

Evaluation of Gold MerCAP™ Process for Flue Gas Mercury Removal

Air Quality V
Alexandria, Virginia
September 2005



URS



NDIC



Presentation Outline

- **Background**
- **Project Description and Objectives**
- **Host Site 1 (Spray-Dryer Application)**
 - Installation
 - Operation
 - Results
- **Host Site 2 (Wet-Scrubber Application)**
 - Installation
 - Schedule
- **Project Status**
 - Future plans

MerCAP™ Background

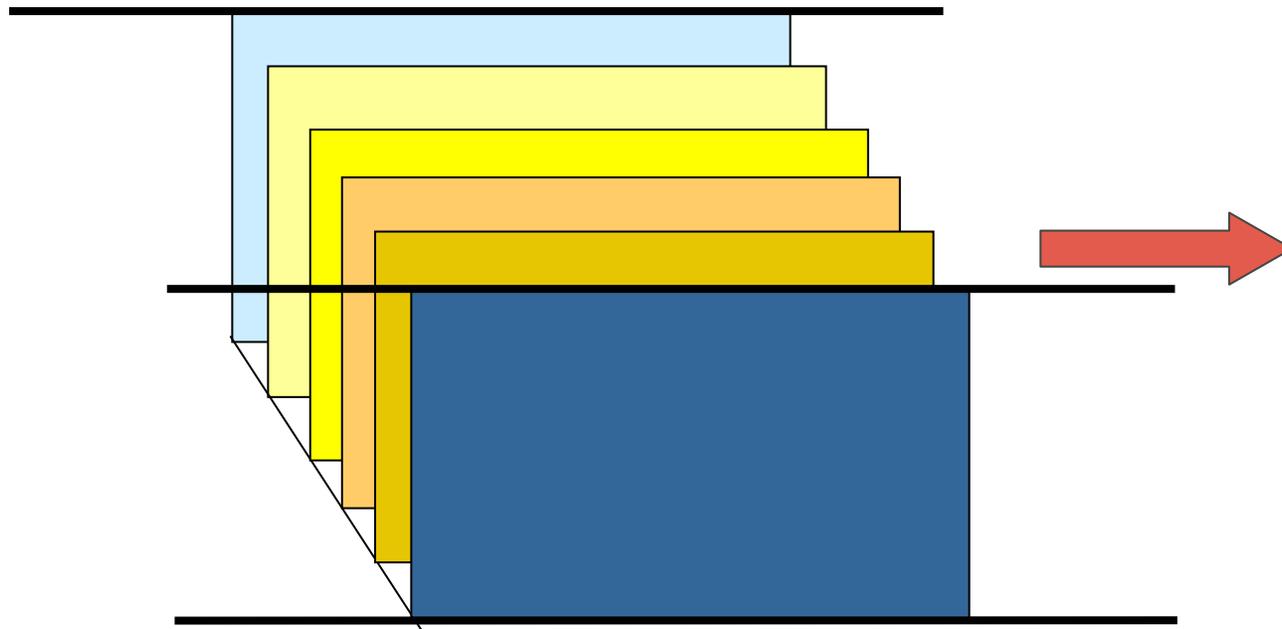
- EPRI Patented Concept
- Fixed Sorbent Structures Used to scrub mercury from gas stream
- Covers a wide range of materials
- Gold coated substrates the most tested and successful



MerCAP™ Background

(Mercury Control via Adsorption Process)

Parallel plates with
sorbent-coated surfaces



EPRI

MerCAP™ Background

Summary of Previous Results

- **Promising Results Downstream of SD-BH**
 - Hg removal demonstrated for extended period in lignite-derived flue gas
 - Regeneration appears feasible (laboratory tests)
- **High Removal Downstream of Wet FGD Absorber**
 - Demonstrated during short-term tests in scrubbed bituminous flue gas
- **Lower Removal in Unscrubbed Gases**

