



ADA-ES/DOE Mercury Control Program at Wisconsin Electric Pleasant Prairie Power Plant

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ADA-ES Hg Control Program

- Full-scale field testing of sorbent-based mercury control on non-scrubbed coal-fired boilers
- Primary funding from DOE National Energy Technology Laboratory (NETL)
- Cofunding provided by:
 - Wisconsin Electric
 - EPRI
 - Southern Company
 - PG&E NEG
 - Ontario Power Generation
 - TVA
 - First Energy
 - Kennecott Energy

Objective

- **Determine the cost and impacts of sorbent injection into the cold side ESP for mercury control.**
 - Conduct tests on $\frac{1}{4}$ of Unit 2 gas stream (150 MW).
 - Evaluate mercury removal as a function of sorbent injection rate.
 - Evaluate impacts including ESP performance and ash marketability.

Key Features of PPPP Tests

- Burns coals from the Powder River Basin
- One ESP chamber can be treated in isolation. (1/4 of unit ~ 150 MW)
- Baseline mercury removal (1999) showed no removal of mercury by the ash. High percentage of elemental mercury.
- Long duct runs provided good residence times for spray cooling and sorbent injection.
- Fly ash is currently sold as a valuable commodity. Impacts on ash re-use are important in determining the real costs of mercury control.

Activated Carbon Storage and Feed System



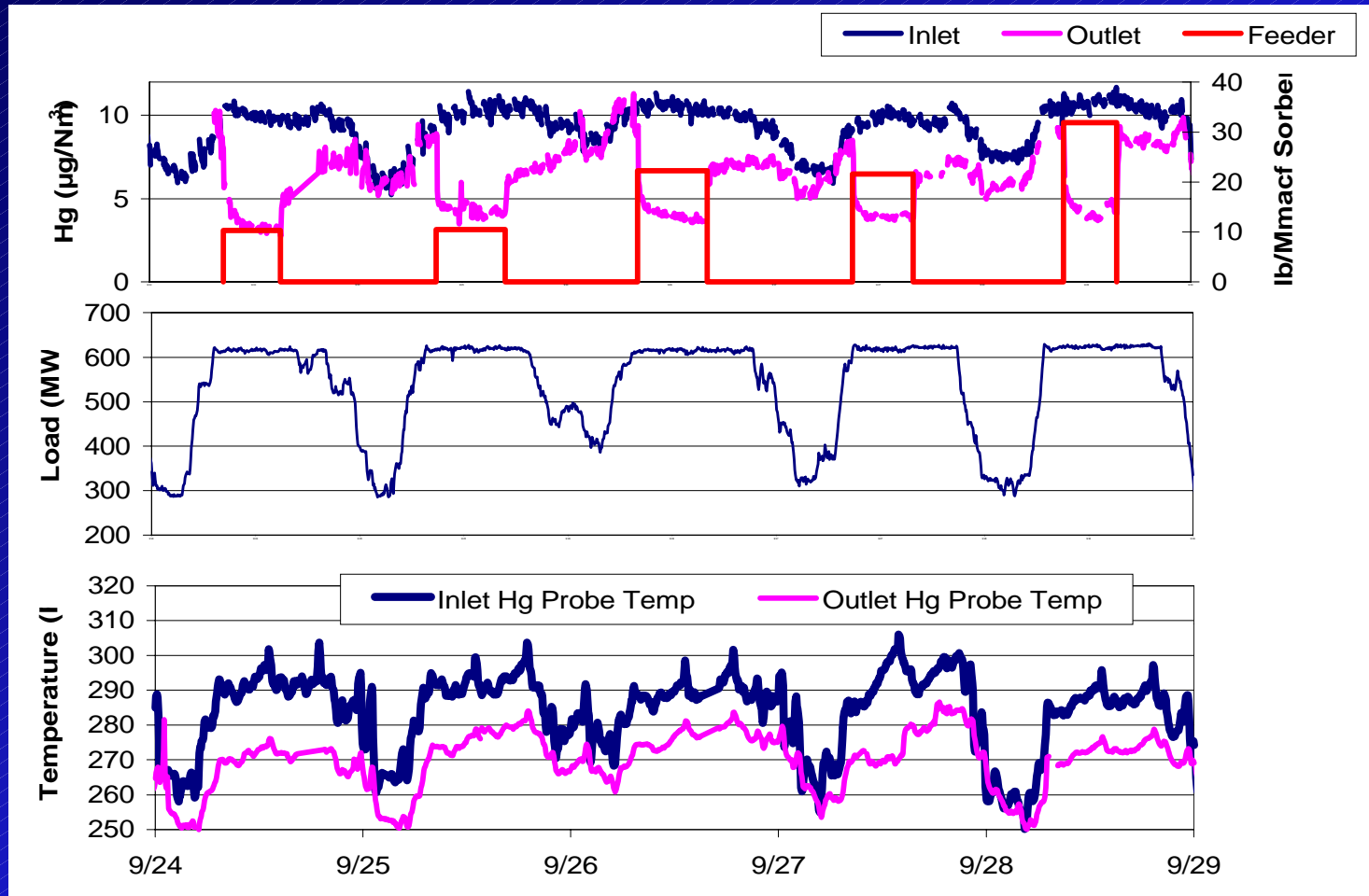
Powdered Activated Carbon Injection System



