RTI INTERNATIONAL | Memorandum

Date: December 16, 2011

Subject: National Emission Standards for Hazardous Air Pollutants (NESHAP) Maximum Achievable Control Technology (MACT) Floor Analysis for Coal- and Oil-fired Electric Utility Steam Generating Units for Final Rule

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Introduction

Section 112 of the Clean Air Act (CAA) requires that the U.S. Environmental Protection Agency (EPA) establish National Emission Standards for Hazardous Air Pollutants **(**NESHAP) for the control of the hazardous air pollutants (HAP) emitted from both new and existing sources in a source category. These standards must reflect the maximum degree of reduction in the HAP emissions that is achievable. The minimum level of control is referred to as the "Maximum Achievable Control Technology (MACT) floor." The method for determining the MACT floor as the minimum control level allowed for establishing standards for a NESHAP is defined for both new and existing sources by CAA section 112(d)(3). For new sources, the MACT floor cannot be less stringent than the emission control that is achieved in practice by the best-controlled similar source. For existing sources, the MACT floor cannot be less stringent than the average emission limitation achieved by the best-performing 12 percent of existing sources for source categories with 30 or more sources, or the best-performing 5 sources for source categories with fewer than 30 sources.

The purpose of this memorandum is to present the methodology and the results of the MACT floor analysis for the NESHAP source category "Coal- and Oil-fired Electric Utility Steam Generating Units" (referred to in this memorandum as "EGUs"). This MACT floor analysis uses data collected in a nationwide survey of EGU owners and operators conducted by the EPA in 2010 under the *Information Collection Request For National Emission Standards For Hazardous Air Pollutants (NESHAP) for Coal- And Oil-Fired Electric Utility Steam Generating Units* (OMB Control No. 2060-0631). Individual EGU operating and air emissions data reported by respondents to the Information Collection Request (ICR) were compiled into a Microsoft Access® data base that serves as the data set used for this MACT floor analysis (referred to in this memorandum as the "ICR data set").

MACT Floor Analysis Hazardous Air Pollutants

The specific chemicals, compounds, or groups of compounds designated to be HAP are listed in CAA section 112(b). Included on the list are metals, organic compounds, and inorganic chemicals. From this HAP list, the following HAP, among others, were identified to be emitted from EGUs and were included in the MACT floor analysis: the metals antimony (Sb), arsenic

(As), beryllium (Be), cadmium (Cd), chromium (Cr), cobalt (Co), lead (Pb), manganese (Mn), mercury (Hg), nickel (Ni), and selenium (Se); organic HAP, and the acid gases hydrogen chloride (HCl) and hydrogen fluoride (HF). In addition to these individual pollutants, MACT floor levels were analyzed using filterable particulate matter (fPM) emissions as a surrogate for HAP metals other than Hg (non-Hg metallic HAP) for coal-fired units and as a surrogate for total HAP metals for oil-fired units. In addition, MACT floor levels were analyzed using HCl as a surrogate for all acid gas HAP, and sulfur dioxide (SO_2) emissions as an alternative equivalent surrogate pollutant for acid gas HAP for units equipped with flue gas desulfurization systems for coal-fired units and solid oil-fired units.

MACT Floor Analysis Subcategories

Under CAA section 112(d)(1), the EPA has the discretion to "...distinguish among classes, types, and sizes of sources within a category or subcategory in establishing..." standards. When separate subcategories are established, a MACT floor is determined separately for each subcategory. To determine whether the EGU source category warrants subcategorization for the MACT floor analysis, the EPA reviewed EGU design, operating information, and air emissions data compiled in the ICR data set and other information collected by the Agency for development of the NESHAP for this source category. Based on this review, the EPA concluded that there are significant design and operational differences in EGUs that affect the levels of emissions of certain HAP to justify subcategorizing EGUs for the purpose of establishing MACT floors.

