



Mercury Emissions & Controls – Issues and Paths to Resolution

George Offen
650-855-8942
goffen@...

Paul Chu
650-855-2812
pchu@...

Ramsay Chang
650-855-2535
rchang@...

...@epri.com

for

**DOE/NETL Contractors Meeting
Pittsburgh, PA
July 14, 2004**

Basic Premises



- **Mercury controls need to be:**
 - Compliant capable
 - Lowest possible cost
 - Small footprint
 - Responsive to cycling
- **Power companies need options**
- **New opportunities**
 - *Proposed MACT may be achievable @ 50–70% Δ Hg*
 - **Cap-and-trade = whatever is cost-effective**
 - Presumes states do not opt out
- **DOE partnership valued and critical to achieving above**

General Issues

- **Regulatory uncertainty**
- **Artifacts/uncertainty in Hg measurements**
- **Limited full-scale, long-term experience**
 - Δ Hg performance
 - Impacts/costs
- **Potential for introduction of new pollutants – all media**
- **Effective management of Hg-containing CCPs**



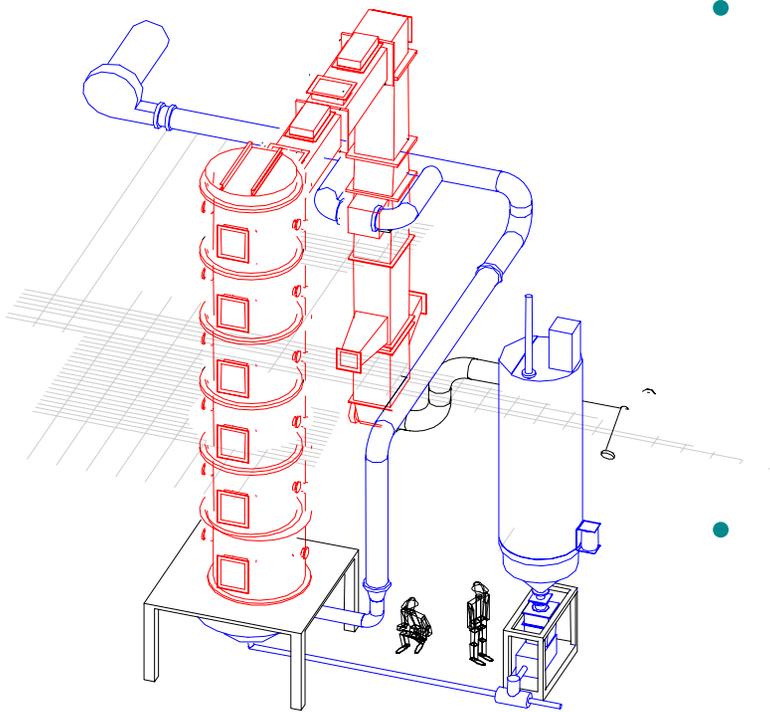
Monitoring, Measurement

- Regulatory uncertainty – SNPR puts QuickSEM™ (QSEM™) applicability in question
- Technical questions remaining
 - Will CEMs/QSEM work in all flue gas environments?
 - Ready in time?
 - Costs, maintenance for CEMs?
- Solution path
 - CEMs – support EPA, vendor testing
 - QSEM - Field tests
 - Emissions test programs at many power companies providing feedback
 - Wet stacks, Se &/or SO₃ rich flue gas, proportional flow



Flue Gas Chemistry

Mercury Speciation at Inlet to 1st APCD



- **Questions remaining**
 - Reactions, rates esp. with unburned carbon, fly ash
 - Model enhancements needed for reliable, confident predictions
 - Inherent, stimulated oxidation/sorption
- **Solution path**
 - Pilot combustor studies
 - Ongoing data sharing with DOE
 - Modeling pilot and field data
 - Fundamental studies by EPA, et.al.

Pre-combustion Mercury Removal

- **Moderate reduction option may open door to greater use of cleaned or “Hg-compliant” coal**
- **Questions remaining**
 - How much Hg-compliant coal available?
 - Removal %, fate of Hg by PRB/lignite upgrading processes
 - Safety, performance in boiler, deployment timeliness
 - Acceptability by fuel purchaser
- **Solution path**
 - Engineering evaluations
 - Possible test burns
 - Possible Hg-balance measurements at upgrading facilities



