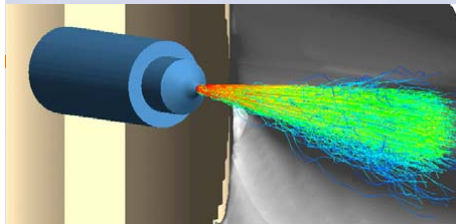




Mercury Control Evaluation of Halogen Injection into a Texas Lignite-Fired Boiler



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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

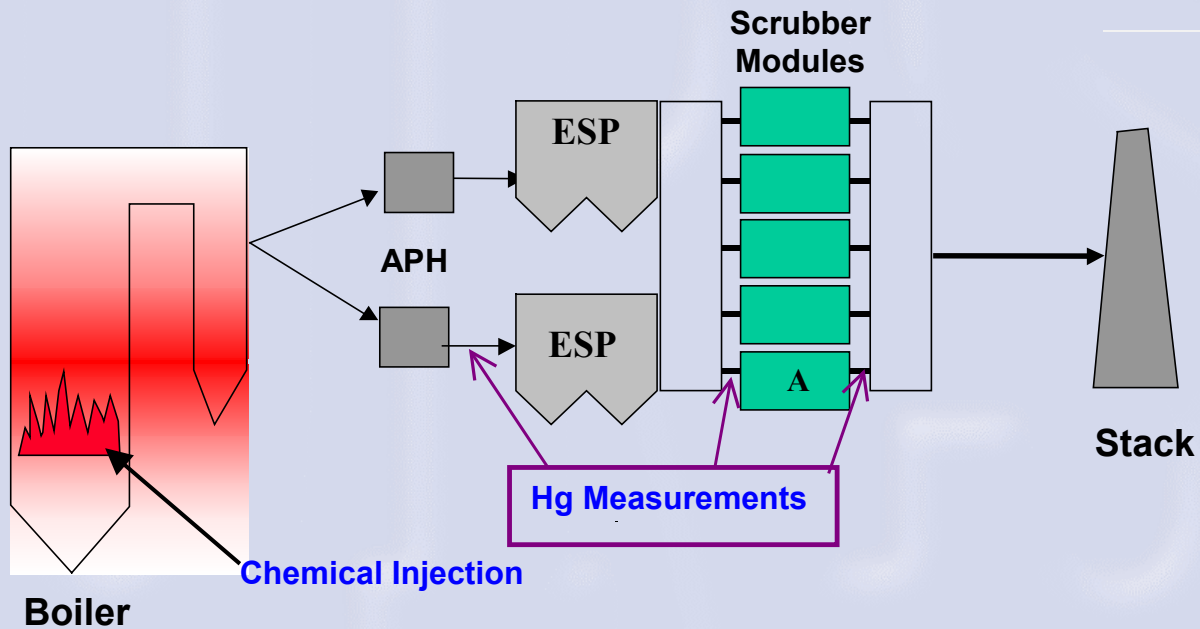


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Chemical Injection Limestone Station Unit 1





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



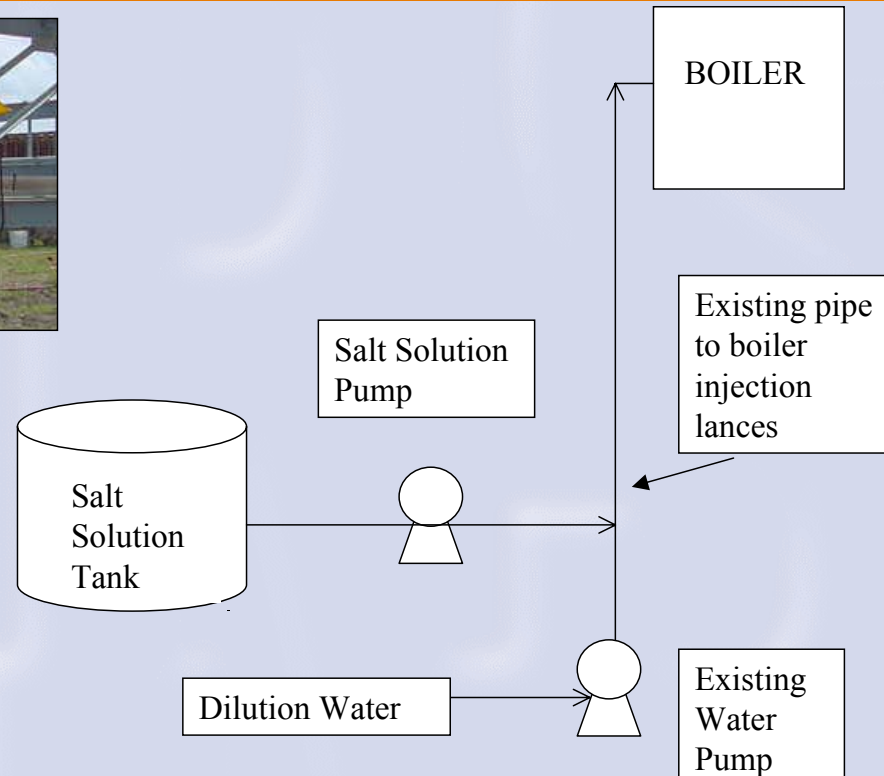
Baseline Mercury Measurements

- Hg at ESP Inlet = 23-33 $\mu\text{g}/\text{Nm}^3$ 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



