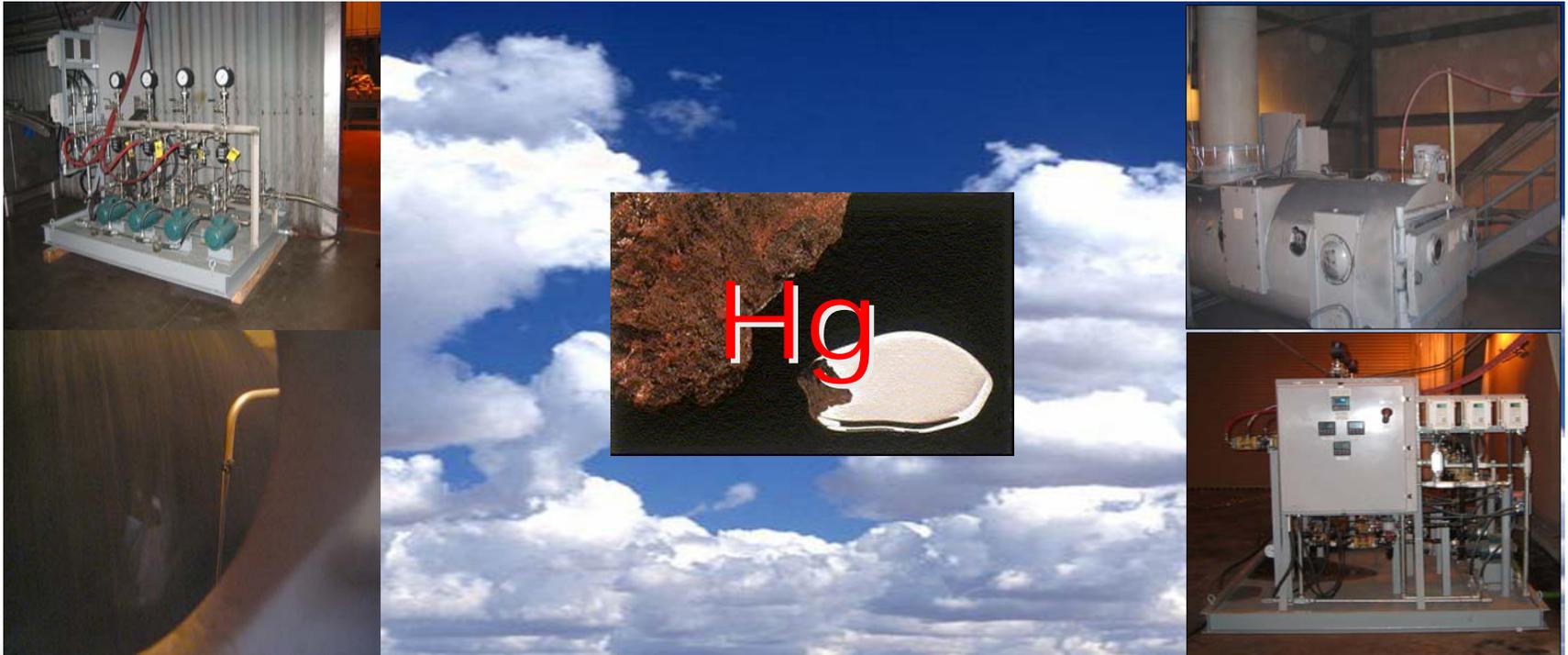


Full-Scale WFGD Hg Removal Additives

**The Babcock and Wilcox Company
Barberton Ohio**

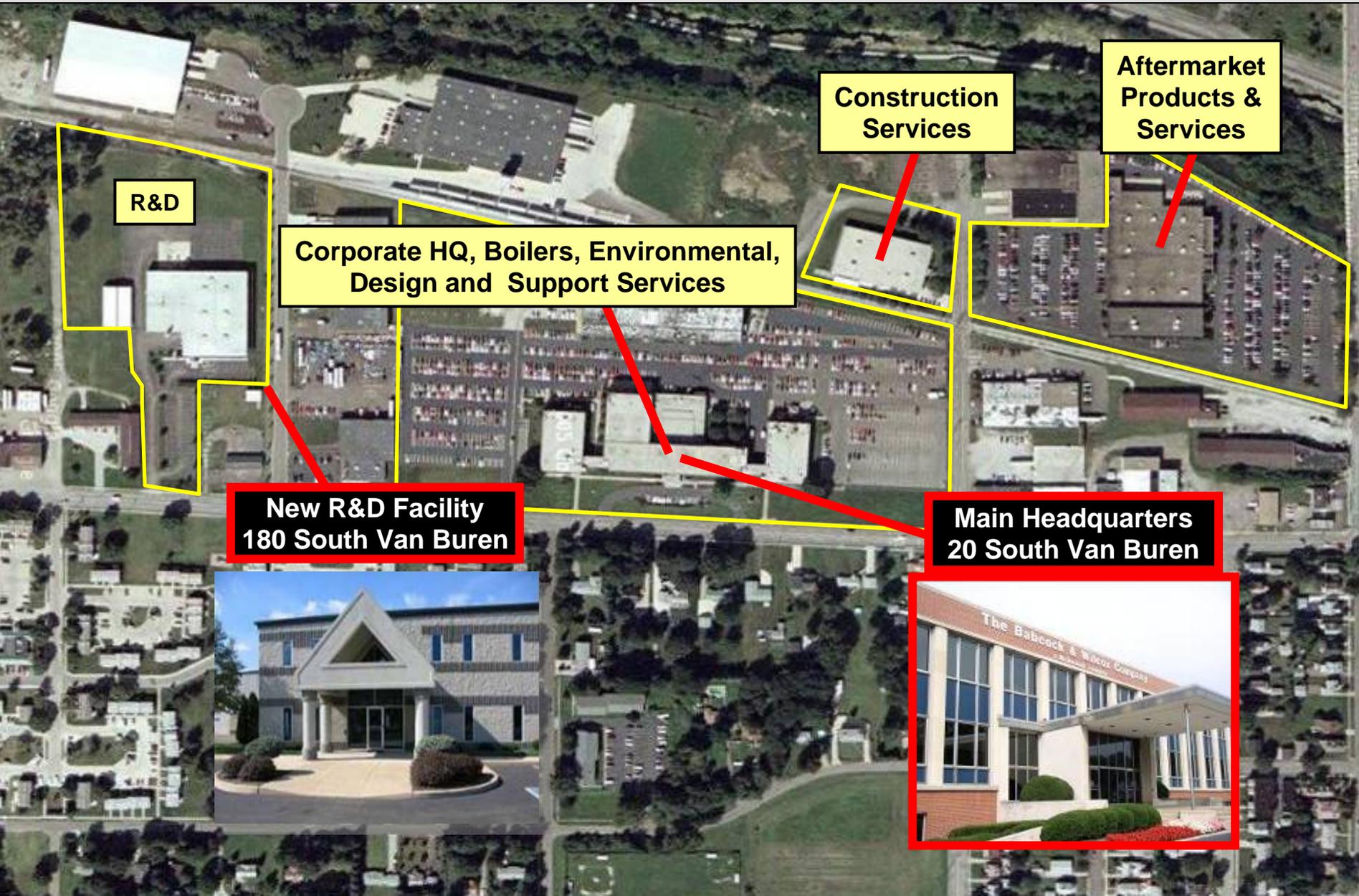
John David, Tony Silva, Shannon Brown



Air Quality VI, September 27th, 2007



B&W Barberton Operations: Fossil, Service and Construction



R&D

Corporate HQ, Boilers, Environmental, Design and Support Services

Construction Services

Aftermarket Products & Services

**New R&D Facility
180 South Van Buren**

**Main Headquarters
20 South Van Buren**



B&W's R&D Program Objectives

To develop mercury removal systems to allow our customers to meet pending regulations in a reliable, cost-effective manner

- **Scrubbed and unscrubbed systems**
- **Eastern and western coals**





B&W has a Commercialization Agreement with The University of North Dakota's Energy and Environmental Research Center

