

Evaluation of Gold MerCAP™ Process for Flue Gas Mercury Removal

Program Kickoff Meeting
December 10, 2003



URS



NDIC



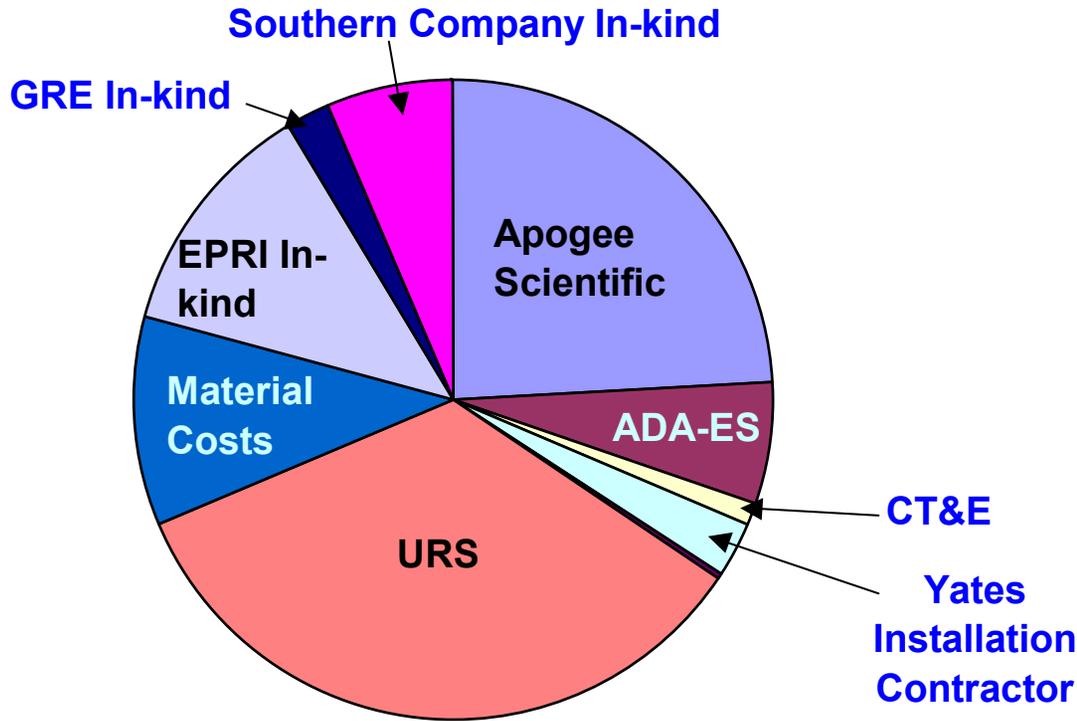
NETL Financial Assistance Programs

- **Field Evaluation of MerCAP™ Technology**
 - **DE-FC26-03NT41993**
 - Pilot-scale testing
 - Polishing technology - downstream of dry or wet scrubber
 - Six-month flue gas exposure tests
- **Total Program Cost - \$1.73 MM**
 - Project Execution - \$1.35 MM
 - NETL Funding - \$1.11 MM
 - Total Cost Share - \$613K (35%)

MerCAP™ Evaluation Program Project Team

- **NETL (COR - Bill Aljoe)**
- **EPRI**
- **Southern Company**
- **Georgia Power (host site)**
- **Great River Energy (host site)**
- **North Dakota Industrial Commission**
- **Apogee Scientific Inc.**
- **ADA-Environmental Solutions LLC**
- **URS Corporation (prime contractor)**