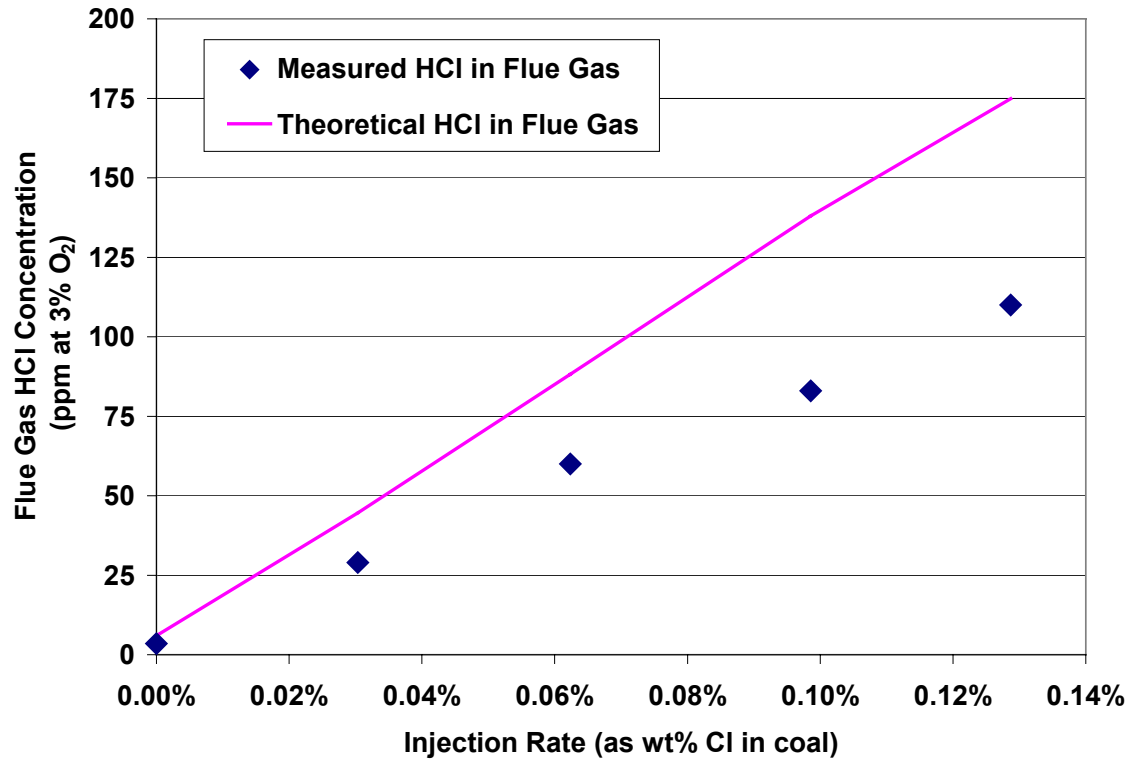


Chemical Addition to Unit 1 Boiler Limestone Station

Salt	Weight % Chloride/Bromide (% relative to coal)	Liquid Salt Feed Rate (gpm)	Theoretical Gas Conc. (ppm HCl or ppm HBr)
CaCl₂ (25 wt%)	0.03	1.9	40
	0.06	4.0	80
	0.10	6.4	120
	0.13	8.2	155
CaBr₂ (52 wt%)	0.09	1.6	50