The data available to the EPA show that the levels of HAP emissions for EGUs burning solid coal are the same for all of the HAP constituents except Hg. To account for the differences in Hg emissions from these units, the EPA identified two subcategories for EGUs burning solid coal. The HAP emissions from integrated gasification combined cycle (IGCC) EGUs are distinct from EGUs burning solid coal because IGCC burn a synthetic gas derived from coal or from a blend of coal and solid oil-derived solid fuel (i.e., petroleum coke). Consequently, a separate subcategory is defined for IGCC units. The data also show differences in all HAP emissions from oil-fired EGUs compared to coal-fired EGUs. Within the grouping of oil-fired EGUs, we have established four (4) subcategories based on distinct differences in the HAP emissions levels from the subcategories. For liquid oil-fired EGUs, we are establishing a subcategory for units located inside the continental United States, a subcategory for units located outside the continental United States, and a subcategory for oil-fired EGUs located inside the continental United States that have an annual oil-fired capacity factor of less than 8 percent. Furthermore, we are also establishing a subcategory for solid oil-fired EGUs because there are distinct differences in the HAP emissions levels from oil-fired EGUs units depending on whether liquid fuel oil is burned or a petroleum-derived solid fuel is burned.

For the MACT floor analysis, the following seven EU subcategories were defined:

Subcategory 1. New and existing EGUs designed to burn a coal having a calorific value (moist, mineral matter-free basis) of greater than or equal to 19,305 kJ/kg (8,300 Btu/lb) that are not coal-fired EGUs in the "unit designed for low rank, virgin coal" subcategory.[1]

Subcategory 2. New and existing EGUs designed to burn and burning nonagglomerating virgin coal having a calorific value (moist, mineral matter-free basis) of less than 19,305 kJ/kg (8,300 Btu/lb) that are constructed and operated at or near the mine that produces such coal.

Subcategory 3. New and existing IGCC EGUs.

Subcategory 4. New and existing EGUs located inside the continental United States that burn liquid oil and have an annual oil-fired capacity factor of greater than or equal to 8 percent.

Subcategory 5. New and existing EGUs located inside the continental United States that burn liquid oil and are classified as limited use by having an annual oil-fired capacity factor of less than 8 percent.

Subcategory 6. New and existing EGUs located outside the continental United States that burn liquid oil.

Subcategory 7. New and existing EGUs that burn solid oil-derived fuel.

Calculating Emission Values used in the MACT Floor Analysis

The EPA received emissions data from industry respondents under the Electric Utility (EU) MACT ICR in a number of different units of measure and converted these units of measure to a common pound per million British thermal units (lb/MMBtu) and pounds per megawatt-hour (lb/MWh) basis shown in the statistical analysis spreadsheets. The emissions data could have been submitted under Part II of the ICR (historical stack testing conducted from 1/1/2005 to 12/31/2009) or from Part III of the ICR (testing done in 2010 or 2011 specifically for the 2010 EGU MACT ICR). Although the Part III data was submitted in the units of measure specified by EPA, the Part II data came in a variety of units of measure. The procedures used for making these unit conversions and the EPA's procedure for converting a unit's stack emission data from a lb/MMBtu basis to a lb/MWh basis are presented in Attachment A. To ensure data quality, the EPA performed three levels of outlier analyses on the submitted data averages before they were considered for the floors. The first level was a visual plotting of the data via a scatter plot to identify obvious outliers that warranted removal from the data set pending further investigation. Using the scatter plot method of outlier identification, 14 data averages were removed from floor consideration. These averages, their pollutant, and unit name are also listed in a table in the attachments. Once these data were removed, the remaining data were then sorted by emission average (low to high) and the MACT floor sets of averages were chosen following the methodology discussed in the following sections. Subsequent outlier analyses were conducted as part of the statistical analysis as discussed on page 12.

[1] Subcategories 1 and 2 were differentiated for mercury emissions only. The remaining standards finalized in this action are the same for the two subcategories.

