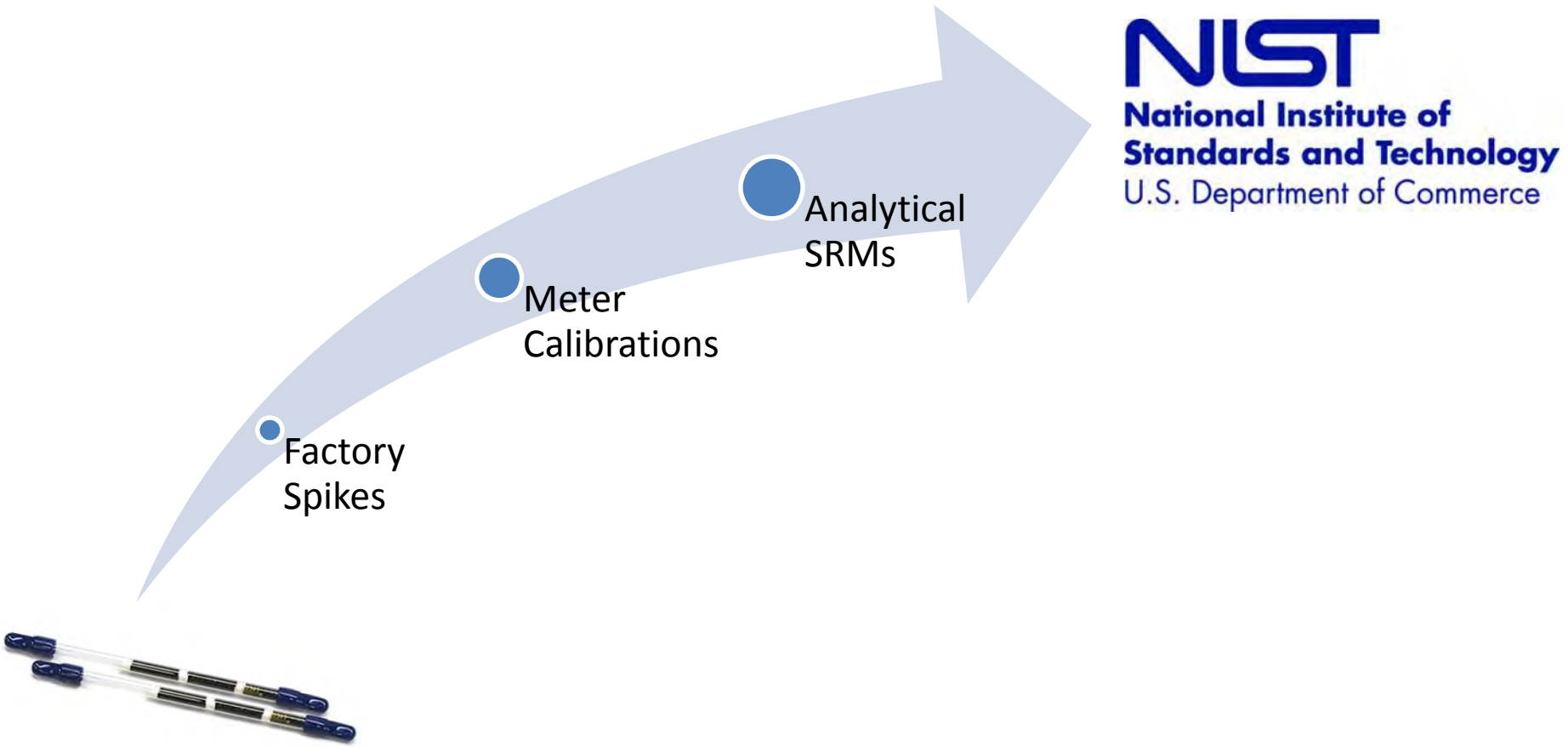
CMMS
7-day calibration error test
Linearity test
3-level system integrity check
Cycle time test
RATA

Certification Requirements
CMMS versus STMMS

CMMS	STMMS
7-day calibration error test	RATA
Linearity test	
3-level system integrity check	
Cycle time test	
RATA	

4.1.2 *Sorbent Trap Monitoring Systems.* For the initial certification of a sorbent trap monitoring system, only a RATA is required.

NIST-Traceability



It works

- No Hg transport issues
- Very low MDL possible
- Built-in QA/QC

It works

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- Built-in QA/QC

✓Spike recovery

✓Breakthrough

✓Paired trap agreement

✓Proportional sampling

Cost-Effectiveness

- Hardware about ⅓ the cost of CMMS
- Operating costs about ½ cost of CMMS

	Type	EPA Estimate[b]	Reality[c]
Capital Costs	CEMS	$220,000	$300-400,000
	Sorbent trap	N/A	$100-150,000
Ongoing Costs[d]	CEMS	$77,000	$50-75,000
	Sorbent trap	N/A	$20-30,000

[a] Costs do not include stack or platform modifications

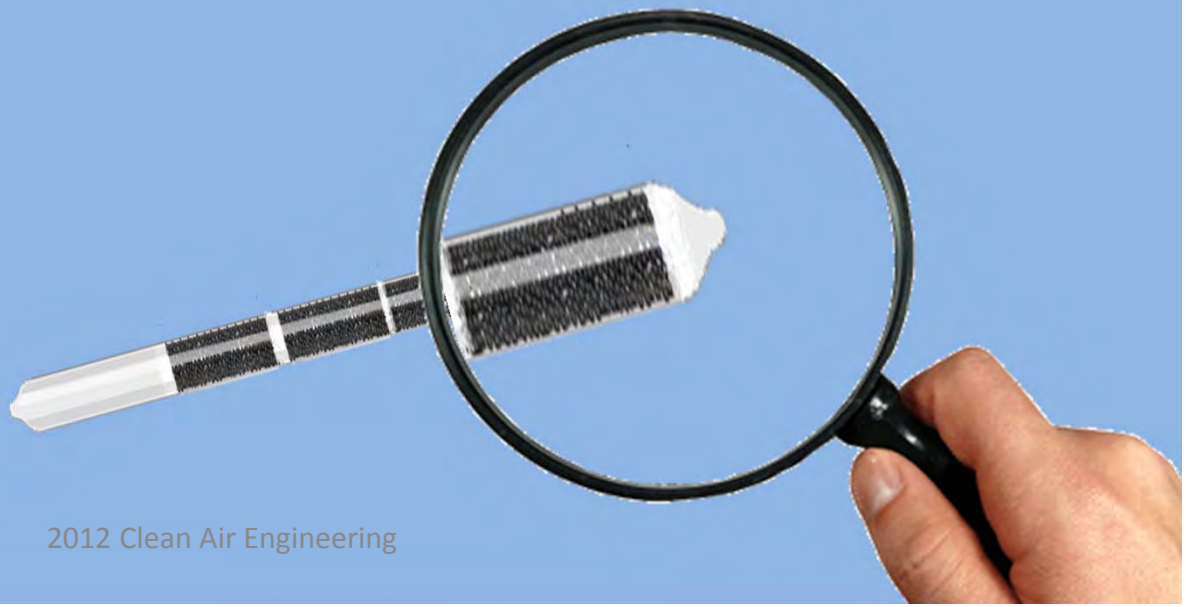
[b] From EPA CEMS Cost Model 03/07/07 w/ 10% inflation adjustment to 2012

[c] Vendor information

[d] Annual Costs. Without capital recovery

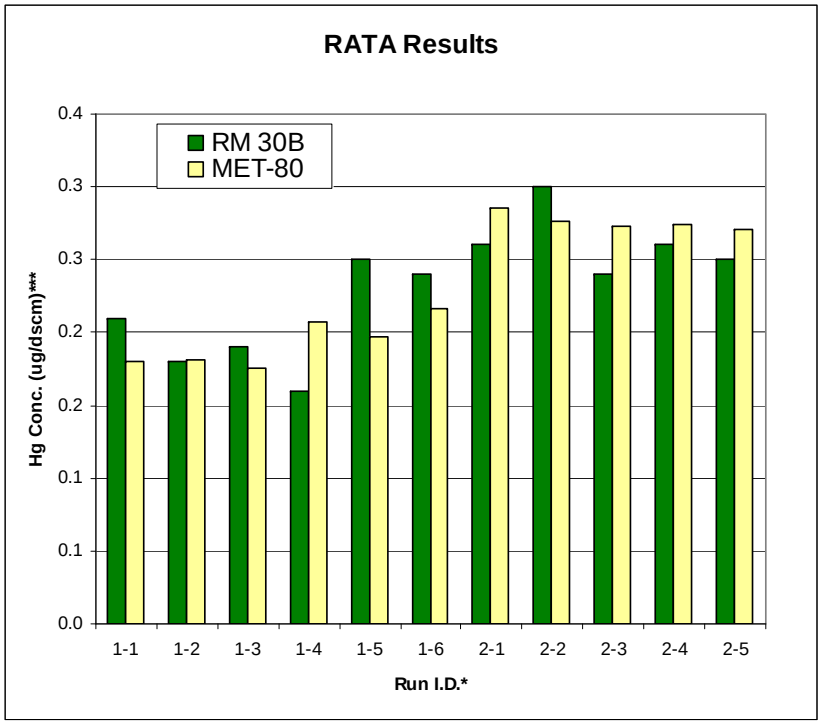
STMMS Performance

- How accurate is it?
- How reproducible is it?
- How reliable is it?
- How low can we go?



