Staff
EXHIBIT NO. 5
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MEMORANDUM

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FROM: Jim Eddinger, Combustion Group, OAQPS, EPA

DATE: March 15, 2005

SUBJECT: Statistical Analysis of Mercury Test Data to Determine BDT for Mercury Emissions

BACKGROUND

Under section 111 of the Clean Air Act, new source performance standards (NSPS) are to established based on best demonstrated technology (BDT) considering cost, non-air quality environmental impacts, and energy requirements. This memorandum presents an approach to determining an appropriate achievable mercury (Hg) emission level for utility boilers fired with bituminous coal, subbituminous coal, lignite coal, and coal refuse that reflects BDT by using ICR-3 data.

For each coal type, ICR-3 data were reviewed to identify the units that were using technologies which were most effective at capturing ' from coal-fired power plants. The technologies that appeared most effective in reducing Hg emissions were those that were installed, or likely would be installed, to comply with the current NSPS standards for particulate matter (PM) and sulfur dioxide (SO_2). This combination of controls was most effective in reducing Hg emissions and, thus, is considered BDT.

For bituminous coal-fired boilers, BDT is considered to be the combination of a fabric filter (FF) and a flue gas desulfirization (FGD) system. However, recent test data reports show that a bituminous coal-based system including an SCR, ESP, and wet FGD may also be capable of meeting the performance limit set for bituminous coal-fired Utility Units, and this was considered in setting the limit. The FGD may be either a wet scrubber system or a spray dryer absorber (SDA). Of the 27 bituminous units listed in ICR-3, five units had a combination of a FF and a FGD. These units are listed in Table 1, along with the control efficiency, test results, and the BDT statistical analysis results.

For subbituminous coal-fired units, BDT was determined to be depended on water availability. For subbituminous units that are under potential water restriction in the western United States and, thus, do not have a wet FGD system as an option for SO2 control, BDT is considered to be a combination of a FF with a SDA (a dry FGD system). For subbituminous units that are not under water restrictions, BDT is a FF in combination with a wet FGD system. Of the 27 subbituminous units listed in ICR-3, two units have controls representing BDT for the wet

FGD subbituminous subcategory and four units have controls representing BDT for the dry FGD subbituminous subcategory. These units are listed in Table 2, along with the control efficiency, test results, and the BDT statistical analysis results.

For lignite coal-fired units, BDT is considered to be either a FF/SDA system or an ESP with a wet FGD system. Of the 12 lignite coal units listed in ICR-3, six units have controls representing BDT. These units are listed in Table 3 along with the control efficiency, test result, and the BDT statistical analysis results.

For coal refuse, the ICR-3 contain data on only two units. Both were fluidized bed combustion (FBC) units equipped with fabric filters. Both have reported Hg control efficiency of greater than 99 percent. Therefore, BDT for coal refuse units would appear to be FBC/FF combination. One unit fired waste anthracite, the other fired waste bituminous.

STATISTICAL ANALYSIS

To determine the appropriate achievable Hg emission level for each coal type that reflects BDT, a statistical analysis was conducted to determine the appropriate control efficiency achieved by BDT. That is, the Hg reduction efficiency achievable for a source using BDT at the 90th percentile confidence limit using the one-sided z-statistics test (i.e., the control efficiency which BDT is estimated to be able to achieve 90 percent of the time) was determined..

The statistical approach used was the one-sided z-statistics test using the equation:

$$\text{confidence limit} = \text{average} - z * \text{standard deviation},$$

where the value of z is a function of the degrees of freedom and obtained from the statistical table listing *t* distribution critical values. The number of degrees of freedom for sample size *n* is simply *n*-1 for a one-sample mean problem. The z values used in determining the 90 percentile confidence limit are:

Degrees of Freedom	z value
2	1.886
3	1.638
4	1.533
5	1.476

The calculated control efficiency for BDT was then applied to the maximum annual average uncontrolled Hg emission rate for that coal type to determine the appropriate NSPS Hg emission limits. The maximum annual average uncontrolled Hg emission rate were calculated from the annual average Hg fuel content values listed in ICR-3. This was considered reasonable since compliance with the NSPS will be based on a 12-month rolling average. Also the maximum annual average Hg fuel content was used for any unit in the subcategories because the NSPS is applicable nationwide. Using the highest Hg fuel content ensures that the developed NSPS limit are achievable by a unit located anywhere in the United States.

