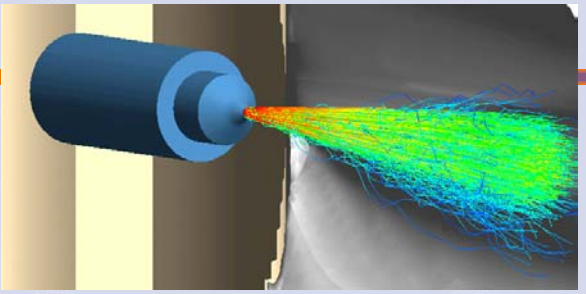
Mercury Control Evaluation of Halogen Injection into a Texas Lignite-Fired Boiler



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Addition of Halogen-Containing Species to Flue Gas

- Oxidation of mercury in flue gas
  - Hg speciation related to flue gas HCl content
  - Higher Hg oxidation may increase Hg removal across flue gas path
- For low-chloride coals, inject halogen species into boiler
  - Increases Hg oxidation in flue gas
  - Potential for enhanced fly ash reactivity
  - Increase in Hg removal across wet scrubber
  - EPRI testing since 2002 shows promising results
    - Lignite and PRB coals

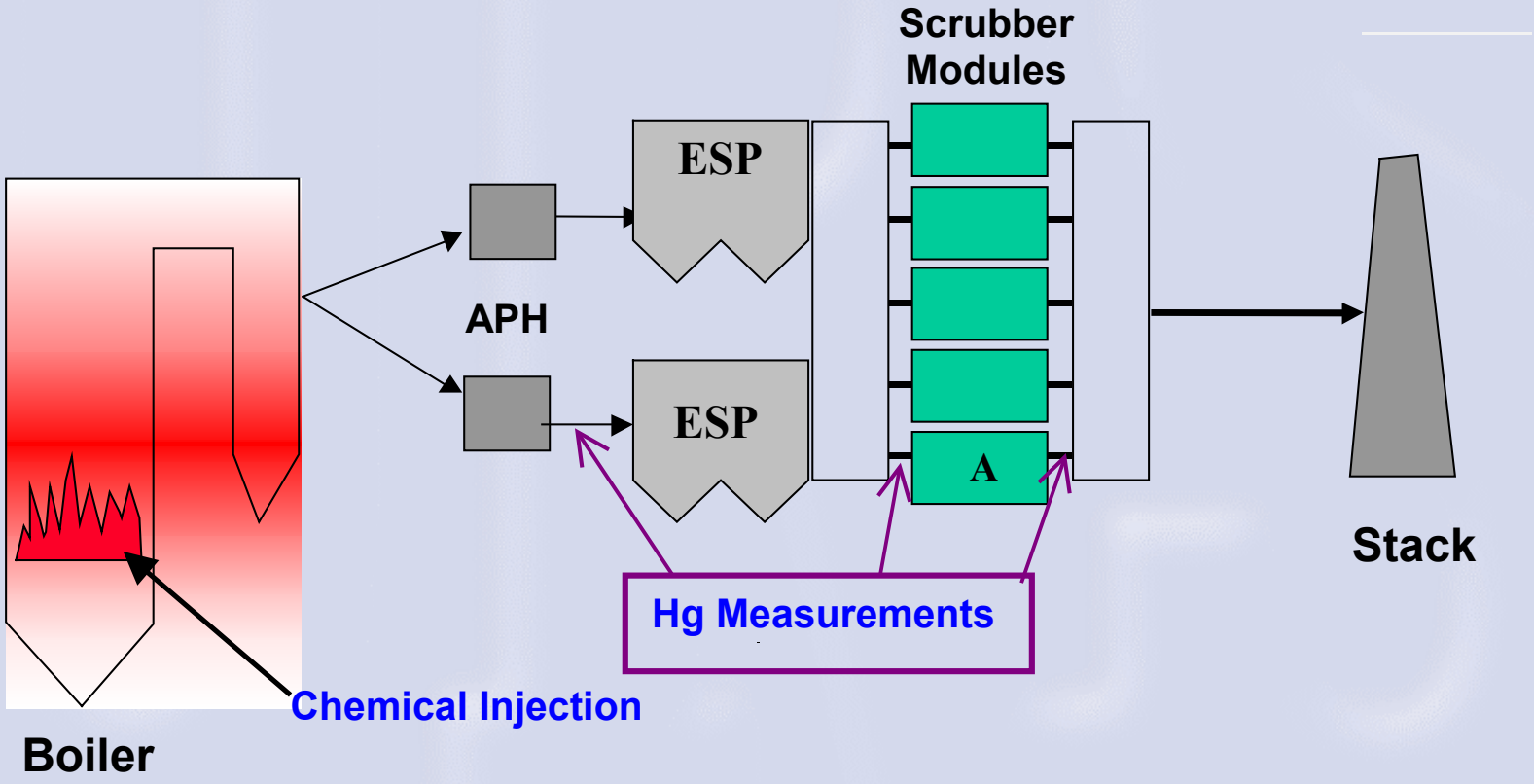
EPRI Chemical Addition Test Objectives

- Increase mercury oxidation in flue gas derived from Texas lignite
- Enhance mercury removal across wet scrubbers
- Parametric Tests
  - $CaCl_2$ – vary injection rates
  - $CaBr_2$ – limited 3-hour test at one rate

Host Site - Texas Genco's Limestone Electric Generating Station

- **Unit 1- 890 MW**
- **Inject into half of split furnace**

Chemical Injection
Limestone Station Unit 1



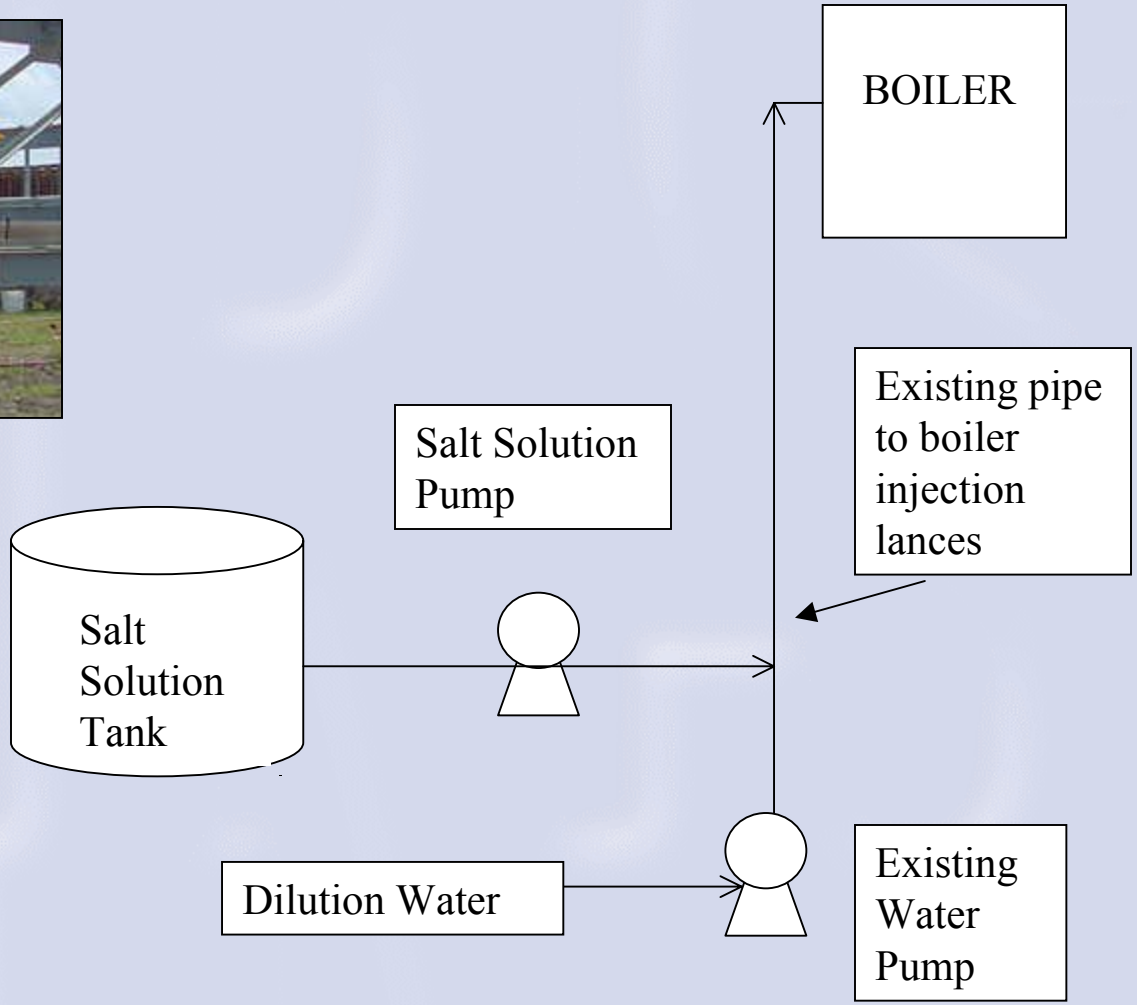
Fuel Parameters During Testing at Limestone