MACT Floor Analysis Methodology

The first step in the MACT floor analysis for each subcategory and HAP (or surrogate) was to rank all of the EGUs in the subcategory (for which there were emissions data in the ICR data set) for the pollutant type by emission level (lowest to highest). From this ranking, a MACT floor pool of sources was identified for determining the minimum control level allowed for the MACT floor, consistent with the criteria defined for new and existing sources by CAA section 112(d)(3). For the new-source MACT floors, the best-controlled similar source was identified for which there were individual source test run data in the ICR data set. For the existing-source MACT floors, selection of the MACT floor pool size (i.e., number of EGUs to be included in the determination of the average emission limitation value) was determined on an individual subcategory basis as described below.

Subcategory 1. The existing-source MACT floors for fPM, HCl, SO_2, total non-Hg HAP metals, and individual non-Hg HAP metals emissions were based on the top 12 percent of the total number of EGUs in the nationwide subcategory coal- and oil-fired EU population (12% of 1,082 sources or 130 EGUs). The existing-source MACT floor for Hg emissions was based on the top 12 percent of the total number of the subcategory EGUs with Hg emissions in the ICR data set (12% of 388 sources or 47 EGUs). In the ICR, EPA required the units selected for non-mercury metal HAP testing to also test for mercury because the test methods are similar for mercury and non-mercury HAP.

Subcategory 2. This subcategory includes greater than 30 (i.e., 36) sources. The EPA differentiated coal-fired units solely for Hg emissions and the existing-source MACT floors for fPM, HCl, SO_2, total non-Hg HAP metals, and individual non-Hg HAP metals emissions were based on the same MACT floor data pool used for *Subcategory 1*. The existing-source MACT floor for Hg emissions for this subcategory was based on the top 2 EGUs of the subcategory for which the EPA had emissions data (12% of 11 sources or 2 EGUs).

Subcategory 3. This subcategory includes 2 sources. The existing-source MACT floors for all HAP and surrogate pollutant emissions were based on the data for both IGCC EGUs in the subcategory.

Subcategory 4. This subcategory includes 40 sources. The existing-source MACT floors for all HAP and HAP surrogates emissions were based on the top 12 percent of the total number of the subcategory EGUs in each specific pollutant's ICR data set.

Subcategory 5. This subcategory includes 78 sources. The existing- and new-source MACT floors will be achieved through work practice standards with no numerical emission limits established.

Subcategory 6. This subcategory includes 31 sources. The existing-source MACT floors for all HAP and HAP surrogates emissions were based on the top 12 percent of the total number of the subcategory EGUs in each specific pollutant's ICR data set.

Subcategory 7. This subcategory includes 11 sources and the ICR data set includes data from 9 of those sources. The existing-source MACT floors for all HAP and HAP surrogates were based on the top five EGUs of the subcategory EGUs in the ICR data set.

The next step in the MACT floor analysis was to incorporate data variability into the calculations of the applicable MACT floor limits for the subcategories using a 99 percent upper prediction limit (UPL) approach. Specifically, the MACT floor limit is an UPL calculated with the Student's t-test using the "TINV" function in Microsoft Excel® software. The Student's t-test has also been used in other EPA rulemakings (e.g., NESHAP for Portland Cement, NSPS for Hospital/Medical/Infectious Waste Incinerators [HMIWI], NESHAP for Industrial, Commercial, and Institutional Boilers and Process Heaters) in accounting for variability and reflects the level of confidence. The level of confidence represents the level of protection afforded to facilities whose emissions are in line with the best performers, and consequently, the level of confidence is not arbitrary. For example, a 99 percent level of confidence means that a facility whose emissions are in line with the best performers has one chance in 100 of exceeding the floor limit. A prediction interval for a single future observation (or an average of several test observations) is an interval that will, with a specified degree of confidence, contain the next (or the average of some other pre-specified number) of randomly selected observation(s) from a population. In other words, the UPL estimates what the upper bound of future values will be, based upon present or past background samples taken. The UPL consequently represents the value at which we can expect the mean of future observations for the HAP or HAP surrogate emissions to fall within a specified level of confidence, based upon the measurements from an independent sample from the same population. The UPL approach encompasses all the data point-to-data point variability. The predictions derive from the data set to which it is applied, and, thus, can be applied to any type of data.