Bituminous Coal

For bituminous coal-fired units, the data used consisted of Hg control efficiency for the 5 units and the annual average fuel Hg content for all bituminous units. The control efficiency of the 5 units using BDT range from 83.8 percent (Intermountain) to 98.5 percent (Mecklenburg Cogeneration Facility). The annual average fuel Hg content for any bituminous coal unit range from a low of 0.0289 ppm (Bay Front Plant Generating) to 0.3186 ppm (AES Cayuga). However, the highest annual average fuel Hg content reported is 85 percent higher than the 2nd highest value and is considered an outliner compared to the other 36 bituminous units. Therefore, the 2nd highest annual average fuel Hg content of 0.1727 ppm (Logan Generating Plant) was used to determine the maximum annual average uncontrolled Hg emission rate.

The average (mean) of the control efficiencies is 94.8 percent, and the standard deviation is 6.2. Therefore, using the above equation:

confidence limit = average - z * standard deviation
90 percent confidence limit = 94.8 - 1.533 * 6.2

the achievable control efficiency for Hg emissions reflecting BDT for bituminous coal-fired units is 85 percent.

Since the Hg emissions from any control system is a linear function of the inlet Hg fuel, assuming a constant control efficiency, the achievable Hg emission limit reflecting BDT for bituminous coal units was calculated by applying the 85 percent reduction to the the maximum annual average uncontrolled Hg emission rate. Therefore, the achievable Hg emission limit reflecting BDT for bituminous coal units is 1.96 lbHg/trillion Btu. The analysis results are reported in Table 1.

Subbituminous Coal

For subbituminous coal-fired units, the same approach was performed as for bituminous coal units, except that the analysis was performed for the two subcategories of subbituminous units (wet FGD and dry FGD).

Wet FGD units

The control efficiency of the 2 units using BDT range are 82.6 percent (Clay Boswell 2) and 62.6 percent (Comanche). Both of these unit are controlled only with a FF, but are considered to reflect BDT since the addition of a wet FGD would only enhance the Hg removal achieved by the FF. There are no subbituminous coal units listed in ICR-3 that have a combination of a FF and a wet FGD. The annual average fuel Hg content for any subbituminous coal unit range from a low of 0.0254 ppm (Craig) to 0.1558 ppm (Jack Watson). However, the highest annual average fuel Hg content reported is 46 percent higher than the 2nd highest value and is considered an outliner compared to the other 34 subbituminous units. Therefore, the 2nd highest annual average fuel Hg content of 0.0918 ppm (San Juan) was used to determine the maximum annual average uncontrolled Hg emission rate.

The average (mean) of the control efficiencies is 72.4 percent, and the standard deviation is 12.9. Therefore, using the above equation:

confidence limit = average - z * standard deviation
90 percent confidence limit = 72.4 - 1.476 * 12.9

the achievable control efficiency for Hg emissions reflecting BDT for wet FGD subbituminous coal units is 53 percent. Therefore, the achievable Hg emission limit reflecting BDT for wet FGD subbituminous coal units calculated by applying the 53 percent reduction to the the maximum annual average uncontrolled Hg emission rate is 4.0 lbHg/TBtu.. The analysis results are reported in Table 2.

Dry FGD units

The control efficiency of the 4 units using BDT range from 23.8 percent (Sherburne County Generation Plant) to 52.5 percent (AES Hawaii). The annual average fuel Hg content for any subbituminous coal unit range from a low of 0.0254 ppm (Craig) to 0.1558 ppm (Jack Watson). However, the highest annual average fuel Hg content reported is 46 percent higher than the 2nd highest value and is considered an outliner compared to the other 34 subbituminous units. Therefore, the 2nd highest annual average fuel Hg content of 0.0918 ppm (San Juan) was used to determine the maximum annual average uncontrolled Hg emission rate.

The average (mean) of the control efficiencies is 35.4 percent, and the standard deviation is 12.15. Therefore, using the above equation:

confidence limit = average - z * standard deviation
90 percent confidence limit = 35.4 - 1.638 * 12.15

the achievable control efficiency for Hg emissions reflecting BDT for dry FGD subbituminous coal units is 16 percent. Therefore, the achievable Hg emission limit reflecting BDT for dry FGD subbituminous coal units calculated by applying the 16 percent reduction to the the maximum annual average uncontrolled Hg emission rate is 7.4 lbHg/TBtu. The analysis results are reported in Table 3.

