

TO: Jeffrey Cole, RTI International

FROM: Clark Allen, RTI International

DATE: December 2003

SUBJECT: Mercury Emission Estimates for Coal-fired Power Plants

The purpose of this memorandum is to explain the basis of the mercury (Hg) air emission estimates from the coal-fired power plant units. These emission estimates are then used to determine the need for additional air emission controls in order for the plant to comply with the regulatory requirements.

**Are all coal fired power plant units included in the estimates?**

Certain co-generation facilities are excluded on the basis of the fraction of power used on-site and the capacity of the unit. Coal-fired electric utility units of less than 25 MWe capacity are excluded from the scope of the regulation. Other than these excluded units, all coal-fired electric utility units are included, as well as units that combust supplemental fuels such as petroleum coke and tire derived fuel (TDF).

**What was calculated?**

The total enthalpy (Btu) of the fuel combusted in the utility unit for the year 1999 was calculated from the reported fuel rate and the reported heat content of the fuel. The total amount of Hg in the fuel that was combusted in the utility unit for the year 1999 was calculated from the reported fuel rate and the reported Hg concentration in that fuel. The plant average Hg content for that type of fuel was assumed for those months without reported Hg fuel concentrations. The emission factor for the utility unit was obtained by identifying a similar type of unit in the test data set. The Hg removal in that similar type of tested unit was used to estimate the Hg control for the utility unit. The emission factor and the total amount of Hg in the fuel was used to estimate the amount of Hg that was discharged from the stack of the utility unit in 1999. The ratio of the pounds of Hg discharged from the stack to the total heat content of the fuel burned in the unit was calculated as the Hg rate, with the units of lb Hg/TBtu. For the case that a plant had multiple coal-fired units, the total Hg rate for all of the plant units were obtained by calculating the total plant Hg (lb) and the total plant energy (TBtu). The plant Hg rate was obtained as the ratio of

those two totals (lb/TBtu). This Hg rate was compared to the MACT regulatory requirement, and emissions greater than the regulatory requirement were identified.

### **What was the source of the data?**

There were two data sets that were used in this emission estimation procedures:

- reported data. Each coal-fired electric utility unit that had a capacity greater than 25 MWe reported 1999 data for coal use and composition for the unit. The data were processed and stored in a master central data base. The software for examining the data base and estimating the air emissions was provided to the public. Comments about the data base were used for correcting and updating this data base.
- test data. A series of 80 emission tests were conducted at coal-fired electric utility units. Most of the units that were tested were tested with three independent measurements of Hg removal by the control device. The results of these tests were used to evaluate the performance of different types of air emission controls for the purpose of estimating the amount of Hg removal that occurred in 1999.

### **How was the Hg removal from existing air emission controls determined?**

Emission factors were determined from the test data. The total Hg in the flue gas was measured, and a summation of the Hg was partitioned in three phases (particulate-bound, ionic, and elemental). The emission factor was based on the fraction of the total Hg that remained in the flue gas after the control device. In the case of multiple air emission controls in series, the fractional removal of Hg by each control was assumed not to be influenced by the other controls.

### **How was the MACT floor requirements determined for each unit?**

First the regulatory requirements were obtained from the MACT floor analysis. These requirements are shown below as MACT floor limits. The estimated Hg rate (lb/TBtu) was compared to the regulatory requirements for the specific coal type. If the estimated Hg rate from a unit was greater than the regulatory requirement, then it was assumed that the unit would require additional air emission control to reduce the unit emissions to the regulatory requirements.

## Regulatory Requirements in this Analysis

Fuel Type	MACT Floor Limit*
Bituminous	2.0 lb/TBtu
Subbituminous	5.8 lb/TBtu
Lignite	9.2 lb/TBtu
Coal refuse	0.38 lb/TBtu
IGCC (Coal gas)	19 lb/TBtu

\* These limits were determined after applying variability as described in the memorandum titled, "MACT Floor Analysis for Coal- and Oil-Fired Electric Utility Steam Generating Units National Emission Standards for Hazardous Air Pollutants" and then rounding the results to 2 significant digits.

### What if a unit burned two types of coal with different MACT floor requirements for each type?

In the case of multiple types of fuels in the same unit at different times, a fuel mass-weighted average of the regulatory requirement for each fuel type was calculated. The regulatory requirement was this composite weighted average. In the case of combined types of fuels in the same unit at the same time, the heat content of the fuel was used to determine the fraction of the different types of fuel that was combusted. Then, a fuel mass-weighted average was used to determine the composite regulatory requirement.

The following heat contents (BTU/lb) were used for the fuel types:

- bituminous 12,250 Btu/lb,
- subbituminous 9,900 Btu/lb, and
- lignite 7,300 Btu/lb.

Fuel mixtures with a heat content greater than that of the bituminous specification were assumed to be bituminous.

### What additional information was obtained from the data base?

In addition to the calculated quantities, the following information was provided in the report, as obtained from the data base:

- name of the unit
- name of the plant
- type of fuel(s)
- quantity of fuel burned
- type of NO<sub>x</sub> control
- type of sulfur control
- type of particulate control

- capacity of the unit
- is the unit a cogeneration unit?

**How many units should have additional air emission control?**

Not all units require additional air emission controls to meet the regulatory requirements. The following list illustrates the distribution of units that require additional control or changes to existing controls. Units not requiring additional control are also shown.

**Regulatory Requirements for Fuels in this Analysis**

Fuel Type	MACT Floor Limit*	Need More Control, No. of units**	More Control Not Needed, No of units**
Bituminous	2.0 lb/TBtu	549	152
Subbituminous	5.8 lb/TBtu	68	168
Lignite	9.2 lb/TBtu	5	19
Coal Refuse	0.38 lb/TBtu	3	14
IGCC (Coal Gas)	19 lb/TBtu	0	2
Blended Coals	Individual Composite***	94	44

- \* These limits were determined after applying variability as described in the memorandum titled, MACT Floor Analysis for Coal- and Oil-Fired Electric Utility Steam Generating Units National Emission Standards for Hazardous Air Pollutants” and then rounding the results to 2 significant digits.
- \*\* The total number of coal-fired electric utility units in the last two columns of this table total to 1,118 not the industry total of 1,143. This difference is due to 25 units firing no coal in 1999.
- \*\*\* Depending on the proportion of each coal type burned this number would vary. Thus, it is a blended MACT Floor limit.

**Are regulatory requirements used for each unit or each plant?**

The emission estimates described her are based on each unit in the database. If plant totals are desired, aggregated limits and emissions can be obtained for each plant.

**What was the format of the emission estimates?**

The calculated values, along with the additional information from the data base, were placed in an electronic spreadsheet. The format for this spreadsheet was designed to facilitate the determination of the cost of additional controls.