Graymont

Lime-based Circulation Dry Scrubber for Existing Coal-fired EGUs to Comply with the Proposed Utility MACT

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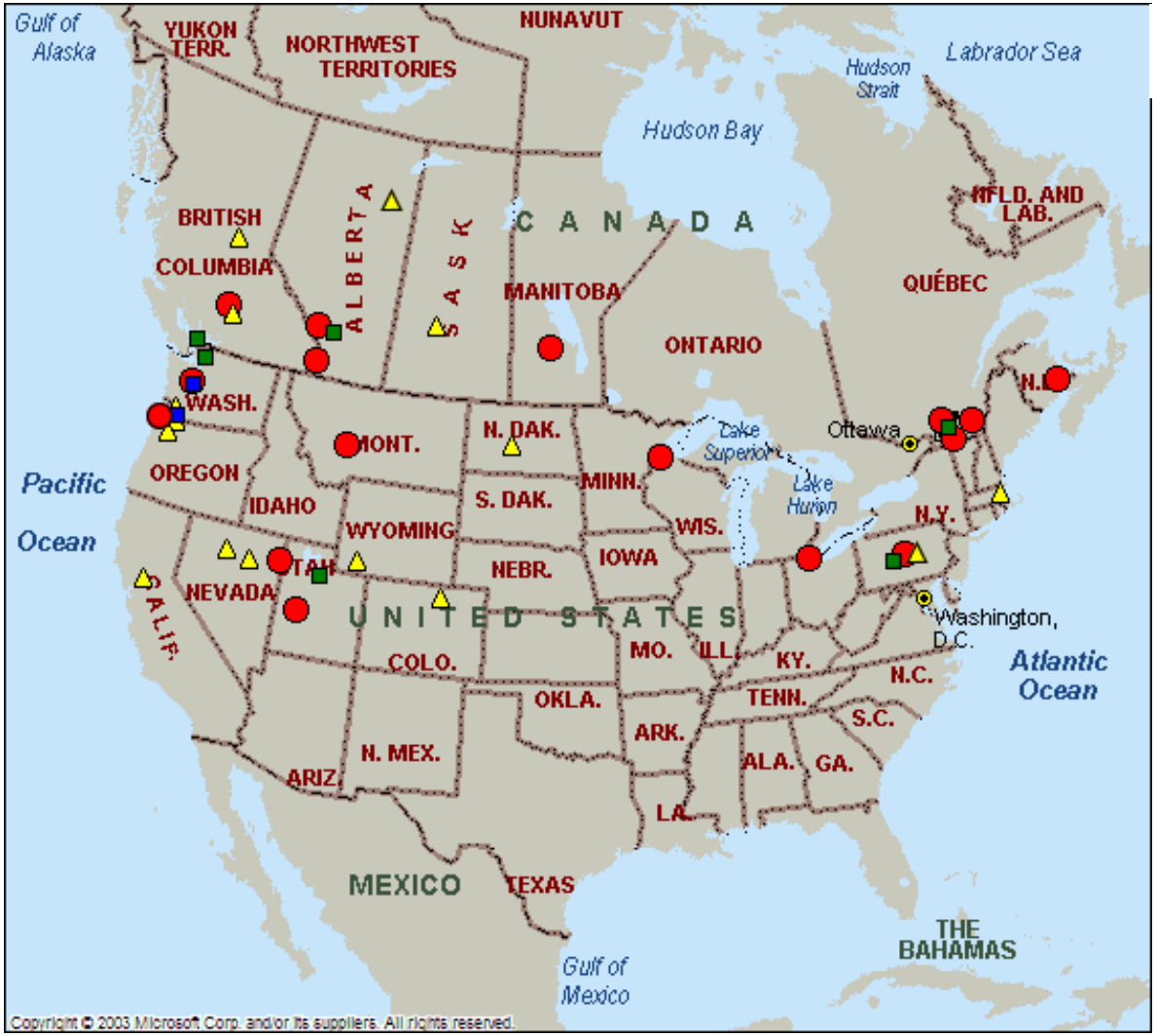
Presentation Outline