Lignite Coal

For lignite coal units, the control efficiency of the 6 units using BDT range from 33.3 percent (Antelope Valley Station) to 57 percent (TNP-One). Two (Heskett Station and TNP-One) of the 6 units are fluidized bed combustion (FBC) units which serves as a dry SO2 control. The annual average fuel Hg content for any lignite coal unit range from a low of 0.0620 ppm (TNP-One which was doubled from the reported value in ICR-3 based on later submitted information) to 0.1754 ppm (Monticello). The highest annual average fuel Hg content of 0.1754 ppm was used to determine the maximum annual average uncontrolled Hg emission rate.

The average (mean) of the control efficiencies is 44.6 percent, and the standard deviation is 8.8. Therefore, using the above equation:

confidence limit = average - z * standard deviation
90 percent confidence limit = 44.6 - 1.476 * 8.8

the achievable control efficiency for Hg emissions reflecting BDT for lignite coal units is 32 percent. Therefore, the achievable Hg emission limit reflecting BDT for lignite coal units calculated by applying the 32 percent reduction to the maximum annual average uncontrolled Hg emission rate is 13.7 lbHg/TBtu. The analysis results are reported in Table 4.

For coal refuse units, the approach was similar except that no statistical analysis of the control efficiency was performed since the reported control efficiency for both units both was 99.9 percent. Both units are FBC boilers with FF. One unit combust waste anthracite, the other combust waste bituminous. The highest annual average Hg fuel content is 0.7029 ppm for waste bituminous. The achievable Hg emission limit reflecting BDT calculated by applying the BDT control efficiency of 99.9 percent to the maximum annual average uncontrolled Hg emission rate is 0.13 lbHg/TBtu.

Conversation to Output-Based Units

The output-based equivalent Hg emission limits of the BDT emission limits (lb Hg/TBtu heat input) calculated above can be computed by using the following equation:

32% efficiency

Eo(lb/MWh) = Ei(lb/million) x n(heat rate) x 1000 kwh/Mwh.
For bituminous coal-fired units the output-based BDT limit would be:
Eo(lb/MWh) = 1.96 lb/trillion x 10,667 Btu/kwh x 1000 kwh/Mwh.x 0.000001
where 0.000001 is the conversion factor from TBtu to million Btu
OR
Eo(lb/MWh) = 1.96 lb/trillion x 1.056
where 1.056 is the conversion factor from lb/TBtu to lb x 10^{-5} lb/Mwh

Therefore, for bituminous coal Eo(lb/MWh) = 0.000021lb/Mwh or 2.1×10^{-5} lb/Mwh

The output-based Hg limits for each coal type would be:

bituminous coal = 2.1×10^{-5} lb/Mwh
subbituminous coal (wet FGD units) = 4.2×10^{-5} lb/Mwh
subbituminous coal (dry FGD units) = 7.8×10^{-5} lb/Mwh
lignite coal = 14.5×10^{-5} lb/Mwh
coal refuse = 0.14×10^{-5} lb/Mwh

Permit Information

Recent, available permit Hg levels were evaluated for comparison with the limits presented above. The available permit information is presented in Appendix A. Comparison of the available permit limits with those developed above is a valid "reality check" on the appropriateness of NSPS's limits determined above that reflect BDT. Available permits on bituminous-fired units have Hg emission limits ranging from approximately 2.0×10^{-5} lb/MWh to 3.9×10^{-5} lb/MWh; those for subbituminous-fired units range from 1.1×10^{-5} lb/MWh to 12.6×10^{-5} lb/MWh. Considering the limited number of permits and the limited experience in developing appropriate Hg limits for those permits, the NSPS Hg emission limits developed above are in reasonable agreement with these permits. Insufficient permit information is available to do a similar comparison for lignite- and coal refuse-fired units but we have used the same analytic procedure for these subcategories.