DOE/NETL Financial Assistance Programs

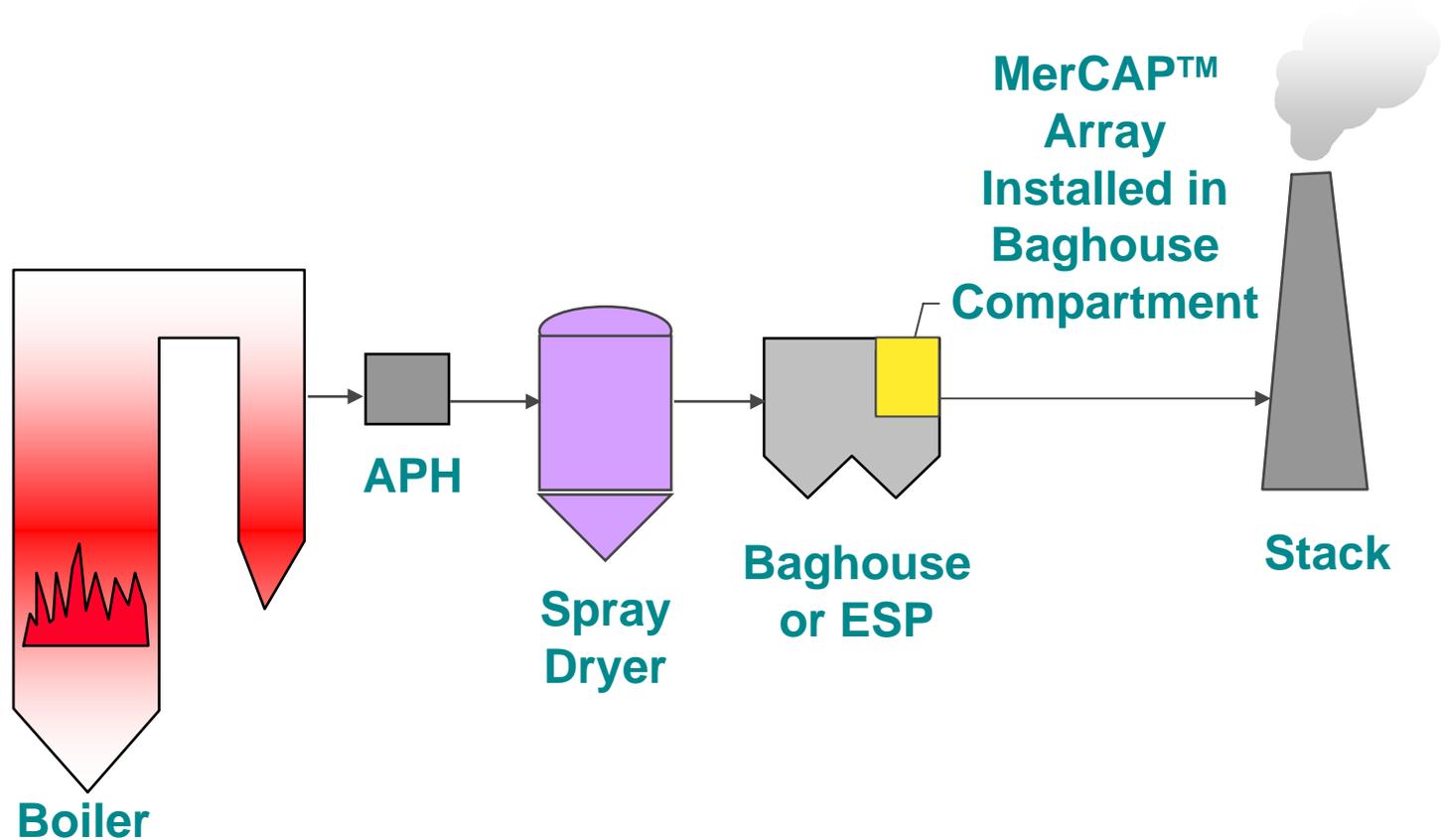
- **Evaluation of MerCAP™ Technology**
 - **DE-FC26-03NT41993**
 - Polishing technology - downstream of dry or wet scrubber
 - Six-month flue gas exposure tests
- **Total Program Cost - \$1.73 MM**

MerCAP™ Project Objectives

Evaluate gold MerCAP™ performance in flue gas derived from ND lignite and bituminous coal

- **Great River Energy Stanton Station**
 - Installed in single compartment of full-scale baghouse
 - 6 MW equivalent (20,000 acfm)
- **Georgia Power Plant Yates**
 - Installed downstream of pilot wet scrubber
 - 1 MW equivalent

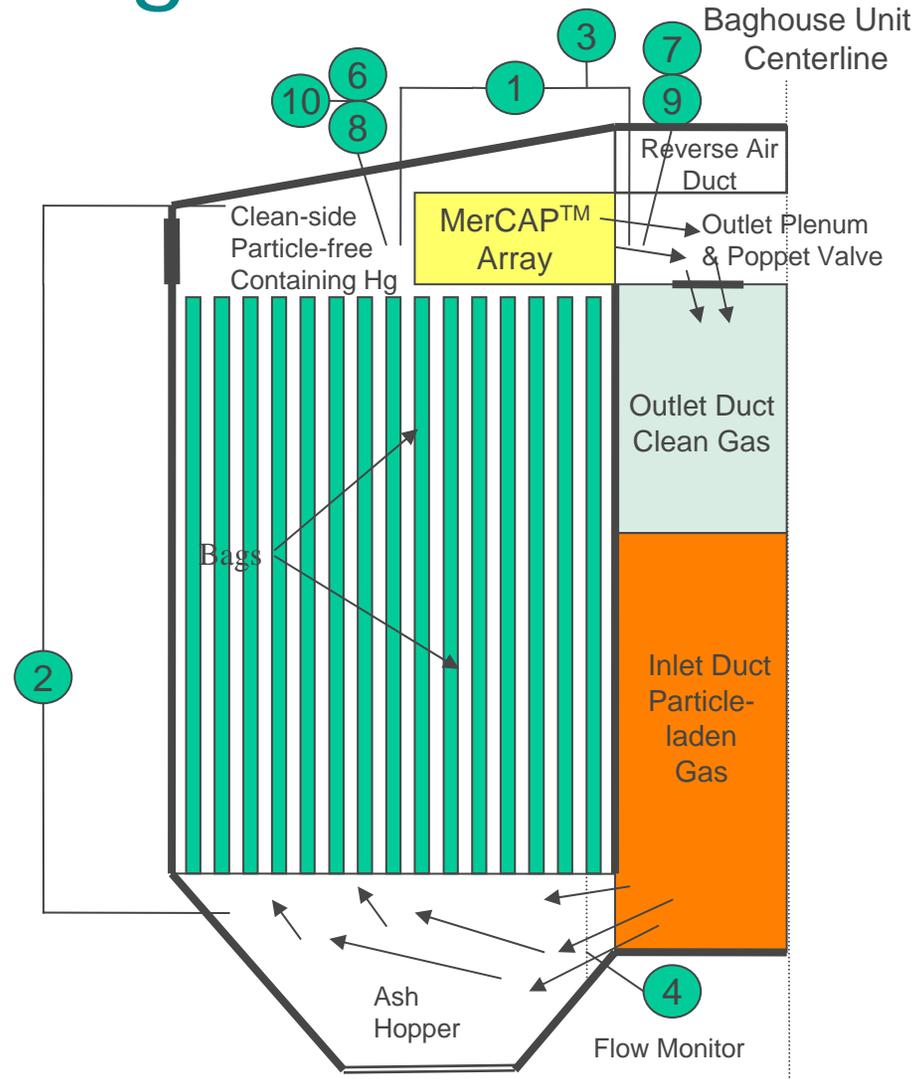
MerCAP™ Installation - Stanton Unit 10 Baghouse Outlet