MerCAP Evaluation Program Costs



Cost Distribution

Cash Contribution

NETL: \$1,113,262

Cost-Share: \$250,000

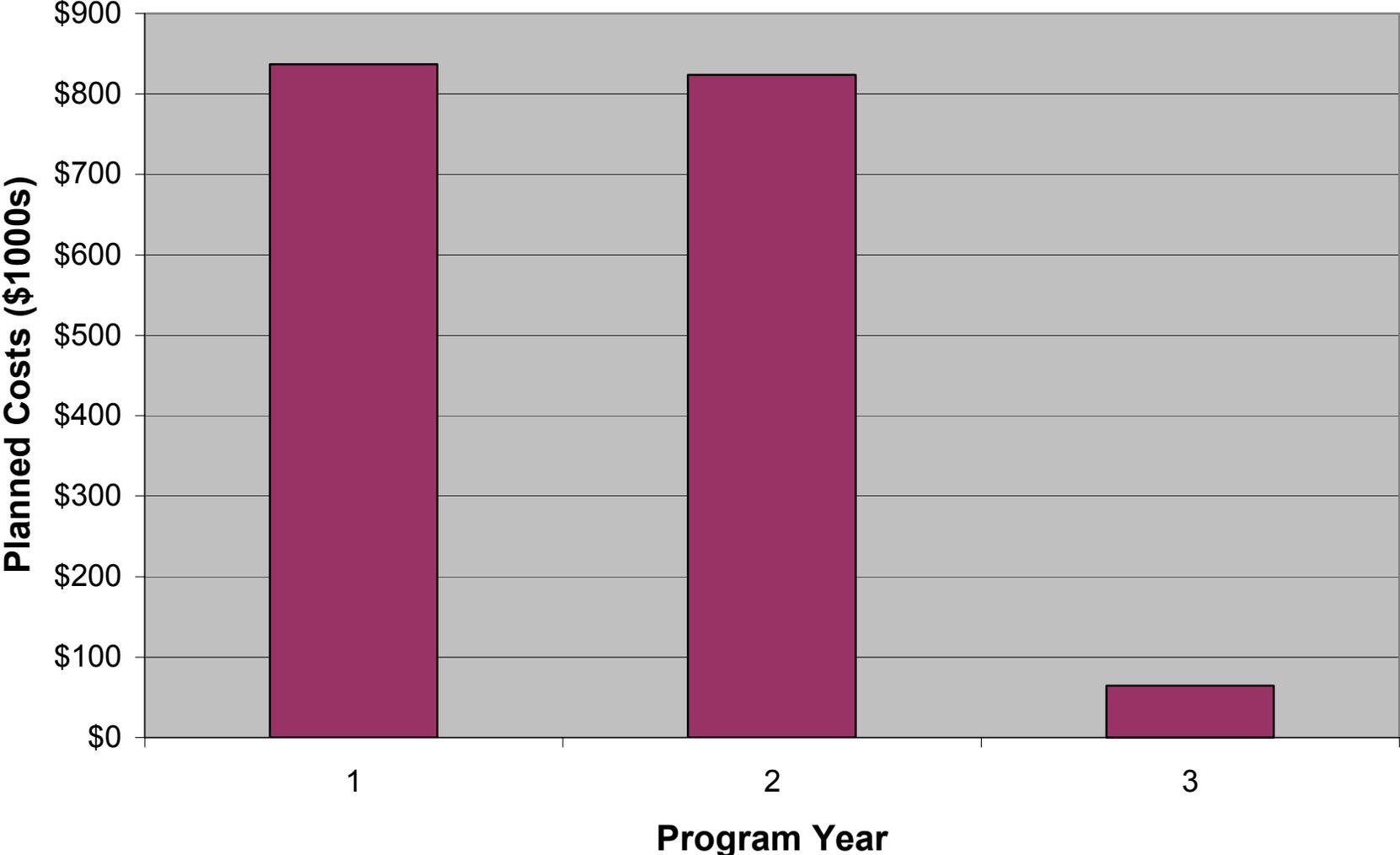
EPRI

NDIC

GRE

Southern Company

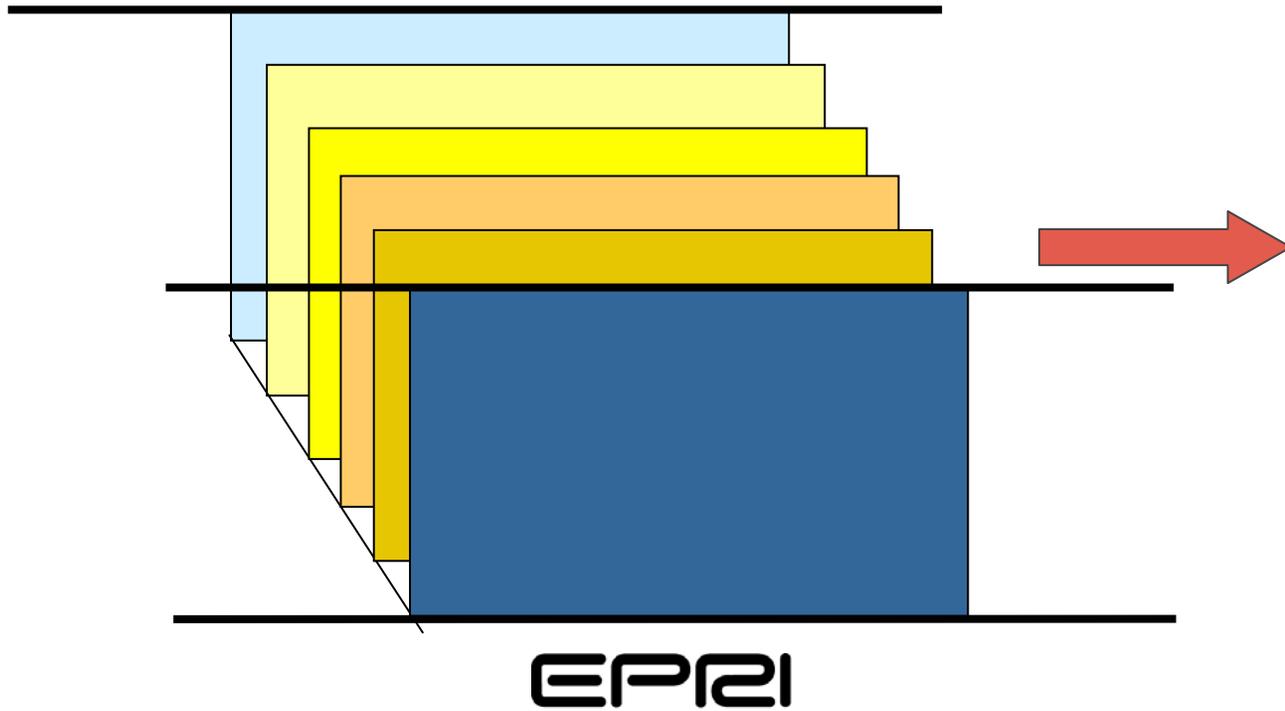
MerCAP™ Evaluation Program Project Spending



MerCAP™ Basic Concept

(Mercury Control via Adsorption Process)

Parallel Plates with
Sorbent-Coated Surfaces



MerCAP™ Basic Concept

(Mercury Control via Adsorption Process)

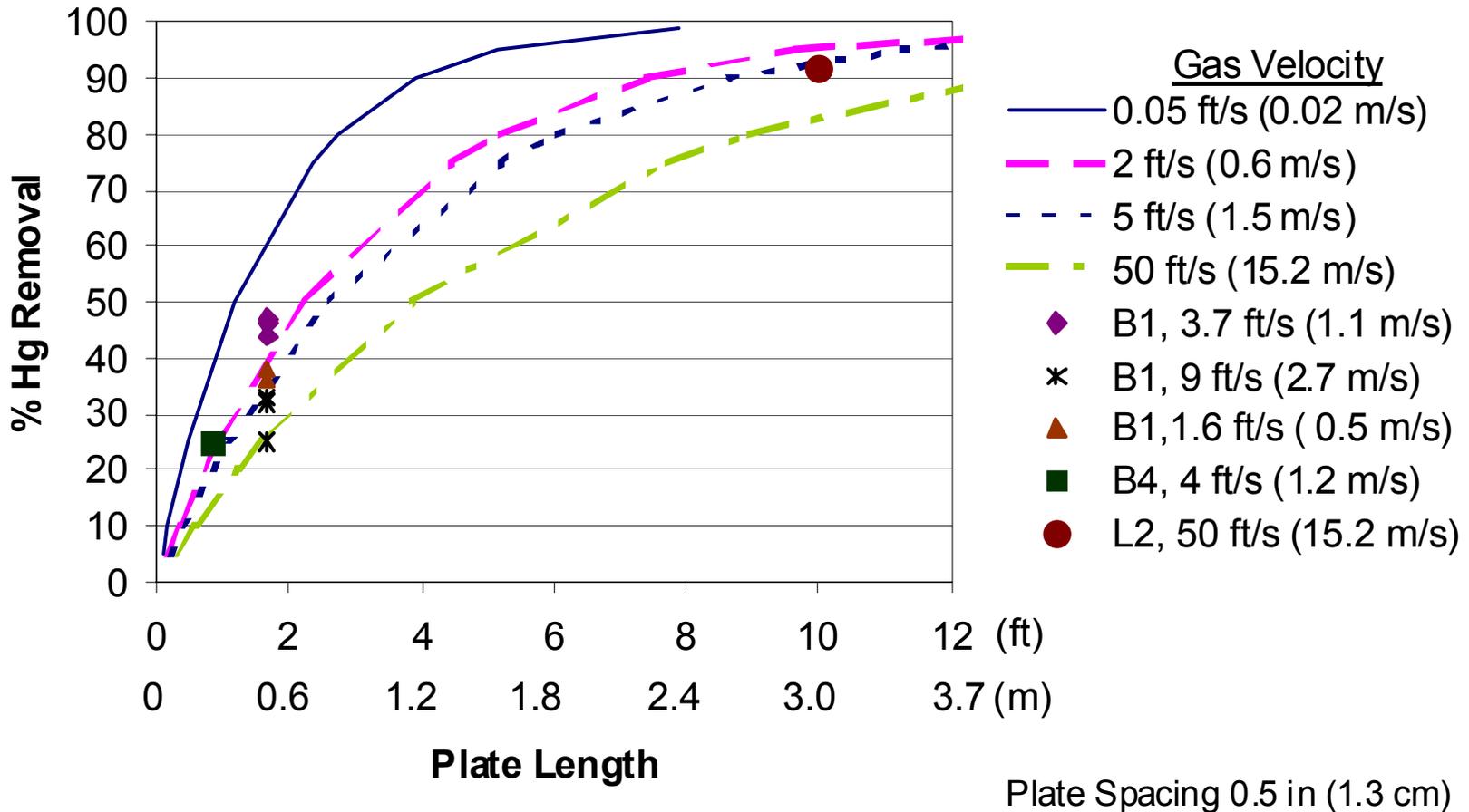
- Process developed by EPRI
- Tests performed over past several years:
 - Slipstream testing (in situ, ex situ tests)
 - Parametric testing
 - Flue gas composition
 - Flue gas flow rate
 - Flue gas exposure time
 - Temperature
 - Effect of substrate type
 - Regeneration testing
 - Best results so far obtained with gold sorbent