In 2007, DOE announced that EERC and B&W received one of only eight long-term mercury field test awards from its Phase III solicitation, \$1,200,000



WFGD Full-Scale Testing Presentation Outline

- **B&W Commercial Technologies**
- **B&W WFGD Host Test Sites**
- **Solucorp WFGD Additive Test Results and Conclusions from MSCPA Endicott Station**
- **B&W WFGD Additive Test Results and Conclusions from E.ON Mill Creek**



WFGD Full-Scale Testing Presentation Outline

- **B&W Commercial Technologies**



The Focus of B&W's Mercury R&D Program

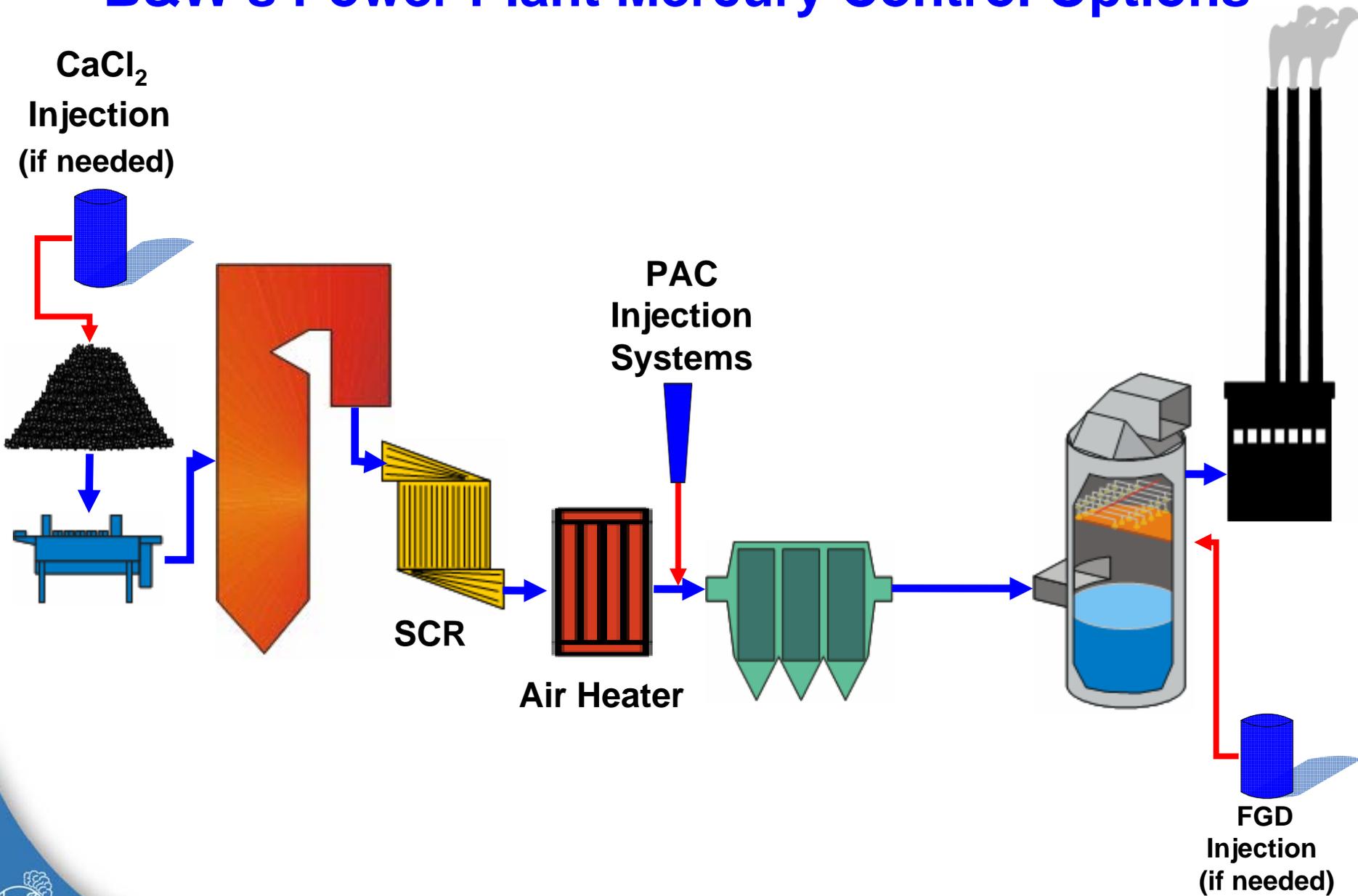
Goal: *Center of R&D Efforts to have the ability to Provide Low Risk Guarantees of 90% Total Hg*

Current Technologies

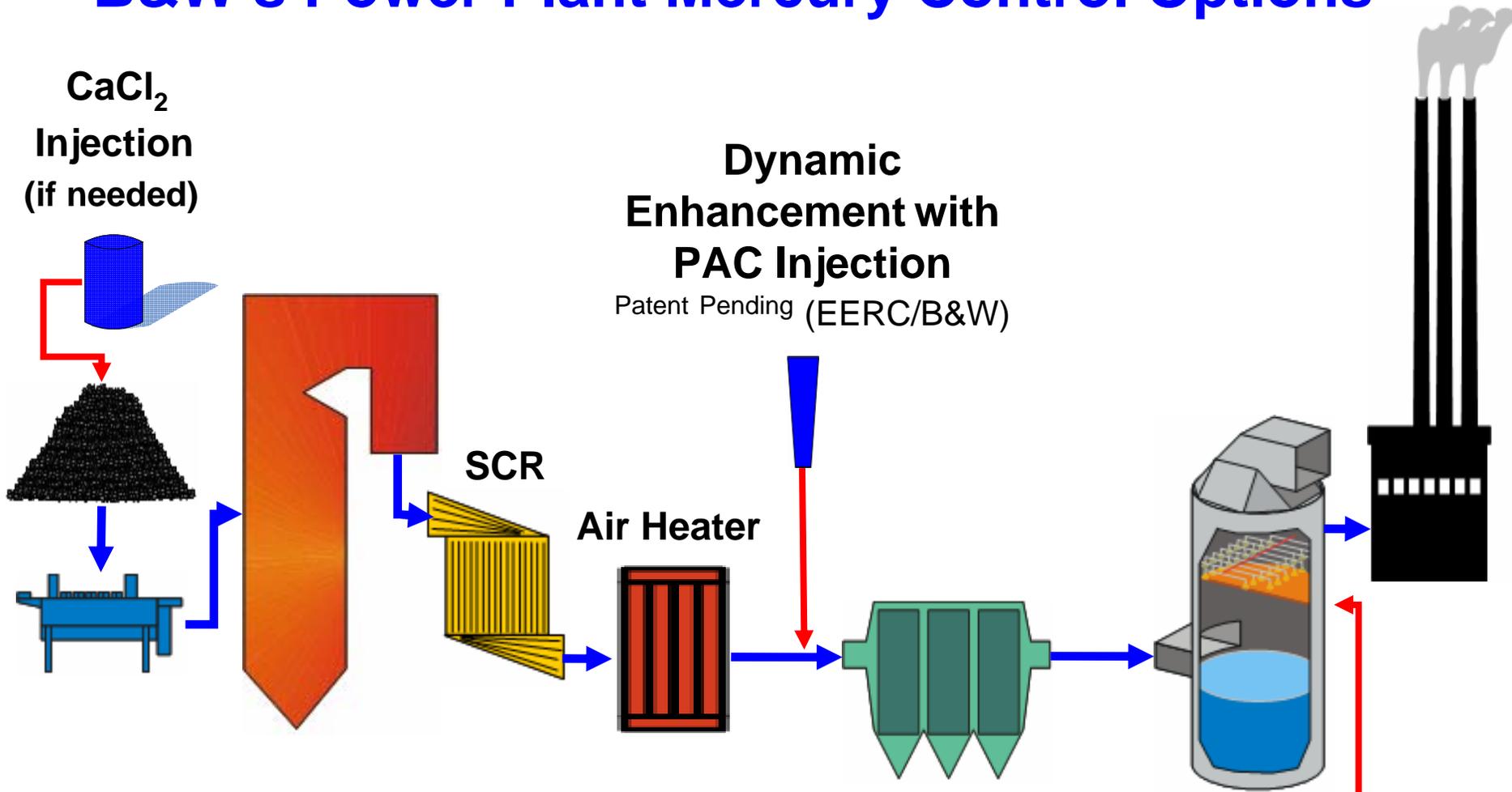
- **SEA injection into the boiler to oxidize Hg in low chlorine coals**
- **Dynamic Enhancement TM;
On-site Carbon Halogenation**
- **PAC Systems and Long-term PAC supply contracts**
- **WFGD Additives to inhibit Hg re-emission and remove Hg⁰ (Absorption Plus(Hg)TM Enhancements)**