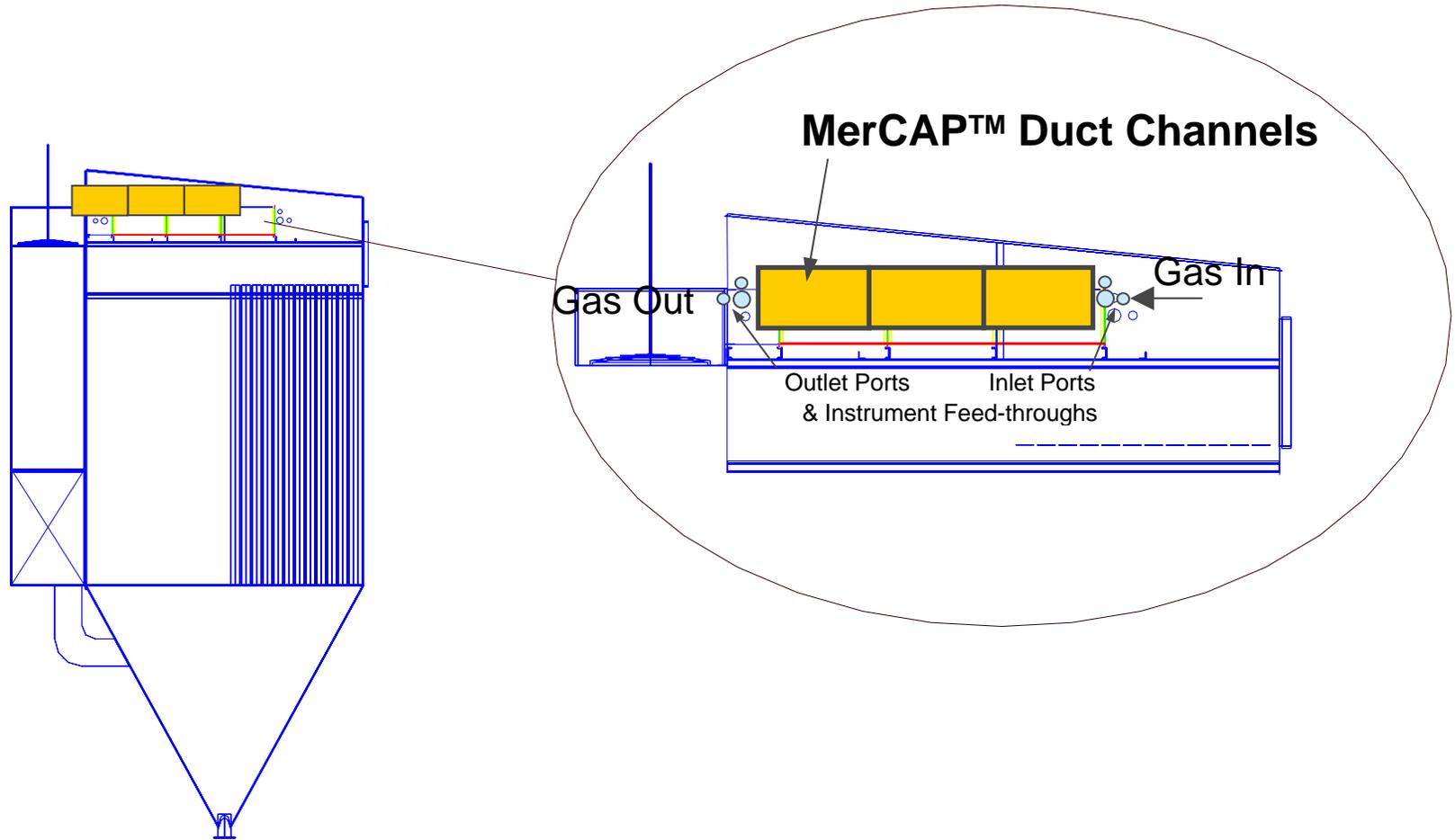
MerCAP™ Installation - Stanton Unit 10 Baghouse Outlet

Measurements and Sampling Locations

1. MerCAP™ Array dP
2. Compartment dP
3. Compartment Static Pressure
4. Compartment Flow
5. Adjacent Compartment dP
(not shown)
6. MerCAP™ Inlet Temperature
7. MerCAP™ Outlet Temperature
8. Inlet MerCAP™ Hg
Concentration
9. Outlet MerCAP™ Hg
Concentration
10. HCl Measurement Location