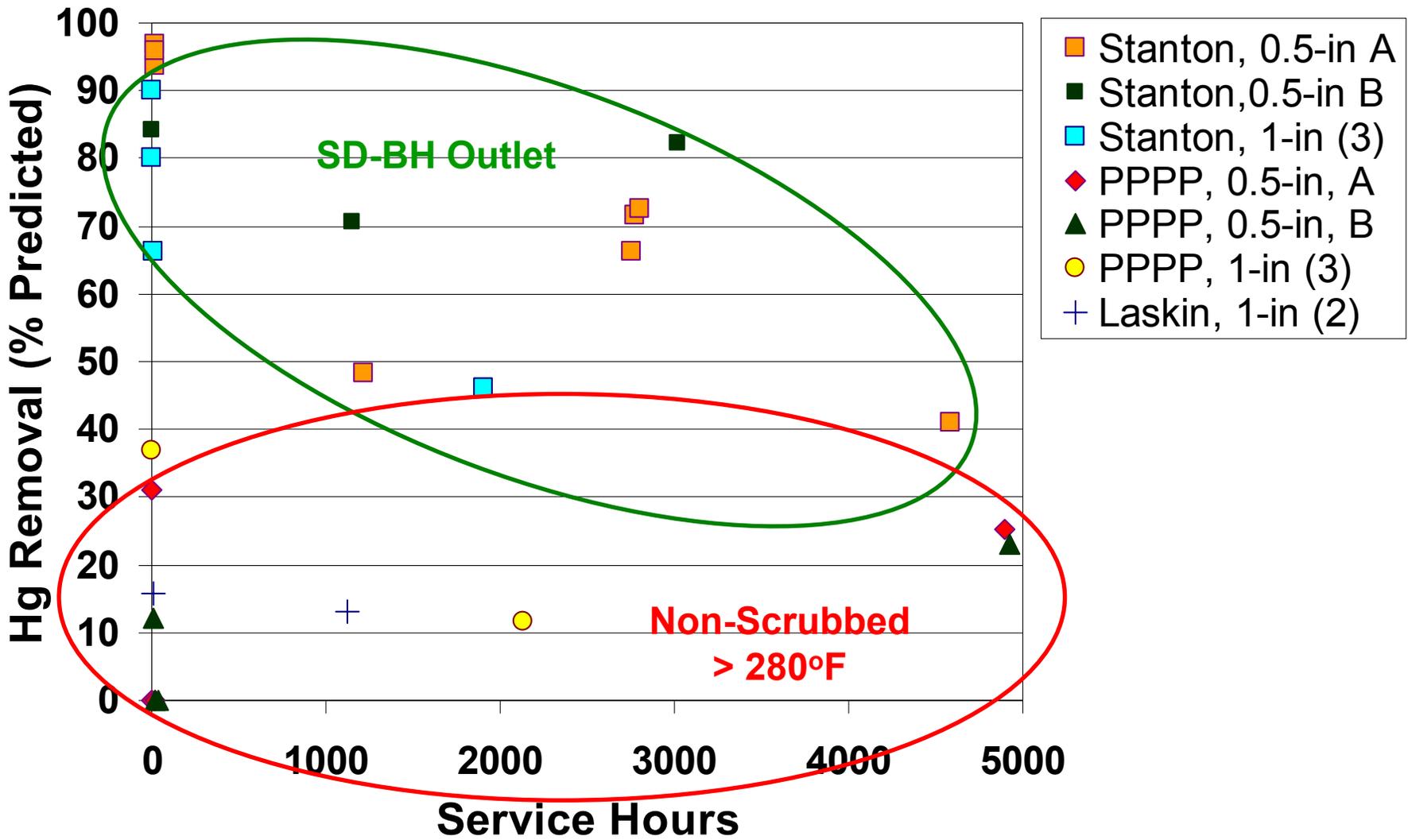
Examples of Gold MerCAP™ Structures



MerCAP™ Hg Adsorption

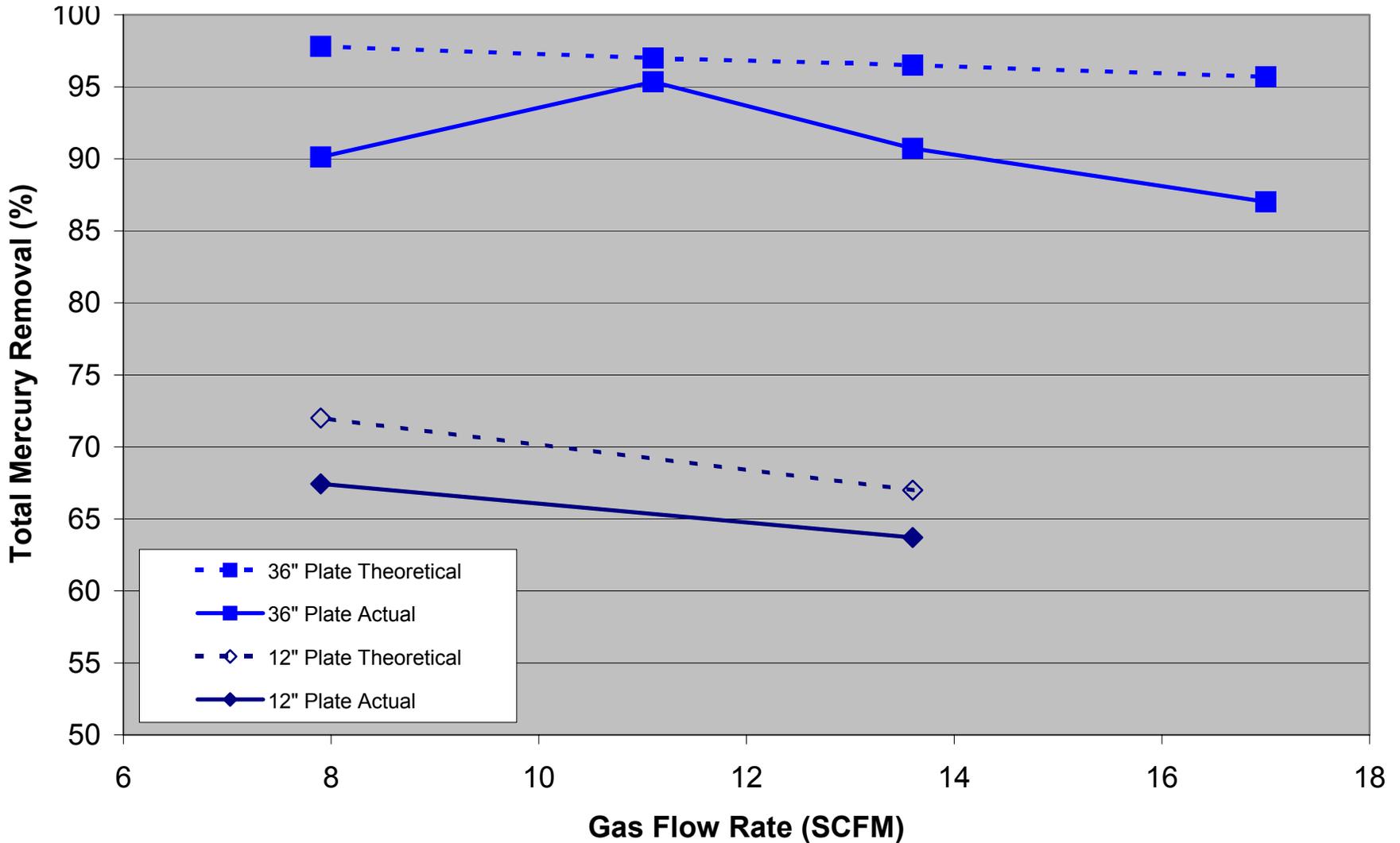


Longevity: Gold Sorbent



Hg Removal by MerCAP™ Configured at FGD Outlet

Plant Yates Unit 1 - March 2003



Mercury Control by MerCAP™

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
 - Flue gas obtained downstream of mist eliminator
- Lower removal in unscrubbed gases
 - higher flue gas temperatures than scrubbed gas

Mercury Control by MerCAP™

- **Information needed to determine MerCAP™ process feasibility**
 - **Demonstrate consistent, long-term performance**
 - **Evaluate how regeneration process affects MerCAP™ performance**
 - **Evaluate how flue gas exposure affects gold surface**
 - **Detailed cost analysis**

Mercury Control by 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 MWe equivalent
- **Georgia Power Plant Yates**
 - installed downstream of pilot scrubber
 - 1 MWe equivalent