- **Graymont and Graymont Lime Operations**
- **U.S. EPA's Proposed Utility MACT (NESHAP)**
  - **Emission Limits for Total PM, HCl & Hg for Existing Coal-fired EGUs**
- **Lime-based Circulation Dry Scrubber (CDS)**
  - **CDS Performance of AES Greenidge Station Unit #4**
- **Take-away**

Graymont and Graymont Lime Operations



- Graymont Regional Offices
- Lime Plants
- Lime Terminals
- PCC Plants

Graymont is a privately owned company, headquartered at Richmond (near Vancouver), BC, Canada. Graymont owns and operates 8 lime plants in Canada and 8 lime plants in the U.S. Graymont is a minority owner of Grupo Calidra, the largest lime producer in Mexico.

Graymont produces quick lime, hydrated lime, limestone, lime kiln dust, and lime slurry for the mining, steel, waste water, flue gas treatment, pulp & paper, chemical, and construction industries.

Graymont has a aggregates/materials division with operations in New York and Quebec areas. Graymont's Ecowaste division operates a landfill near Vancouver, BC, Canada.

Graymont's Products are being Used in Various Flue Gas Treatment Systems

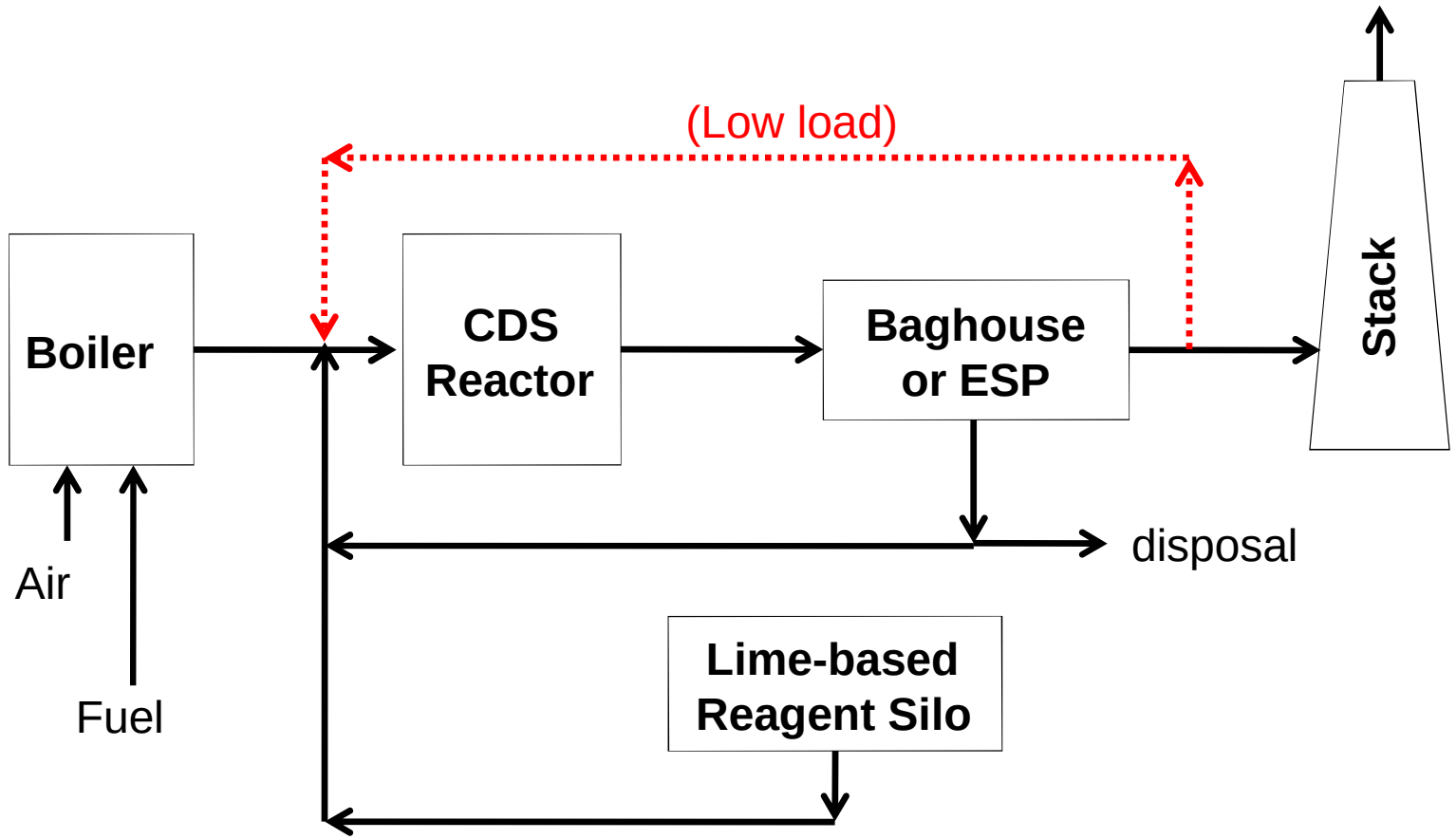
U.S. EPA's Proposed Utility MACT (NESHAP)