Baghouse Cross-Section



MerCAP™ Design Parameters

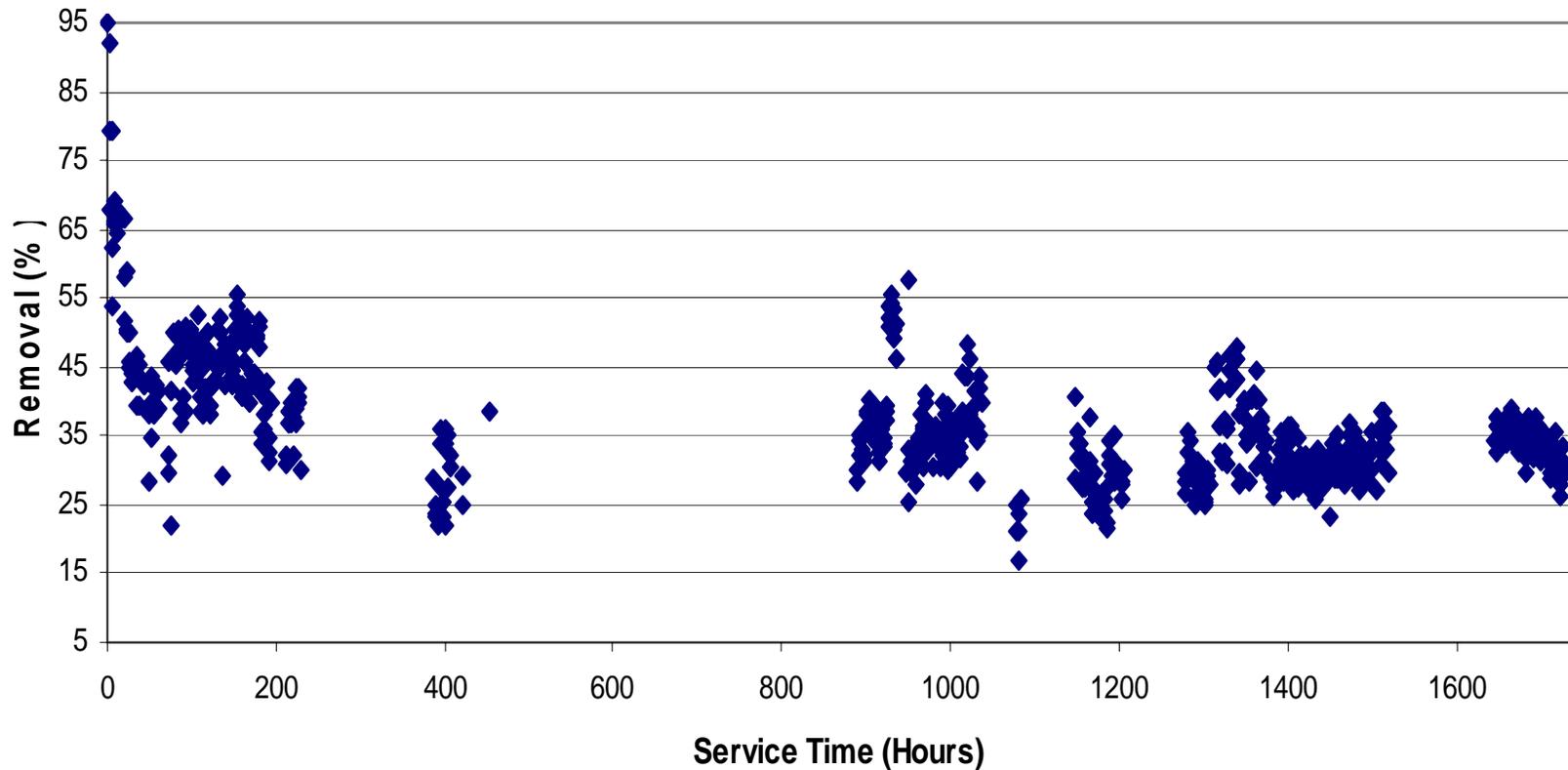
- **Target Mercury Removal Rate of 55%**
- **10-foot Active Length**
- **1-inch Spacing Between Substrates**
- **25-feet per Second Gas Face Velocity**
- **Expected Pressure Drop of 0.3 inches H₂O**