Mercury Control by MerCAP™

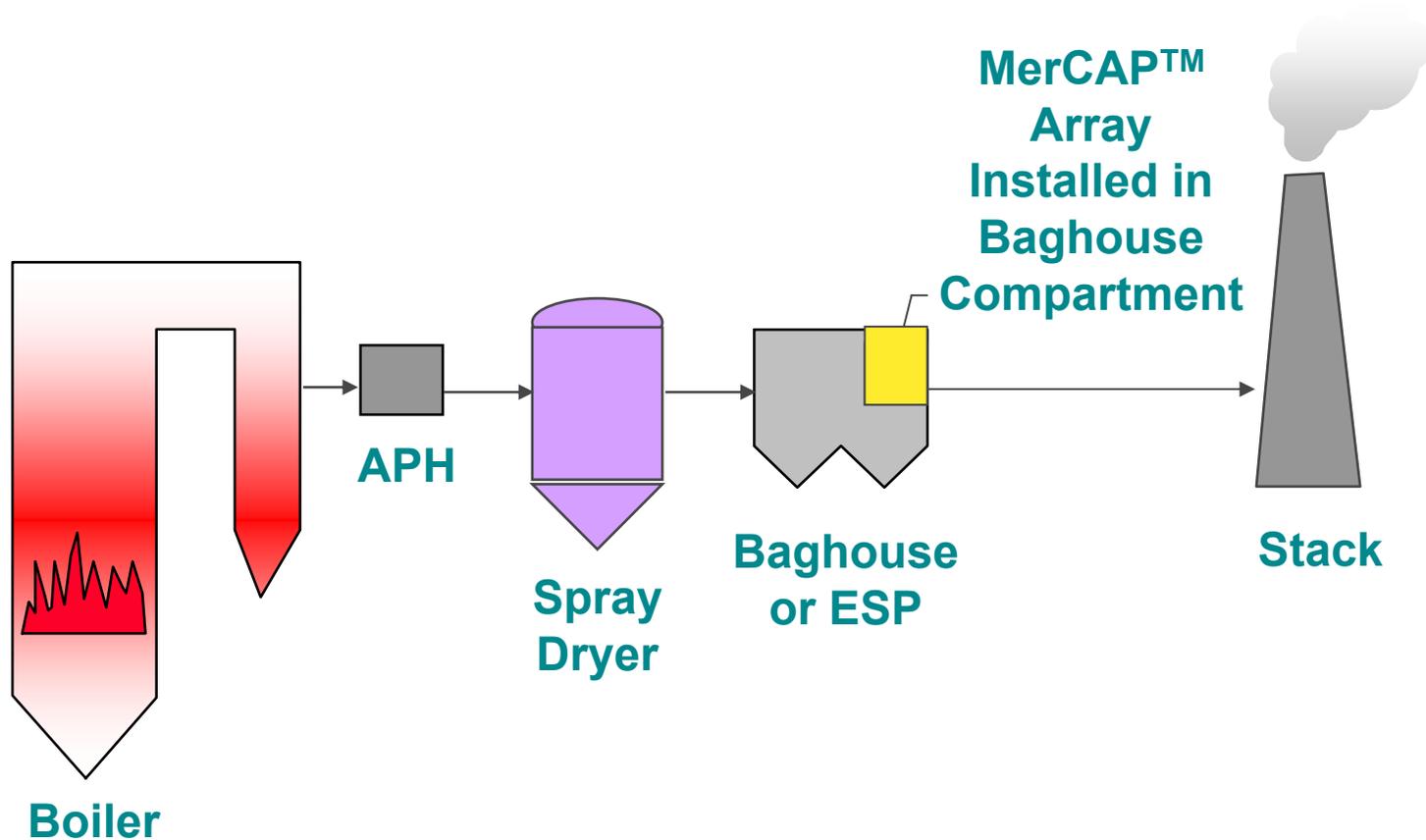
Planned Tests

- Long-term performance in scrubbed flue gas
 - 6-month performance test at two host sites
 - Periodic measurement trips to verify performance
 - every 30-40 days
- Parametric tests
 - Carried out with “mini-MerCAP™” probe
 - effects of gas flow rate
 - Regeneration tests with extractive probe
 - ability to thermally regenerate sorbent
 - effects of multiple regeneration cycles

Host Sites

Parameter	Stanton Unit 10	Yates Unit 1
Boiler		
Type	CE Tangential-Fired	CE Tangential-Fired
Equivalent MWe	60	100
Coal		
Coal Type	North Dakota Lignite	Eastern Bituminous (1.6% sulfur)
Sulfur (%)	0.6 – 0.8	1.0
Chloride (mg/kg, dry)	25-35	300-1400
Mercury (mg/kg, dry)	~0.055	~0.16
Particulate Control	Reverse Gas Baghouse	ESP (SCA-173 ft²/1000 acfm)
NO_x Control	Low NO_x Burners	Low NO_x Burners
SO₂ Control	Spray Dryer (Research Cottrell)	Chiyoda CT-121 Wet Scrubber