Accuracy

	Hg conc. (µg/dscm)			
	RM	MET80		
Run*	$C_{RM - Avg}$	$C_{CMMS-AVG}$	DIFF	%DIFF
1-1	**0.21**	**0.18**	0.03	14.3%
1-2	**0.18**	**0.18**	0.00	-0.6%
1-3	**0.19**	**0.18**	0.01	7.4%
1-4	**0.16**	**0.21**	-0.05	-29.4%
1-5	**0.25**	**0.20**	0.05	21.2%
1-6	**0.24**	**0.22**	0.02	10.0%
2-1	**0.26**	**0.29**	-0.03	-9.6%
2-2	**0.30**	**0.28**	0.02	8.0%
2-3	**0.24**	**0.27**	-0.03	-13.8%
2-4	**0.26**	**0.27**	-0.01	-5.4%
2-5	**0.25**	**0.27**	-0.02	-8.4%
All data (n=11)	**0.231**	**0.231**	0.0004 0.021 9.2%	



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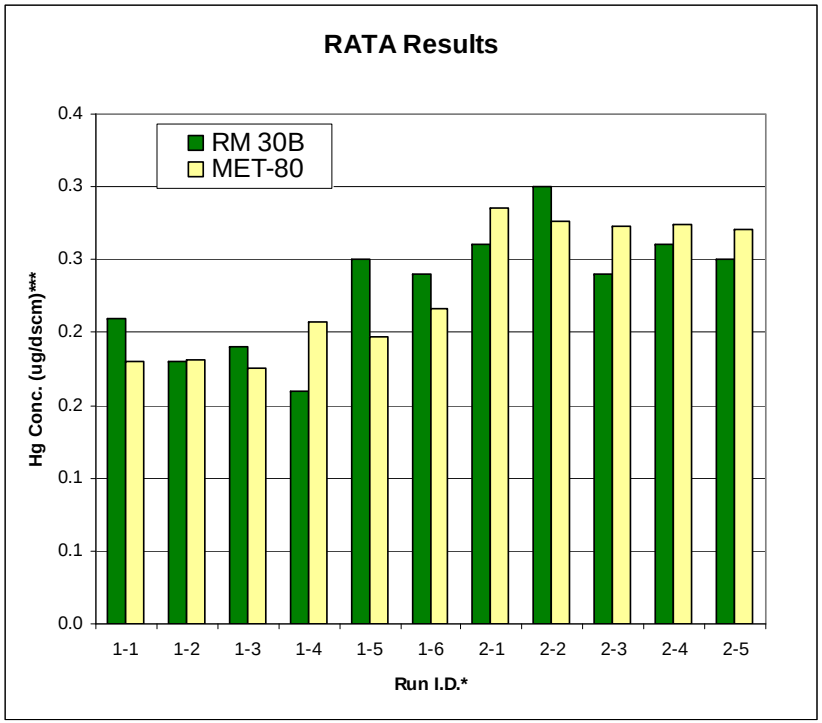
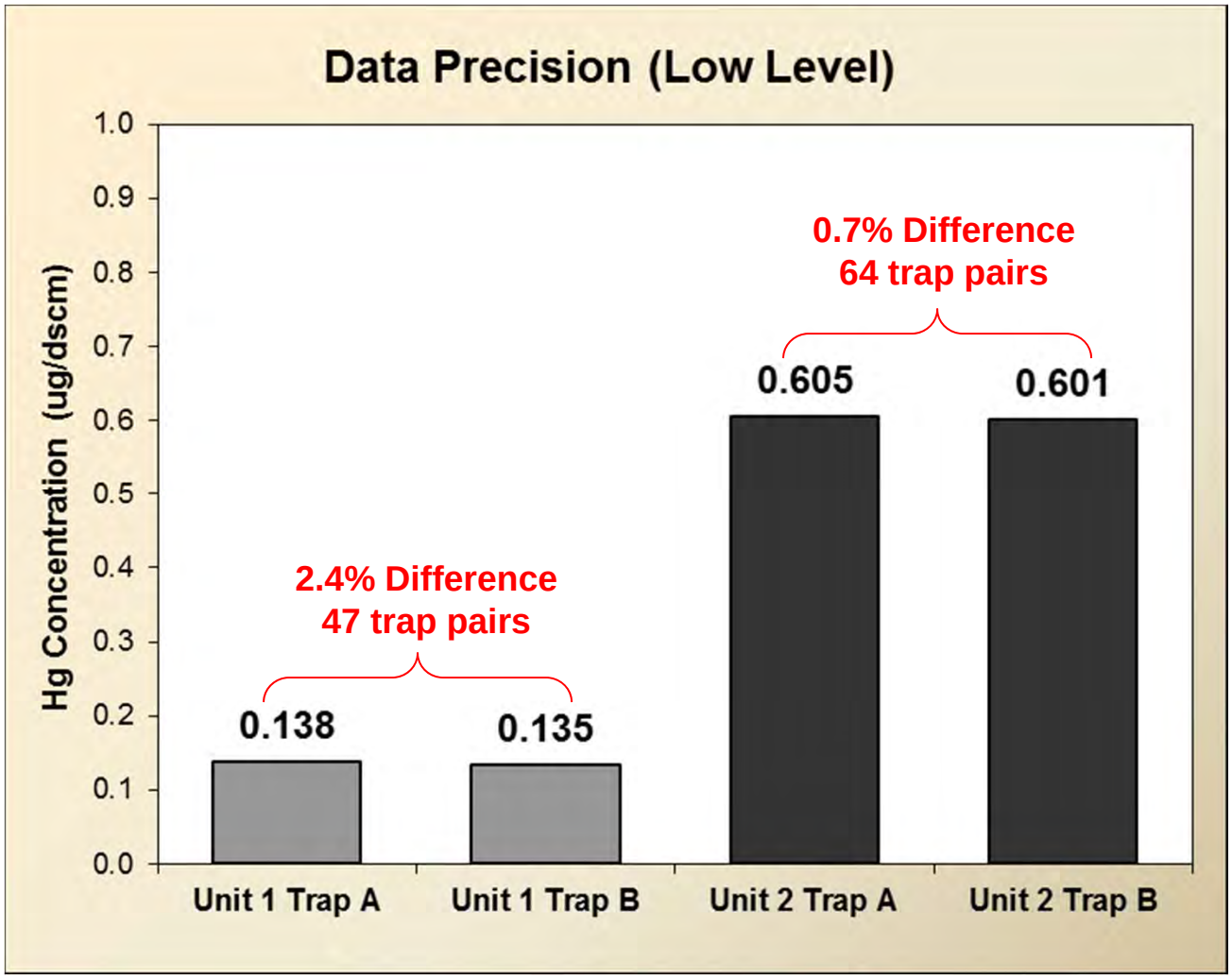
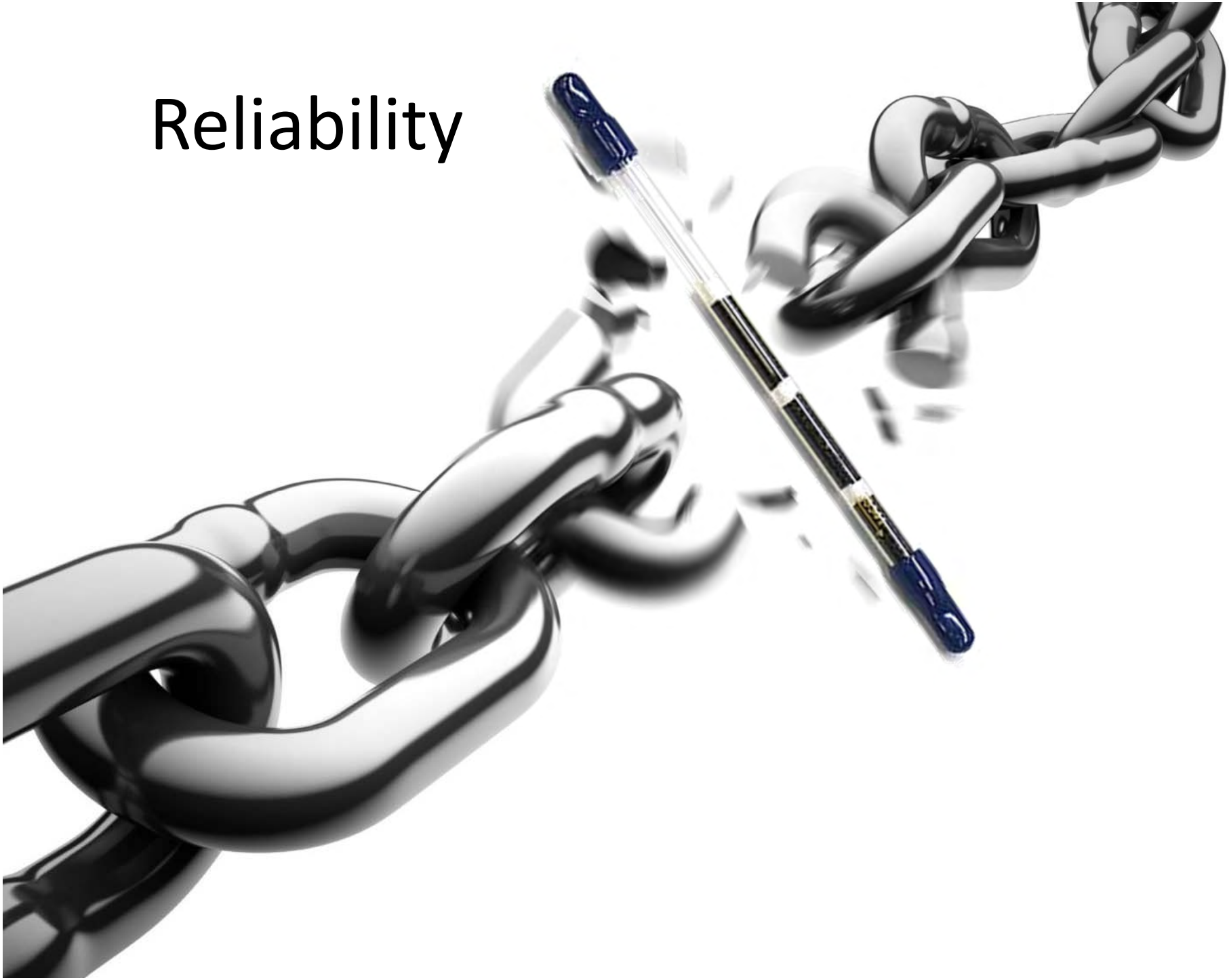


