Mercury Stability in FGD Byproducts

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Presentation Outline

- EPRI Hg Stability in FGD Byproducts Project
  - Project background
  - Approach
  - Results to date
  - Laboratory setup for stability tests
- DOE/EPRI Pilot-testing of Mercury Oxidation Catalysts for Upstream of Wet FGD Systems

Project Background

- Oxidized mercury in flue gas is scrubbed in wet FGD systems
- Prior pilot-scale results showed that scrubbed mercury ends up in the FGD byproduct solids
- It is generally presumed that mercury in FGD solids is relatively stable (i.e., not likely to volatilize or leach out)
- This project is conducting laboratory simulations to determine mercury stability as a function of FGD reagent and oxidation mode

Project Background - Previous EPRI Tests

- Air and water stability of Hg on sorbents & fly ash
  - Hg sorbents treated in simulated flue gas (Hg^0, $HgCl_2$)
  - Hg sorbents treated in actual flue gas
  - Fly ash from various coal types
- Air stability parametric tests
  - Exposure time (1 to 8 months)
  - Air temperature (75°F to 140°F)
  - Effect of air flow rate (1-30 air changes/hr)
  - Effect of methane, UV light
- Leaching tests (EPA Method 1312)

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Project Background - Previous EPRI Tests

- No appreciable mercury loss from solids during air purging or water leaching tests
  - <0.05% desorbed in air over 8-month period at lower flow rates
  - Up to 0.34% desorbed in air at highest flow rate
  - No effect of temperature, methane, UV-light, flue gas type (synthetic vs. actual, Hg^0 vs. $HgCl_2$)
  - No mercury detected in leachate solution

Project Approach

- Collect representative samples of FGD byproduct, coal, fly ash, FGD liquor, FGD fines blow down from a range of FGD systems
  - Measure Hg concentrations in all
  - Calculate approximate Hg balance around plant

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Project Approach (continued)

- Conduct Hg stability tests on FGD byproduct samples
  - Conduct TCLP tests for water leaching stability
  - Flow air over byproduct samples for 6 months to simulate disposal, periodically collect and measure Hg that evolves from samples (Hopcalite sorbent tubes)
  - Simulate gypsum calcining, collect and measure mercury that evolves
- Future testing may involve measurements at full-scale wallboard plants

Variables for Laboratory Simulation

- Landfill disposal simulation (sulfite and gypsum)
  - Vary air flow past solids
  - Air temperature (75^{o}F, 125^{o}F)
- Wallboard production simulation (gypsum only)
  - Calcining temperature (300^{o}F, 350^{o}F)
- FGD reagent (lime or limestone)
- FGD oxidation mode (sulfite or gypsum producers)
- Coal type

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Sample Sources for Laboratory Simulation

Coal Type	FGD Reagent	Oxidation Mode
Bituminous	Limestone	Inhibited
Bituminous	Limestone	Forced
PRB	Limestone	Forced
Texas Lignite	Limestone	Inhibited
Texas Lignite	Limestone	Forced
Bituminous	Lime	Natural
Bituminous*	Lime*	Forced-External*

*Still need host site for these samples

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Project Status

- Five of eight sample sets have been collected
- Still need one or two more plants to participate (anonymously); need lime-based gypsum system
- Have determined mercury concentrations in first 5 sample sets
- Have conducted TCLP tests on ~half of samples (to determine water leaching stability)
- Have begun 6-month landfill stability tests on first 5 byproduct samples
- Calcining tests planned for March/April

Sample Mercury Concentrations Sulfite Producers (ppm)

- Concentration values:
  - Coal samples ~0.1 ppm Hg
  - Fly ash and FGD liquor <0.1 ppm Hg
  - FGD solid samples ~0.5 to 2 ppm Hg
- Most of the mercury in the byproduct (fly ash, FGD solids and entrained liquor) comes in with the FGD solids

Sample Set Mercury Concentrations Gypsum Producers (ppm)