MerCAP™ Installation - Stanton Unit 10 Baghouse Outlet

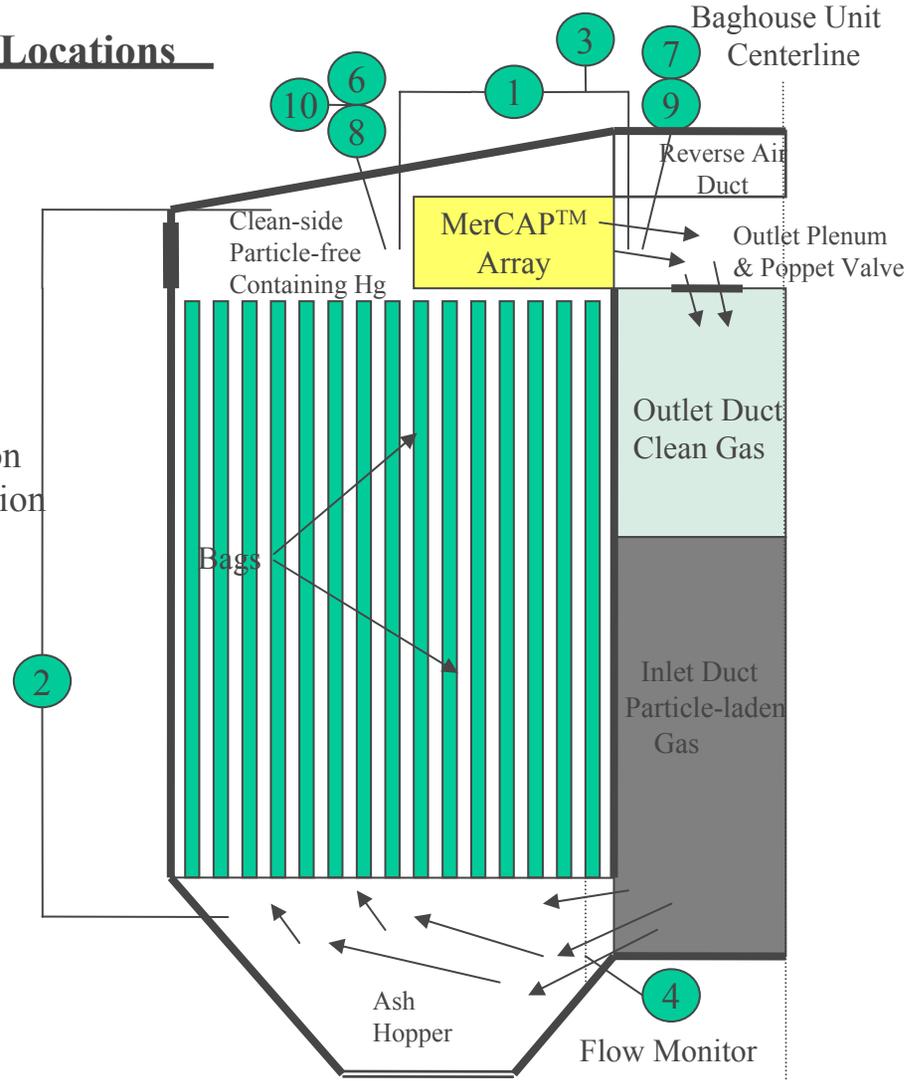


MerCAP™ Installation - Stanton

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

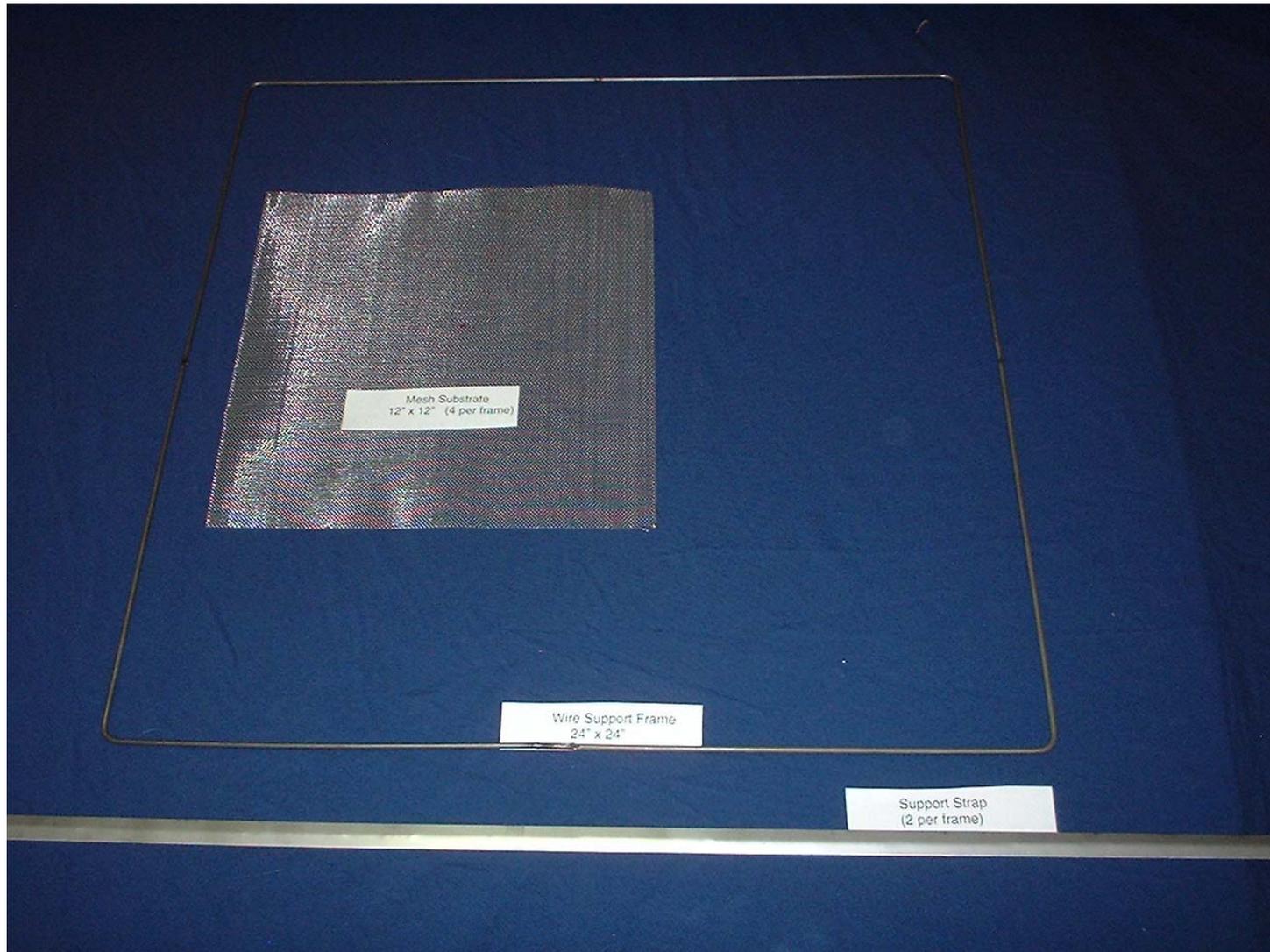


Stanton MerCAP™ Installation Baghouse Compartment



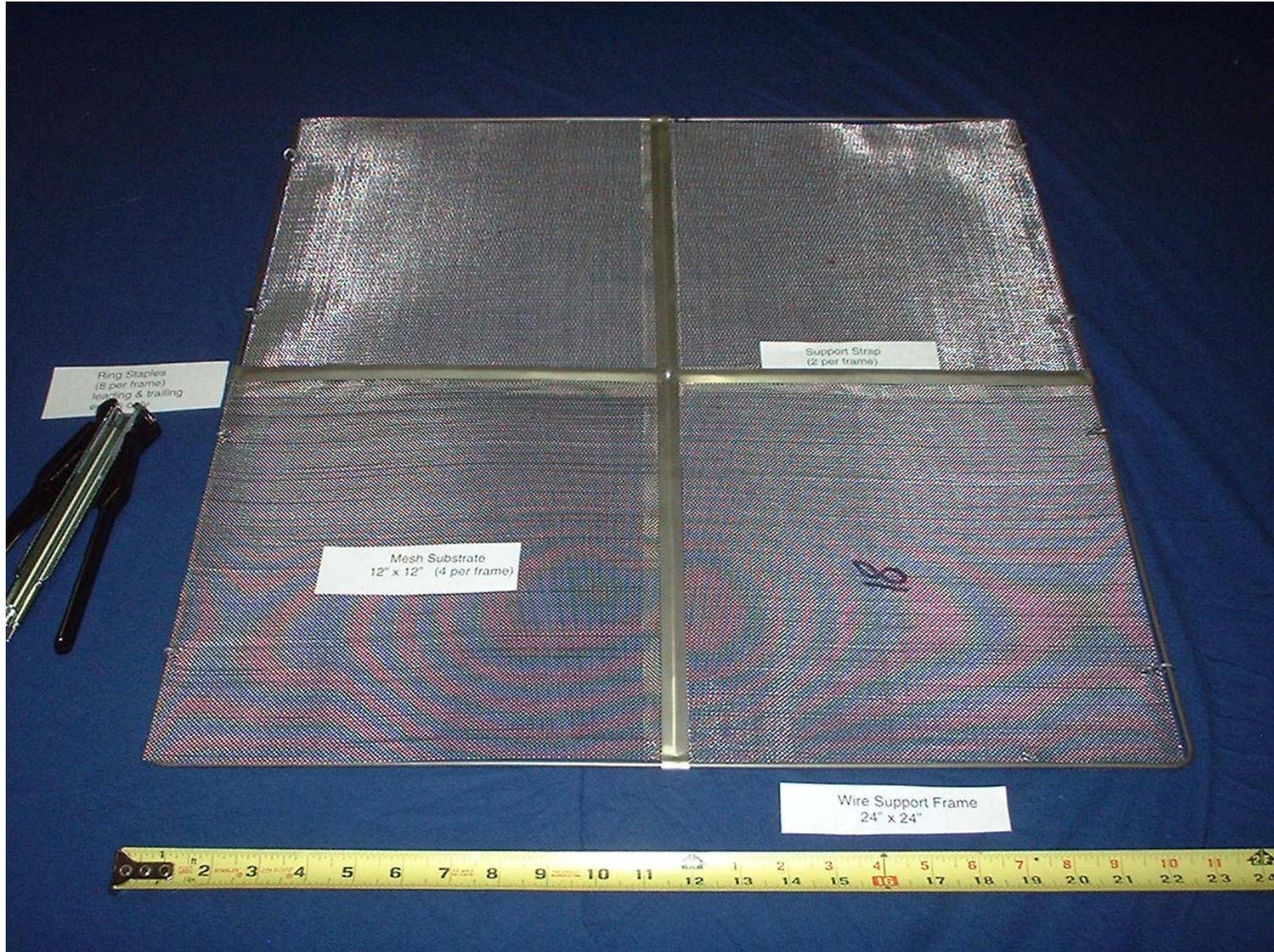
MerCAP™ Installation - Stanton