Reproducibility



Reliability

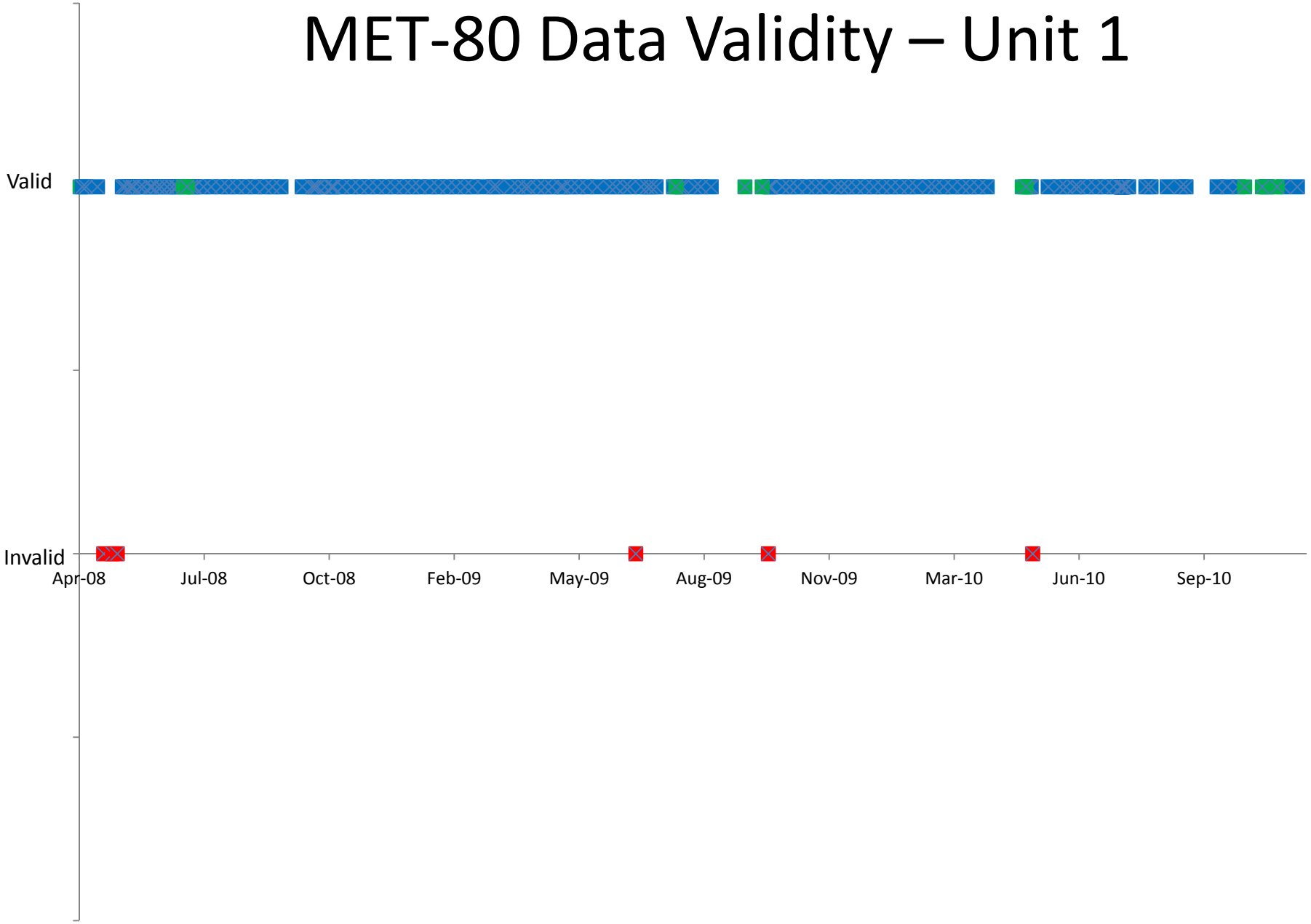


Reliability

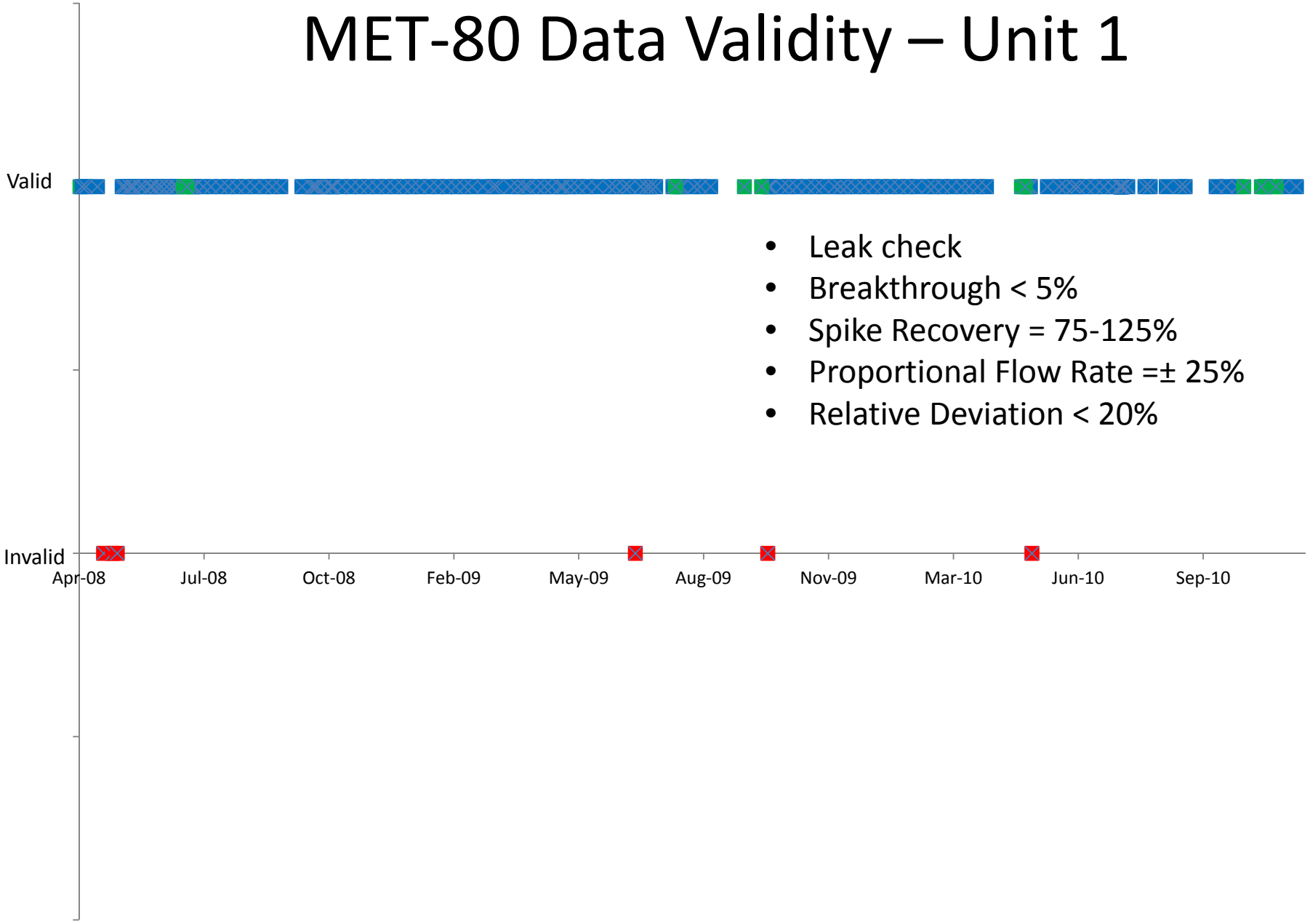
Case study

- Dominion Salem Harbor
- Compliance monitoring since 2008
- Three MET-80 systems

MET-80 Data Validity – Unit 1

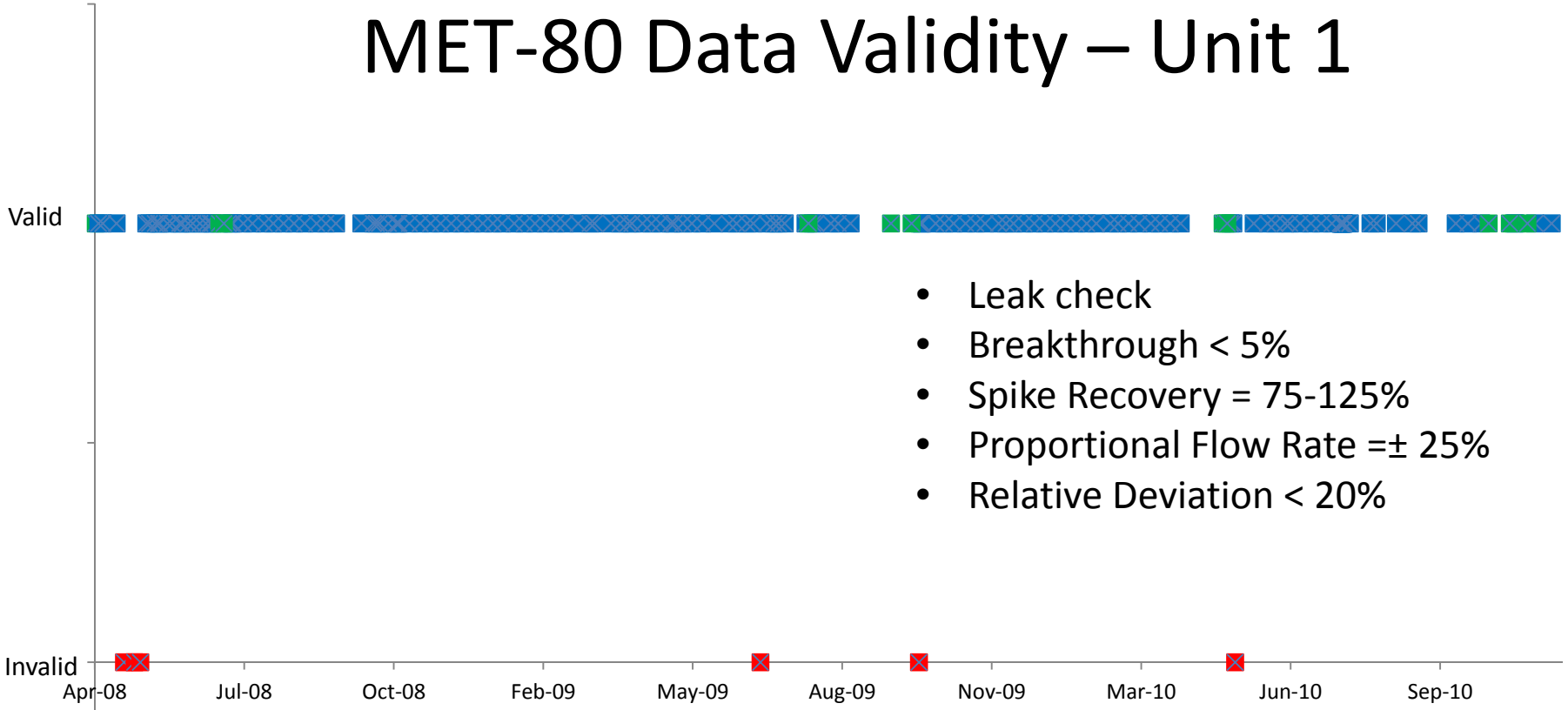


MET-80 Data Validity – Unit 1



- Leak check
- Breakthrough < 5%
- Spike Recovery = 75-125%
- Proportional Flow Rate =± 25%
- Relative Deviation < 20%