B&W's Power Plant Mercury Control Options



B&W's Power Plant Mercury Control Options



United States

1. Patent Application Publication (10) Pub. No.: US 2007/0051239 A1

2. (43) International Publication Date
6 October 2005 (06.10.2005)

PCT

(10) International Publication Number
WO 2005/092476 A1

FGD
Injection
(if needed)



WFGD Full-Scale Testing Presentation Outline

- **B&W Commercial Technologies**
- **B&W WFGD Host Test Sites**



Host Site Selection

- **Michigan South Central Power Agency (MSCPA)**
 - Endicott Station Unit 1, Litchfield, MI
 - Limestone, forced oxidized system
 - Dual Tray tower
 - Good working relationship
 - Previous Hg testing with Absorption Plus(Hg)TM

- **E-ON U.S.A. – Mill Creek Station**
 - Mill Creek Station Unit 4, Louisville, KY
 - Limestone, forced oxidized system
 - Single Tray tower
 - Good working relationship
 - Previous Hg testing with Absorption Plus(Hg)TM



WFGD Full-Scale Testing Presentation Outline

- **B&W Commercial Technologies**
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- **Solucorp WFGD Additive Test Results and Conclusions from MSCPA Endicott Station**



Endicott Station Site Description

- **Solucorp WFGD Chemical Additive**
- **Air Quality Control system consists of ESP + WFGD**
- **Boiler burns Bituminous coal with some pet coke (0-15% blend)**



Field Test at MSCPA Endicott, WFGD Additive

Solucorp's Molecular Bonding System Additive

1. Lab tests at B&W Alliance R&D Center in 2006
 - WFGD additive inhibited re-emission and removed Vapor phase Hg^0
 - B&W Lab-scale test showed up to 30% removal of vapor phase Hg^0
2. Lab tests justified Full-scale testing at MSCPA Endicott Station in August 2007

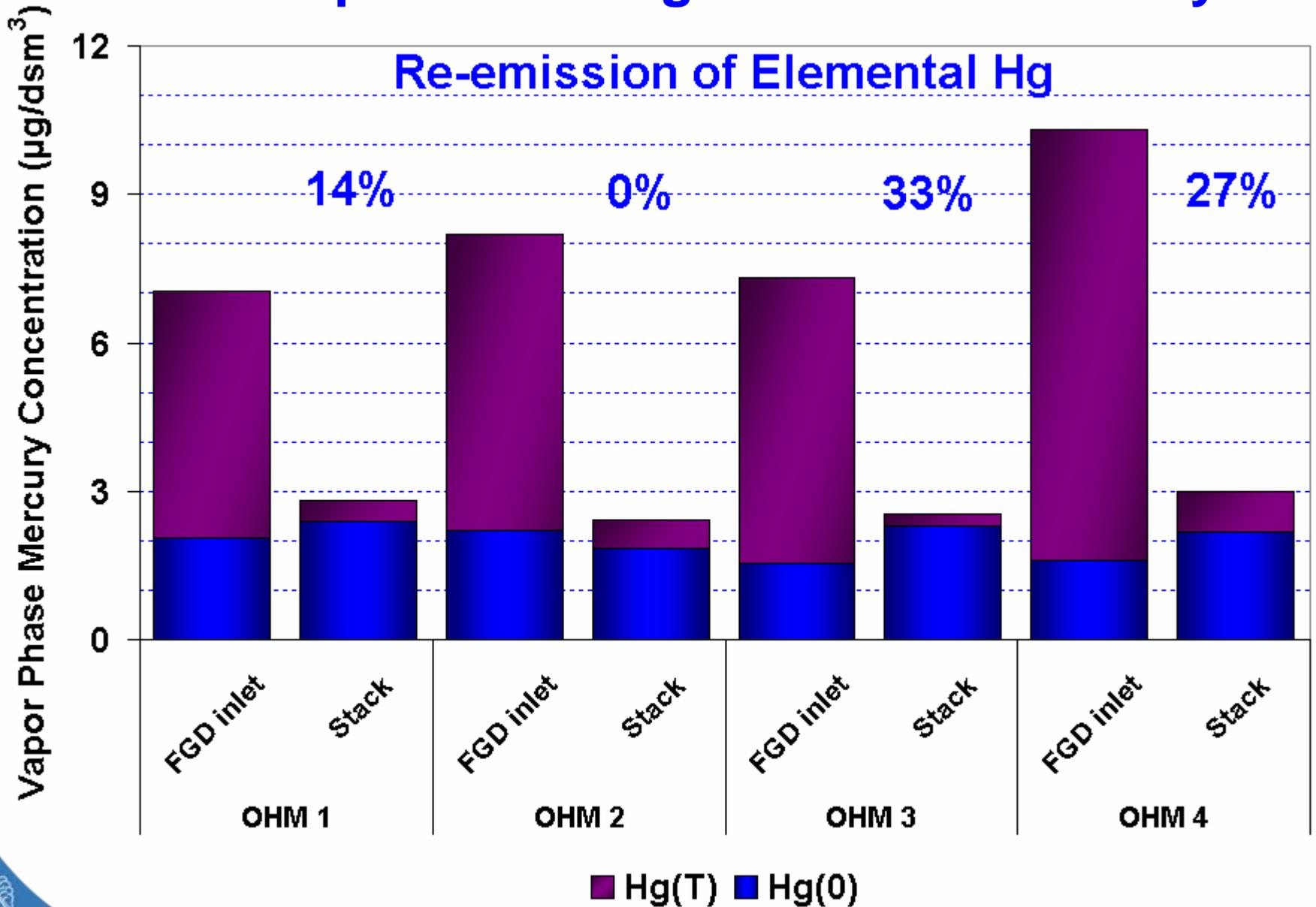


Field Test at MSCPA Endicott, WFGD Additive Continued...

