

## **MEMORANDUM**

TO: Robert Wayland, Group Leader, Combustion Group, OAQPS, EPA

FROM: Bill Maxwell, Combustion Group, OAQPS, EPA

DATE: October 21, 2005

SUBJECT: Revised New Source Performance Standard (NSPS) Statistical Analysis for Mercury Emissions

## **BACKGROUND**

Under section 111 of the Clean Air Act, new source performance standards (NSPS) are to be 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 using the 1999 information collection request (ICR) data. This memorandum revises and supersedes the March 15, 2004 memorandum entitled "Statistical Analysis of Mercury Test Data to Determine BDT for Mercury Emissions" from Jim Eddinger to you based on issues raised in a Petition to Reconsider the May 18, 2005 Clean Air Mercury Rule (CAMR).

For each coal type, ICR emission test data (ICR-3) were reviewed to identify the units that were using technologies which were most effective at capturing Hg 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<sub>2</sub>). 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 desulfurization (FGD) system. The FGD may be either a wet scrubber system or a spray dryer absorber (SDA). Of the 27 bituminous units listed in ICR-3, 6 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 dependent on water availability. For new subbituminous units that are located where an adequate water supply is not available (i.e., in areas receiving less than or equal to 25 inches per year [in/yr] mean annual precipitation, based on U.S. Department of Agriculture 30-year data), BDT is considered to be a dry FGD system (i.e., a combination of a FF with a SDA). For new subbituminous units that are located where an adequate water supply is available (i.e., in areas receiving greater than 25 in/yr mean annual precipitation, based on U.S. Department of Agriculture 30-year data), BDT is considered to be a wet FGD system. Of the 27 subbituminous units listed in ICR-3, 2 units have controls representing BDT for the “wet” subbituminous subcategory and 4 units have controls representing BDT for the “dry” 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, a fluidized bed combustor (FBC) with an ESP, or an ESP with a wet FGD system. Of the 12 lignite coal units listed in ICR-3, 7 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 contains data on only two units. Both were FBC units equipped with FF. Both have reported Hg control efficiency of greater than 99 percent. Therefore, BDT for coal refuse units is considered to be a 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, we determined the 90<sup>th</sup> percentile Hg reduction efficiency achievable for a source using BDT (i.e., the control efficiency which BDT is estimated to achieve 90 percent of the time) using the one-sided t-statistics test.

The control efficiency used was the greater of that achieved either from the coal-to-the-stack or across the control device as shown through the ICR-3 3-run averages. This approach was used to minimize the impact of “negative” control removals indicated by some of the test results. It is recognized that Hg cannot be generated within a utility boiler/control system and that any negative removals merely indicate that no control is being shown. However, it is also believed that most of the Hg control achieved is being effected by the last control device (the one tested during the ICR program) and that little Hg is removed in the boiler. Therefore, it is believed that use of the highest control adequately reflects performance of the entire system. Further, as negative reductions are not realistic, any negative reductions found were equated to zero.

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

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

where the value of  $t$  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  $t$  values used in determining the 90<sup>th</sup> percentile confidence limit are:

Degrees of Freedom	T value
1	3.078
3	1.638
5	1.476
6	1.440

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 analysis was based on a reasonable maximum Hg content in coal (represented by the 90<sup>th</sup> percentile of measured Hg concentrations in coal) as listed in the ICR coal data (ICR-2). This was considered reasonable since compliance with the NSPS will be based on a 12-month rolling average. Also, this reasonable maximum annual average Hg fuel content was used for any unit in the subcategory 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 under conditions that are reasonably expected to recur.

### Bituminous Coal

For bituminous coal-fired units, the data used consisted of Hg control efficiency for the 6 units and the annual average fuel Hg content for all bituminous units. The control efficiency of the 6 units using BDT range from 83.8 percent (Intermountain) to 98.8 percent (Mecklenburg Cogeneration Facility). The 90<sup>th</sup> percentile annual average Hg content for any bituminous coal was 0.2 ppm.