TABLE 1
MERCURY DATA FOR BITUMINOUS COAL-FIRED UTILITY BOILERS USED FOR DETERMINING BDT

BDT: Fabric filter and spray dryer absorber OR Fabric filter and wet FGD
Units using BDT:

Plant Name	Unit Name	Controls	Test Average (lb/TBtu)	Control Efficiency (%)	Fuel Hg content during test (ppm)	Annual Average fuel Hg content (ppm)
Mecklenburg Cogeneration Facility	GEN 1	FF/SDA	0.1062	98.5	0.0967	0.0932
SEI - Birchwood Power Facility	1	FF/SDA/SCR	0.2379	97.2	0.1100	0.1470
Logan Generating Plant	GEN 1	FF/SDA/SCR	0.3348	97.8	0.1800	0.1727
Clover Power Station	2	FF/WS	0.3529	96.7	0.1594	0.0978
Intermountain	2SGA	FF/WS	0.2466	83.8	0.0233	0.0391

Average percent reduction of BDT units: 94.8 percent
Standard deviation: 6.2
Percent reduction of BDT: 85 percent
Highest annual average Hg content used: 0.1727 ppm (Logan Generating Plant)
Maximum annual average uncontrolled Hg emission rate: 13.3 lb/T Btu
Basis for calculated uncontrolled emission rate:

Annual average fuel Hg content = 0.1727 ppm
Average heat content of bituminous coal = 13,000 Btu/lb (Steam)

TABLE 2
MERCURY DATA FOR SUBBITUMINOUS COAL - WET FGD UNITS USED FOR DETERMINING BDT

BDT: Fabric filter and wet FGD
Units using BDT:

Plant Name	Unit Name	Controls	Test Average (lb/TBtu)	Control Efficiency (%)	Fuel Hg content during test (ppm)	Annual Average fuel Hg content (ppm)
Clay Boswell	2	FF	0.6633	86.0	0.0567	0.0701
Comanche	2	FF	2.5931	65.8	0.0922	0.0767

Average percent reduction of BDT units: 72.4 percent
Standard deviation: 12.9
Percent reduction of BDT: 53 percent
Highest annual average Hg content used: 0.0918 ppm (San Juan)
Maximum annual average uncontrolled Hg emission rate: 8.7 lb/T Btu
Basis for calculated uncontrolled emission rate:

Annual average fuel Hg content = 0.0918 ppm
Average heat content of bituminous coal = 12,280 Btu/lb (Steam)

TABLE 3
MERCURY DATA FOR SUBBITUMINOUS COAL - DRY FGD UNITS USED FOR DETERMINING BDT

BDT: Fabric filter and SDA
Units using BDT:

Plant Name	Unit Name	Controls	Test Average (lb/TBtu)	Control Efficiency (%)	Fuel Hg content during test (ppm)	Annual Average fuel Hg content (ppm)
AES Hawaii	A	FBC/FF	0.4606	52.5	0.0267	0.0279
Craig	3	FF/SDA	0.7248	33.6	0.0100	0.0254
Sherburne County	3	FF/SDA	7.5401	23.8*	0.0800	0.0528
Rawhide	101	FF/SDA	7.7630	31.8	0.0733	0.0469

* Run 1 control efficiency, runs 2 and 3 were unrealistic and not used.

Average percent reduction of BDT units: 35.4 percent
Standard deviation: 12.15
Percent reduction of BDT: 16 percent
Highest annual average Hg content used: 0.0918 ppm (San Juan)
Maximum annual average uncontrolled Hg emission rate: 8.7 lb/T Btu
Basis for calculated uncontrolled emission rate:

Annual average fuel Hg content = 0.0918 ppm
Average heat content of bituminous coal = 12,280 Btu/lb (Steam)

TABLE 4
MERCURY DATA FOR LIGNITE COAL USED FOR DETERMINING BDT

BDT: Fabric filter and SDA

Units using BDT:

Plant Name	Unit Name	Controls	Test Average (lb/TBtu)	Control Efficiency (%)	Fuel Hg content during test (ppm)	Annual Average fuel Hg content (ppm)
R.M. Heskett Station	B2	ESP-CS	3.9768	56.1	0.0863	0.0881
Coyote	1	FF/SDA	7.9523	38.2	0.1107	0.1348
Limestone	1	ESP/WS	13.6612	51.0	0.1390	0.1460
Monticello	3	ESP/WS	18.3232	47.6	0.4150	0.1754
Antelope Valley Station	B1	FF/SDA	4.0042	65.7	0.0620	0.0658
TNP-One	U2	FF	10.8596	59.2	0.2547	0.0620*

* ICR-3 value doubled based on later data received

Average percent reduction of BDT units: 44.6 percent

Standard deviation: 8.8

Percent reduction of BDT: 32 percent

Highest annual average Hg content used: 0.1754 ppm (Monticello)

Maximum annual average uncontrolled Hg emission rate: 20.1 lb/T Btu

Basis for calculated uncontrolled emission rate:

Annual average fuel Hg content = 0.1754 ppm

Average heat content of bituminous coal = 8,735 Btu/lb (Steam)

TABLE 4
MERCURY DATA FOR COAL REFUSE-FIRED UTILITY BOILERS USED FOR DETERMINING BDT

Plant Name	Unit Name	Fuel	Controls	Test Average (lb/TBtu)	Control Efficiency (%)	Fuel Hg content during test (ppm)	Annual Average fuel Hg content (ppm)
Kline Township Cogen Facility	GEN 1	Waste Anthracite	FBC/FF	0.0816	99.9	0.3333	0.1733
Scrubgrass Generating Company	GEN 1	Waste Bituminous	FBC/FF	0.0936	99.9	0.5267	0.7029

APPENDIX A

Table 1. Summary of Approved State Air Permits with Mercury Emission Limitations for Coal-Fired Electric Utility Steam Generating Units

Category	State Permitting Authority	Electric Utility Source			Permit Information			Project Status	Comments
		Name	Boiler Type	Unit Capacity	Type	Approval Date	Hg Emissions Limitation		
Bituminous	Illinois EPA	Prairie State Generating Co. Prairie State Generating Station Units 1 and 2	PC	750 MW (each unit)	Construction	1-14-2005	Federal NESHAP limit		
	Illinois EPA	Corn Belt Energy Corporation Prairie Energy Power Plant	PC	91 MW	Construction	12-17-2002	4 x 10^{-6} lb/MMBtu heat input		
	Illinois EPA	Indeck-Elwood LLC (Indeck)	CFB	660 MW	Construction	10-10-2003	2 x 10^{-6} lb/MMBtu heat input		
	South Carolina DHEC	Santee Cooper Power Cross Generating Station Units 3 and 4	PC	660 MW (each unit)	Construction	2-5-2004	3.6 x 10^{-6} lb/MMBtu heat input	Under construction	Facility subject to consent decree with EPA
	Kentucky DEP	Thoroughbred Generating Station Units 1 and 2	PC	750 MW (each unit)	Construction	10-11-2002	3.21 x 10^{-6} lb/MMBtu heat input		
	Kentucky DEP	Hugh L. Spurlock Power Station	CFB	270 MW	Air Quality Permit	8-4-2002	2.65 x 10^{-6} lb/MMBtu heat input		
	West Virginia DEP	Longview Power	PC	600 MW	Construction	3-2-2004	1.46 x 10^{-2} lb/hr based on a 3-hour average and 6.38 x 10^{-2} TPY based on 12 month rolling average.		
Subbituminous	Iowa DNR	MidAmerican Energy Co. Council Bluffs Energy Center Unit 4	PC	790 MW	Construction	6-17-2003	1.7 x 10^{-6} lb/MMBtu heat input		PRB coal Supercritical boiler Sorbent injection
	Utah DEQ	Sevier Power Company's NEVCO Energy	CFB	270 MW	Air Quality Permit	10-12-2004	4 x 10^{-7} lb/MMBtu heat input		Burns a mixture of western bituminous / western (non SRB) subbituminous coal
	Arkansas ADEQ	Plum Point Energy Associates	PC	550-800 MW	Operating	8-20-2003	12.8 x 10^{-6} lb/MMBtu heat input		
	Montana DEQ	Bull Mountain Energy Roundup Power Plant Units 1 and 2	PC	390 MW (each unit)	MACT	7-25-2003	3.23 x 10^{-6} lb/MMBtu heat input		
	Montana DEQ	Rocky Mountain Power Hardin Generation Project	PC	113 MW	Air Quality Permit	12-22-2004	5.8 lb/TBtu heat input based on 1-hour average	Permit decision under appeal	Existing unit permit revision triggered by reconstruction

Table 1 (Continued)