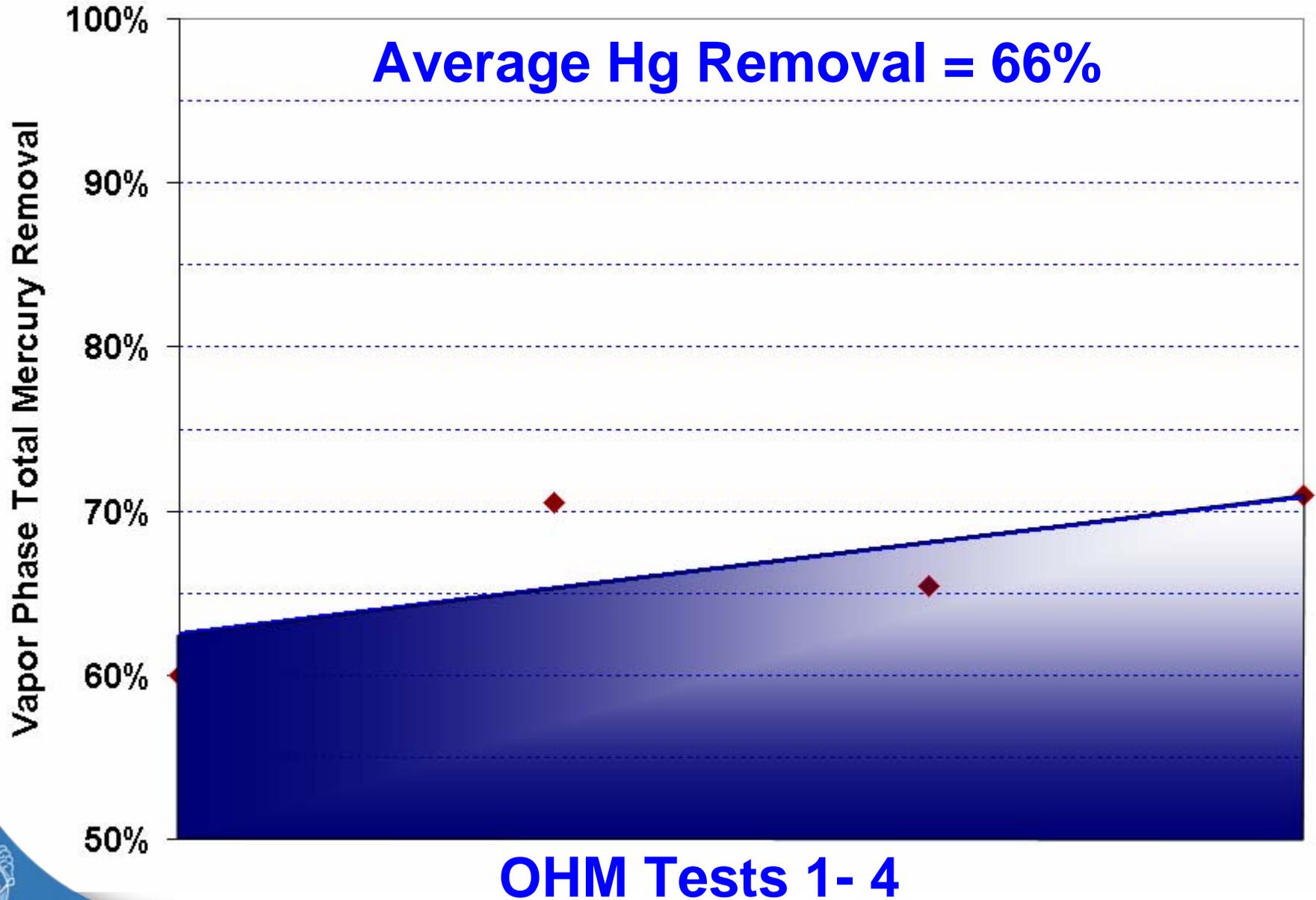
- IFS-2C Injection as a slurry at inlet of recirculation pump
- Parametric testing, chemical addition rates of 20, 40, 60, 80, 100, and 120 gph
- IFS-2C Mercury removal based on SCEMs, OHM results pending
- Base-line Mercury Removal across WFGD ~70%