MET-80 Data Validity – Unit 1



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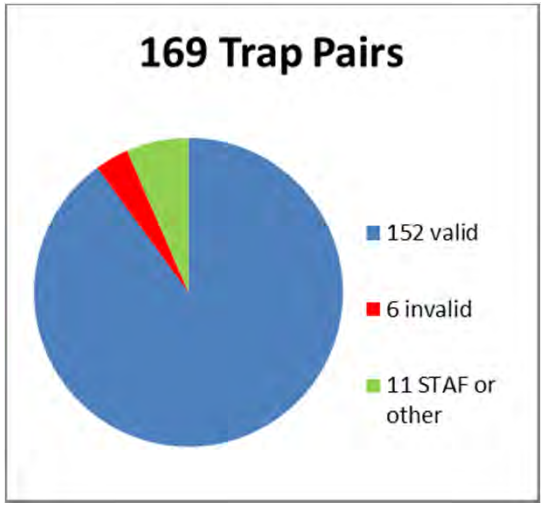
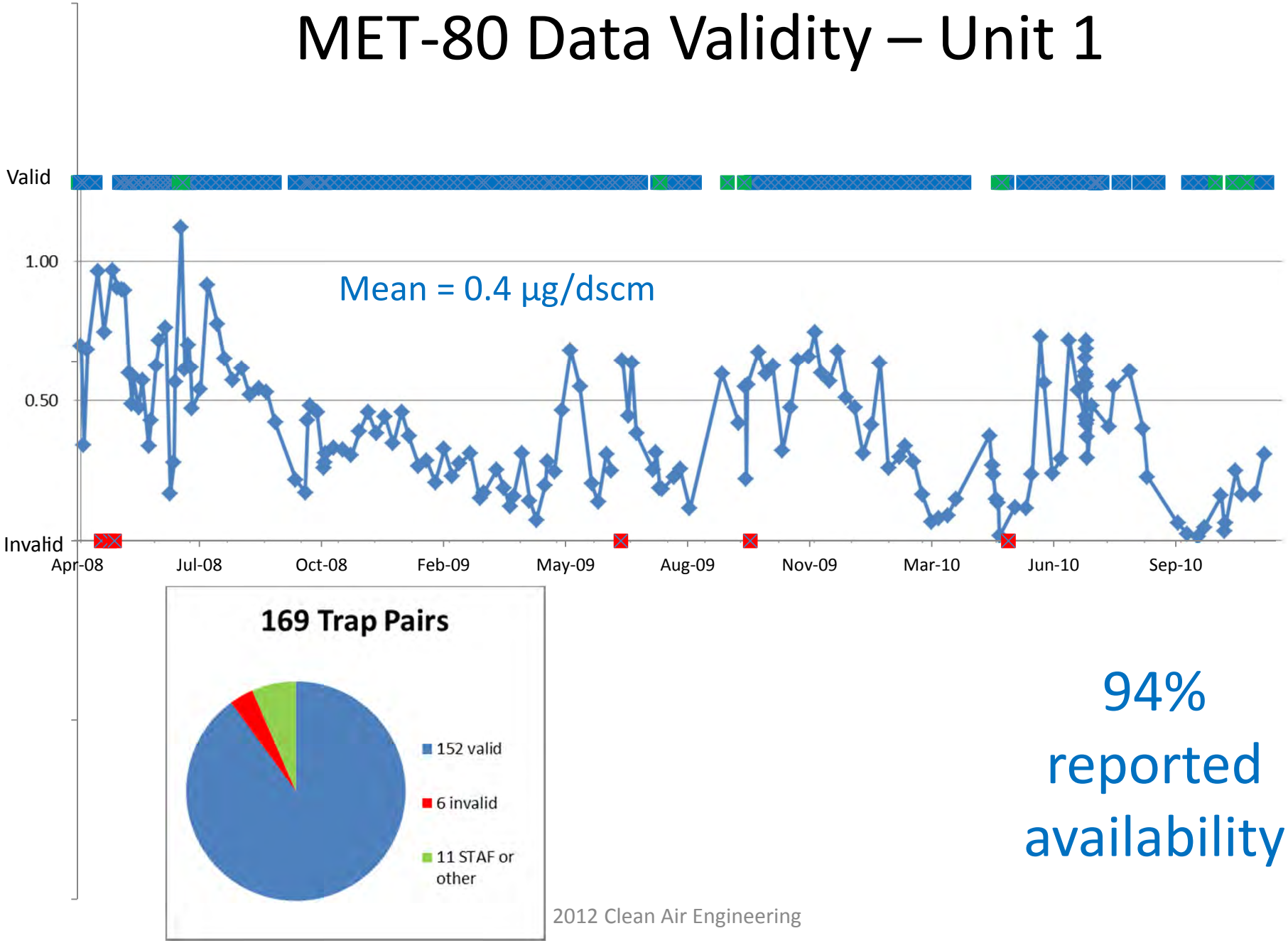