Proposed emission limits for existing coal-fired and solid oil-derived fuel-fired electricity generating units (EGUs) are subcategorized by fuel and boiler types.

Subcategory	Total PM	HCl	Hg
Existing coal-fired unit designed for coal > 8,300 Btu/lb	0.03 lb/MMBtu (0.30 lb/MWh)	0.002 lb/MMBtu (0.020 lb/MWh)	1.0 lb/TBtu (0.0008 lb/GWh)
Existing coal-fired unit designed for coal < 8,300 Btu/lb	0.03 lb/MMBtu (0.30 lb/MWh)	0.002 lb/MMBtu (0.020 lb/MWh)	11.0 lb/TBtu (0.20 lb/GWh) 4.0 lb/TBtu* (0.04 lb/GWh*)
Existing - IGCC	0.05 lb/MMBtu (0.30 lb/MWh)	0.0005 lb/MMBtu (0.0030 lb/MWh)	3.0 lb/TBtu (0.020 lb/GWh)
Existing - Solid oil-derived	0.20 lb/MMBtu (2.0 lb/MWh)	0.005 lb/MMBtu (0.080 lb/MWh)	0.20 lb/TBtu (0.0020 lb/GWh)

The proposed regulations were signed by EPA administrator Lisa Jackson on March 16, 2011, and a final rule is to be completed by November 2011. http://www.epa.gov/airquality/powerplanttoxics/)