WFGD Vapor Phase Hg Removal Efficiency

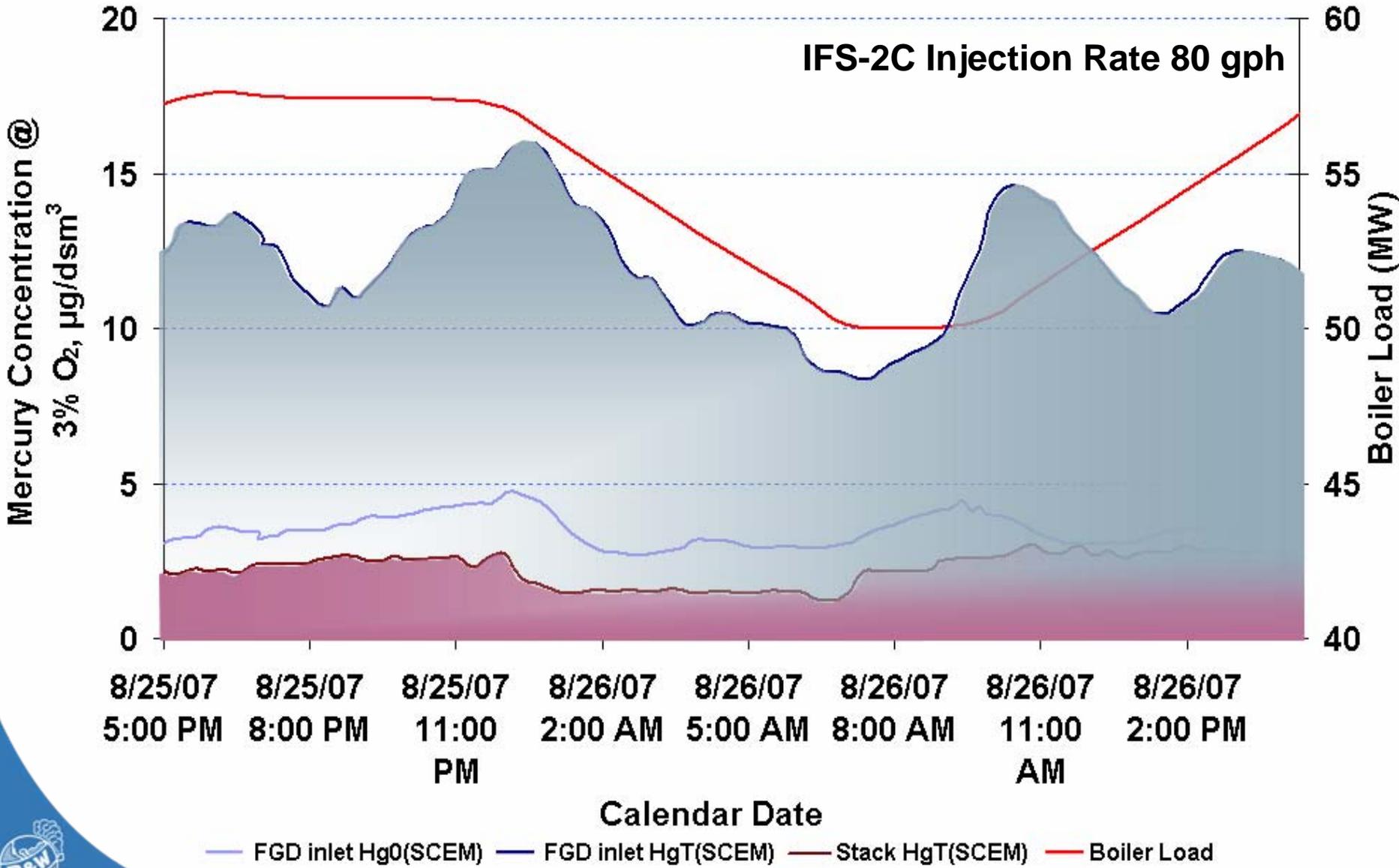


MSCPA WFGD Base-line Vapor Phase Hg Removal

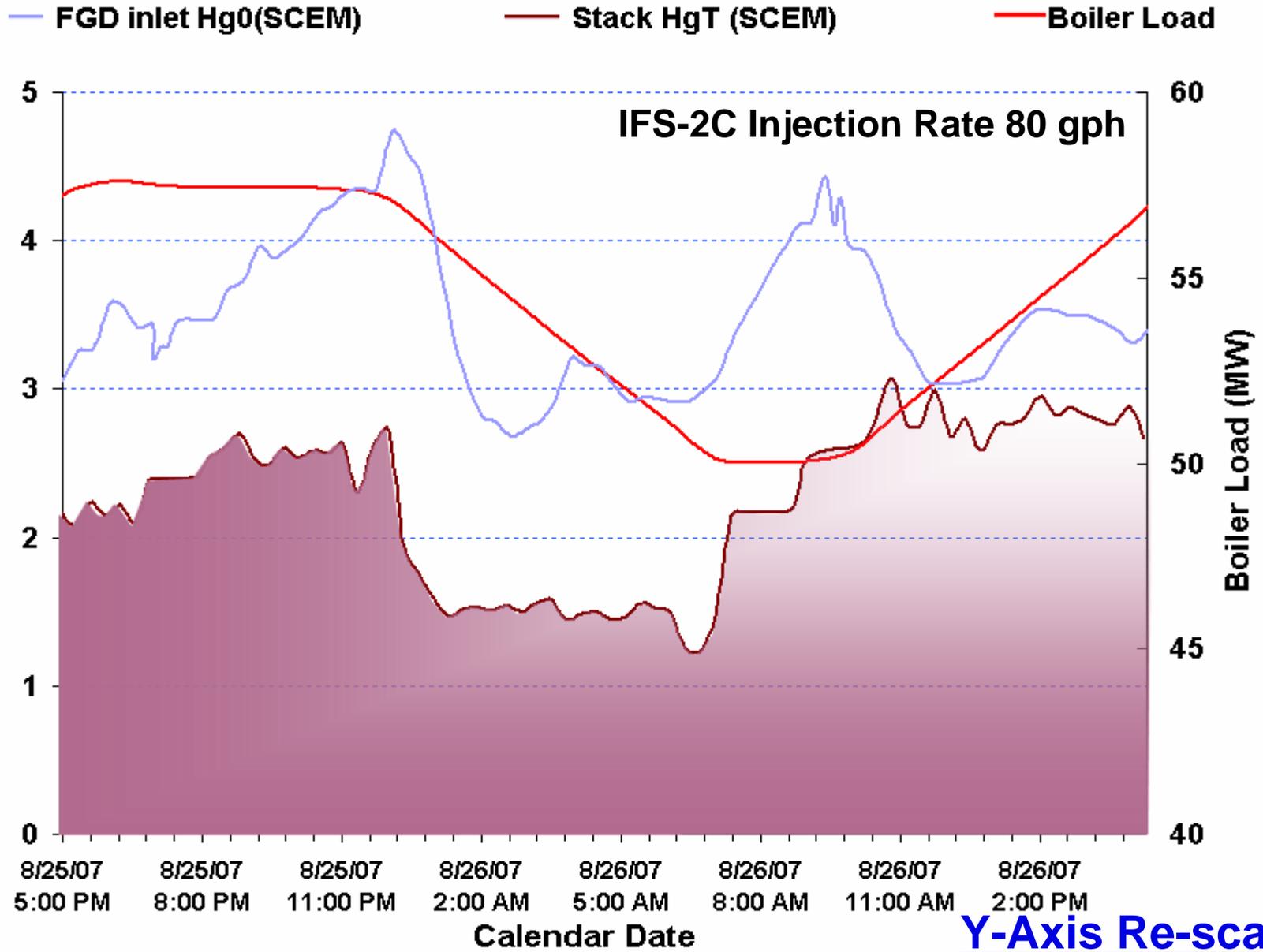


OHM Tests 1- 4

MSCPA Endicott Station WFGD Removal Efficiency



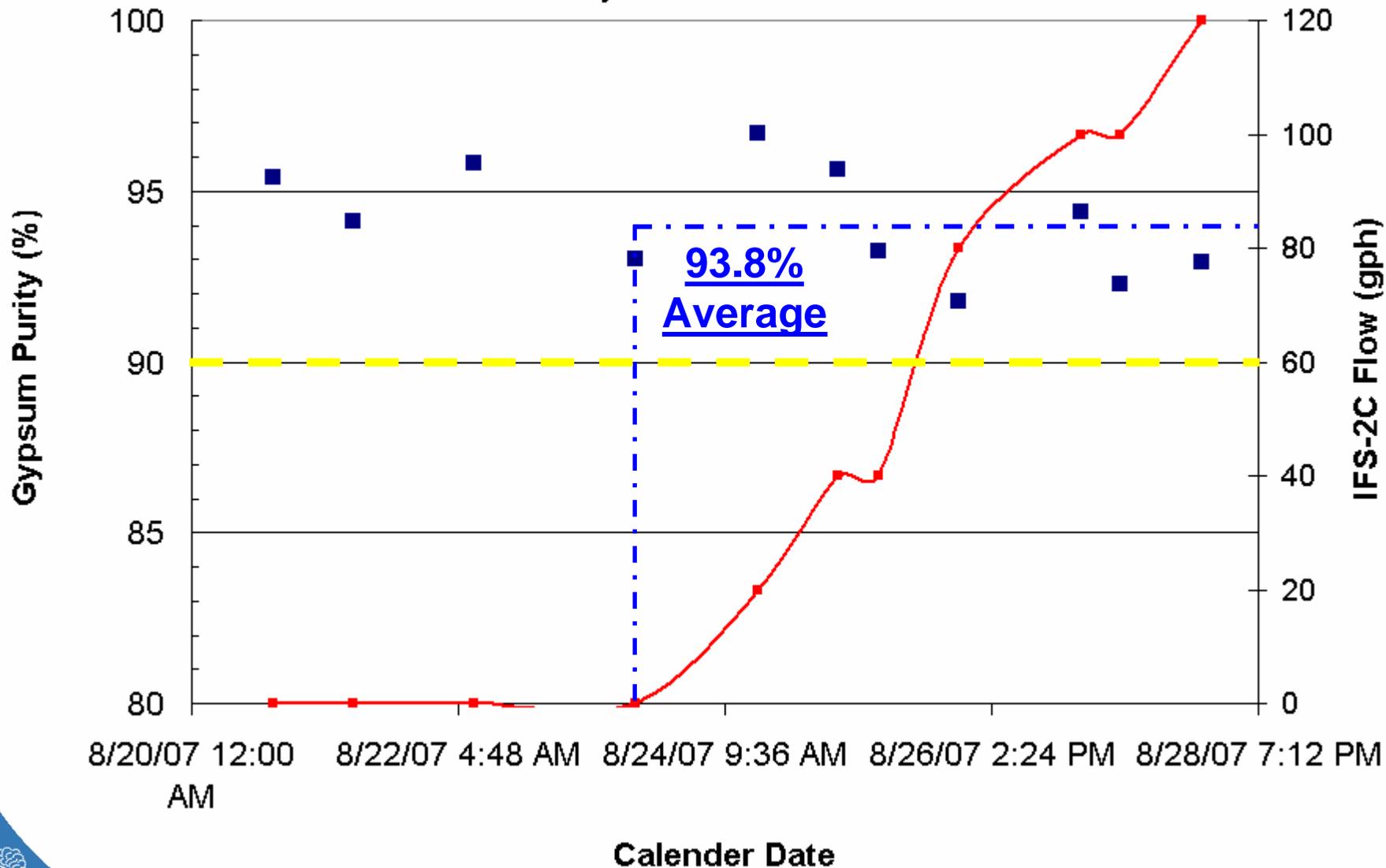
MSCPA Endicott Station WFGD Removal Efficiency



MSCPA Endicott Gypsum Purity

(as sampled from absorber module)

■ Purity — IFS-2C Flow-rate



Conclusions for Solucorp Field Test

Based on SCEMs, Solucorp WFGD Additive:

- At lower flow-rates inhibits Hg re-emission
- At higher flow-rates removes 25-45% of FGD inlet vapor-phase Hg⁰
- Long-term Full-Scale testing warranted for FY 2008
- Preliminary tests show no effect on gypsum purity further testing is needed to substantiate this
- Preliminary tests show no affect on SO₂ removal
- Next test will use dry injection method vs. injecting the additive as a slurry