The average (mean) of the control efficiencies is 95.0 percent, and the standard deviation is 5.6 percent. Therefore, using the above equation:

$$\begin{aligned} \text{confidence limit} &= \text{average} - t * \text{standard deviation} \\ 90^{\text{th}} \text{ percentile confidence limit} &= 95.0 - 1.476 * 5.6 \end{aligned}$$

the achievable control efficiency for Hg emissions reflecting BDT for bituminous coal-fired units is 87 percent.

Because 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 87 percent reduction to the 90<sup>th</sup> percentile annual average uncontrolled Hg emission rate. Therefore, the achievable Hg emission limit reflecting BDT for bituminous coal units is 1.89 lb Hg/TBtu. 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” and “dry”).

“Wet” units

The control efficiency of the 2 units using BDT is 86 percent (Clay Boswell 2) and 66 percent (Comanche). Both of these units are controlled only with a FF, but are considered to reflect BDT since the addition of a wet FGD system would only enhance the Hg removal achieved by the FF. There are no subbituminous coal units listed in ICR-3 that utilize a FF/wet FGD combination. The 90<sup>th</sup> percentile annual average fuel Hg content for subbituminous coal is 0.114 ppm.

The average (mean) of the control efficiencies is 75.9 percent, and the standard deviation is 14.3 percent. Therefore, using the above equation:

$$\begin{aligned} \text{confidence limit} &= \text{average} - t * \text{standard deviation} \\ 90\% \text{ confidence limit} &= 75.9 - 3.078 * 14.3 \end{aligned}$$

the achievable control efficiency for Hg emissions reflecting BDT for wet subbituminous coal units is 32 percent. Therefore, the achievable Hg emission limit reflecting BDT for wet FGD subbituminous coal units is 6.2 lb Hg/TBtu. The analysis results are reported in Table 2.

“Dry” units

The control efficiency of the 4 units using BDT ranges from 8.2 percent (Sherburne County Generation Plant) to 78.8 percent (AES Hawaii). The 90<sup>th</sup> percentile annual average fuel Hg content for subbituminous coal is 0.114 ppm.

The average (mean) of the control efficiencies is 38.1 percent, and the standard deviation is 29.5 percent. Therefore, using the above equation:

$$\begin{aligned} \text{confidence limit} &= \text{average} - t * \text{standard deviation} \\ 90\% \text{ confidence limit} &= 38.1 - 1.638 * 29.5 \end{aligned}$$

the achievable control efficiency for Hg emissions reflecting BDT for dry subbituminous coal units, because of the high standard deviation, was calculated to be a negative removal; this value has been set to 0 percent. Therefore, the achievable Hg emission limit reflecting BDT for dry FGD subbituminous coal units is 9.1 lb Hg/TBtu. The analysis results are reported in Table 3.

Lignite Coal

For lignite coal units, the control efficiency of the 6 units using BDT ranges from 5.9 percent (Stanton 10) to 65.7 percent (Antelope Valley). Two units (R.M. Heskett and TNP-One) are FBC units which serve as a dry SO<sub>2</sub> control. The 90<sup>th</sup> percentile annual average fuel Hg content for lignite coal is 0.217 ppm.

The average (mean) of the control efficiencies is 48.8 percent, and the standard deviation is 21.1 percent. Therefore, using the above equation:

$$\begin{aligned}\text{confidence limit} &= \text{average} - t * \text{standard deviation} \\ 90\% \text{ confidence limit} &= 48.8 - 1.440 * 21.1\end{aligned}$$

the achievable control efficiency for Hg emissions reflecting BDT for lignite coal units is 18 percent. Therefore, the achievable Hg emission limit reflecting BDT for lignite coal units is 16.4 lb Hg/TBtu. The analysis results are reported in Table 4.

### Coal Refuse

For coal refuse units, the control efficiency of the 2 units was 99.9 percent. Both units are FBC boilers with FF. One unit combusts waste anthracite, the other combusts waste bituminous. The 90<sup>th</sup> percentile annual average Hg fuel content for waste bituminous (the primary waste coal utilized) is 0.88 ppm.