Structure Hardware

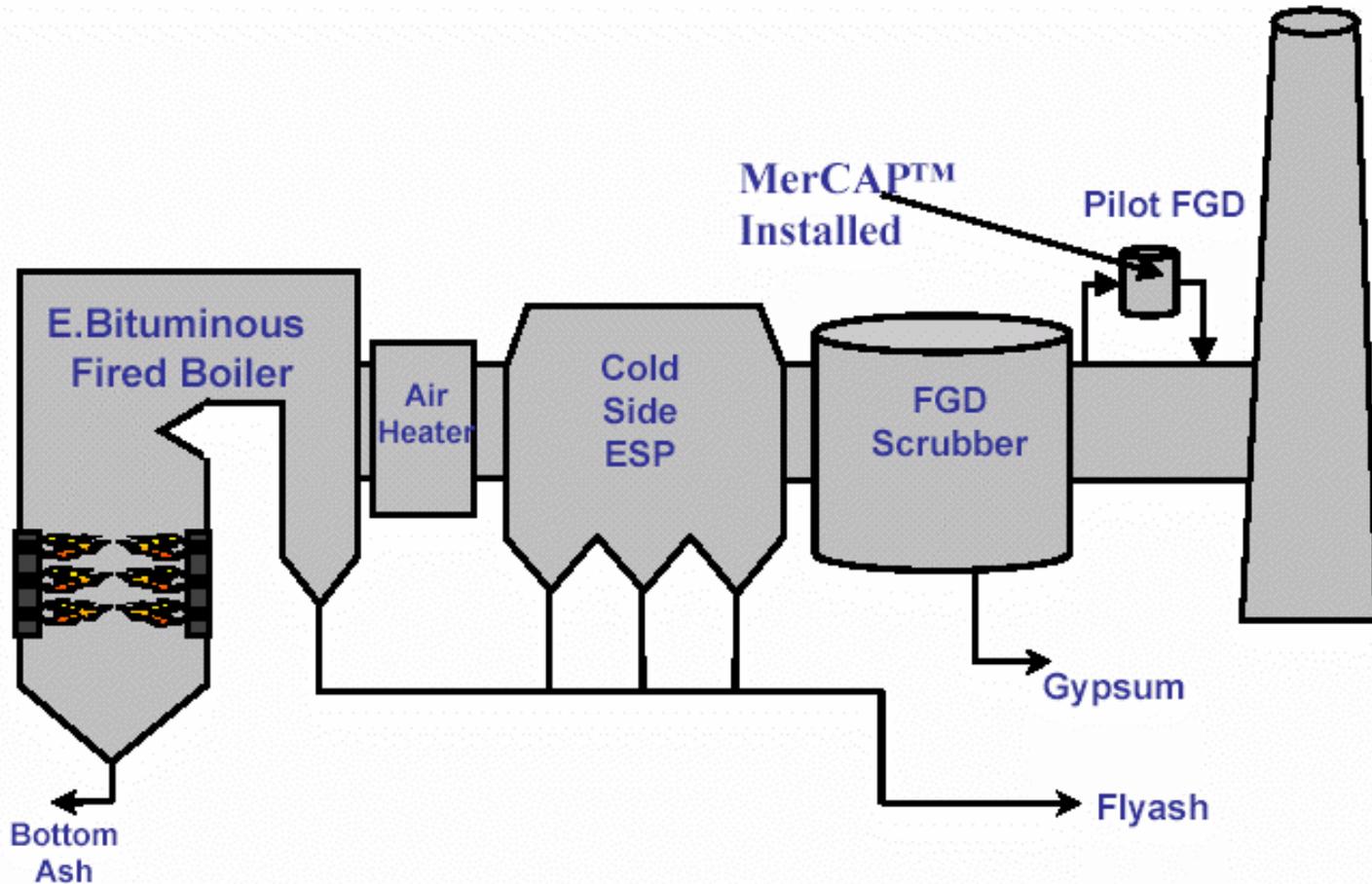


MerCAP™ Installation - Stanton

Framed Screen Substrate

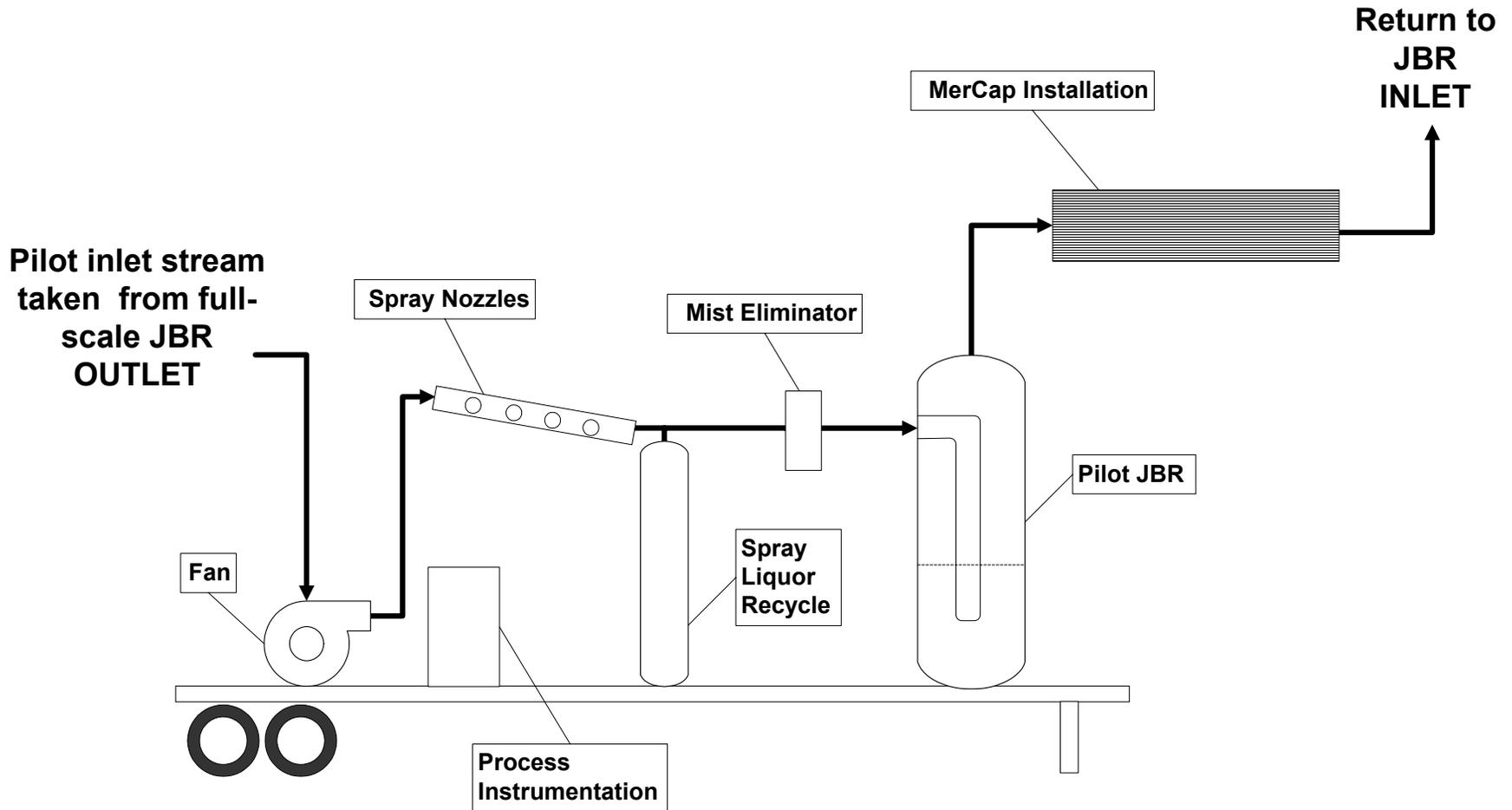


MerCAP Installation - Plant Yates 1 MWe Test Unit - Unit 1



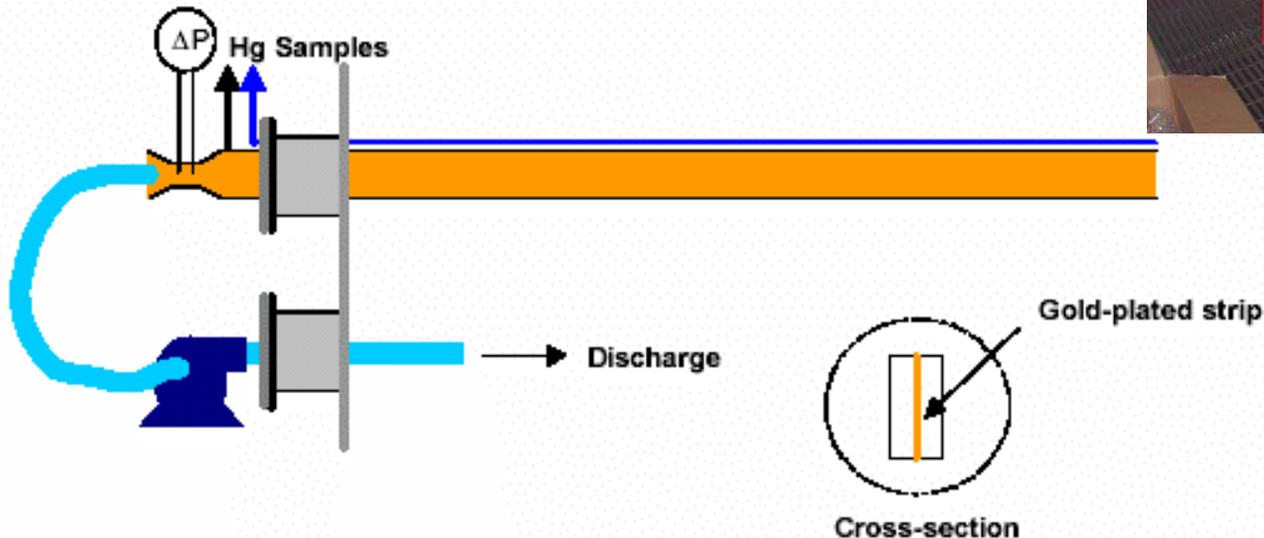
MerCAP Installation - Plant Yates

Southern Company Pilot Unit