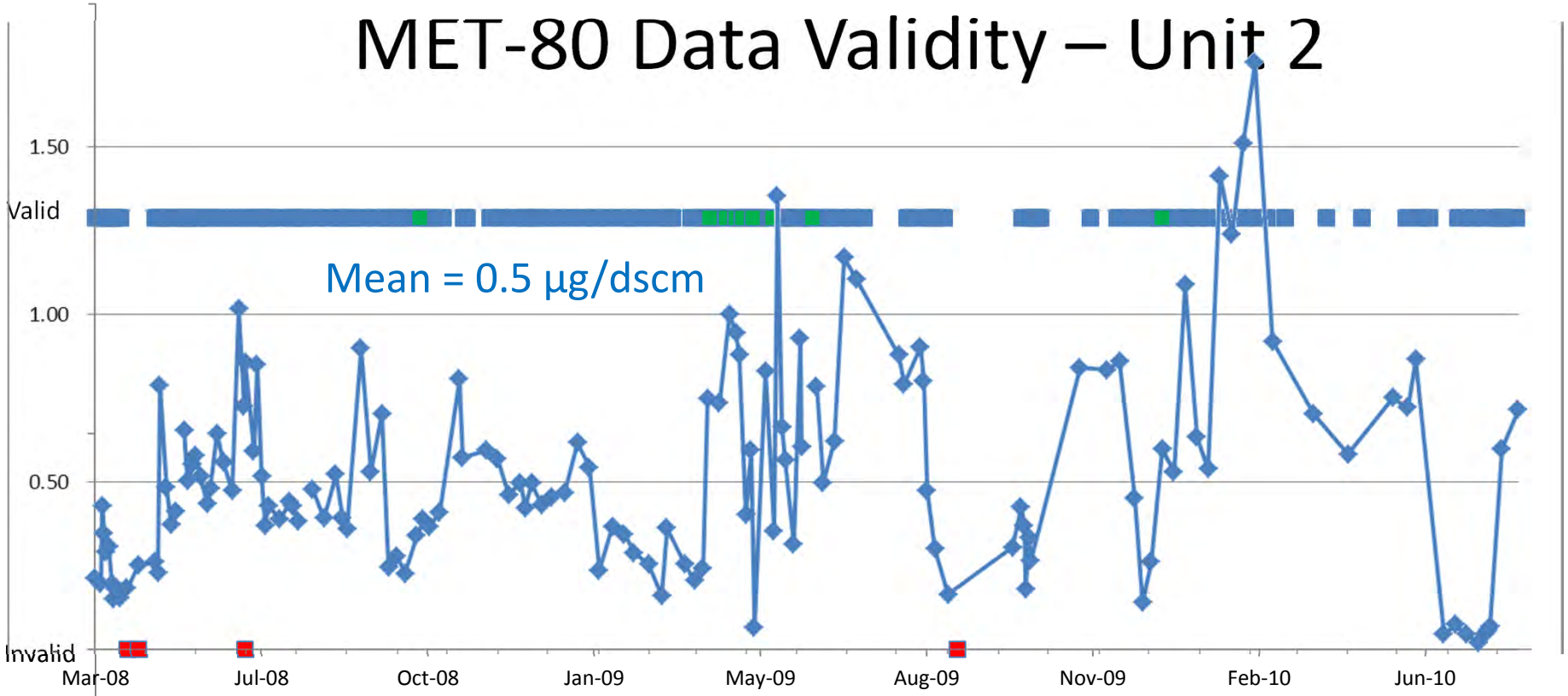
94% reported availability

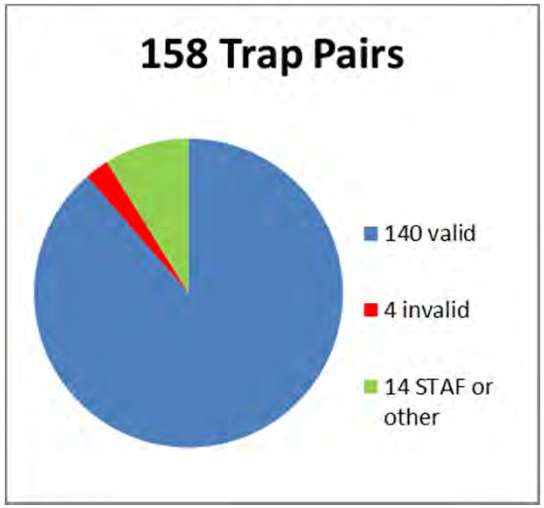
MET-80 Data Validity – Unit 1



94% reported availability

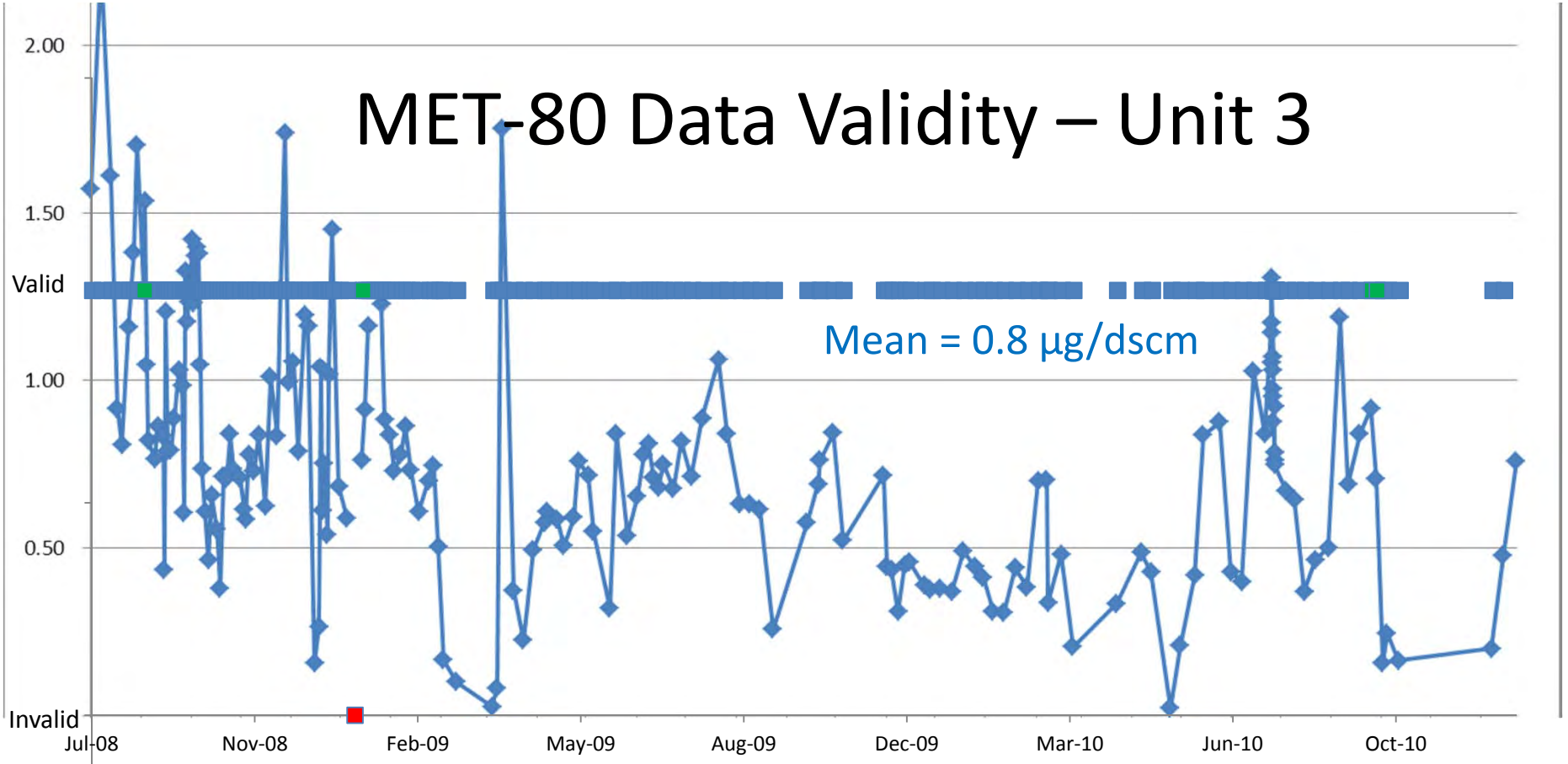
MET-80 Data Validity – Unit 2

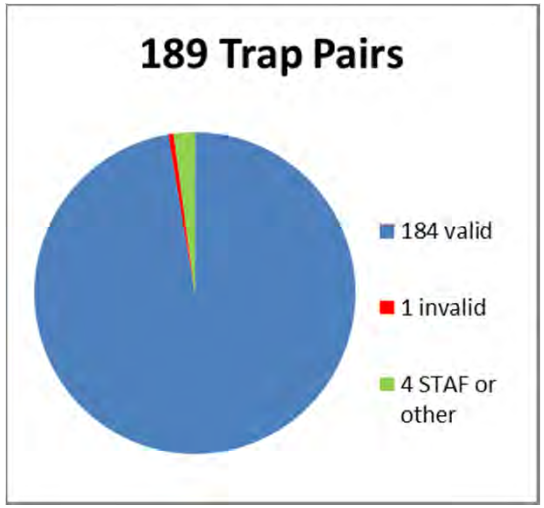




91% reported availability