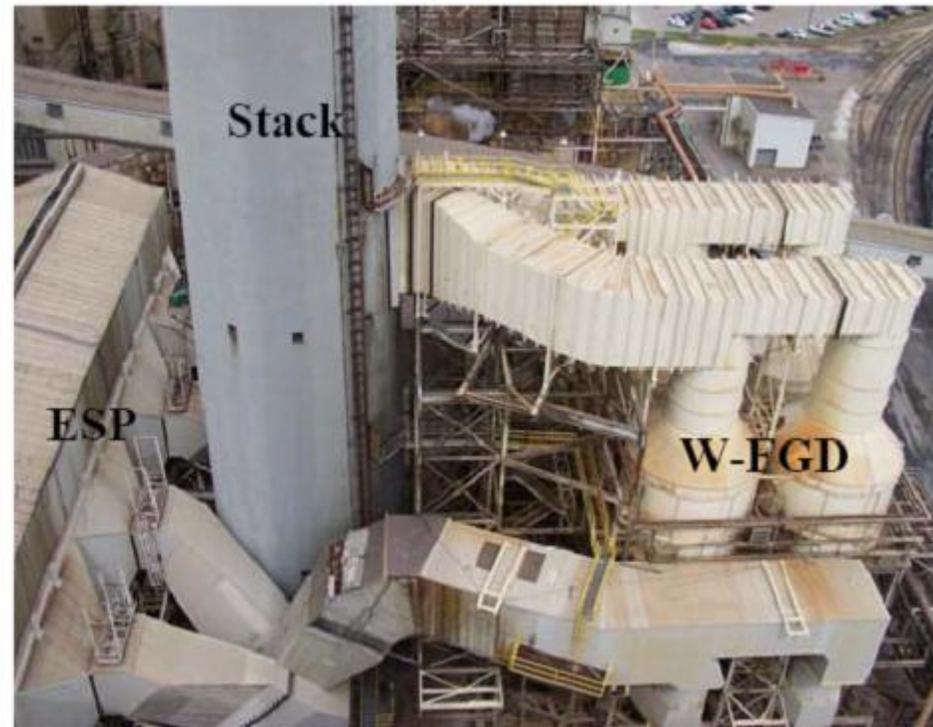
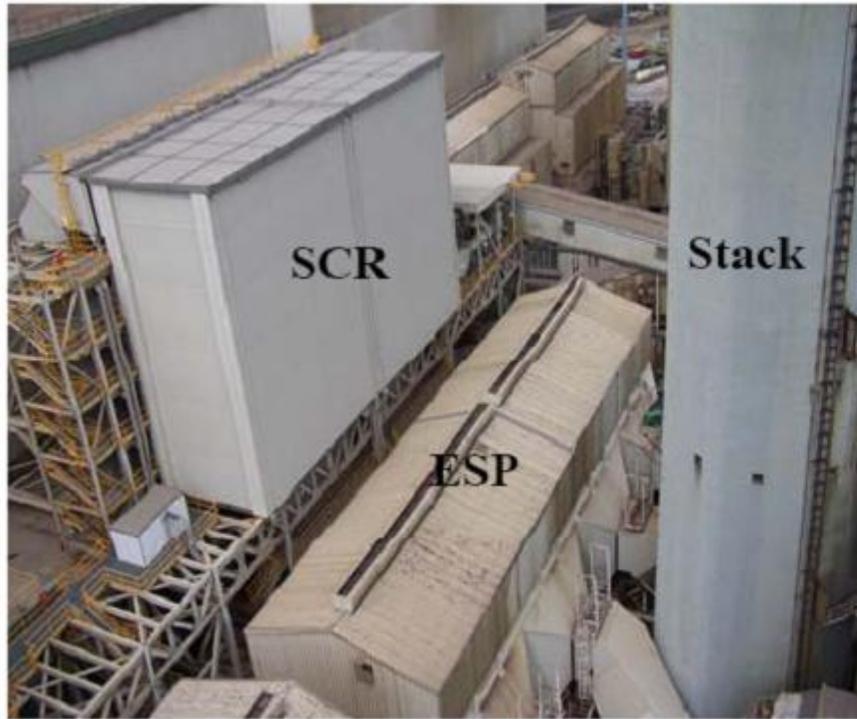


WFGD Full-Scale Testing Presentation Outline

- **B&W Commercial Technologies**
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- **Solucorp WFGD Additive Test Results and Conclusions from MSCPA Endicott Station**
- **B&W WFGD Additive Test Results and Conclusions from E.ON Mill Creek**



E.on America's Mill Creek Unit 4 Louisville, KY



- **DOE/EERC Phase III Mercury Testing**
- **B&W WFGD Additive Absorption Plus(Hg)TM**
- **Burns high sulfur bituminous coal**
- **Air Quality Control System consists of SCR + ESP + WFGD**



WFGD Additive Absorption Plus(Hg)TM



US006503470B1

(12) **United States Patent**
Nolan et al.

(10) **Patent No.:** **US 6,503,470 B1**
(45) **Date of Patent:** **Jan. 7, 2003**

(54) **USE OF SULFIDE-CONTAINING LIQUORS
FOR REMOVING MERCURY FROM FLUE
GASES**

5,834,525 A 11/1998 Fish 521/33
6,214,304 B1 * 4/2001 Rosenthal et al. 423/210

FOREIGN PATENT DOCUMENTS

(75) Inventors: **Paul S. Nolan**, North Canton, OH
(US); **William Downs**, Alliance, OH
(US); **Ralph T. Bailey**, Uniontown, OH
(US); **Stanley J. Vecci**, Alliance, OH
(US)

EP 0709 128 A3 5/1996
JP 57-7232 A * 1/1982 423/210
JP 62-186925 A * 8/1987 423/210

OTHER PUBLICATIONS

(73) Assignees: **The Babcock & Wilcox Company**,
New Orleans, LA (US); **McDermott
Technology, Inc.**, New Orleans, LA
(US)

B. L. Jackson and M. S. Devito, *Major Findings and Results
from Comprehensive Assessment of Emissions from Two
Coal-Fired Power Plants*, U. S. Dept. of Energy, PETC,
Tenth Annual Coal Preparation, Utilization and Environ-
mental Contractor's Conference, Proceedings, vol. 1, Jul.
18-21, 1994, pp. 275-285.

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 0 days.

Steam/its generation and use, 40th Edition, The Babcock &
Wilcox Company ©1992, pp. 35-2 through 35-13.

J. Peterson et al., "Mercury Removal by Wet Limestone
FGD Systems: EPRI HSTC Test Results," 94-RP114B.01,
presented at the 87th Annual Meeting & Exhibition of Air &
Waste Management Association, Cincinnati, Ohio, Jun.
19-24, 1994, pp. 1-16.