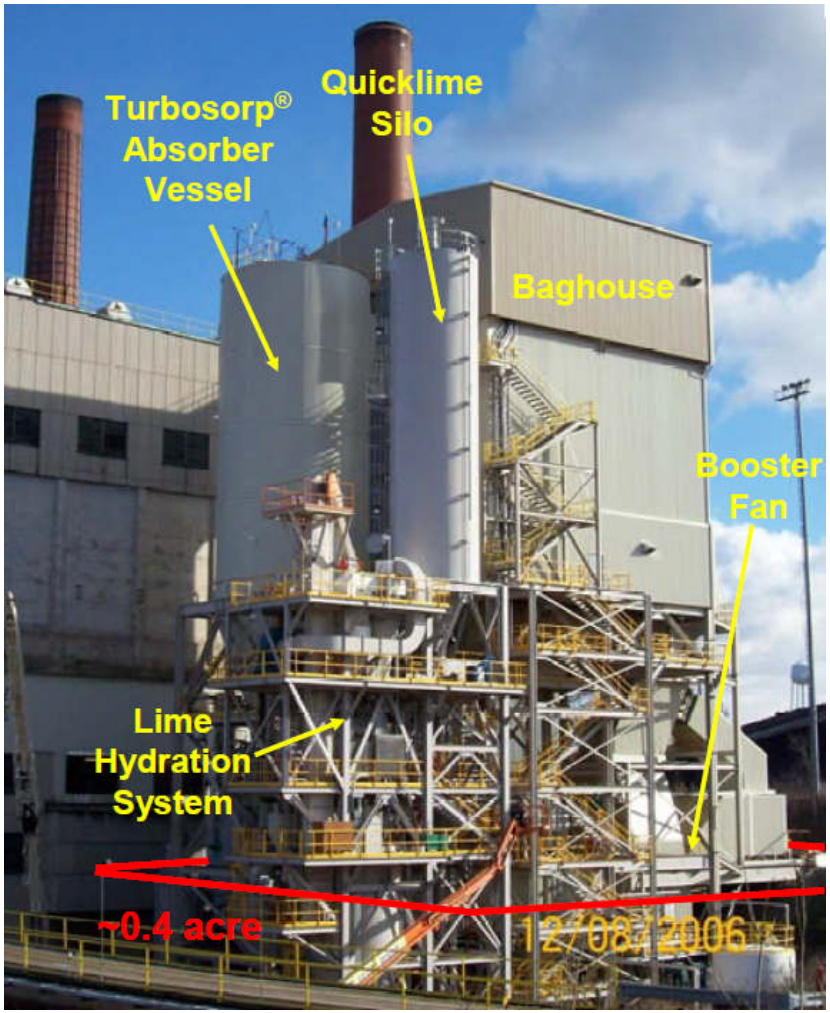
Generic Process Flow Diagram of a CDS System



Process Characteristics of a CDS System

- High circulation rate of finely divided solids
- Lower capex (compared with wet scrubbing systems)
- Multi-pollutant controls (SO_2, SO_3, HCl, HF, Hg, trace metals)
- Fuel flexibility
- Small footprint, simple process, easy to maintain
- Low water consumption
- Dry byproduct (i.e., no waste sludge to handle)

CDS at AES Greenidge Station Unit #4



AES Greenidge Station Unit #4 (Boiler #6)

- **Dresden, NY**
- **107 MW (net)**
- **Combustion Engineering T-fired boiler**
- **Boiler commissioned in 1953**
- **780,000 lb/h steam @1465 psig and 1005ºF**
- **Eastern bituminous coal w/2.5% S**

CDS vendor: Babcock Power Environmental

- **CDS startup: Dec 2006**
- **Onsite hydrator**

The *multi-pollutant control project* at AES Greenidge received funding from the U.S. Department of Energy under Cooperative Agreement DE-FC26-06NT41426

Source: Paper presented by Daniel P. Connell of CONSOL Energy at 2007 Annual AWMA Conference.