The form of the UPL equation differs somewhat depending upon the nature of the data set to which it is applied. To this end, the data sets were evaluated for each HAP and HAP surrogate to ascertain whether the data were normally distributed, or distributed in some other manner (i.e., log normally). For data sets where the number of available EGUs was 15 or more, use of the UPL was based on assuming a normal distribution based on the *Central Limit Theorem* (Durrett, 1996). The Central Limit Theorem states that regardless of the shape of the original distribution, if the distribution has a finite mean (μ) and variance (σ^2), the sampling distribution of the mean approaches a normal distribution with a mean of (μ) and a variance of σ^2/N as N, the sample size, increases (Durrett, 1996).

When the sample size is smaller than 15 and the distribution of the data is unknown, the Central Limit Theorem cannot be used to support the normality assumption. Statistical test of the kurtosis, skewness, and goodness of fit test are then used to evaluate the normality assumption. The *skewness statistic* (S) characterizes the degree of asymmetry of a given data distribution. Normally distributed data have an S value of 0. An S value that is greater (less) than 0 indicates that the data are asymmetrically distributed with a right (left) tail extending towards positive (negative) values. Further, the *standard error of the skewness statistic* (SES) can be approximated by SES = SQRT(6/N), where N is the sample size. According to the small sample skewness hypothesis test, if the S value is greater than two times the SES, the data distribution can be considered non-normal. The *kurtosis statistic* (K) characterizes the degree of peakedness or flatness of a given data distribution in comparison to a normal distribution. Normally distributed data have a K value of 3. A K value that is greater (less) than 3 indicates a relatively peaked (flat) distribution. Further, the *standard error of the kurtosis statistic* (SEK) can be approximated by SEK = SQRT(24/N), where N is the sample size. According to the small sample kurtosis hypothesis test, if the K value is greater than two times the SEK value, the data distribution is typically considered to be non-normal.

For each data set to which the UPL was applied (i.e., the separate data sets for each HAP and HAP surrogate type applicable to the subcategory), the S and K statistics were calculated using both the reported test values and the log-transformed reported test values. If the S and K values statistics of the reported data set were both less than twice the SES and SEK, respectively, the dataset was classified as normally distributed. If neither of the S and K values, or only one of these statistical values were less than twice the SES or SEK, respectively, then the skewness and kurtosis hypothesis tests were conducted for the natural log-transformed data. If the S and K values of the log-transformed reported data set were both less than twice the SES and SEK, respectively, the log-transformed dataset was classified as normally distributed. In this case, the MACT floor was calculated using an UPL equation developed for log-normal data (Bhaumik and Gibbons, 2004). If both the reported values and the natural-log transformed reported values had S and K values that were greater than twice the SES or SEK, respectively, the normally distributed dataset was selected as the basis of the floor to be conservative. If the results of the skewness and kurtosis hypothesis tests were mixed for the reported values and the natural log-transformed reported values, the normal distribution was chosen to be conservative. This approach is more accurate and obtained more representative results than a more simplistic normal distribution assumption.

Specifically, in the case of normal distributed data, the MACT floor limit is an UPL calculated as:

$$\text{UPL} = \bar{x} + t_{df,.99}\sqrt{s^2\left(\frac{1}{n}+\frac{1}{m}\right)}$$

Where:

$\bar{x}$ = mean of the top performing sources calculated as $\bar{x} = \frac{1}{n}\sum_{i=1}^{N}\sum_{j=1}^{n_i} x_{ij}$

n = Number of test runs = $\sum_{i=1}^{N} n_i$

m = Number of future test runs in the compliance average

N = Number of sources

s^2 = pooled variance calculated as $s^2 = \frac{1}{n-1}\sum_{i=1}^{n}\left(x_i - \bar{X}\right)^2$