(21) Appl. No.: **09/464,806**

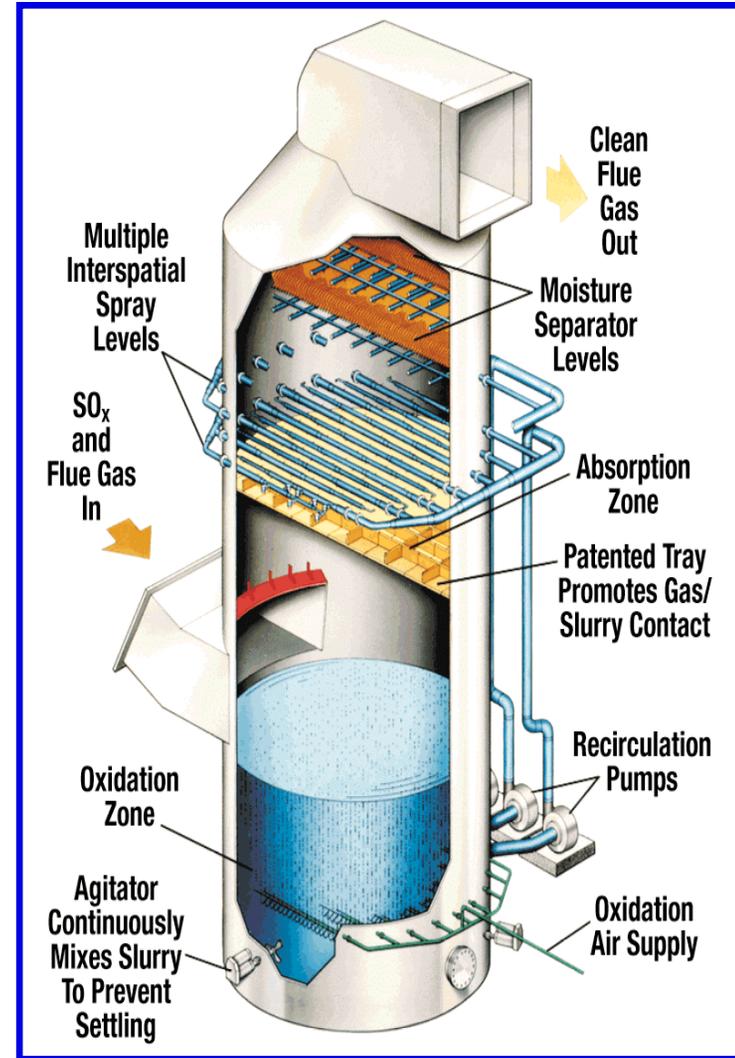
Filed: **Dec. 17, 1999**



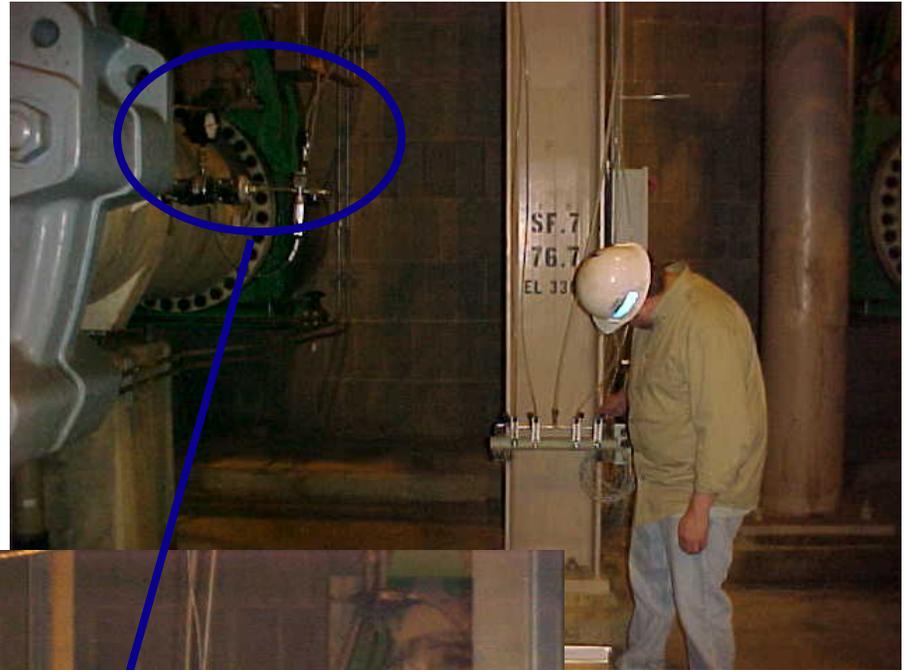
B&W's FGD Enhanced Mercury Removal Method

-Absorption Plus(Hg)TM

- Commercially available from B&W
- Captures primarily oxidized forms of Hg
- Prevents mercury re-emission
- Results in an overall 10-25% increase in total mercury capture
- Readily available and inexpensive