MerCAP™ Installation - Stanton

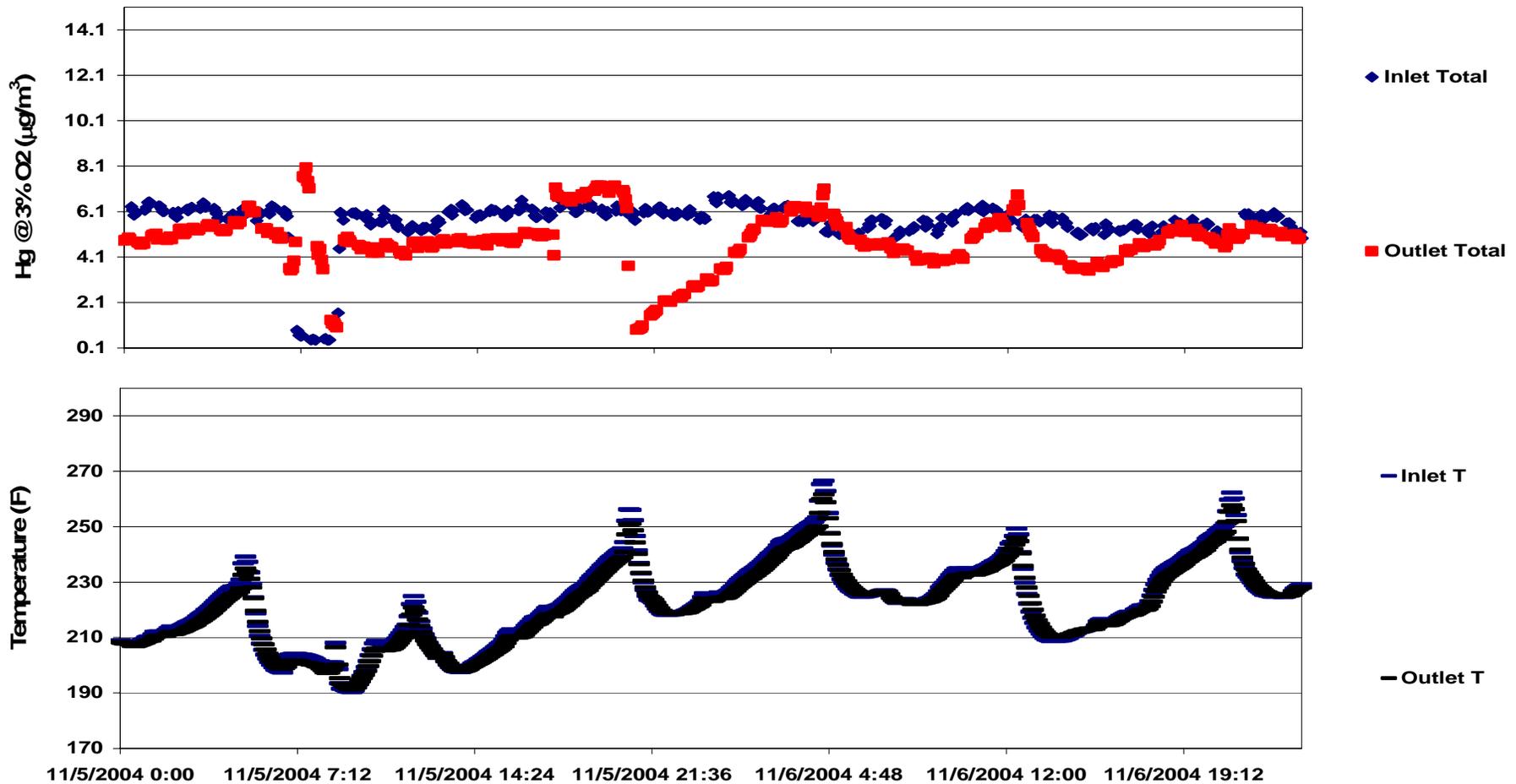
Duct 1 of 4



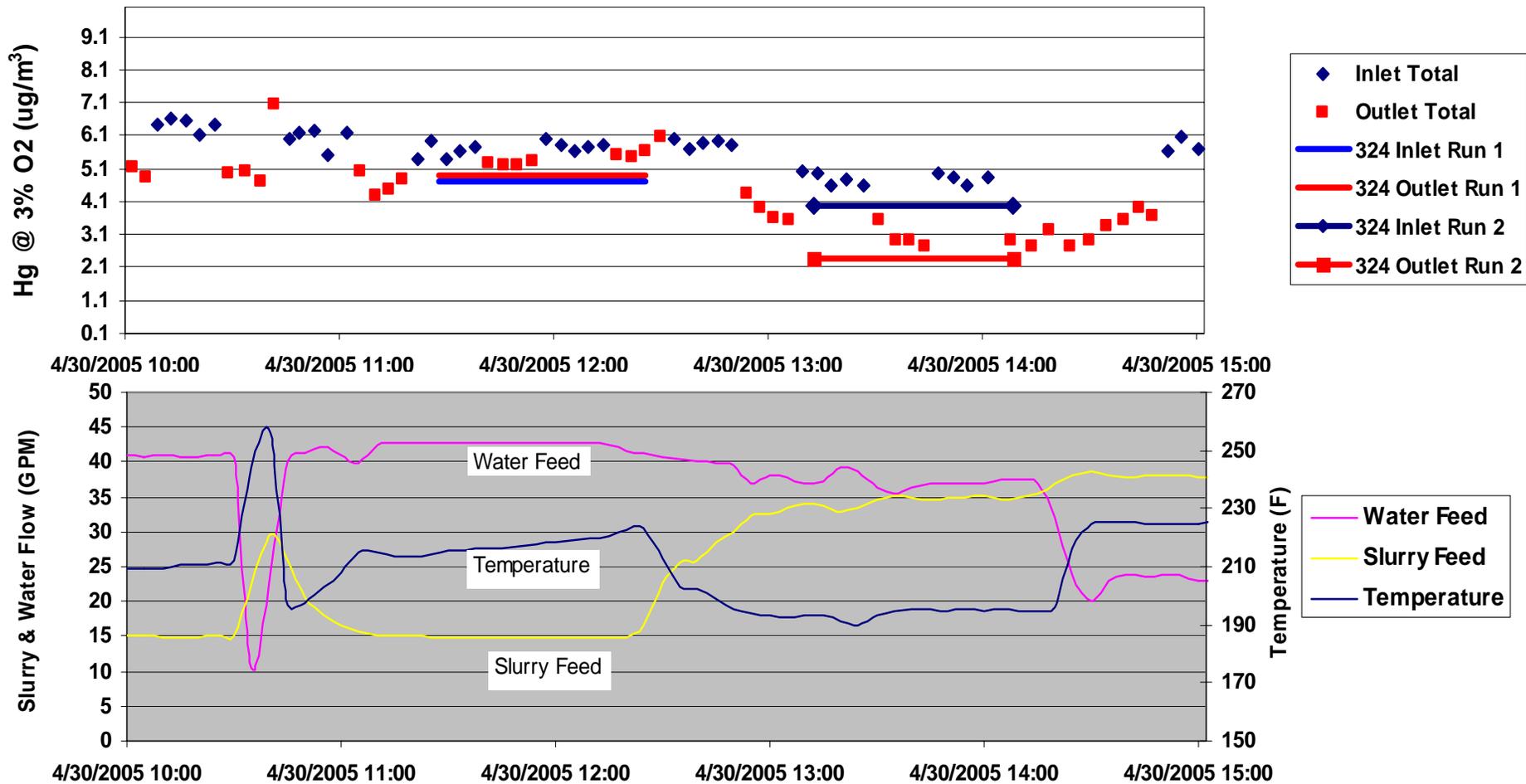
Results Full-Scale Compartment Demonstration North Dakota Lignite