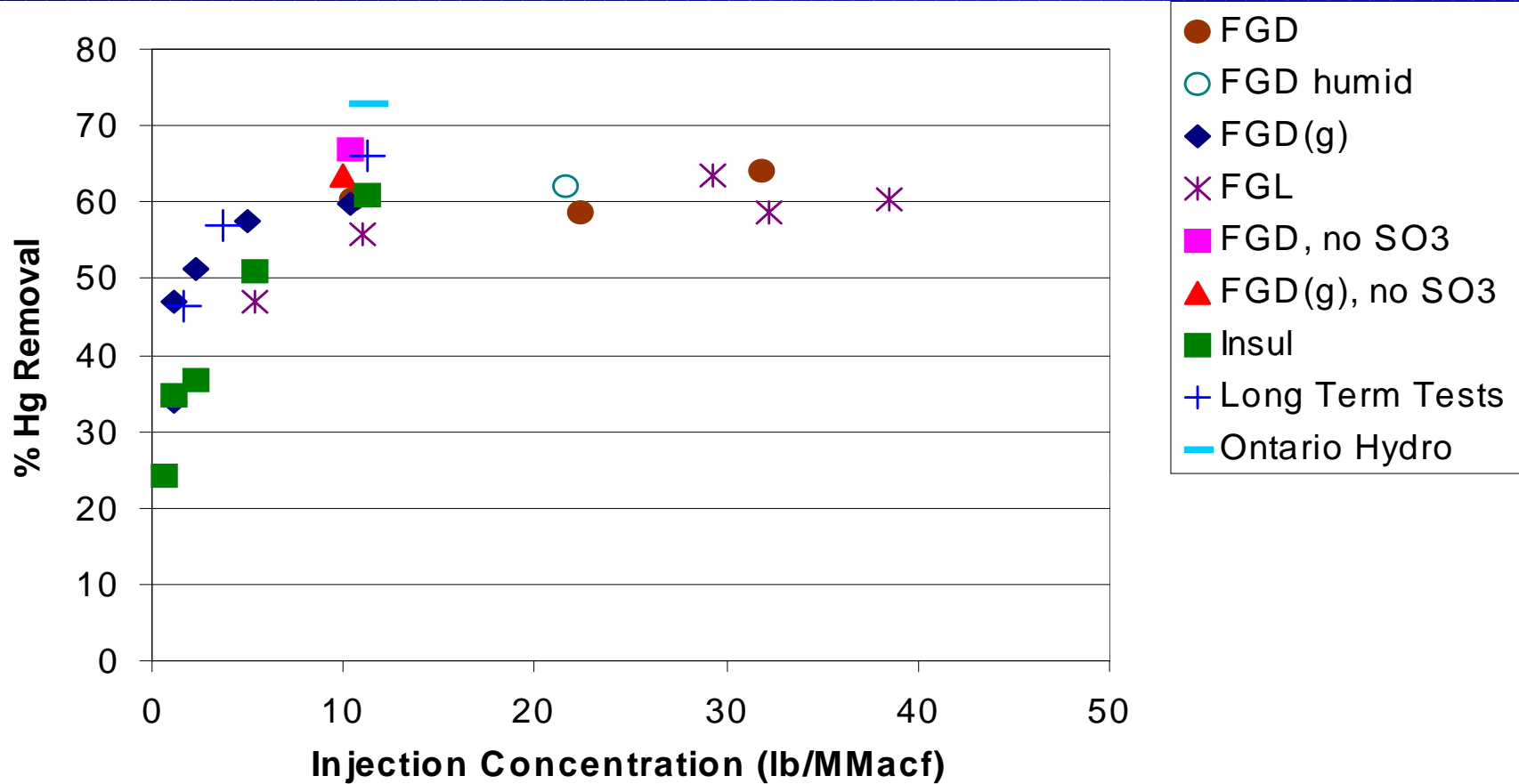
Baseline Hg Measurements ($\mu\text{g}/\text{dscm}$)