Category	State Permitting Authority	Electric Utility Source			Permit Information			Project Status	Comments
		Name	Boiler Type	Unit Capacity	Type	Approval Date	Hg Emissions Limitation		
	Missouri DNR	City Utilities of Springfield Southwest Power Station Unit 2	PC	275 MW	Construction	12-15-2004	7.5 x 10^{-6} lb/MMBtu heat input		
	Arizona DEQ	Tucson Electric Power Company Springerville Units 3 and 4	PC	400 MW (each unit)	Air Quality Permit	2-14-2002	6.9 x 10^{-6} lb/MMBtu heat input		
	Wisconsin DER	WE Energies Elm Road Generating Station	PC	615 MW (each unit)	Construction	1-14-2004	1.12 lb/TBtu heat input in any 12-consecutive months		PRB coal Supercritical boiler
	Wisconsin DER	Wisconsin Public Service Corp. Weston Plant	PC	500 MW	Construction	10-19-2004	1.7 lb/TBtu heat input in any 12-consecutive months	Permit decision under appeal	PRB coal Supercritical boiler Sorbent injection
Lignite	Texas TCEQ	Texas-New Mexico Power Company TNP One Units 1 and 2	CFB	175 MW (each unit)	Air Quality Permit	5-12-1987	Maximum Allowable Emission Rates 0.3 lb/hr, 1.3 TPY		Permit to construct and operate Issued 5/12/87
Lignite	Texas TCEQ	Alcoa's Rockdale Power Plant CFB 1and CFB 2	CFB	216.5 MW Net (each unit)	Air Quality Permit	10-25-2003	Maximum Allowable Emission Rates 0.033 lb/hr, 0.048 TPY		While these units will be industrial boilers at a primary aluminum plant they are fed by a mine-mouth facility and by permit must meet 40 CFR Part 60 Subparts A and Da.
IGCC	No units of this design have been permitted								
Coal refuse	Kentucky DEP	Kentucky Mountain Power	CFB	250 MW	Construction	6-15-2000	81 x 10^{-6} lb/MMBtu heat input		
Coal refuse/coal	Illinois EPA	EnviroPower of Illinois, LLC	CFB	250 MW (each unit)	Construction	7-3-2001	4 x 10^{-6} lb/MMBtu heat input		Burns a mixture of bituminous coal refuse (culm) and bituminous coal

Table 2. Summary of Air Pollution Control Configfurations for Coal-Fired Electric Utility Steam Generating Units With Approved State Air Permits with Mercury Emission Limitations

Category	Electric Utility Source			Air Emission Control Configuration					Comments
	Name	Boiler Type	Unit Capacity	Combustion Controls	Post- Combustion Control Sequence				
Bituminous	Prairie State Generating Co. Prairie State Generating Station Units 1 and 2	PC	750 MW (each unit)	Low-NO_x burners	SCR	ESP	Wet FGD Scrubber	Wet ESP	
	Corn Belt Energy Corporation Prairie Energy Power Plant	PC	91 MW	Low-NO_x burners/staged combustion	SCR	ESP	Wet FGD Scrubber		
	Indeck-Elwood LLC (Indeck)	CFB	660 MW		SNCR	Lime Injection		Fabric Filter	
	Santee Cooper Power Cross Generating Station Units 3 and 4	PC	660 MW (each unit)		SCR	ESP	Wet FGD Scrubber		
	Thoroughbred Generating Station Units 1 and 2	PC	750 MW (each unit)	Low-NO_x burners	SCR	ESP	Wet FGD Scrubber	Wet ESP	
	Hugh L. Spurlock Power Station	CFB	270 MW		SNCR	Lime Injection		Fabric Filter	
	Longview Power	PC	600 MW	Low-NO_x burners	SCR		Wet FGD Scrubber	Fabric Filter	
Subbituminous	MidAmerican Energy Co. Council Bluffs Energy Center Unit 4	PC	790 MW	Low-NO_x burners	SCR	Activated Carbon Injection	Lime Spray Dryer	Fabric Filter	
	Sevier Power Company's NEVCO Energy	CFB	270 MW		SNCR	Lime Injection	Lime Spray Dryer	Fabric Filter	Burns a mixture of western bituminous / western (non SRB) subbituminous coal
	Arkansas Plum Point Energy Associates	PC	550-800 MW		SCR		Wet FGD Scrubber	Fabric Filter	
	Bull Mountain Energy Roundup Power Plant Units 1 and 2	PC	390 MW (each unit)	Low-NO_x burners	SCR		Lime Spray Dryer	PJ Fabric Filter	
	Rocky Mountain Power Hardin Generation Project	PC	113 MW		SCR		Lime Spray Dryer	Fabric Filter	
	City Utilities of Springfield Southwest Power Station Unit 2	PC	275 MW	Low-NO_x burners	SCR	Activated Carbon Injection (Note A)	Lime Spray Dryer	Fabric Filter	

Table 2 (Continued)