The average (mean) of the control efficiencies is 99.9 percent, and the standard deviation is 0.02 percent. Therefore, using the above equation:

$$\begin{aligned}\text{confidence limit} &= \text{average} - t * \text{standard deviation} \\ 90\% \text{ confidence limit} &= 99.9 - 3.078 * 0.02\end{aligned}$$

the achievable control efficiency for Hg emissions reflecting BDT for coal refuse units is 99.9 percent. Therefore, the achievable Hg emission limit reflecting BDT for coal refuse units is 0.09 lb Hg/TBtu. The analysis results are reported in Table 5.

### **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:

$$E_o (\text{lb/MWh}) = E_i (\text{lb/million}) \times n (\text{heat rate}) \times 1000 \text{ kWh/MWh}$$

For bituminous coal-fired units the output-based BDT limit would be:

$$E_o (\text{lb/MWh}) = 1.96 \text{ lb/trillion} \times 10,667 \text{ Btu/kWh} \times 1000 \text{ kWh/MWh} \times 0.000001$$

where 0.000001 is the conversion factor from trillion Btu to million Btu

OR

$$E_o (\text{lb/MWh}) = 2.09 \text{ lb/trillion} \times 1.056$$

where 1.056 is the conversion factor from lb/TBtu to lb x 10<sup>-5</sup> lb/MWh

Therefore, for bituminous coal  $E_o (\text{lb/MWh}) = 0.000022 \text{ lb/MWh}$  or  $2.2 \times 10^{-5} \text{ lb/MWh}$

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

Bituminous coal =	$2.0 \times 10^{-5}$ lb/MWh
Subbituminous coal (wet units) =	$6.6 \times 10^{-5}$ lb/MWh
Subbituminous coal (dry units) =	$9.7 \times 10^{-5}$ lb/MWh
Lignite coal =	$17.5 \times 10^{-5}$ lb/MWh
Coal refuse =	$0.1 \times 10^{-5}$ lb/MWh

### **Permit Information**

Recent, available permit (available in March 2005) 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 limits determined above that reflect BDT. Available permits on bituminous-fired units have Hg emission limits ranging from approximately  $2.0 \times 10^{-5}$  lb/MWh to  $3.9 \times 10^{-5}$  lb/MWh; those for subbituminous-fired units range from  $1.1 \times 10^{-5}$  lb/MWh to  $12.6 \times 10^{-5}$  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: FF and SDA; FF and wet FGD

Units using BDT:

Plant Name	Unit Name	Controls	Test Average (lb/TBtu)	Highest Control Efficiency (%)	Fuel Hg content during test (ppm)	Annual Average fuel Hg content (ppm)
Mecklenburg Cogeneration Facility	GEN 1	FF/SDA	0.1062	98.8	0.0967	0.0932
SEI - Birchwood Power Facility	1	FF/SDA/SCR	0.2379	97.8	0.1100	0.1470
Logan Generating Plant	GEN 1	FF/SDA/SCR	0.2801	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
Collier	2B	FF/SDA	0.1074	95.2	0.0300	0.0767

Average percent reduction of BDT units: 95.0 %

Standard deviation: 5.6 %

Percent reduction of BDT: 86.7 %

90<sup>th</sup> percentile annual average Hg content used: 0.2 ppm

Maximum annual average uncontrolled Hg emission rate: 14.3 lb/TBtu

Basis for calculated uncontrolled emission rate:

90<sup>th</sup> percentile annual average fuel Hg content = 0.2 ppm

90<sup>th</sup> percentile heat content of bituminous coal = 14,018 Btu/lb (ICR-2 data)

**TABLE 2  
MERCURY DATA FOR SUBBITUMINOUS COAL-FIRED (WET) UTILITY BOILERS  
USED FOR DETERMINING BDT**

BDT: FF 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: 75.9 %

Standard deviation: 14.3 %

Percent reduction of BDT: 31.8 %

90<sup>th</sup> percentile annual average Hg content used: 0.114 ppm

Maximum annual average uncontrolled Hg emission rate: 9.1 lb/T Btu

Basis for calculated uncontrolled emission rate:

90<sup>th</sup> percentile annual average fuel Hg content = 0.114 ppm

90<sup>th</sup> percentile average heat content of subbituminous coal = 12,522 Btu/lb (ICR-2 data)

**TABLE 3  
MERCURY DATA FOR SUBBITUMINOUS COAL-FIRED (DRY) UTILITY BOILERS  
USED FOR DETERMINING BDT**

BDT: FF and SDA; FBC and FF

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	78.8	0.0267	0.0279
Craig	3	FF/SDA	0.7248	33.6	0.0100	0.0254
Sherburne County	3	FF/SDA	7.5401	8.2	0.0767	0.0528
Rawhide	101	FF/SDA	7.7630	31.8	0.0733	0.0469

Average percent reduction of BDT units: 38.1 %

Standard deviation: 29.5 %

Percent reduction of BDT: 0.00 %

90<sup>th</sup> percentile annual average Hg content used: 0.114 ppm

Maximum annual average uncontrolled Hg emission rate: 9.1 lb/T Btu

Basis for calculated uncontrolled emission rate:

90<sup>th</sup> percentile annual average fuel Hg content = 0.114 ppm

90<sup>th</sup> percentile average heat content of subbituminous coal = 12,522 Btu/lb (ICR-2 data)

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

BDT: FF and SDA; FBC and ESP or FF; ESP and wet FGD

Units using BDT:

<b>Plant Name</b>	<b>Unit Name</b>	<b>Controls</b>	<b>Test Average (lb/TBtu)</b>	<b>Control Efficiency (%)</b>	<b>Fuel Hg content during test (ppm)</b>	<b>Annual Average fuel Hg content (ppm)</b>
R.M. Heskett	B2	FBC/ESP	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	65.1	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*
Stanton	10	FF/SDA	6.2517	5.9	0.0835	0.0833

\* ICR-3 value doubled based on later data received

Average percent reduction of BDT units: 48.8 %

Standard deviation: 21.1 %

Percent reduction of BDT: 18.4 %

90<sup>th</sup> percentile annual average Hg content used: 0.217 ppm

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

Basis for calculated uncontrolled emission rate:

90<sup>th</sup> percentile annual average fuel Hg content = 0.217 ppm

90<sup>th</sup> percentile average heat content of lignite coal = 10,820 Btu/lb (ICR-2 data)

**TABLE 5**  
**MERCURY DATA FOR COAL REFUSE-FIRED UTILITY BOILERS**  
**USED FOR DETERMINING BDT**

BDT: FBC and FF

Units using BDT:

<b>Plant Name</b>	<b>Unit Name</b>	<b>Fuel</b>	<b>Controls</b>	<b>Test Average (lb/TBtu)</b>	<b>Control Efficiency (%)</b>	<b>Fuel Hg content during test (ppm)</b>	<b>Annual Average fuel Hg content (ppm)</b>
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

Average percent reduction of BDT units: 99.9 %

Standard deviation: 0.02 %

Percent reduction of BDT: 99.9 %

90<sup>th</sup> percentile annual average Hg content used: 0.88 ppm

Maximum annual average uncontrolled Hg emission rate: 71.6 lb/T Btu

Basis for calculated uncontrolled emission rate:

90<sup>th</sup> percentile annual average fuel Hg content = 0.88 ppm

90<sup>th</sup> percentile average heat content of coal refuse (bituminous) = 12,288 Btu/lb (ICR-2 data)

## **APPENDIX A**

**Table A-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	$4 \times 10^{-6}$ lb/MMBtu heat input		
	Illinois EPA	Indeck-Elwood LLC (Indeck)	CFB	660 MW	Construction	10-10-2003	$2 \times 10^{-6}$ 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	$3.6 \times 10^{-6}$ 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	$3.21 \times 10^{-6}$ lb/MMBtu heat input		
	Kentucky DEP	Hugh L. Spurlock Power Station	CFB	270 MW	Air Quality Permit	8-4-2002	$2.65 \times 10^{-6}$ lb/MMBtu heat input		
	West Virginia DEP	Longview Power	PC	600 MW	Construction	3-2-2004	$1.46 \times 10^{-2}$ lb/hr based on a 3-hour average and $6.38 \times 10^{-2}$ 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	$1.7 \times 10^{-6}$ 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	$4 \times 10^{-7}$ 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	$12.8 \times 10^{-6}$ 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	$3.23 \times 10^{-6}$ lb/MMBtu heat input		