Fuel Type	Texas Lignite	PRB
Heating Value (as received)	5500-6900 Btu/lb	7900-8300 Btu/lb
Ash	15-27%	4-8%
Sulfur	0.9-1%	0.3-0.5%
Water	29-32 %	30%
Mercury	0.15-0.22 ppm	0.06-0.10 ppm
Chlorine	50-100 ppm	25-60 ppm

Baseline Mercury Measurements

- Hg at ESP Inlet = 23-33 μg/Nm^3 at 3% O_2
- 45% Oxidation at ESP Inlet
- Baseline HCl = 3 ppm
- Hg vapor removal by fly ash < 5%
- System Hg vapor removal = 50 to 65%

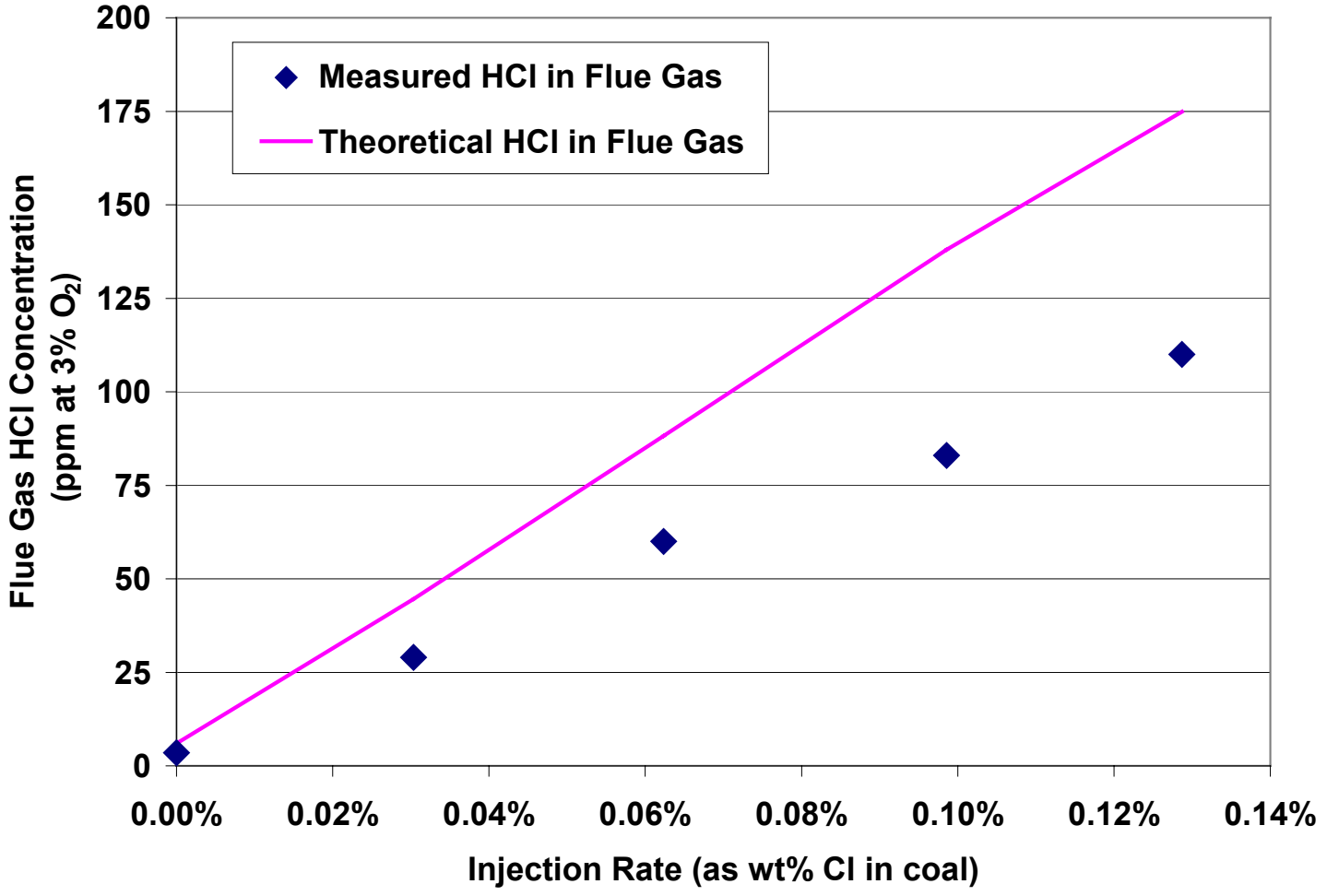
Schematic of Injection Equipment



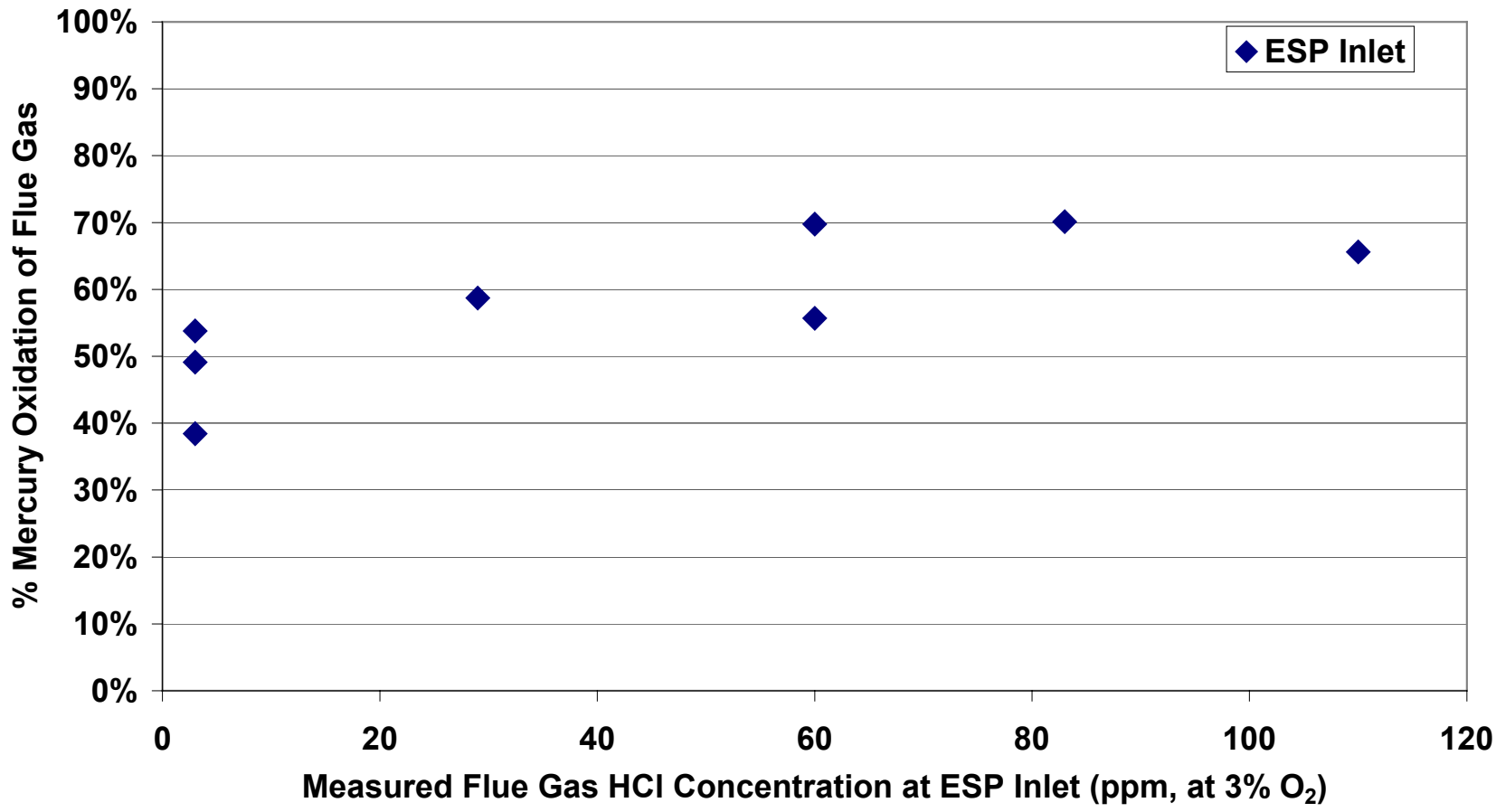
Chemical Addition to Unit 1 Boiler Limestone Station