Category	Electric Utility Source			Air Emission Control Configuration					Comments
	Name	Boiler Type	Unit Capacity	Combustion Controls	Post- Combustion Control Sequence				
	Tucson Electric Power Company Springerville Units 3 and 4	PC	400 MW (each unit)	Low-NO_x burners	SCR		Lime Spray Dryer	Fabric Filter	
	WE Energies Elm Road Generating Station	PC	615 MW (each unit)	Low-NO_x burners	SCR	ESP	Wet FGD Scrubber	Wet ESP	
	Wisconsin Public Service Corp. Weston Plant	PC	500 MW	Low-NO_x burners	SCR	Activated Carbon Injection	Lime Spray Dryer	Fabric Filter	
Lignite	Texas-New Mexico Power Company TNP One Units 1and 2	CFB	175 MW (each unit)			Lime Injection		Fabric Filter	
Lignite	Alcoa's Rockdale Power Plant CFB 1and CFB 2	CFB	216.5 MW Net (each unit)		SNCR	Lime Injection		Fabric Filter	
IGCC	No units of this design have been permitted								
Coal refuse	Kentucky Mountain Power	CFB	250 MW		SCNR	Lime Injection		Fabric Filter	
Coal refuse	EnviroPower of Illinois, LLC	CFB	250 MW (each unit)		SNCR	Lime Injection		Fabric Filter	Burns a mixture of bituminous coal refuse (culm) and bituminous coal

Note A. The entity building this plant decided to include as a part of this project the emissions associated with a potential Hg control system. The entity building this plant is anticipating controlling Hg emissions by means of injecting powdered activated carbon. However, a final decision as to the exact method of Hg control has not been made. The entity building this plant does plan on installing some type of Hg control, but is holding off making a final decision until a later date so that the most effective system of Hg control that has been shown to be compatible with the NO_x, PM, and SO_x pollution control technologies can be determined. If the Hg control is not powdered activated carbon, then it will be at least as effective.

Table 3. Summary of Mercury Emission Limitations for Coal-Fired Electric Utility Steam Generating Units

Category	Electric Utility Source		Emission Limits		Comments
	Name	Permit Hg Emissions Limitation	Converted to input-based Emissions Limitation	Converted to output-based Emissions Limitation	
Bituminous	Prairie State Generating Co. Prairie State Generating Station Units 1 and 2	Federal NESHAP limit	NA	NA	No defined emission limit
	Corn Belt Energy Corporation Prairie Energy Power Plant	4 x 10^{-6} lb/MMBtu heat input	4 lb/TBtu	3.9 x 10^{-5} lb/MWh	A
	Indeck-Elwood LLC (Indeck)	2 x 10^{-6} lb/MMBtu heat input	2 lb/TBtu	2 x 10^{-5} lb/MWh	A
	Santee Cooper Power Cross Generating Station Units 3 and 4	3.6 x 10^{-6} lb/MMBtu heat input	3.6 lb/TBtu	3.5 x 10^{-5} lb/MWh	A
	Thoroughbred Generating Station Units 1 and 2	3.21 x 10^{-6} lb/MMBtu heat input	3.21 lb/TBtu	3.2 x 10^{-5} lb/MWh	A
	Hugh L. Spurlock Power Station	2.65 x 10^{-6} lb/MMBtu heat input	2.65 lb/TBtu	2.6 x 10^{-5} lb/MWh	A
	Longview Power	1.46 x 10^{-2} lb/hr based on a 3-hour average and 6.38 x 10^{-2} TPY based on 12 month rolling average.	2.4 lb/TBtu	2.3 x 10^{-5} lb/MWh	A, B
Subbituminous	MidAmerican Energy Co. Council Bluffs Energy Center Unit 4	1.7 x 10^{-6} lb/MM Btu heat input	1.7 lb/TBtu	1.7 x 10^{-5} lb/MWh	A
	Sevier Power Company's NEVCO Energy	4 x 10^{-7} lb/MM Btu heat input	0.4 lb/TBtu	0.39 x 10^{-5} lb/MWh	A
	Plum Point Energy Associates	12.8 lb/TBtu heat input	12.8 lb/TBtu	12.6 x 10^{-5} lb/MWh	A
	Bull Mountain Energy Roundup Power Plant Units 1 and 2	3.23 x 10^{-6} lb/MMBtu heat input	3.23 lb/TBtu	3.2 x 10^{-5} lb/MWh	A
	Rocky Mountain Power Hardin Generation Project	5.8 lb/TBtu heat input based on 1-hour average	5.8 lb/T Btu	5.7 x 10^{-5} lb/MWh	A
	City Utilities of Springfield Southwest Power Station Unit 2	7.5 x 10^{-6} lb/MMBtu heat input	7.5 lb/TBtu	7.4 x 10^{-5} lb/MWh	A