- Coal samples all ~0.1 ppm Hg
- PRB and Texas lignite sample set showed little of captured Hg in fly ash or FGD liquor
  - >90% of captured Hg found in gypsum
  - ~0.5 ppm Hg in gypsum
- Bituminous coal sample set:
  - Hg in gypsum ~10% of captured Hg
  - <0.1 ppm Hg in gypsum
  - Most of the captured mercury is in the fines blow down

TCLP Results

Sample Type	Mercury in Leachate (ppb)
PRB, LS, FO	<0.06
Tx Lig, LS, FO	<0.06
Bituminous, LS, Inhibited	0.34
Bituminous, LS, FO	<0.06
TCLP Limit	200

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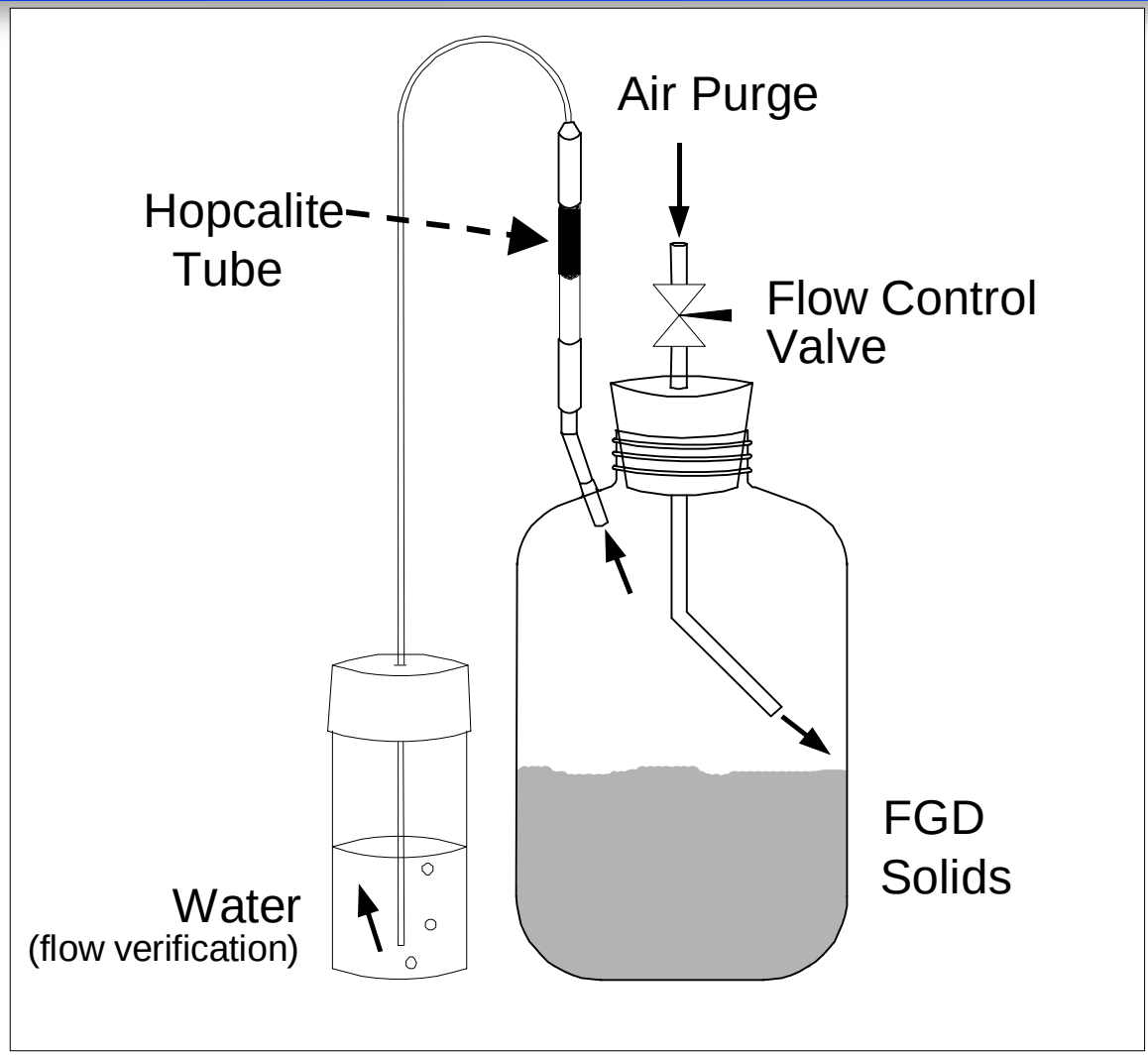
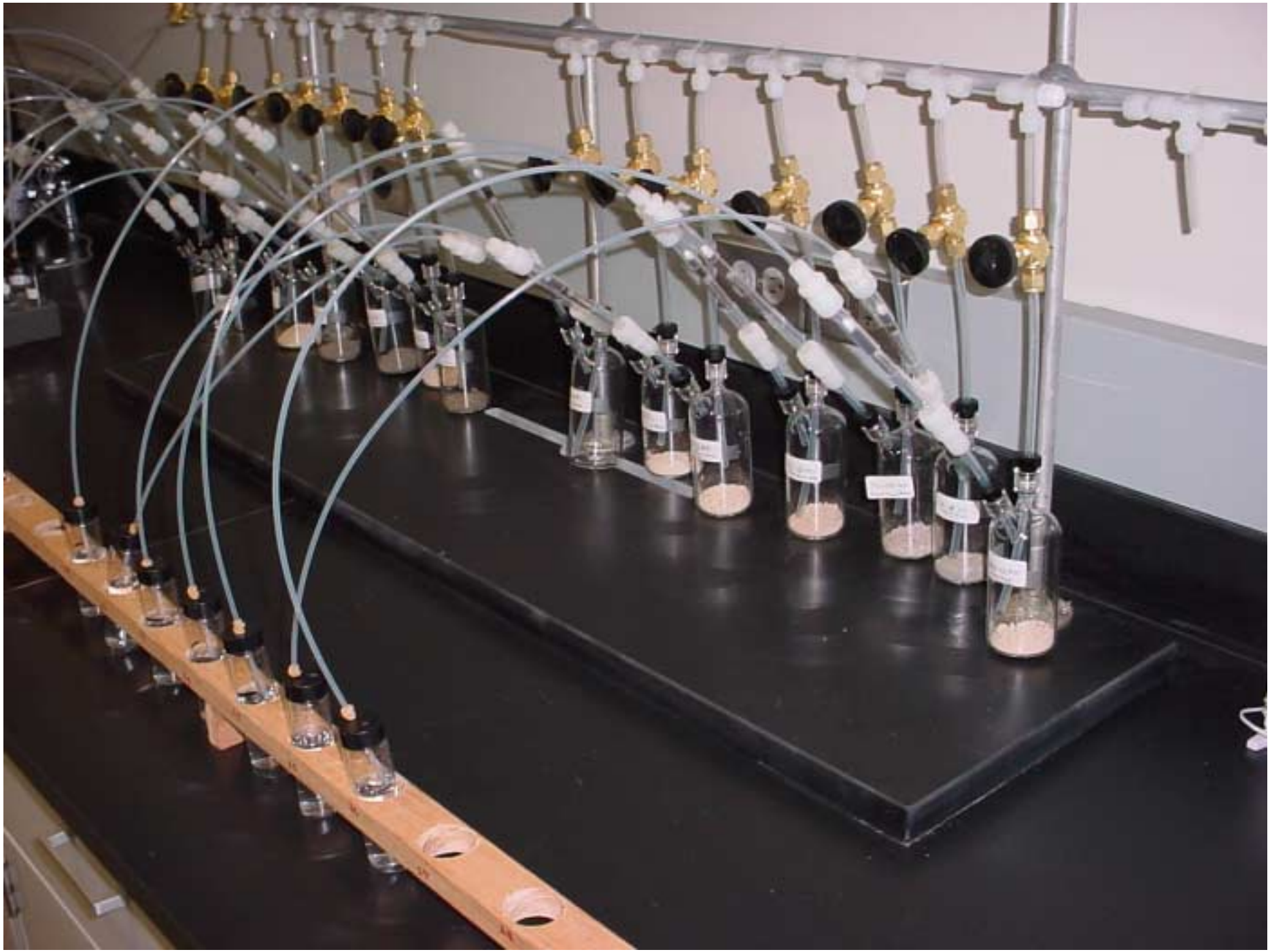
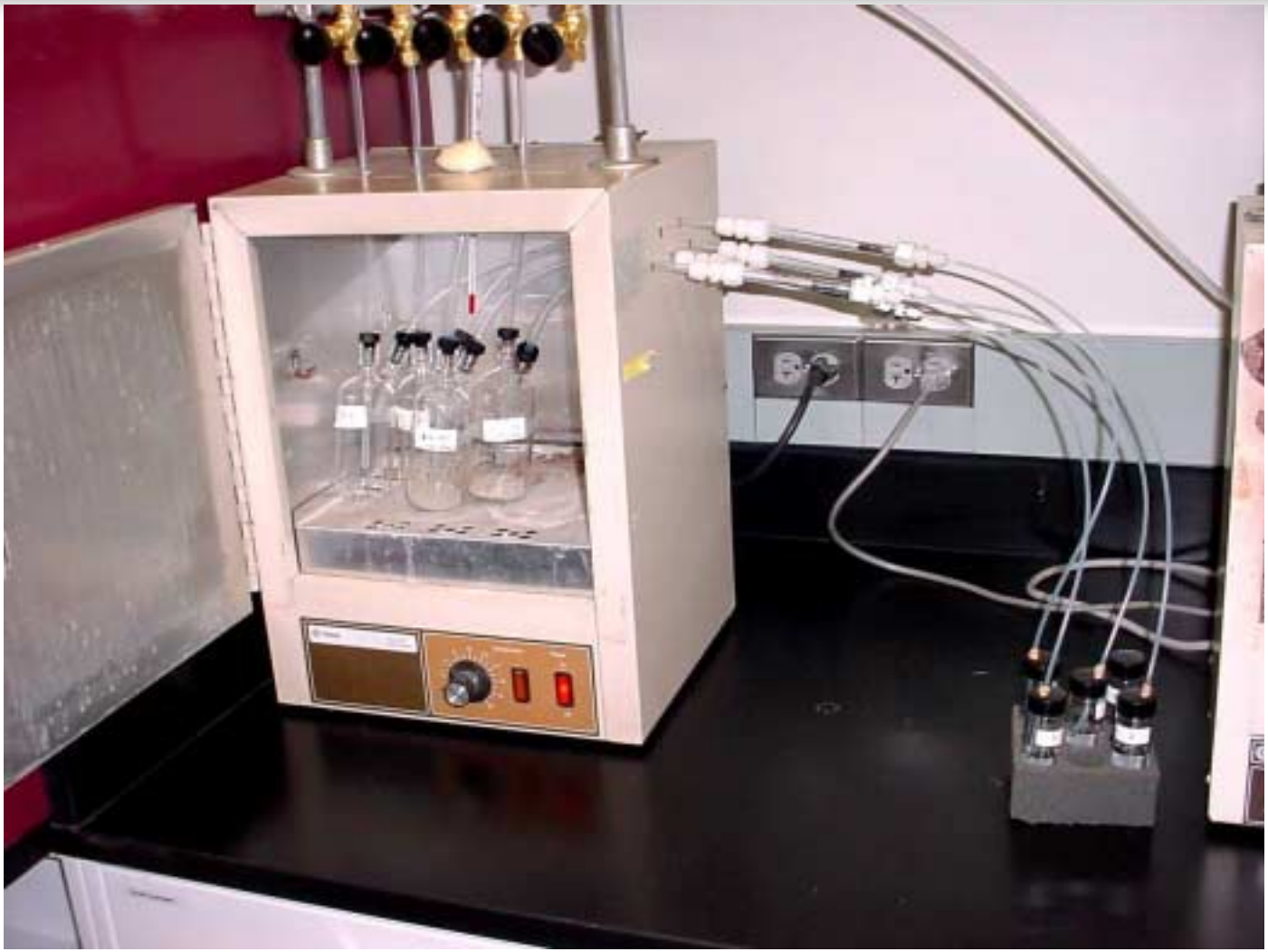
Landfill Simulation Apparatus