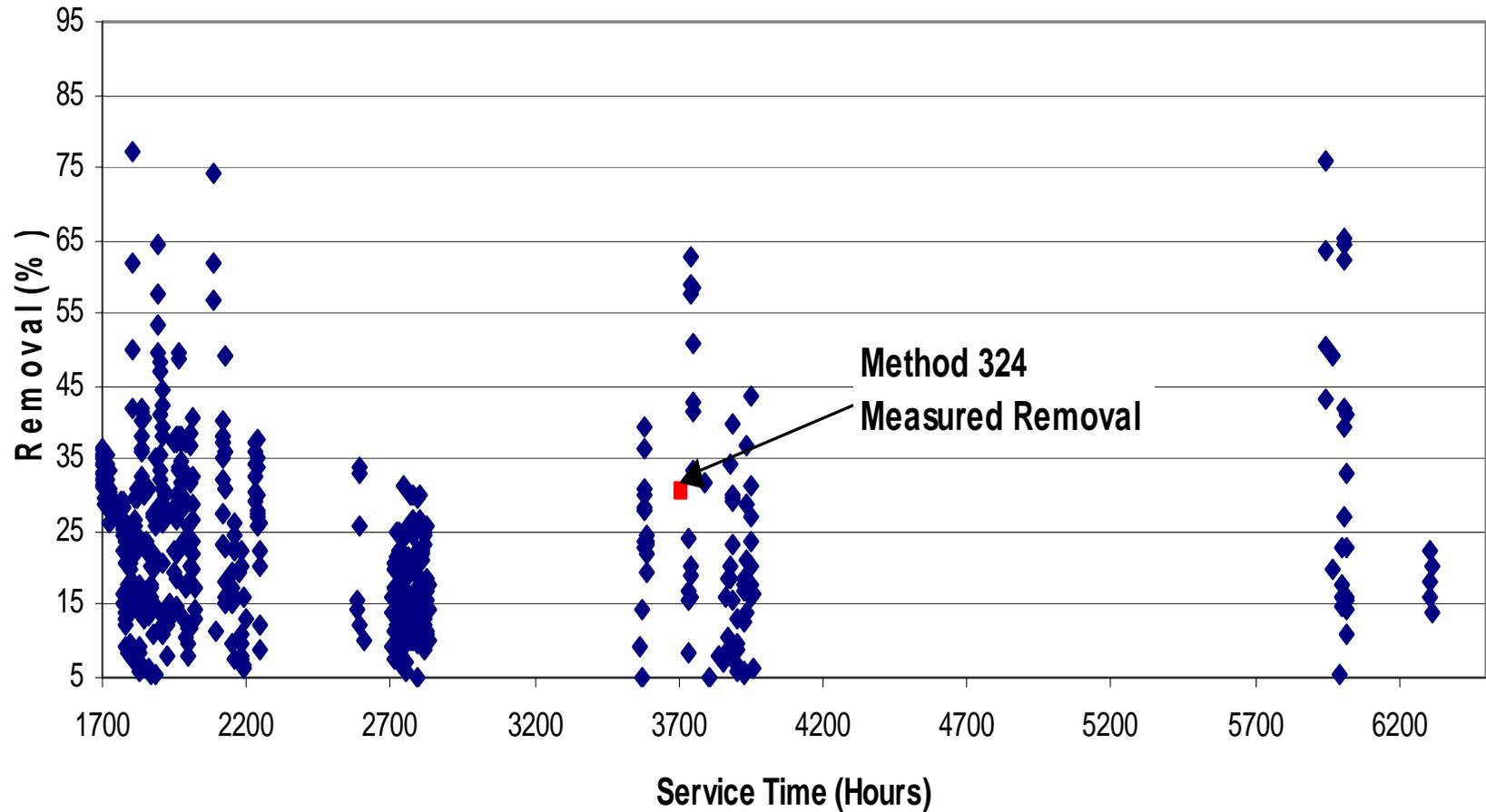
Results Full-Scale Compartment Demonstration PRB Subbituminous



Results Full-Scale Compartment Demonstration PRB Subbituminous



Results Full-Scale Compartment Demonstration PRB Subbituminous



Measurement Comparisons

CEM and Method 324

Run Date	Mercury CEM ($\mu\text{g}/\text{nm}^3$)			Method 324 ($\mu\text{g}/\text{nm}^3$)		
	Inlet Total	Outlet Total	Removal (%)	Inlet Total	Outlet Total	Removal (%)
1/25/05	4.29	3.35	22.0	4.56	3.48	23.7
4/30/05 #1	5.73	5.38	6.0	4.71	4.92	-4.6
4/30/05 #2	4.77	3.02	36.7	3.96	2.40	39.4