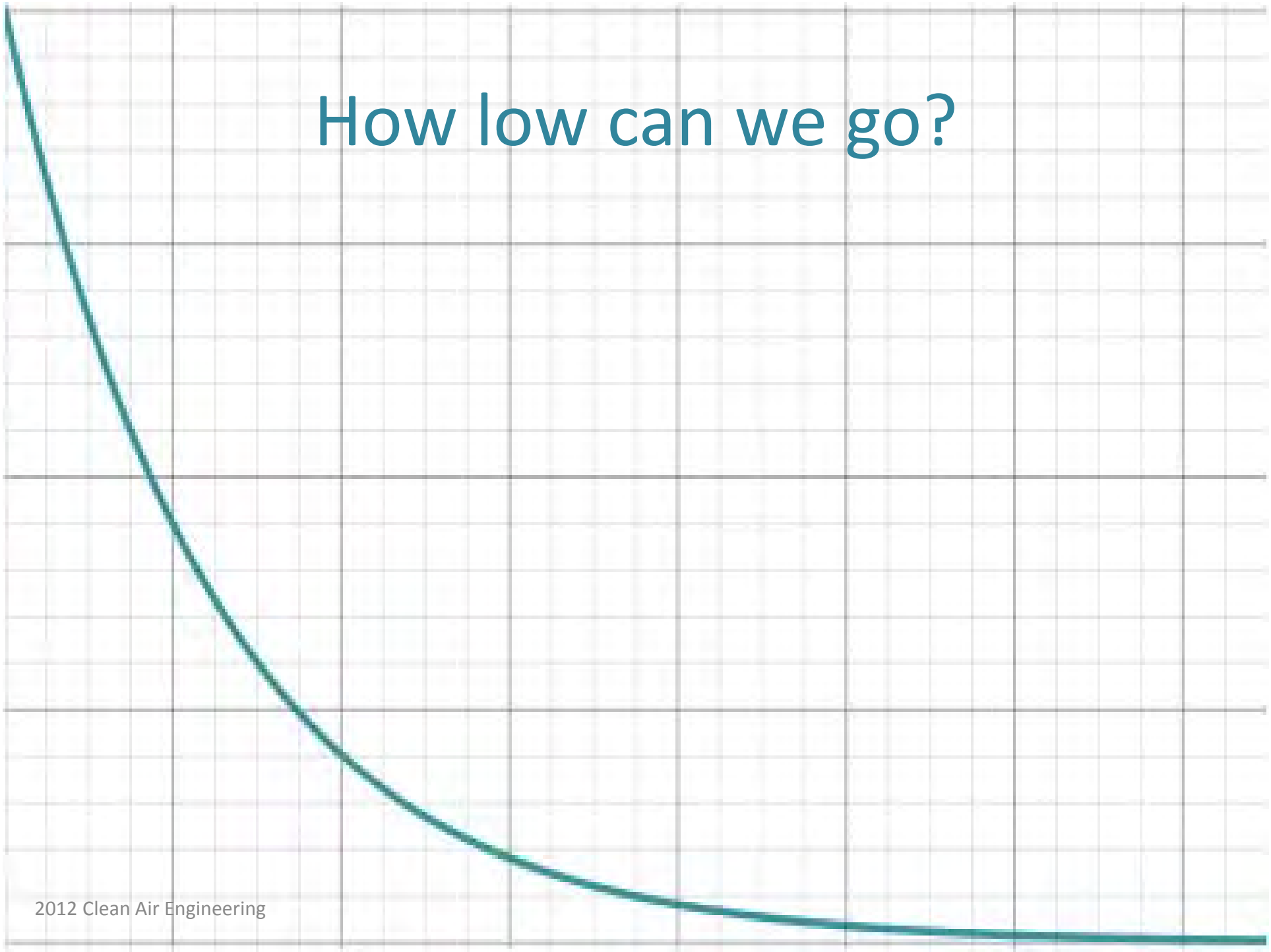
MET-80 Data Validity – Unit 3

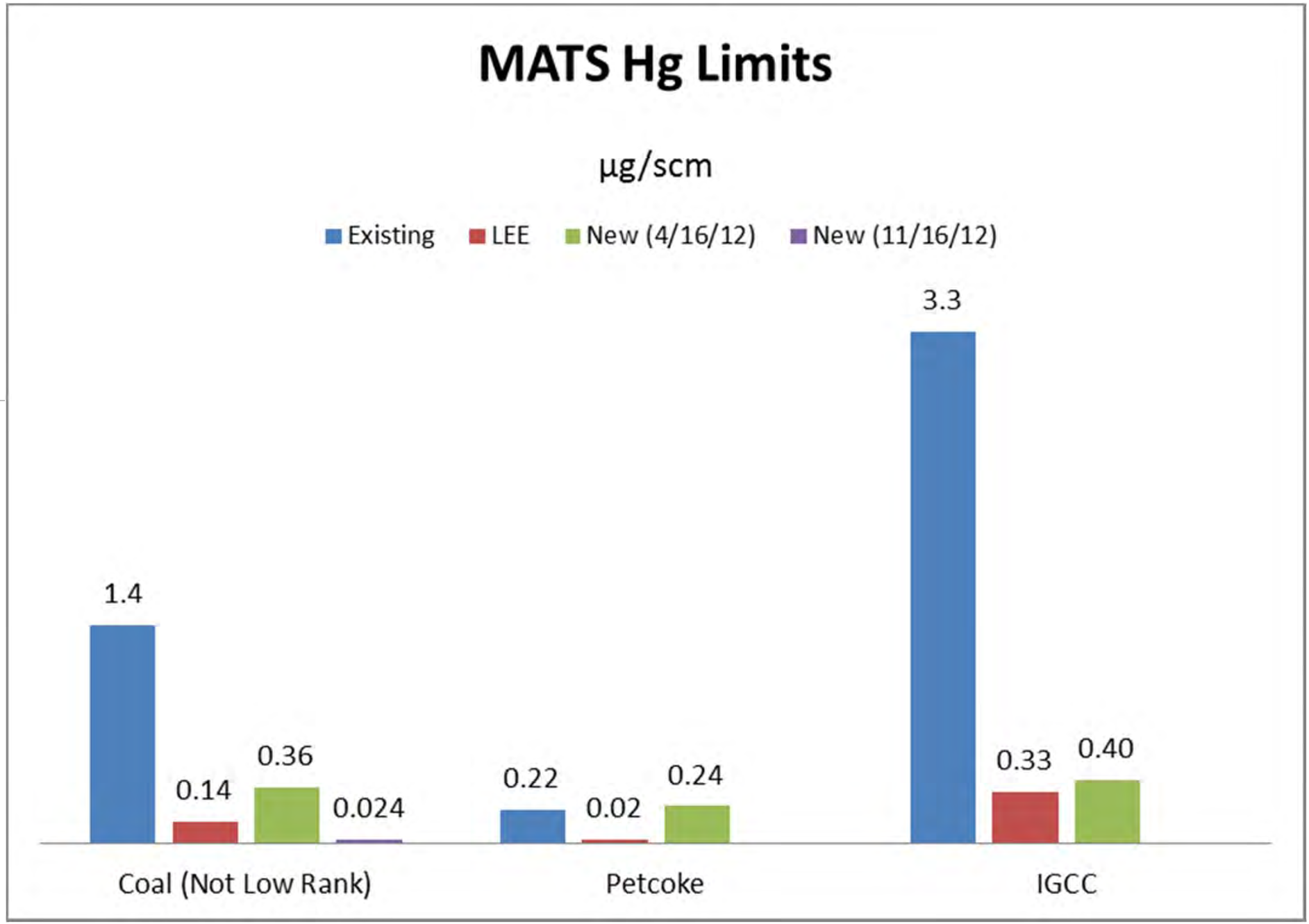


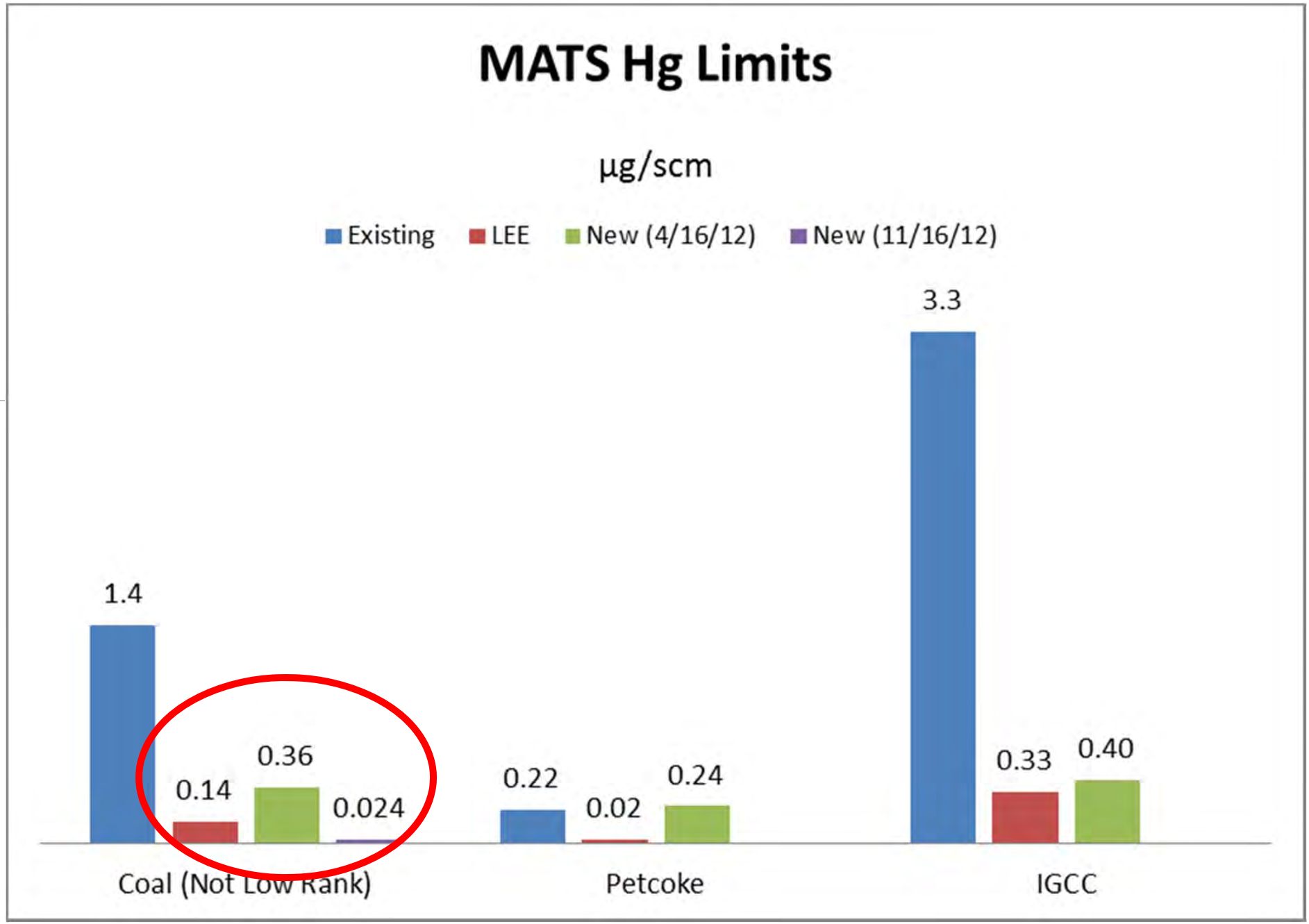


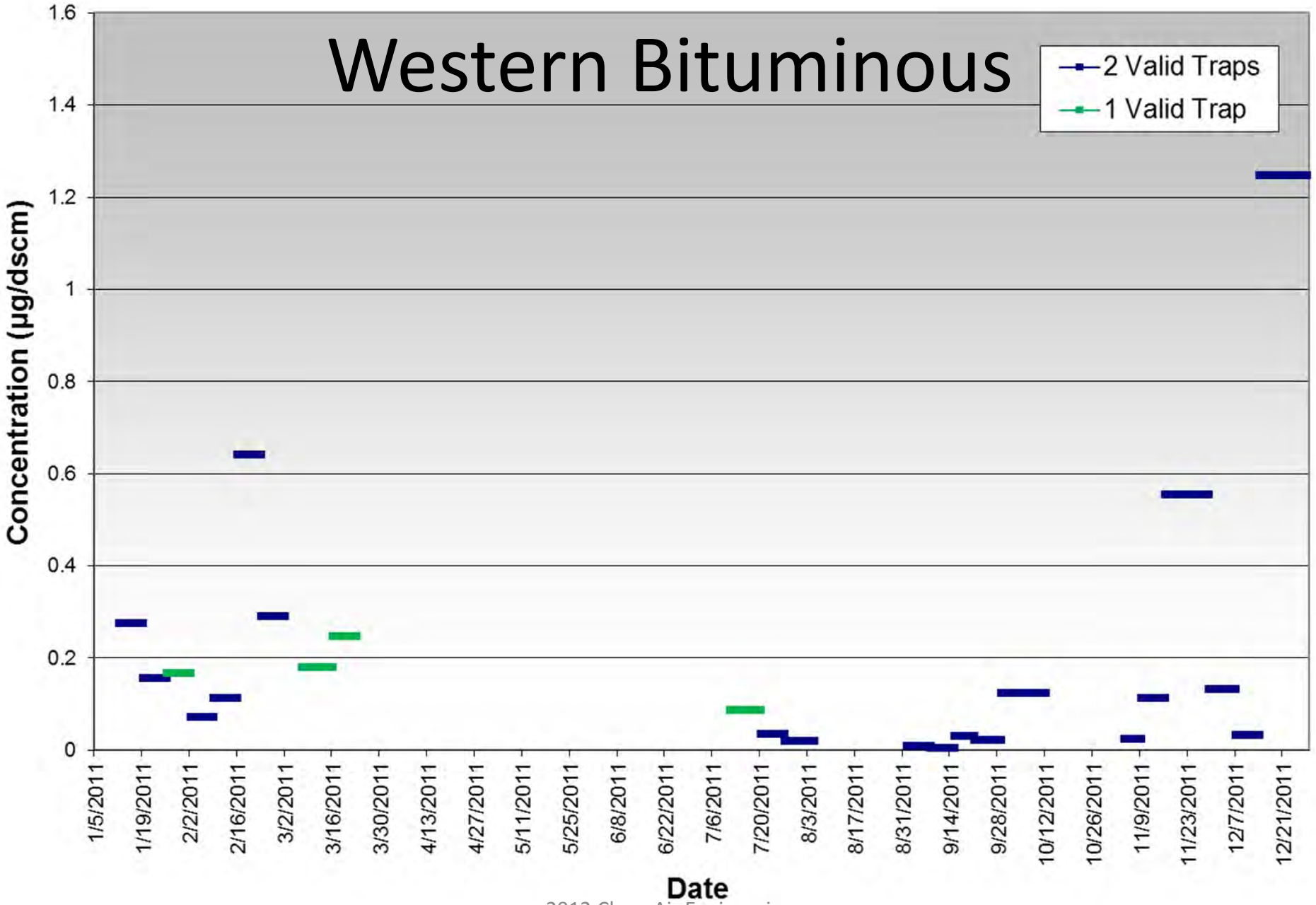
96% reported availability

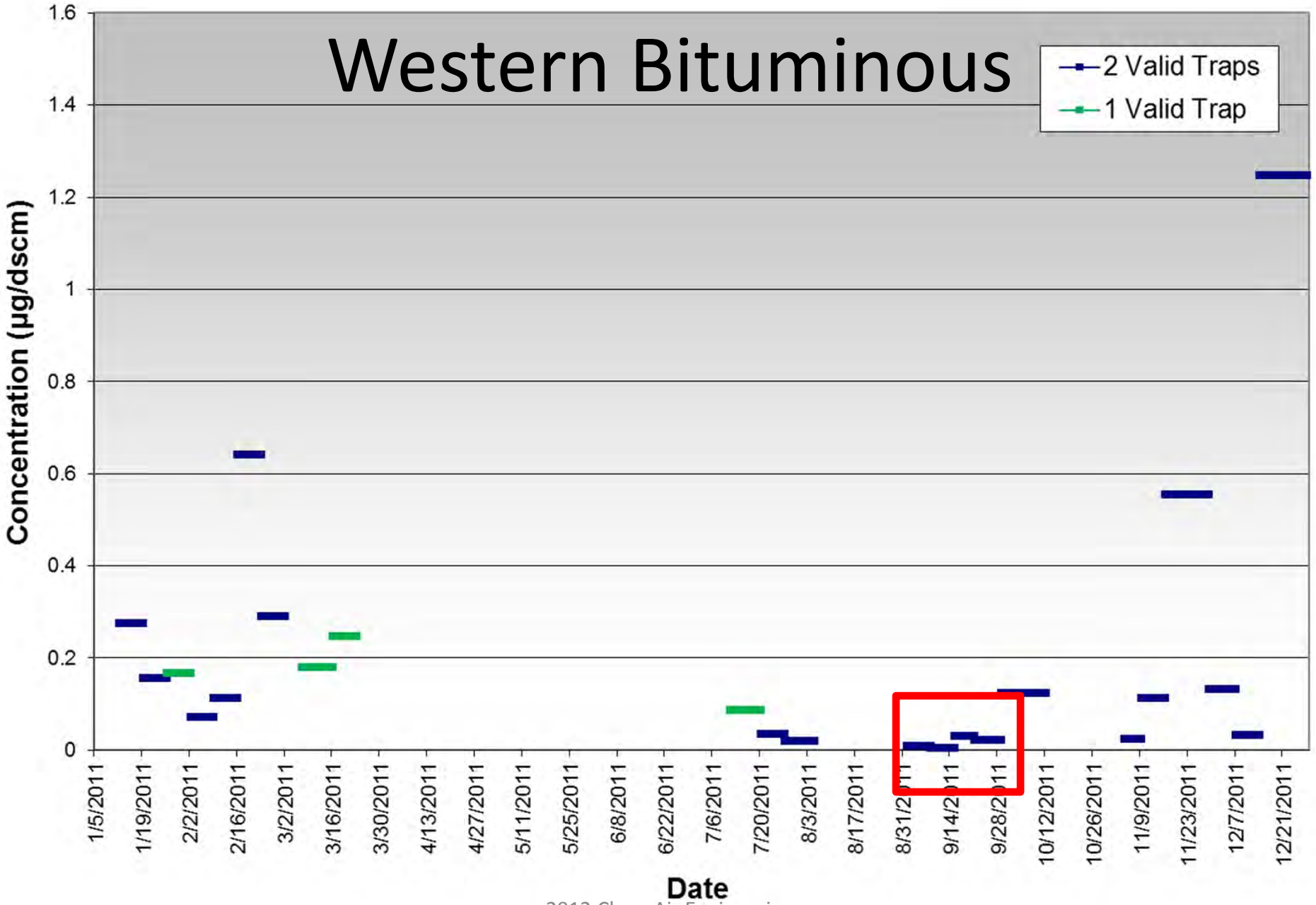
How low can we go?

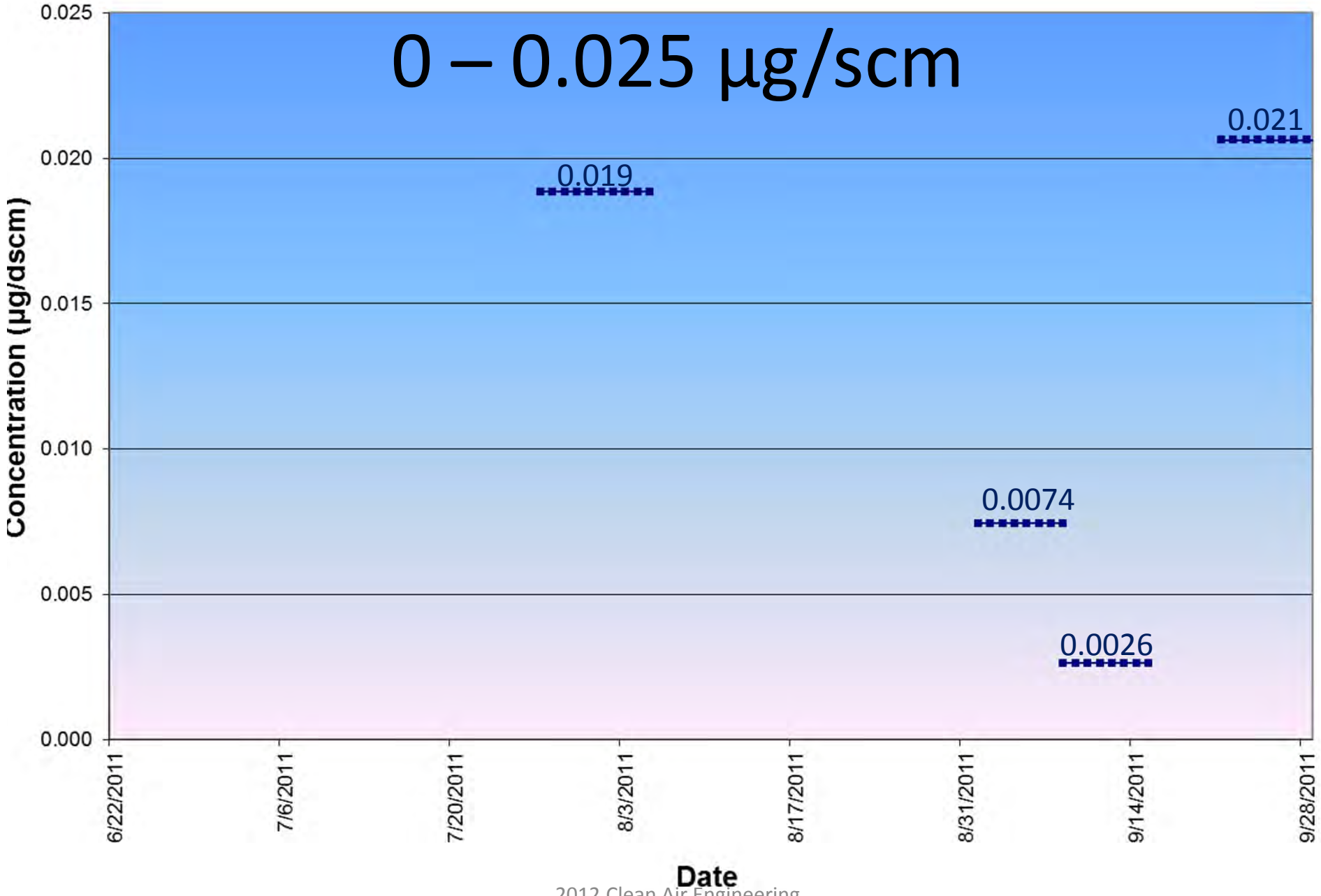



MATS Hg Limits
µg/scm
Existing
LEE
New (4/16/12)
New (11/16/12)
1.4
0.14
0.36
0.024
0.22
0.02
0.24
3.3
0.33
0.40
Coal (Not Low Rank)
Petcoke
IGCC


MATS Hg Limits
µg/scm
Existing
LEE
New (4/16/12)
New (11/16/12)
1.4
0.14
0.36
0.024
0.22
0.02
0.24
3.3
0.33
0.40
Coal (Not Low Rank)
Petcoke
IGCC