Category	State Permitting Authority	Electric Utility Source			Permit Information			Project Status	Comments
		Name	Boiler Type	Unit Capacity	Type	Approval Date	Hg Emissions Limitation		
	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
	Missouri DNR	City Utilities of Springfield Southwest Power Station Unit 2	PC	275 MW	Construction	12-15-2004	7.5 x 10 <sup>-6</sup> 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 <sup>-6</sup> 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 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
	Texas TCEQ	Alcoa's Rockdale Power Plant CFB 1 and 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 <sup>-6</sup> 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 <sup>-6</sup> lb/MMBtu heat input		Burns a mixture of bituminous coal refuse (culm) and bituminous coal

Note: Data current as of March 2005.

**Table A-2. Summary of Air Pollution Control Configurations 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 <sub>x</sub> burners	SCR	ESP	Wet FGD Scrubber	Wet ESP	
	Corn Belt Energy Corporation Prairie Energy Power Plant	PC	91 MW	Low-NO <sub>x</sub> 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 <sub>x</sub> 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 <sub>x</sub> burners	SCR		Wet FGD Scrubber	Fabric Filter	
Subbituminous	MidAmerican Energy Co. Council Bluffs Energy Center Unit 4	PC	790 MW	Low-NO <sub>x</sub> 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
	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 <sub>x</sub> 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 <sub>x</sub> burners	SCR	Activated Carbon Injection	Lime Spray Dryer	Fabric Filter	A

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 <sub>x</sub> burners	SCR		Lime Spray Dryer	Fabric Filter	
	WE Energies Elm Road Generating Station	PC	615 MW (each unit)	Low-NO <sub>x</sub> burners	SCR	ESP	Wet FGD Scrubber	Wet ESP	
	Wisconsin Public Service Corp. Weston Plant	PC	500 MW	Low-NO <sub>x</sub> burners	SCR	Activated Carbon Injection	Lime Spray Dryer	Fabric Filter	
Lignite	Texas-New Mexico Power Company TNP One Units 1 and 2	CFB	175 MW (each unit)			Lime Injection		Fabric Filter	
	Alcoa's Rockdale Power Plant CFB 1 and 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	
	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: Data current as of March 2005.

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<sub>x</sub>, PM, and SO<sub>x</sub> pollution control technologies can be determined. If the Hg control is not powdered activated carbon, then it will be at least as effective.

**Table A-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	$4 \times 10^{-6}$ lb/MMBtu heat input	4 lb/TBtu	$3.9 \times 10^{-5}$ lb/MWh	A
	Indeck-Elwood LLC (Indeck)	$2 \times 10^{-6}$ lb/MMBtu heat input	2 lb/TBtu	$2 \times 10^{-5}$ lb/MWh	A
	Santee Cooper Power Cross Generating Station Units 3 and 4	$3.6 \times 10^{-6}$ lb/MMBtu heat input	3.6 lb/TBtu	$3.5 \times 10^{-5}$ lb/MWh	A
	Thoroughbred Generating Station Units 1 and 2	$3.21 \times 10^{-6}$ lb/MMBtu heat input	3.21 lb/TBtu	$3.2 \times 10^{-5}$ lb/MWh	A
	Hugh L. Spurlock Power Station	$2.65 \times 10^{-6}$ lb/MMBtu heat input	2.65 lb/TBtu	$2.6 \times 10^{-5}$ lb/MWh	A
	Longview Power	$1.46 \times 10^{-2}$ lb/hr based on a 3-hour average and $6.38 \times 10^{-2}$ TPY based on 12 month rolling average.	2.4 lb/TBtu	$2.3 \times 10^{-5}$ lb/MWh	A, B
Subbituminous	MidAmerican Energy Co. Council Bluffs Energy Center Unit 4	$1.7 \times 10^{-6}$ lb/MM Btu heat input	1.7 lb/TBtu	$1.7 \times 10^{-5}$ lb/MWh	A
	Sevier Power Company's NEVCO Energy	$4 \times 10^{-7}$ lb/MM Btu heat input	0.4 lb/TBtu	$0.39 \times 10^{-5}$ lb/MWh	A
	Plum Point Energy Associates	12.8 lb/TBtu heat input	12.8 lb/TBtu	$12.6 \times 10^{-5}$ lb/MWh	A
	Bull Mountain Energy Roundup Power Plant Units 1 and 2	$3.23 \times 10^{-6}$ lb/MMBtu heat input	3.23 lb/TBtu	$3.2 \times 10^{-5}$ 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	$5.7 \times 10^{-5}$ lb/MWh	A
	City Utilities of Springfield Southwest Power Station Unit 2	$7.5 \times 10^{-6}$ lb/MMBtu heat input	7.5 lb/TBtu	$7.4 \times 10^{-5}$ lb/MWh	A