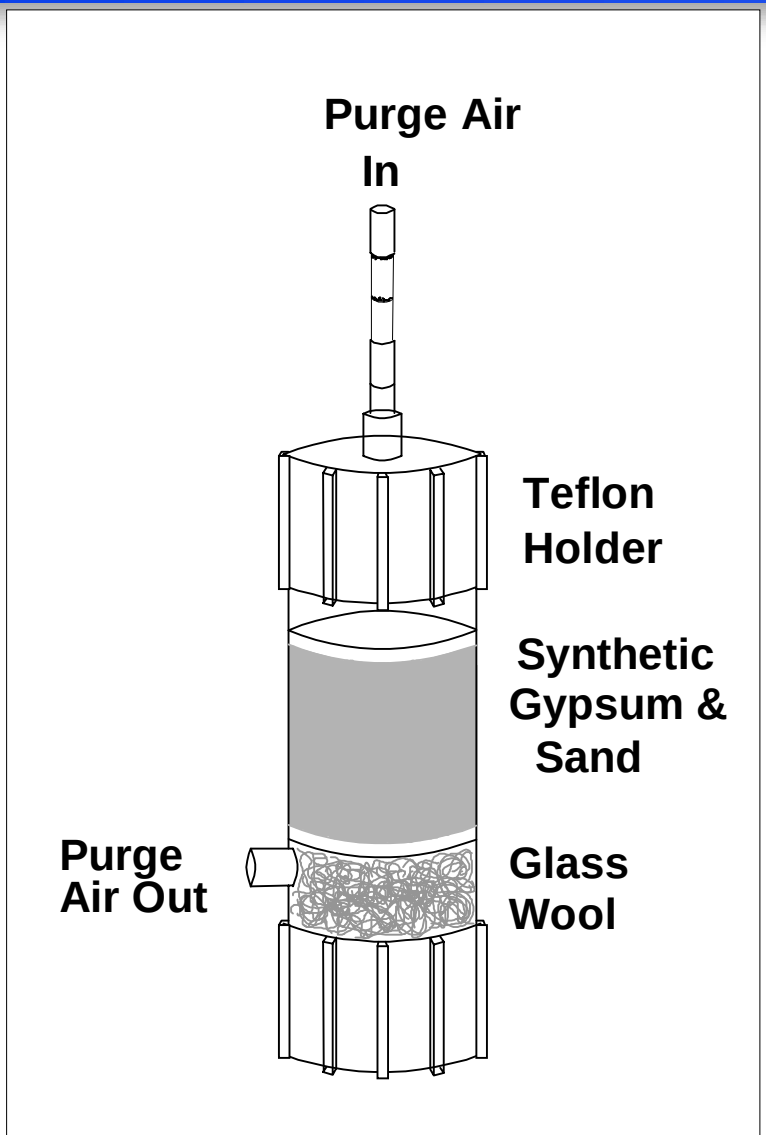
Laboratory Setup



High Temperature Landfill Simulation



Calcining Simulation Setup



DOE Co-funded Project

- Pilot testing of mercury oxidation catalysts for upstream of wet FGD systems
- Project objectives:

  Demonstrate at pilot scale the ability to use honeycomb catalysts to oxidize elemental mercury to a form that can be scrubbed in wet FGD systems, for periods of 14 months at each of two sites
- Project team members include EPRI (co-funder), Great River Energy, and City Public Service (San Antonio)