4/30/05 #1 was conducted during minimal spray dryer SO₂ scrubbing conditions

4/30/05 #2 was conducted during optimal spray dryer SO₂ scrubbing conditions

Measurement Comparisons

CEM and OH Method

Mercury CEM ($\mu\text{g}/\text{nm}^3$)			Ontario Hydro Method ($\mu\text{g}/\text{nm}^3$)		
Inlet Total	Outlet Total	Removal (%)	Inlet Total	Outlet Total	Removal (%)
8.24 (.71)	6.68 (.16)	18.9	8.38 (.61)	7.73 (.57)	7.8

Value in parenthesis is (Standard Deviation)

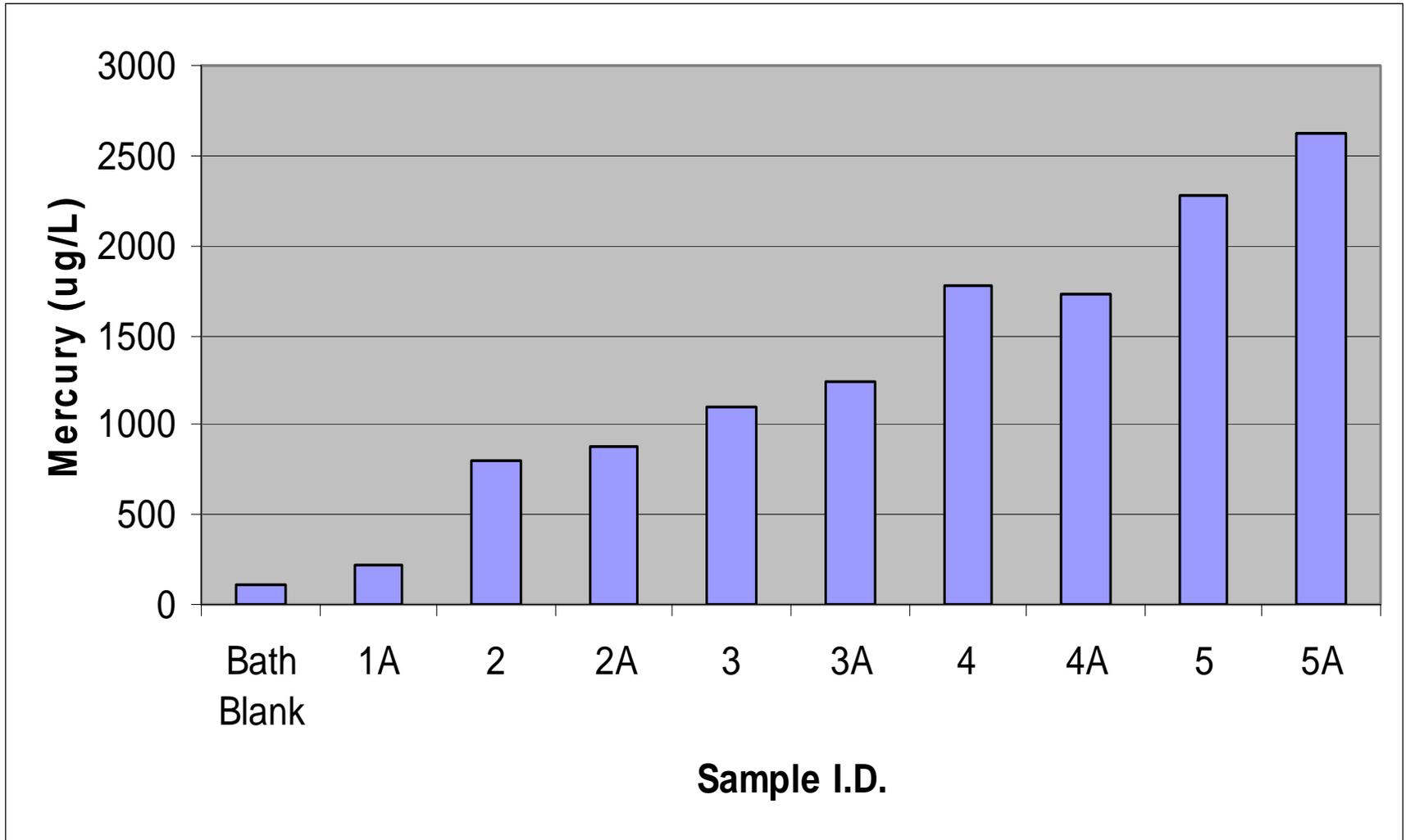
Regeneration Results

- **Thermal regeneration (4 cycles) conducted on same gold substrate section.**
- **Post regeneration mercury removal performance has been comparable or better than that measured prior to regeneration.**
- **Ten gold substrate modules installed in the full-scale test compartment were subjected to chemical regeneration (acid bath) and demonstrated improved performance when returned to service.**
- **Analysis of acid bath showed minimal loss of gold coating demonstrating this as an alternative regeneration technique.**

Regeneration Results

Cycle #	Date of Regen	Hg Removal Before Regen (%)	Mass of Hg Desorbed (mg)	Hg Removal After Regen (%)	Regeneration Method
1	07/26/04	0 - 5	Not Measured	Initially >90, Then 35 - 45	Chemical
2	2/1/05	10 – 15	4.9	15 – 20	Thermal
3	2/2/05	15 - 20	11.4	30 – 35	Thermal
4	2/3/05	30 – 35	0.4	35 – 40	Thermal
5	4/29/05	Not Measured	4.5	Not Measured	Thermal

Regeneration Results



MerCAP™ Status

Full-scale SD-BH Demonstration Complete

- Over 7000 Hours of Operation
 - 1700 Hours on North Dakota Lignite
 - 5300 Hours on Subbituminous (PRB)
- Removal levels ranging from 65%-5%
- Removal performance demonstrated wide variability. The primary identified variables are slurry feed to the scrubber unit indicating a possible acid gas constituent or concentration level that limits or degrades the Hg capture performance and operating temperature.
- Non-ideal operating conditions do not cause permanent degradation of the gold substrate.