Salt	Weight % Chloride/ Bromide (% relative to coal)	Liquid Salt Feed Rate (gpm)	Theoretical Gas Conc. (ppm HCl or ppm HBr)
$CaCl_2$ (25 wt%)	0.03	1.9	40
	0.06	4.0	80
	0.10	6.4	120
	0.13	8.2	155
$CaBr_2$ (52 wt%)	0.09	1.6	50

Effect of $CaCl_2$ Addition Limestone Station



$CaCl_2$ Effect on Hg Oxidation at ESP Inlet

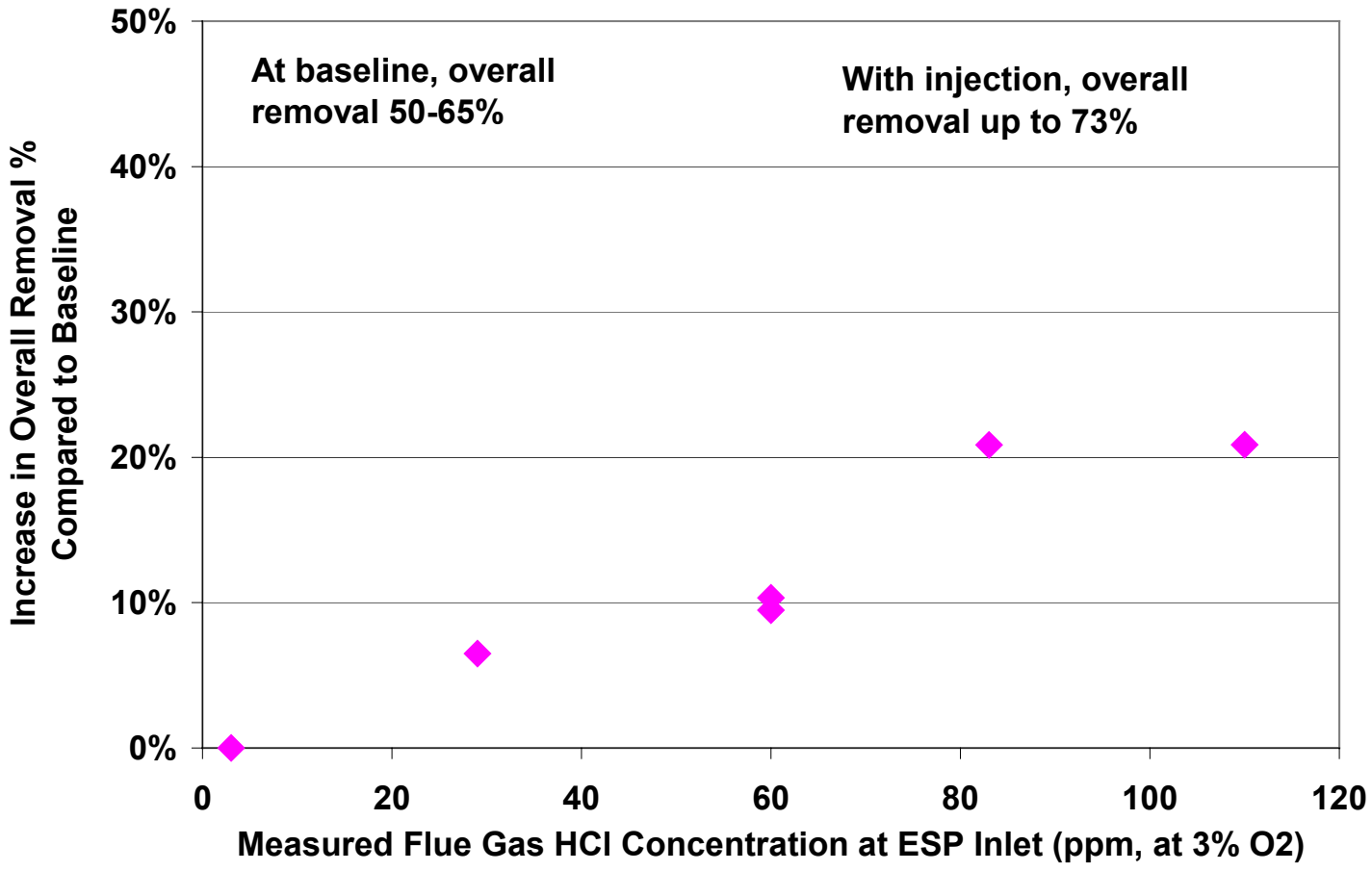


% Removal of Hg across System

- Compares the ESP inlet Hg to the FGD outlet Hg.
- Includes both native removal and effect of $CaCl_2$ injection.
- Calculated as:

$$\text{Removal across ESP/FGD} = 100 * \left(1 - \frac{Hg^{Total}_{FGD\ Out,Inj}}{Hg^{Total}_{ESP\ In,Inj}}\right)$$

Increase in System Hg Removal Percentage - $CaCl_2$ Tests



Effect of $CaBr_2$ Tests

- Limited, three-hour test of calcium bromide
- Injected 0.09 wt% as Br in coal
  - 48 ppm HBr in flue gas
- Results:
  - 81% overall removal across ESP/FGD (observed 73% removal with 60 ppm Cl)

Summary

- Oxidation of mercury increased with each salt tested
  - Oxidation at ESP Inlet increased from 45% to 70%
- Scrubber removal enhanced
  - With $CaCl_2$ injection, achieved as high as 73% system Hg removal
  - With $CaBr_2$ injection, achieved 81% system removal

Further Testing Needed

- Evaluate long-term operation
- Characterization of potential balance-of-plant impacts of chemical injection
  - Boiler corrosion
  - Air heater plugging
  - FGD performance
  - FGD materials of construction

Plan Forward

- Additional Tests Planned at Limestone for 2005-2006
  - Process optimization tests
  - Balance of plant determinations
- Project team is soliciting participation from other Power Generators

Plan Forward

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