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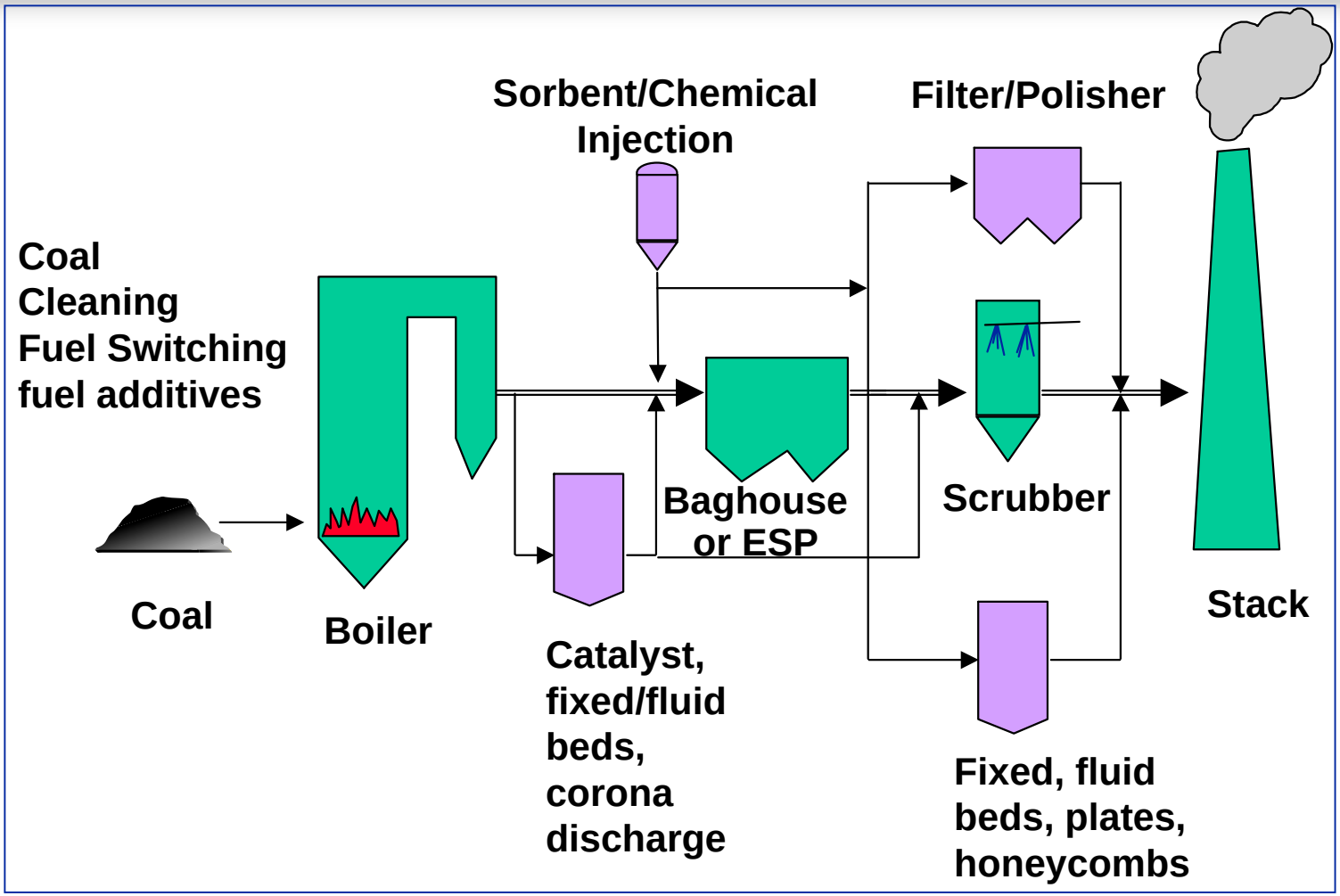
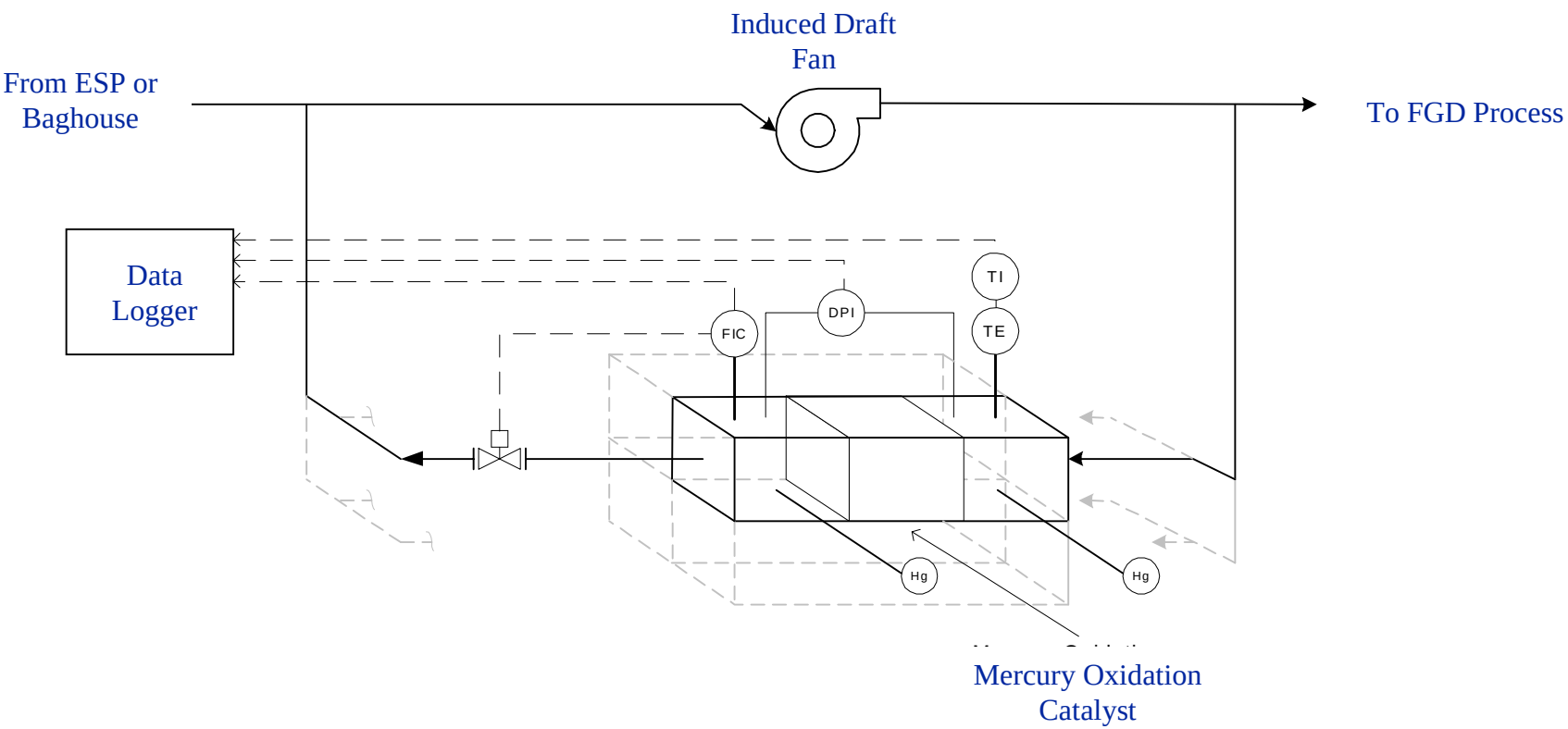
Project Background