Location	Particle Bound	Oxidized, Hg^{2+}	Elemental, Hg^0	Total, Hg
Inlet '99	0.16	2.29	6.21	8.65
Outlet '99	0.13	4.14	5.23	10.37
Inlet '01	1.84	2.34	11.39	15.55
Outlet '01	0.01	5.60	9.13	14.7

Mercury Trends Week 1



Carbon Injection Performance on a PRB Coal with an ESP



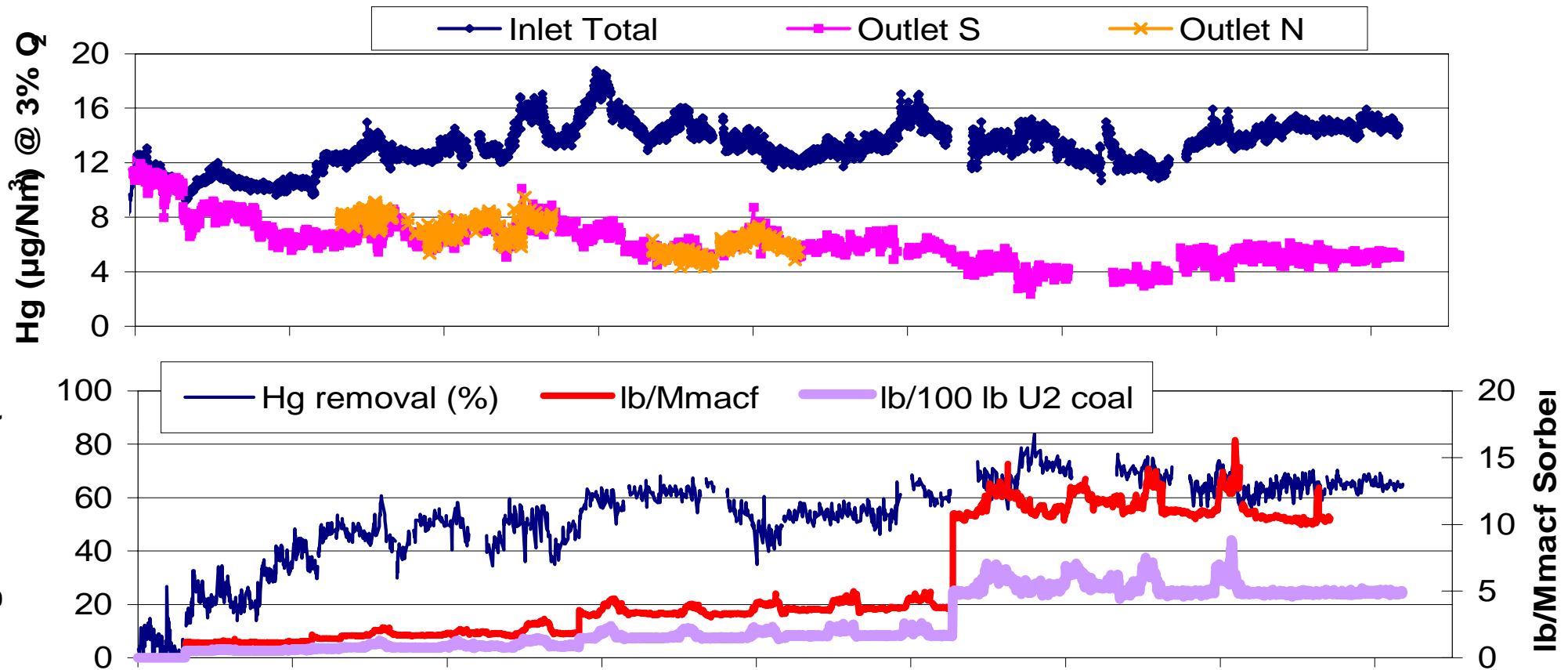
Parametric Test Conclusions

- Higher than expected removal observed at very low injection rates
- Hg removal improves rapidly with injection rates up to nominally 5 lbs/Mmacf
- Increase in performance minimal above 5 lbs/Mmacf
- No significant impact of SO₃ injection on Hg removal
- No improvement with spray cooling of 40 – 50°F
- No significant difference between carbons
- Smaller sized sorbent did not improve performance
- Achieving 60 – 65% removal at lower than expected injection rates (insignificant increase in removal by injecting additional carbon)

Long-Term Test Plan (5 days each)

- All tests conducted with Norit Americas Darco FGD
- Very Low Rate of 1 lb/MMacf
 - Minimize impact on ash
 - What is removal efficiency at very low rate?
- Low Rate of 3 lbs/Mmacf
 - Logarithmic “middle” point
 - Will removal efficiency increase with time?
- Highest Removal at 10 lbs/MMacf
 - Ontario Hydro Tests
 - Impact on ESP

Long-Term Trend Data



Speciated Mercury Measured by S-CEM

Species (microg/dncm)	1 lb/Mmacf		3 lb/Mmacf		10 lb/Mmacf	
	Inlet	Outlet	Inlet	Outlet	Inlet	Outlet
Particulate	NA	NA	NA	NA	NA	NA
Elemental	10.7	4.9	11.7	4.5	11.0	3.2
Oxidized	1.3	1.9	2.2	1.5	2.6	1.3