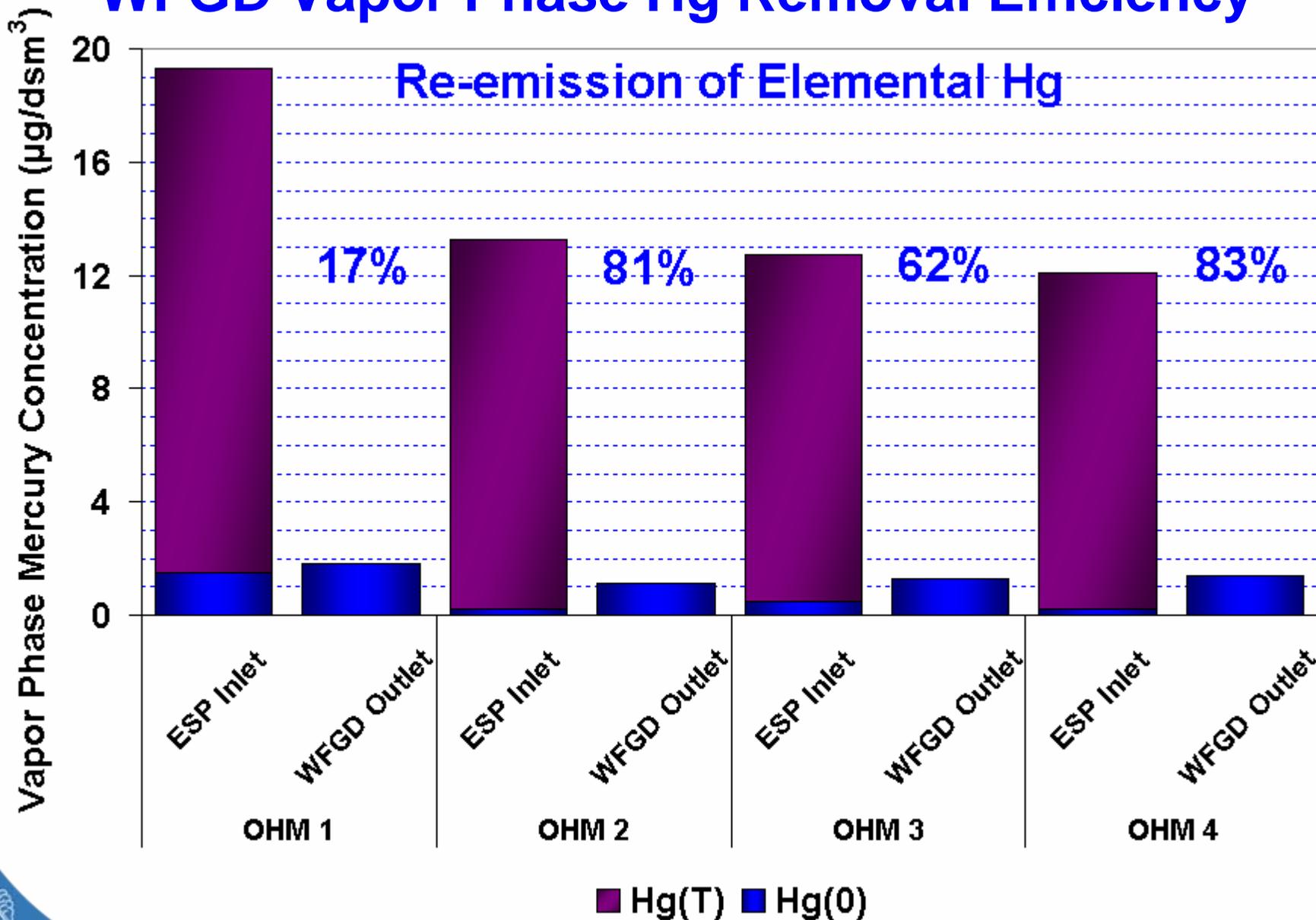
Absorption Plus(Hg)TM Injection System



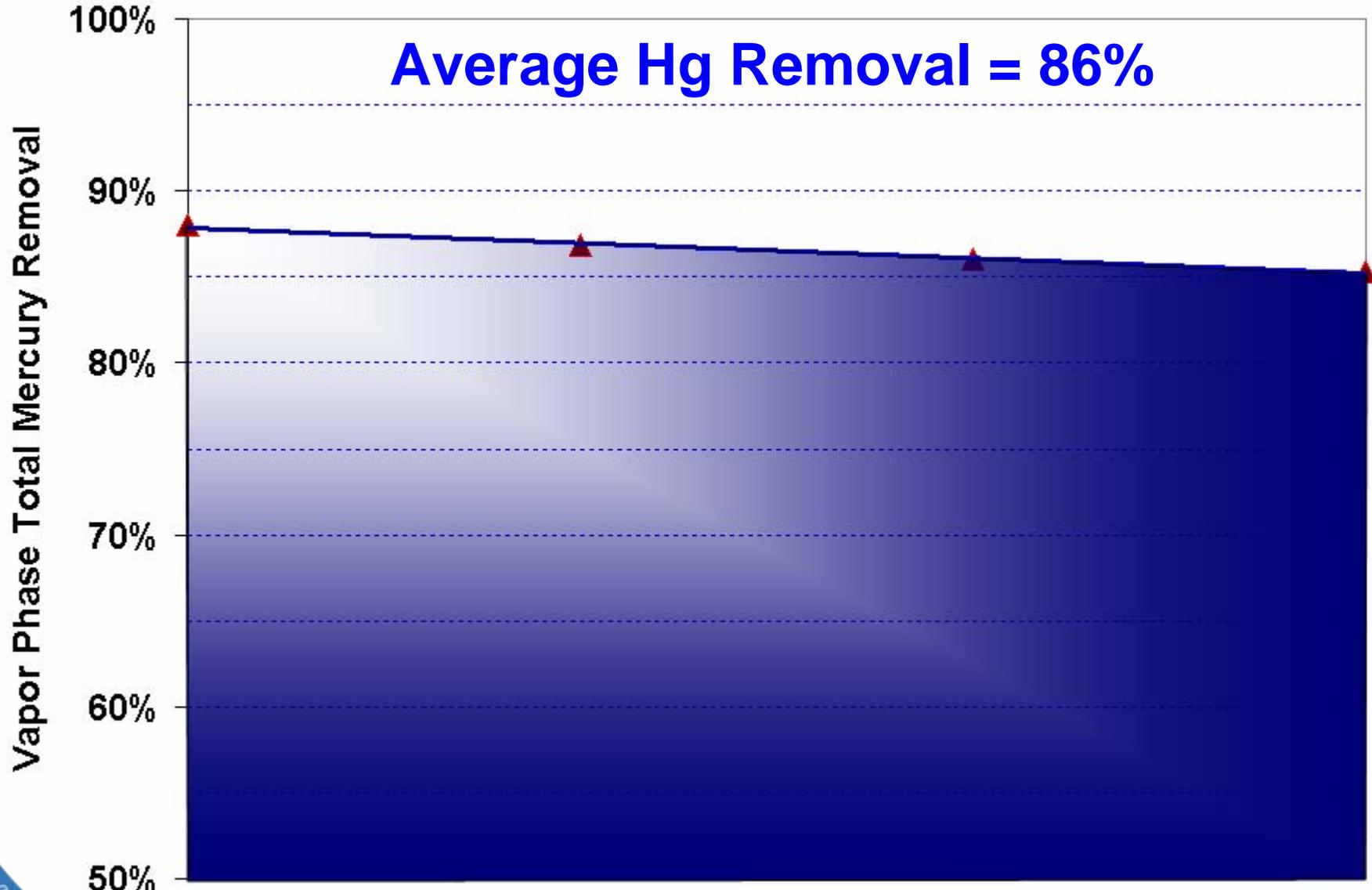
Absorption Plus(Hg)TM Feed



WFGD Vapor Phase Hg Removal Efficiency



Mill Creek WFGD Base-line Vapor Phase Hg Removal

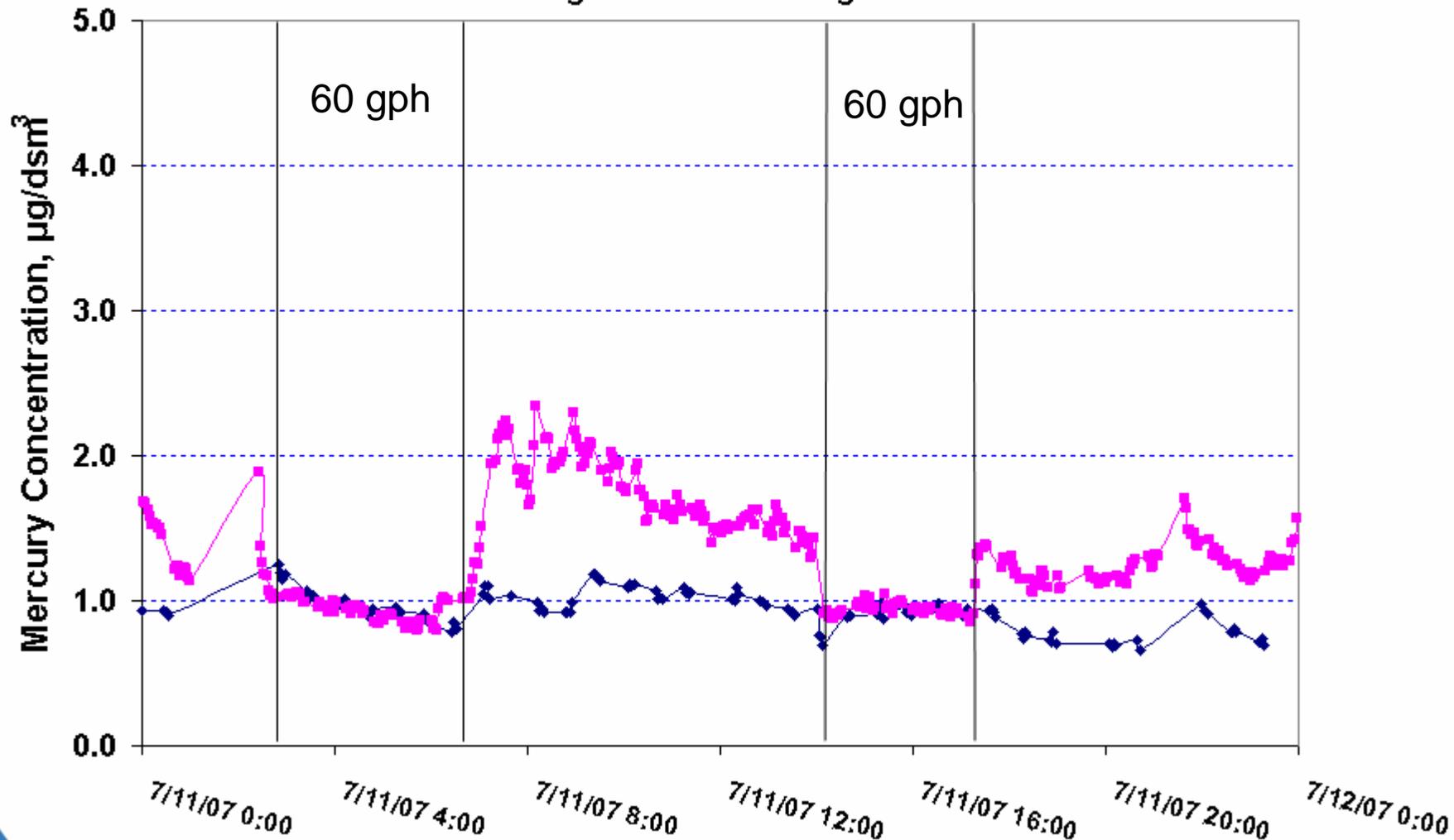


OHM Tests 1 - 4



E.ON Mill Creek WFGD Outlet B&W WFGD Additive (Raw Data, 07/11/07)

—◆— Hg Elemental —■— Hg Total



Conclusions for B&W Absorption Plus(Hg)TM Field Test

- Past Field Tests at Parish, Endicott, Zimmer, Mill Creek
- Inhibits Hg re-emission
- Removes an additional 10-25% Hg
- Tests show NO effect on gypsum purity or SO₂ Removal
- With B&W additive Total Hg removal over 90% @ Mill Creek
- Commercial Injection Units Available from B&W



Acknowledgements

- ***MSCPA Endicott Station, Litchfield, MI***
- ***E.ON Mill Creek Station, Louisville, Kentucky***
- ***Solucorp, Nyack, NY***
- ***EERC, Grand Forks, North Dakota***
- ***WKU, Bowling Green, Kentucky***



THANK YOU !



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