- Technology under development uses catalysts to oxidize elemental Hg in flue gas
- Oxidized mercury is scrubbed in wet FGD systems
- Development as part of DOE MegaPRDA project, 1995-2001
  - Laboratory and slipstream tests in actual flue gas
  - Evaluated catalysts derived from various carbons, metals, and fly ashes
- DOE Award for pilot-scale investigation August 2001

Mercury Control Options



Simplified P&ID for Pilot Unit



Planned Mercury Stability Testing

- Mercury oxidation catalyst pilot unit will not be integrated with a pilot wet scrubber
  - ICR, EPRI, DOE data show high Hg^{+2} removal in wet FGD
- Will conduct mercury balance measurements at host sites
  - Measure Hg removal across wet FGD (demonstrate high % Hg removal)
  - Conduct mercury stability tests on FGD byproduct (verify Hg stability)
  - Use methods and apparatus described previously for EPRI project

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DOE Project Status

- Begin pilot testing at first site (GRE Coal Creek Station) ~June 2002
  - 2 x 550 MW, North Dakota lignite
  - ESP followed by wet scrubber
- Mercury balance and Hg stability work beginning mid-summer
- Pilot testing at second site (CPS Spruce Plant) scheduled to begin late 2002 to late 2003
  - 550 MW, PRB
  - Baghouse followed by wet scrubber

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Questions?