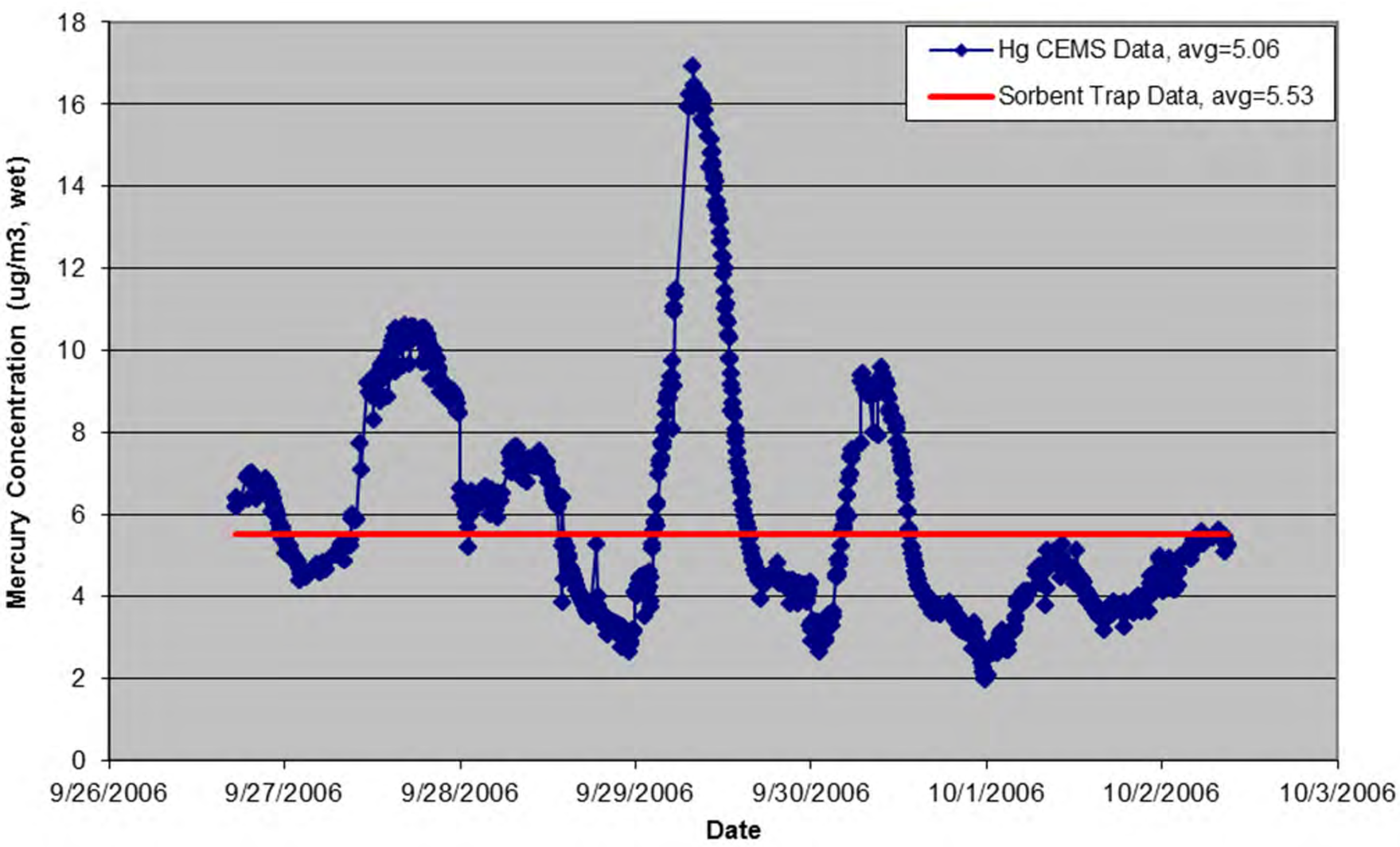

Western Bituminous
2 Valid Traps
1 Valid Trap
Concentration (µg/dscm)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1/5/2011
1/19/2011
2/2/2011
2/16/2011
3/2/2011
3/16/2011
3/30/2011
4/13/2011
4/27/2011
5/11/2011
5/25/2011
6/8/2011
6/22/2011
7/6/2011
7/20/2011
8/3/2011
8/17/2011
8/31/2011
9/14/2011
9/28/2011
10/12/2011
10/26/2011
11/9/2011
11/23/2011
12/7/2011
12/21/2011
Date


Western Bituminous
2 Valid Traps
1 Valid Trap
Concentration (µg/dscm)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1/5/2011
1/19/2011
2/2/2011
2/16/2011
3/2/2011
3/16/2011
3/30/2011
4/13/2011
4/27/2011
5/11/2011
5/25/2011
6/8/2011
6/22/2011
7/6/2011
7/20/2011
8/3/2011
8/17/2011
10/12/2011
10/26/2011
11/9/2011
11/23/2011
12/7/2011
12/21/2011
Date


0 – 0.025 µg/scm
Concentration (µg/dscm)
0.025
0.020
0.015
0.010
0.005
0.000
0.019
0.021
0.0074
0.0026
6/22/2011
7/6/2011
7/20/2011
8/3/2011
8/17/2011
8/31/2011
9/14/2011
9/28/2011
Date

Problem with Sorbent Traps

Real Time Data


Hg CEMS Data, avg=5.06
Sorbent Trap Data, avg=5.53
Mercury Concentration (ug/m3, wet)
0
2
4
6
8
10
12
14
16
18
9/26/2006
9/27/2006
9/28/2006
9/29/2006
9/30/2006
10/1/2006
10/2/2006
10/3/2006
Date

Need for Real-Time Data

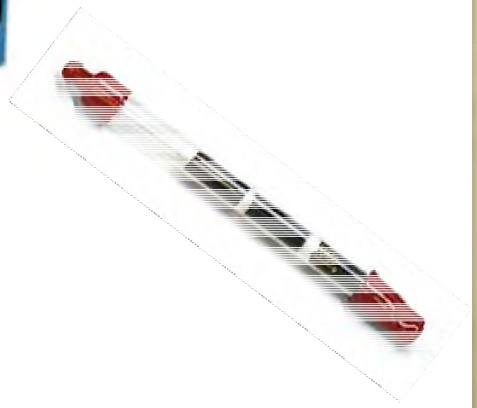
COMPLIANCE CONTROL

- Active Hg control
- Process Hg control

Hybrid System Advantages

- Real-time CMMS trending data
- NIST-traceable STMMS compliance data

A Hybrid Approach



- Process Hg Analyzer
- Internal zero/cal

- Compliance
- Analyzer check

Questions?

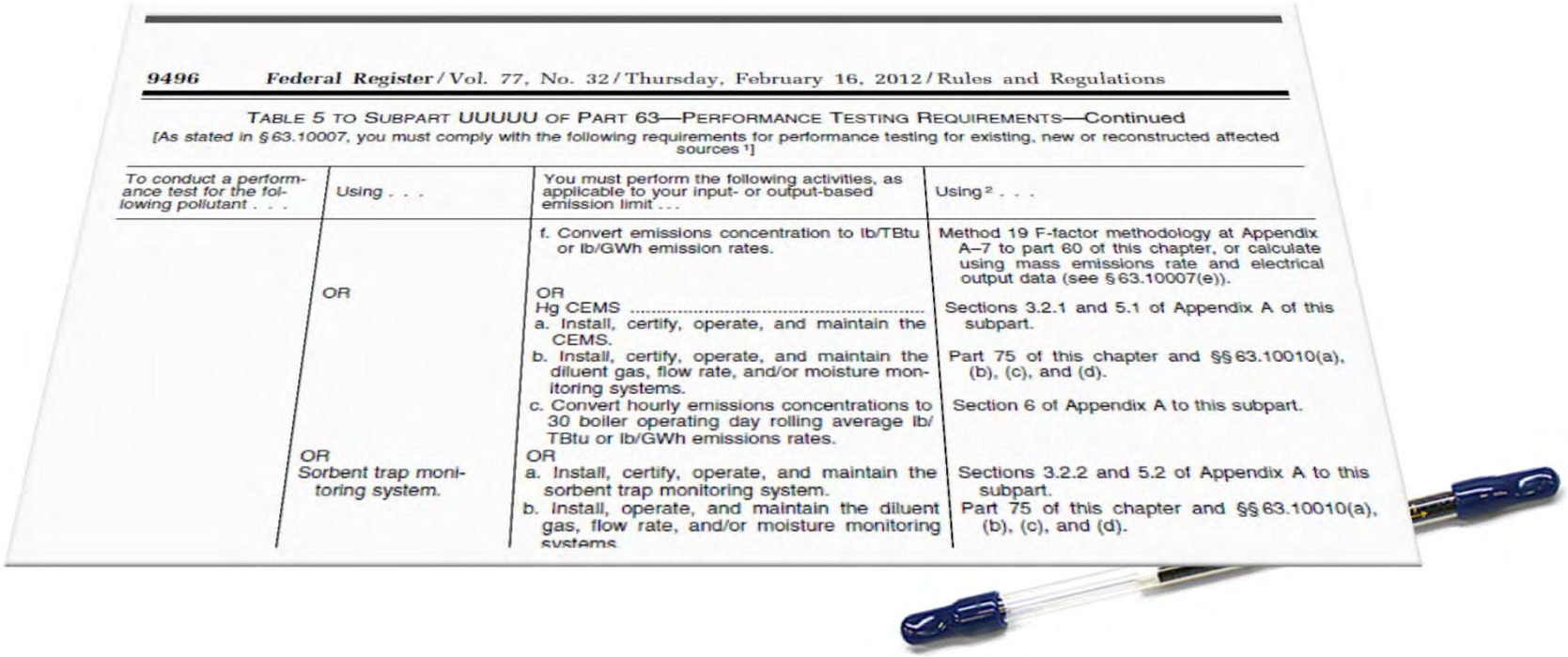


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TABLE 5 TO SUBPART UUUUU OF PART 63—PERFORMANCE TESTING REQUIREMENTS—Continued

[As stated in §63.10007, you must comply with the following requirements for performance testing for existing, new or reconstructed affected sources [1]]

To conduct a performance test for the following pollutant . . .	Using . . .	You must perform the following activities, as applicable to your input- or output-based emission limit . . .	Using [2] . . .
		f. Convert emissions concentration to lb/TBtu or lb/GWh emission rates.	Method 19 F-factor methodology at Appendix A–7 to part 60 of this chapter, or calculate using mass emissions rate and electrical output data (see §63.10007(e)).
	OR	OR Hg CEMS	
		a. Install, certify, operate, and maintain the CEMS.	Sections 3.2.1 and 5.1 of Appendix A of this subpart.
		b. Install, certify, operate, and maintain the diluent gas, flow rate, and/or moisture monitoring systems.	Part 75 of this chapter and §§63.10010(a), (b), (c), and (d).
		c. Convert hourly emissions concentrations to 30 boiler operating day rolling average lb/TBtu or lb/GWh emissions rates.	Section 6 of Appendix A to this subpart.
	OR Sorbent trap monitoring system.	OR a. Install, certify, operate, and maintain the sorbent trap monitoring system.	Sections 3.2.2 and 5.2 of Appendix A to this subpart.
		b. Install, operate, and maintain the diluent gas, flow rate, and/or moisture monitoring systems.	Part 75 of this chapter and §§63.10010(a), (b), (c), and (d).

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