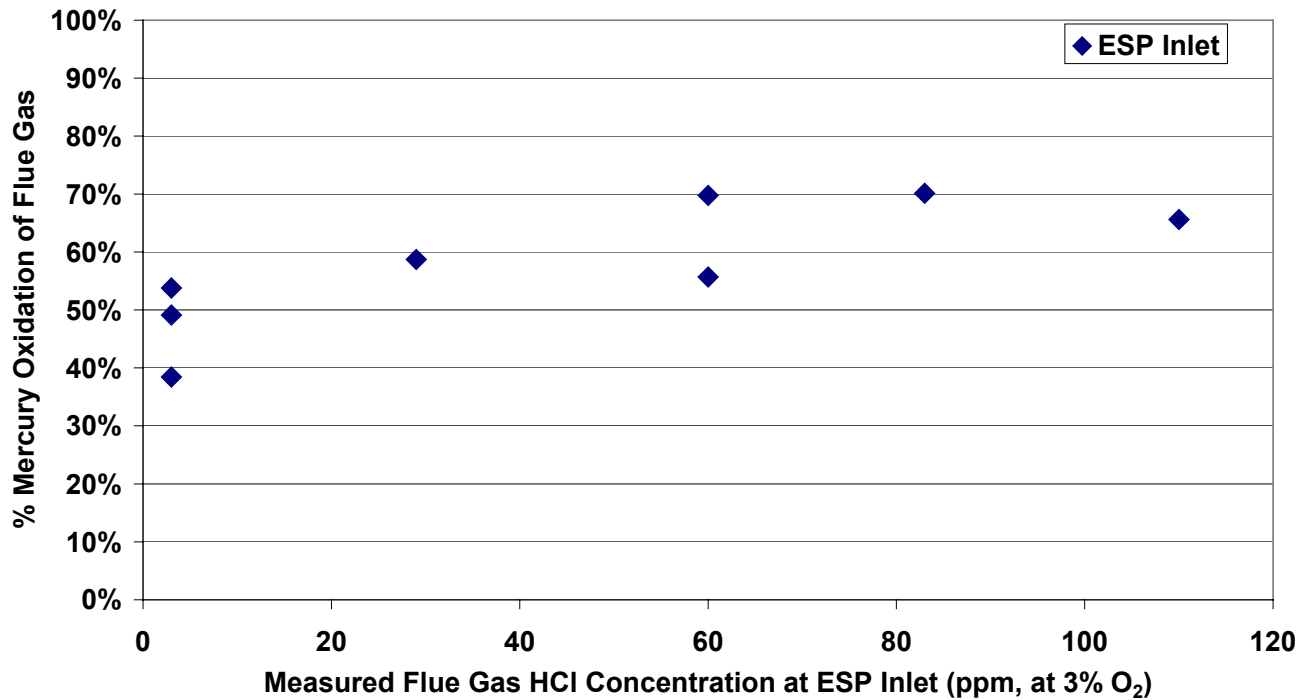


Effect of CaCl_2 Addition Limestone Station





CaCl₂ Effect on Hg Oxidation at ESP Inlet





% Removal of Hg across System

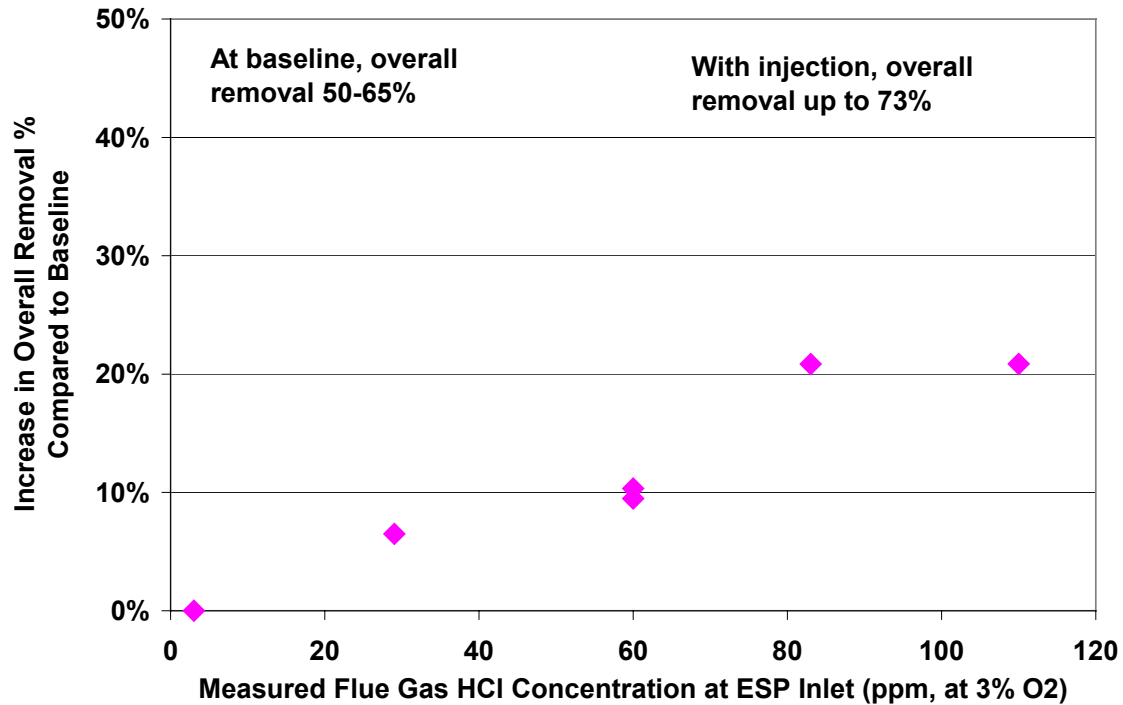
- Compares the ESP inlet Hg to the FGD outlet Hg.
- Includes both native removal and effect of CaCl_2 injection.
- Calculated as:

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





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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