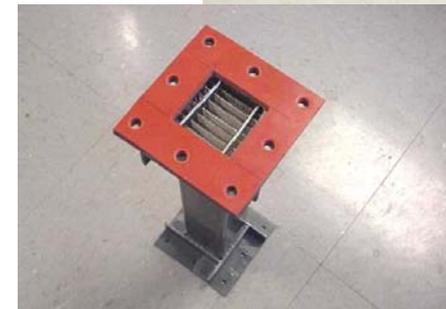
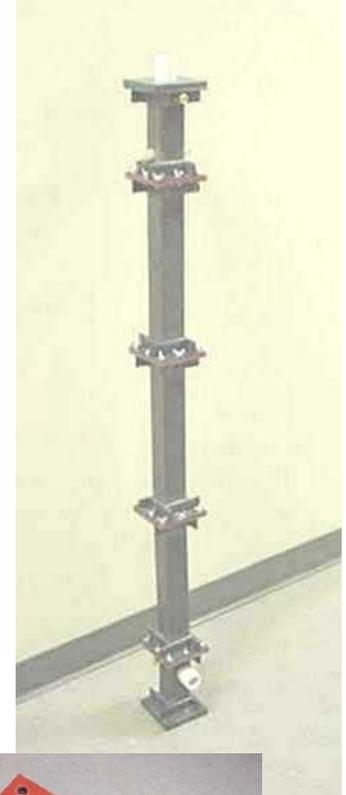
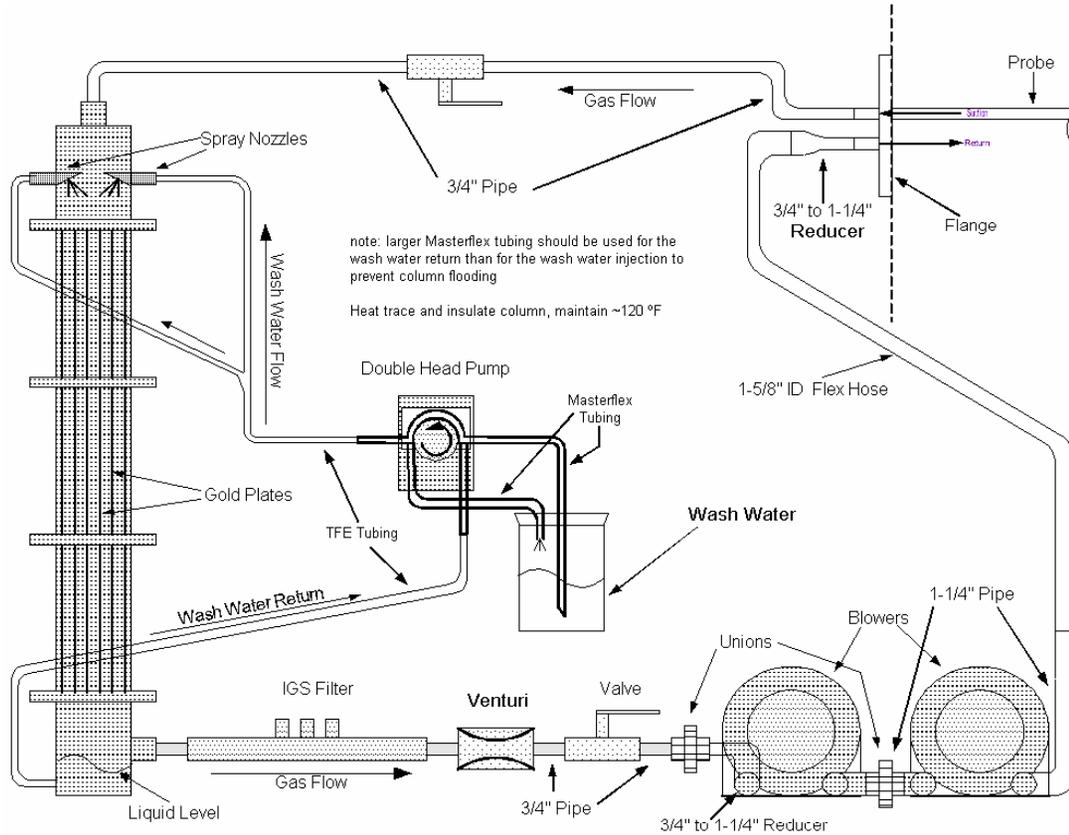


Mercury Control by MerCAP™ Test Equipment

- EPRI Mini-MerCAP™ extractive test probe:
 - Parametric testing
 - Regeneration testing



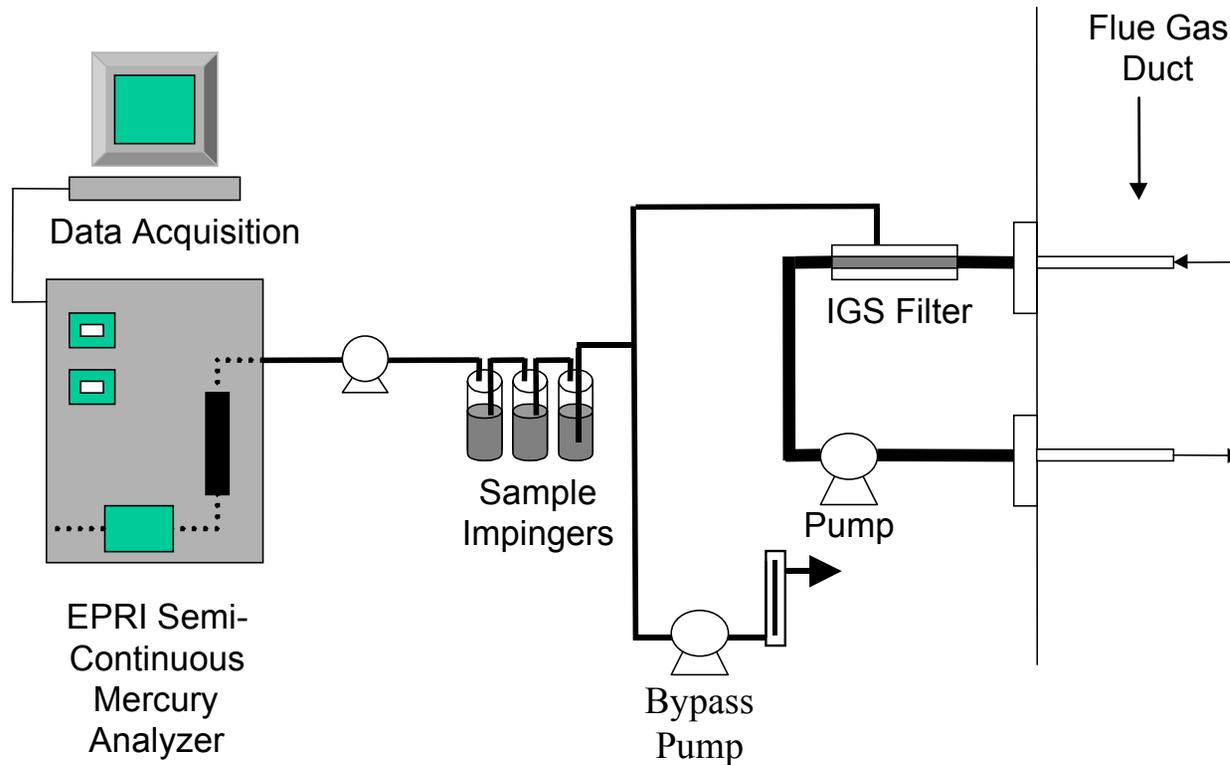
MerCAP™ Test Setup for Saturated Flue Gas