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	$6.9 \times 10^{-6}$ lb/MMBtu heat input	6.9 lb/TBtu	$6.8 \times 10^{-5}$ lb/MWh	A
	WE Energies Elm Road Generating Station	1.12 lb/TBtu heat input in any 12-consecutive months	1.12 lb/TBtu	$1.1 \times 10^{-5}$ lb/MWh	A
	Wisconsin Public Service Corp. Weston Plant	1.7 lb/TBtu heat input in any 12-consecutive months	1.7 lb/TBtu	$1.7 \times 10^{-5}$ 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	$186 \times 10^{-5}$ lb/MWh	A, C, D
	Alcoa's Rockdale Power Plant CFB 1 and CFB 2	Maximum Allowable Emission Rates 0.033 lb/hr, 0.048 TPY	3.7 lb/TBtu	$3.6 \times 10^{-5}$ lb/MWh	A, E
IGCC	No units of this design have been permitted			$2 \times 10^{-5}$ lb/MWh	F
Coal refuse	Kentucky Mountain Power	$81 \times 10^{-6}$ lb/MMBtu heat input	81 lb/TBtu	$80 \times 10^{-5}$ lb/MWh	A
Coal refuse/coal	EnviroPower of Illinois, LLC	$4 \times 10^{-6}$ lb/MMBtu heat input	4 lb/TBtu	$3.9 \times 10^{-5}$ lb/MWh	A, G

Note: Data current as of March 2005.

- A The emission limits were converted from input-based standard (lb/TBtu) to output-based standard (lb/MWh) by multiplying by  $9.8 \times 10^{-6}$ . 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  $6.38 \times 10^{-2}$  TPY \* 2,000 lb/T/8,760 hr/yr/6,114 MMBtu/hr =  $2.4 \times 10^{-6}$  lb/MMBtu or 2.4 lb/TBtu.  $2.4 \text{ lb/TBtu} * 9.8 \times 10^{-6} = 2.3 \times 10^{-5}$  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 6,670 Btu/lb.  $234,897 \text{ lb/hr} * 6,670 \text{ Btu/lb}/1,000,000 = 1,566.6$  MMBtu/hr. A permitted emission limit of 1.3 TPY \* 2,000 lb/T/8,760 hr/yr/1,566.6 MMBtu/hr =  $1.90 \times 10^{-4}$  lb/MMBtu or 190 lb/TBtu.  $190 \text{ lb/TBtu} * 9.8 \times 10^{-6} = 186 \times 10^{-5}$  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 an Hg emission limit.
- E Based on a boiler capacity of 2,960 MMBtu/hr. A permitted emission limit of 0.048 TPY \* 2,000 lb/T/8,760 hr/yr/2,960 MMBtu/hr =  $3.7 \times 10^{-6}$  lb/MMBtu or 3.7 lb/TBtu.  $3.7 \text{ lb/TBtu} * 9.8 \times 10^{-6} = 3.6 \times 10^{-5}$  lb/MWh.
- F 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 emission limit data from the only two IGCC units in the country.
- G 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.