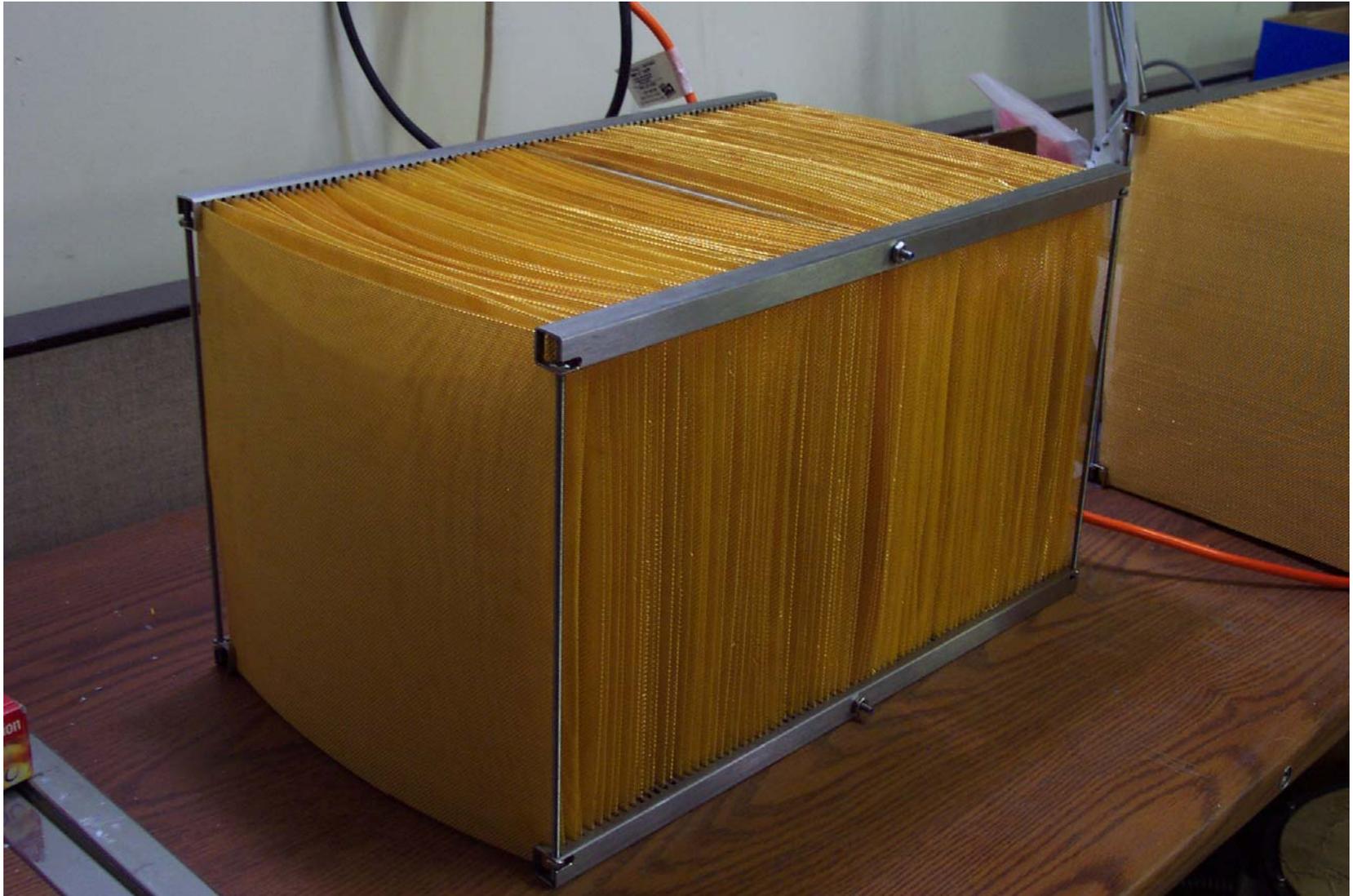
MerCAP™ Installation-Plant Yates Southern Company Pilot Unit



MerCAP™ Test Setup for Wet Scrubbers



MerCAP™ Screen Module



Plant Yates Proposed Schedule

- **Installation in November 2005**
- **Initial Startup in November/December 2005**
- **Planned Operation for 6 Months**
 - Plant outage scheduled for Oct. 1 – Nov. 20
 - Unit will be isolated during outage and restarted in November

MerCAP™ Status

Wet Scrubber Demonstration

- Installation November 2005
- Demonstration thru Winter 2005 Spring 2006

Mercury Control by MerCAP™

- **Information Needed to Further Determine MerCAP™ Applicability**
 - Better identify / establish relationship of interferents
 - Investigate alternative amalgamation coatings
 - Improve overall removal efficiencies (>70%)
- **Economic Analysis**
 - Full-scale regeneration costs (thermal/chemical)
 - Optimize geometry for retrofits
 - Gold integrity - Substrate life

Acknowledgements

- Great River Energy – Mark Strohfus, Steve Smokey, Stanton Station
- Southern Company/Alabama Power – People Needed Here
- EPRI – Ramsay Chang
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- NDIC