SCR + FGD Co-benefits

– Questions remaining

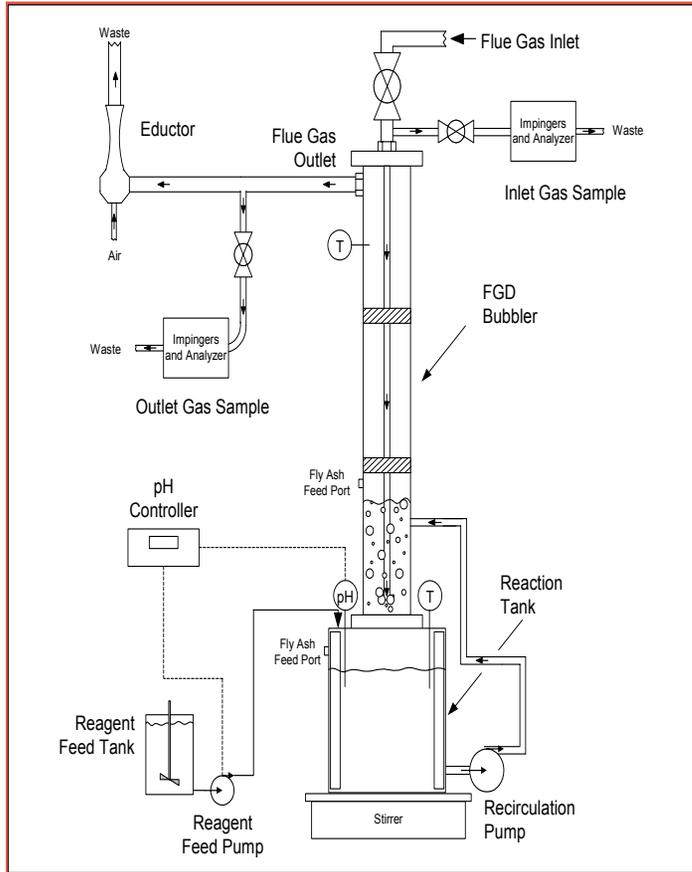
- Effect of FGD design on Hg removals?
- Re-emissions?
- PRB coals – are co-benefits possible?
- Predicting SCR oxidation: variation with catalyst, SO₃ oxidation, flue gas, catalyst age

– Solution path

- Field tests to include:
 - Limestone, forced oxidation FGDs
 - PRB coals, more bituminous
- Pilot sidestream SCR, bench-scale tests



Capture/Fate of Mercury in FGD



- Question remaining
 - Not all Hg^{++} captured by FGD
 - Some captured Hg^{++} emitted as Hg^0
 - Chemistry causing above poorly understood
 - Possibly sampling artifact?
- Solution path
 - Field tests to seek patterns
 - Full-scale (EPRI and DOE/EPRI)
 - Large pilot (DOE/EPRI)
 - Lab tests in representative pilot

Sorbent Injection



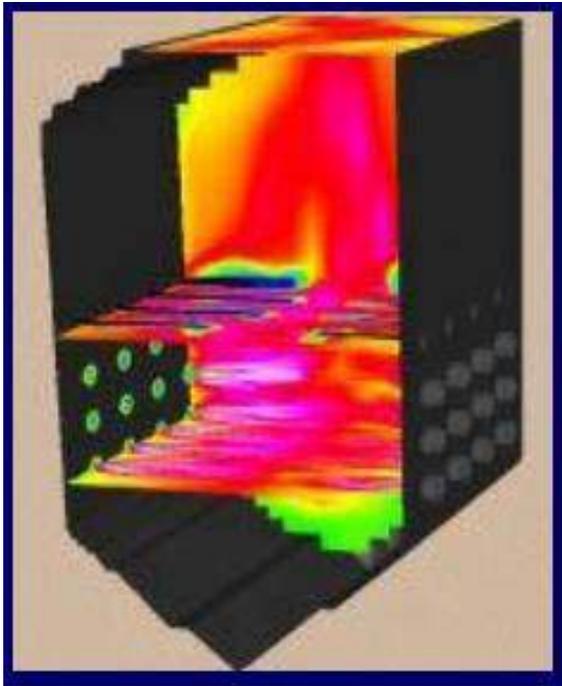
- **Questions remaining**
 - Sustainable performance, costs, impacts for range of coals, combustion conditions (?), particulate controls (incl. hot ESP)
 - Enhancement via chemical addition (W. fuels)
 - Lowest practically-achievable concentrations
- **Solution path**
 - DOE, EPRI/member, other field tests
 - Special interest in: advanced; lower cost; concrete friendly; and non-carbon sorbents and in chemical injection
 - Developing sorbent-adaptable fabrics
 - TOXECON™ II
 - Supporting lab, field pilot

Options for Low/Mod. Hg⁺⁺ & FGD

- Investigating oxidation catalysts (post-ESP) and chemical addition
 - Also FGD additives
- Questions remaining
 - Catalyst performance, life, cost for range of fuels
 - What chemicals work, how much needed, differences with coal, boiler impacts, safety, costs
- Solution path
 - DOE catalysts field pilot tests, full-scale designs
 - Full-scale injection tests, pilot combustor trials, modeling



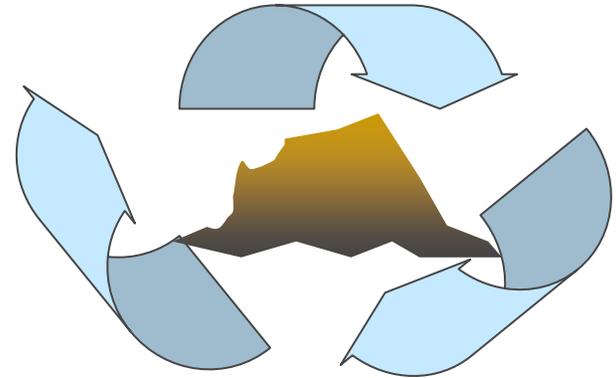
Enhancing Capture by UBC – Option for Small, Cycling Plants?