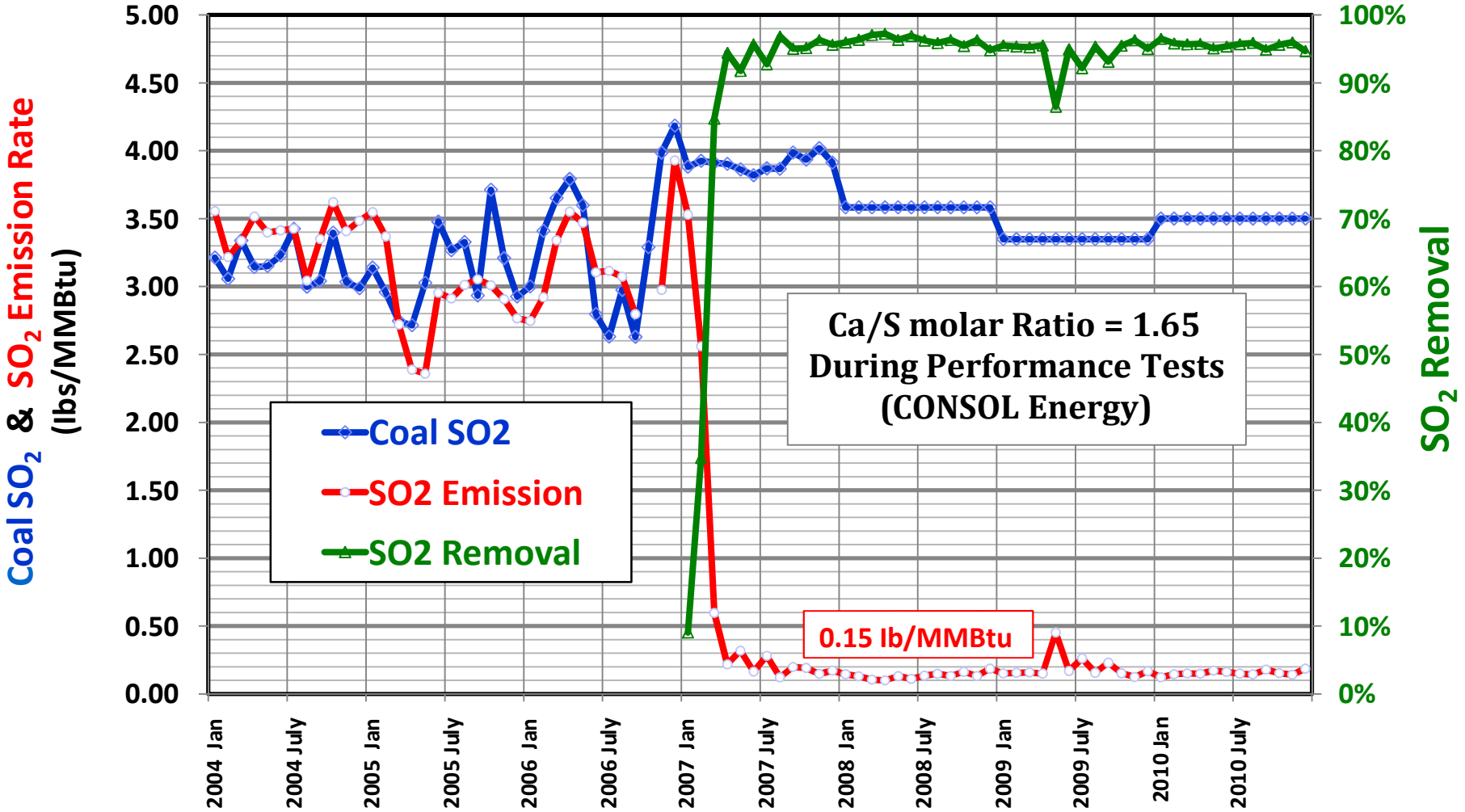
CDS Performance at AES Greenidge Station Unit #4

Fuel: 2.5-3.0% sulfur eastern U.S. bituminous coal

Parameter	Target	Measured
NO_x emissions	≤ 0.10 lb/mmBtu	0.10 lb/mmBtu (Stack CEM, 3/28/07)
SO_2 removal	≥ 95%	96% (Stack CEM, 3/29/07)
Hg removal	≥ 90%	
Without ACI		≥ 95% (Ontario Hydro, 3/28/07)
With ACI		≥ 94% (Ontario Hydro, 3/30/07)
SO_3 removal	≥ 95%	97% (Controlled Condensation, 5/2/07)
HCl removal	≥ 95%	97% (EPA Method 26, 5/4/07)

Source: Paper presented by Daniel P. Connell of CONSOL Energy at 2007 Annual AWMA Conference.

AES Greenidge Station Unit #4



Emission Tests Conducted at AES Greenidge Station Unit #4

- **2004.11.17- Baseline Tests**

In the following tests, the loadings and emissions of PM, SO_3, HCl, HF, and Hg (with speciation) were taken.