Total	12.0	6.8	13.9	6.0	13.6	4.5
% Oxidized	11	28	16	25	19	28

Note: Total and elemental mercury measured directly, oxidized mercury calculated from the difference.

Speciated Mercury Measured by Ontario Hydro Method (10 lbs/MMacf)

	Baseline		Long Term	
	Inlet	Outlet	Inlet	Outlet
Particulate	1.97	0.01	0.98	0.00
Elemental	12.22	9.80	14.73	4.27
Oxidized	2.51	6.01	1.73	0.44
Total	16.71	15.82	17.44	4.71
% Oxidized	15.0%	38.0%	9.9%	9.3%

Comparison of OH and S-CEM*, Long-Term Tests (10 lbs/MMacf)

Run Number Date	Run 1 11/12/2001		Run 2 11/13/2001		Run 3 11/13/2001		Average	
	S-CEM*	OH	S-CEM*	OH	S-CEM*	OH	S-CEM*	OH
Inlet (micrograms/dncm)	13.5	15	13.7	18.3	14.3	19.1	13.8	17.4
Outlet (micrograms/dncm)	4.8	4.0	5.1	5.0	5.4	4.7	5.1	4.7
Removal Efficiency (%)	64.4%	73.4%	62.8%	72.8%	64.0%	75.3%	63.7%	72.9%

* S-CEM measures only gas phase mercury, average calculated over same time as OH tests

Long-Term Test Conclusions

- Hg removal efficiency of 40 - 50% obtained at 1 lb/Mmacf
- Hg removal efficiency of 50 - 60% obtained at 3 lb/Mmacf
- Hg removal efficiency of 60 - 70% obtained at 10 lb/Mmacf
- PAC injection reduced both elemental and oxidized mercury concentrations
- Fly ash could not be used for concrete with PAC present
- More development needed to fully assess and mitigate PAC effects on ash
- No detrimental impact on ESP performance
- On a PRB ash, if the gas temperature is below 300 °F, it appears that additional cooling does not improve capture of mercury