- **Questions remaining**
 - Applicability to all coals, firing types
 - Ability to achieve goal @ no/small increase in UBC?
 - Monitors needed?
 - Ability to control combustion process day-to-day?
 - Ash beneficiation/disposal trade-off
- **Solution path**
 - Field tests
 - Possible modeling

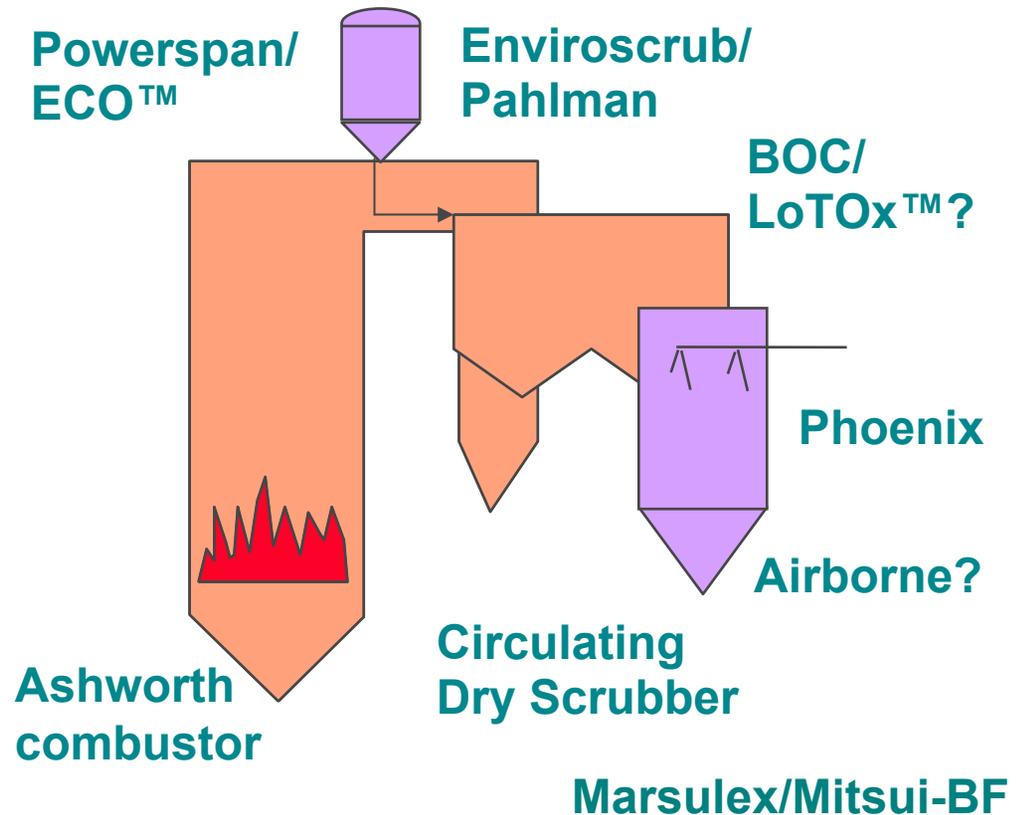
Impacts of Controls on Combustion Product Use

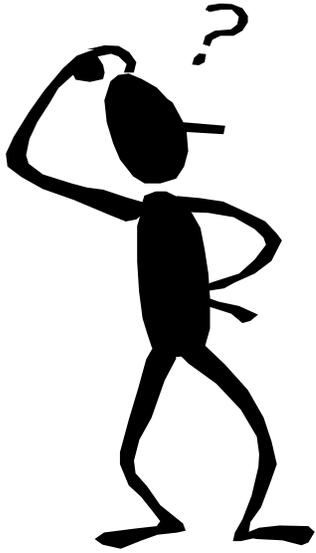
- **Mercury appears fixed in ash, less certain about gypsum in landfill**
- **General interest in using ash, gypsum to avoid landfill, gain other benefits**
- **Questions remaining – fate of Hg when**
 - Ash used in high temperature applications
 - Gypsum calcined for wallboard
 - Gypsum or ash used in land applications
- **Solution path:**
 - Lab tests
 - Field test of gypsum plant, possibly cement kiln using ash feedstock
 - Scoping effort for land applications – esp. gypsum for agriculture



Emerging Multi-Pollutant Controls – A Potential Option

- Many processes, a few leaders
- Niche technology – need for 3-P controls simult.
- Expect 10-25% savings over separate controls
 - Fertilizer market key to economics
- Commercial availability 3-5 years
 - Supportive legislation?
- EPRI seeking out, evaluating, testing





Questions?