- **2007.3.28-29 & 2007.5.4 – Performance Guarantee Tests**
- **2007.3.30 – Carbon Injection Tests**
- **2007.10.2-3 – High S Coal Tests**
- **2007.10.5 – High S Coal with Carbon Injection Tests**
- **2007.10.8-10 – Turbosorp™ Parametric Tests**
- **2007.10.13, 14, & 16 – Low Load & Biomass Co-firing Tests**

- **2008.3.10-13 – Biomass Co-firing Tests**
- **2008.5.19-22 – Low Load Tests**
- **2008.06.10-13 – Follow-up Tests**

Results of Performance Guarantee Tests Conducted at AES Greenidge Station Unit #4

Location	AHO-1	Stack-1	AHO-2	Stack-2	AHO-3	Stack-3	Test 1 Removal	Test 2 Removal	Test 3 Removal
Date	March 28, 2007								
Heat Input (MMBtu/hr) *	1,031	1,034	1,082	1,052	1,055	1,035			
PM (lb/MMBtu) **	5.212	0.00012	4.628	0	4.945	0	100.0%	100.0%	100.0%
Total Hg (lb/TBtu)	7.29	<0.35	8.4	<0.37	7.96	<0.40	>95.2%	>95.6%	>95.0%
Location	AHO-1	Stack-1	AHO-2	Stack-2	AHO-3	Stack-3			
Date	March 29, 2007								
Heat Input (MMBtu/hr) *	1,068.9	959.5	1,035.1	1,014.0	1,052.3	1,006.3			
PM (lb/MMBtu) **	5.108	0.00074	4.818	0.00047	5.071	0.00056	100.0%	100.0%	100.0%
HCl (lb/MMBtu)	Test disqualified ***		0.0386	0.0029	0.0408	0.0012		92.5%	97.1%
HF (lb/MMBtu)	<1.96E-04	<1.15E-04	<2.03E-04	<1.38E-04	<2.00E-04	<1.19E-04			
Location	AHO-1	Stack-1	AHO-2	Stack-2	AHO-3	Stack-3			
Date	May 2, 2007								
SO_3 (lb/MMBtu)	7.51E-02	0.0033	7.35E-02	0.0019	7.56E-02	0.0019	95.6%	97.4%	97.5%
Location	AHO-1	Stack-1	AHO-2	Stack-2					
Date	May 4, 2007								
Heat Input (MMBtu/hr) *	924.4	987.1	1,009.1	983.3					
HCl (lb/MMBtu)	0.0435	0.0014	0.0424	0.0011			96.8%	97.5%	
HF (lb/MMBtu)	<1.51E-04	<9.12E-05	<1.19E-04	<9.15E-05					
* The calculated Heat Input was F-factor based.									
** The PM data were the "front-half" catch of EPA Method 5 sampling train.									
*** The Tests were disqualified due to impinger backflushing									

The original data were taken from “Greenidge Project Final Report” dated May 27, 2009.

Results of Performance Guarantee Tests Conducted at AES Greenidge Station Unit #4

	Total PM (lb/MMBtu)		HCl (lb/MMBtu)	Hg (lb/TBtu)	Date
Utility MACT Proposed by U.S. EPA	0.03		0.002	1.0	Mar. 16, 2011
	PM (lb/MMBtu)	SO_3 (lb/MMBtu)	HCl (lb/MMBtu)	Hg (lb/TBtu)	Date
AES Greenidge Performance Tests	0.00012			<0.37	Mar. 28, 2007
	0.00059		0.0021		Mar. 29, 2007
		0.0024			May 2, 2007
			0.0013		May 4, 2007

The performance test data summarized in the above table were the averages of two or three tests.

Results obtained from performance guarantee tests show that :

(1) The emission of Total PM (non-condensable & condensable) was lower than the proposed utility MACT limit

(2) The emission of HCl met or was lower than the proposed utility MACT limit

(3) The emission of Hg was lower than the proposed utility MACT limit

Take-away

Data obtained from the "performance guarantee tests" conducted at AES Greenidge Station Unit #4 show that the emissions from an existing bituminous coal-fired EGU with a well designed and operated *circulation dry scrubber* with *baghouse* can meet/exceed the Utility MACT limits proposed by U.S. EPA on March 16, 2011.