Table 3 (Continued)

Category	Electric Utility Source		Emission Limits		Comments
	Name	Permit Hg Emissions Limitation	Converted to input-based Emissions Limitation	Converted to output-based Emissions Limitation	
	Tucson Electric Power Company Springerville Units 3 and 4	6.9×10^{-6} lb/MMBtu heat input	6.9 lb/TBtu	6.8×10^{-5} lb/MWh	A
	WE Energies Elm Road Generating Station	1.12 lb/TBtu heat input in any 12-consecutive months	1.12 lb/TBtu	1.1×10^{-5} lb/MWh	A
	Wisconsin Public Service Corp. Weston Plant	1.7 lb/TBtu heat input in any 12-consecutive months	1.7 lb/TBtu	1.7×10^{-5} lb/MWh	A
Lignite	Texas-New Mexico Power Company TNP One Units 1 and 2	Maximum Allowable Emission Rates 0.3 lb/hr, 1.3 TPY	190 lb/TBtu	186×10^{-5} lb/MWh	A, C, D
	Alcoa's Rockdale Power Plant CFB 1and CFB 2	Maximum Allowable Emission Rates 0.033 lb/hr, 0.048 TPY	3.7 lb/TBtu	3.6×10^{-5} lb/MWh	A, E
IGCC	No units of this design have been permitted			2×10^{-5} lb/MWh	F
Coal refuse	Kentucky Mountain Power	81×10^{-6} lb/MMBtu heat input	81 lb/TBtu	80×10^{-5} lb/MWh	A, G
Coal refuse/coal	EnviroPower of Illinois, LLC	4×10^{-6} lb/MMBtu heat input	4 lb/TBtu	3.9×10^{-5} lb/MWh	A, H

Notes:

A The emission limits were converted from input-based standard (lb/TBtu) to output-based standard (lb/MWh) by multiplying by 9.8×10^{-6}. This factor incorporates a 35 percent efficiency is 10 joules per watt hour (J/Wh) (9,833 Btu per kilowatt hour (kWh)).

B Based on a boiler capacity of 6,114 MMBtu/hr. A permitted emission limit of 6.38×10^{-2} TPY * 2000 lb/T / 8760 hr/yr / 6,114 MMBtu/hr = 2.4×10^{-6} lb/ MMBtu or 2.4 lb/ Tbtu. 2.4 lb/ Tbtu * 9.8×10^{-6} = 2.3 $\times 10^{-5}$ lb/MWh.

C Based on EPA ICR stack testing done on 10/6 - 10/8/99. While testing the coal feed averaged 234,897 lb/hr. The heat content of the coal averaged 6670 Btu/lb. 234,897 lb/hr • 6670 Btu/lb / 1,000,000 = 1,566.6 MMBtu/hr. A permitted emission limit of 1.3 TPY * 2000 lb/T / 8760 hr/yr / 1,566.6 MMBtu/hr = 1.90×10^{-4} lb/MMBtu or 190 lb/Tbtu. 190 lb/Tbtu * 9.8×10^{-6} = 186 $\times 10^{-5}$ lb/MWh.

D This permit level predates the 1990 Amendments to the CAA so we would not give it much credence. There appear to be no other new or existing lignite-fired units with a Hg emission limit.

E Based on a boiler capacity of 2,960 MMBtu/hr. A permitted emission limit of 0.048 TPY * 2000 lb/T / 8760 hr/yr / 2,960 MMBtu/hr = 3.7×10^{-6} lb/ MMBtu or 3.7 lb/ Tbtu. 3.7 lb/ Tbtu • 9.8×10^{-6} = 3.6 $\times 10^{-5}$ lb/MWh.

F The are currently no units of this design (IGCC) have been permitted. However it is prudent to promulgate a new emissions limit. For this limit we used the ICR proposed emission limit data from the only two IGCC units in the country.

G This is a very high limit for a bituminous coal refuse (culm)-fired unit with this furnace type and these controls. We called Kentucky DEP and asked about the limit and they also noted it was very high and wondered why it hadn't been challenged.

H This unit is permitted to fire a mixture of waste bituminous (culm) and bituminous coal therefore it is not strictly a coal refuse-fired unit.