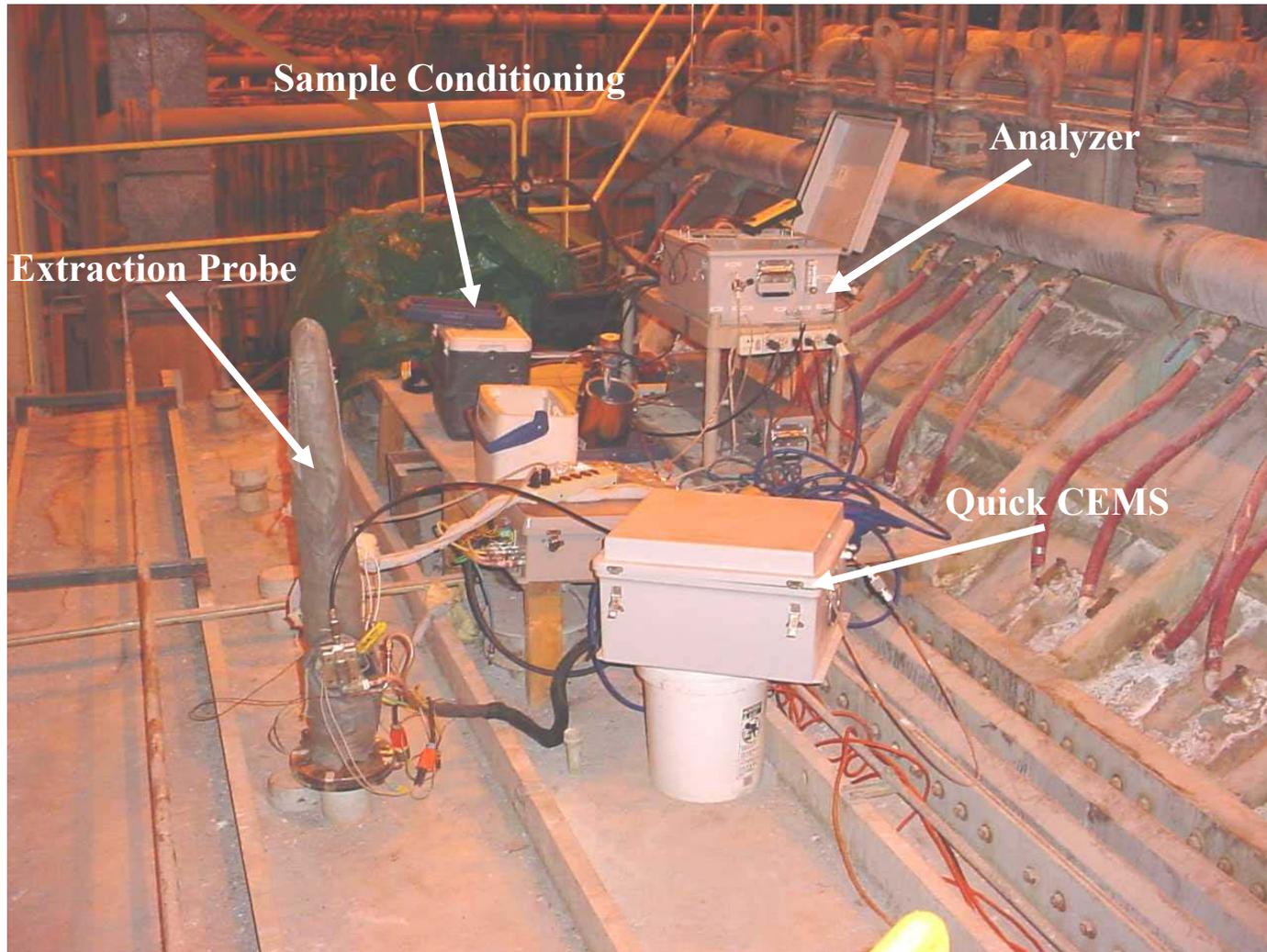
Test Equipment

Mercury SCEMs

EPRI Hg SCEM equipment



EPRI Hg SCEM Typical Setup



Mercury Control by MerCAP™

Flue Gas Characterization

- **Speciated Mercury**
 - SCEM (MerCAP™ inlet/outlet)
 - Ontario Hydro (during baseline and long-term exposure tests)
- **Chloride**
 - M26a (MerCAP™ inlet)
- **Particulate Loading**
 - M5 or M17 (MerCAP™ inlet)
- **Flue Gas Velocity**
 - M1 (MerCAP™ inlet)

Mercury Control by MerCAP™

Process Samples

- **Coal**
 - Hg, Cl, Ult/prox., HHV
- **Fly ash**
 - SD-BH solids at Stanton Station
 - ESP ash at Plant Yates
 - Hg, LOI analyses
 - Mercury stability testing (NETL)
- **Pilot Unit ME wash water (Plant Yates)**
 - Hg, pH, Cl⁻, SO₃⁻², SO₄⁻²

Mercury Control by MerCAP™ Process Data

- **Boiler**
 - Unit load
- **Available duct temperatures**
 - Economizer outlet, APH outlet, APC temps, etc.
- **CEM data**
 - NO_x, O₂ (Stanton), CO₂, SO₂
- **Pilot unit parameters**
 - Temperatures
 - Pressure drop
 - ME wash rate (Yates)

Mercury Control by MerCAP™

Proposed Test Schedule

Period	Test Type	Duration
Week 1	Baseline Testing	1-2 days
	Frame Installation	1-2 days
	Baseline Testing	1 day
	MerCAP™ Installation	2 days
Week 2	Intensive Testing:	
	MerCAP™ Performance Tests	7 days
	Parametric Tests	
Regeneration Tests		
Weeks 3-26	Periodic Measurements:	
	MerCAP™ Performance Tests Regeneration Tests	3-4 days

Mercury Control by MerCAP™

Key Decision Points

EPRI

- **Completion of pre-test substrate evaluation**
 - **EPRI tests to evaluate substrate performance**
 - **Prior to Stanton gold structure fabrication**

NETL

- **Initial intensive period**
 - **Initial process performance**
- **Long-term test period**
 - **Possible deactivation**
- **End of Stanton long-term exposure test**
 - **Apply lessons-learned to Yates design**

Mercury Control by MerCAP™

Post-test Activities

- **Gold Characterization**
 - Contamination vs deactivation
 - Lab regeneration, adsorption tests
 - Coating integrity
- **Economic Analysis**
 - Performance
 - Operating parameters
 - Sorbent life
 - Installation requirements
 - Gold integrity

Mercury Control by MerCAP™

Proposed Program Schedule

- **Stanton Station Testing**
 - July 2004 - Dec. 2004/Jan. 2005
 - Apogee to lead field testing effort
- **Plant Yates Testing**
 - Jan. 2005 – Aug. 2005
 - URS to lead field testing effort
- **Economic Analysis/Gold Characterization**
 - Sept.-Oct. 2005
- **Report Draft/Finalization**
 - December 2005/March 2006

MerCAP™ Evaluation Program

Current Scheduling Issues

- **Gold substrate performance**
 - **EPRI-funded tests planned to verify performance**
 - **Mini-probe tests at Stanton (start Jan 04)**
- **Schedule for Stanton tests**
 - **Delay in MerCAP™ installation**
 - **ACI test program at Stanton**
 - **Fuel test burn (late spring)**
- **Others?**



Project Responsibilities

Organization	Responsibility
DOE NETL	Project funding
EPRI	Project co-funding
NDIC	Project co-funding
Great River Energy	Host Site; co-funding
Southern Company	Project co-funding
Georgia Power	Host Site; co-funding
Apogee Scientific	Stanton design & testing
ADA-ES	Planning; data evaluation
URS	Prime contractor; Yates tests
All	Technical support