$t_{df,99}$ = 99th – quantile of t-distribution with *df* degrees of freedom

df = degrees of freedom calculated as $df = \left(\sum_{i=1}^{N} n_i\right) - 1$

This calculation was performed using the following Excel® functions:

*Normal distribution: 99th Confidence UPL = AVERAGE(Test Runs in Top 12%) + [STDEV(Test Runs in Top 12%) x TINV(2 x probability, n-1 degrees of freedom)*SQRT((1/n)+(1/m))], for a one-tailed t-value, probability of 0.01, and sample size of n.*

The 99th confidence UPL was selected as a reasonable upper limit because only 1 percent of future tests of the MACT pool of lowest emitting EGUs will exceed the limit if they are performing as well as the emission test data indicate (i.e., these EGUs will be below or achieve the limit 99 percent of the time in the future). If variability was not accounted for in this manner and a limit was set based solely on the average performance, then these EGUs could exceed the limit half the time or more.

For some data sets, a single floor average per source or unit was available; analysis based solely in these single per unit observations will not reflect any possible within-source variability. In cases where additional available emissions data from past years were available, it was decided to incorporate these data in the estimation of the variance term, s^2, allowing for consideration of within- and between-source variability. The most recent data (e.g., single floor average) were used to calculate the average in the UPL equation. The UPL equation for this case is calculated as:

$$\text{UPL} = \bar{x} + t_{df,.99}\sqrt{s^2\left(\frac{1}{N}+\frac{1}{m}\right)}$$

Where:

m = Number of future test runs in the compliance average

N = Number of units involved in calculating the average (a single measurement (e.g., floor average) per unit)

n_i = Number of data points (e.g., stack averages) collected in the past for the i-th source

$$n = N + \sum_{i=1}^{N} n_i$$

x_i = Current information (e.g., single floor average) for the i-th source

y_i = Past information (e.g., stack average) for the i-th source

$\bar{x}$ = mean of the top performing sources calculated as $\bar{x} = \frac{1}{N}\sum_{i=1}^{N} x_i$

$\bar{\bar{x}}$ = grand mean (mean of the current and past information from the top performing sources

$$\bar{\bar{x}} = \frac{1}{n}\left(\sum_{i=1}^{N} x_i + \sum_{i=1}^{N} \sum_{j=1}^{n_i} y_i \right)$$

s^2 = variance calculated as $s^2 = \frac{1}{n-1}\left\{ \sum_{i=1}^{N} \left(x_i - \bar{\bar{x}}\right)^2 + \sum_{i=1}^{N} \sum_{j=1}^{n_i} \left(y_{ij} - \bar{\bar{x}}\right)^2 \right\}$

$t_{df,\,99}$ = 99^{th} quantile t-distribution with *df* degrees of freedom

df = Degrees of freedom = n -1

The calculation of this UPL was performed using the following Excel® function:

*Normal distribution: 99% UPL = AVERAGE (Test Runs in Top 12%) + [STDEV(Test Runs in Top 12%, stack averages) x TINV(2 x probability, (n-1) degrees of freedom)*SQRT((1/N)+(1/3))], for a one-tailed t-value (with 2 x probability), probability of 0.01, and sample size of n.*

The UPL, to test compliance based on a 3-run average and assuming log-normal data, is calculated by the following equation (Bhaumik and Gibbons, 2004):

$$UPL = e^{\hat{\mu}+\frac{\hat{\sigma}^2}{2}} + \frac{z_{.99}}{m}\sqrt{me^{2\hat{\mu}+\hat{\sigma}^2}(e^{\hat{\sigma}^2}-1) + m^2 e^{2\hat{\mu}+\hat{\sigma}^2}\left(\frac{\hat{\sigma}^2}{n} + \frac{\hat{\sigma}^4}{2(n-1)}\right)}$$

Where:

$\hat{\mu} = \frac{\sum_{i=1}^{n} \log\left(y_i\right)}{n}$ the average of the log transformed data from the top performing sources

$\hat{\sigma}^2 = \frac{\sum_{i=1}^{n} \left(\log\left(y_i\right) - \hat{\mu}\right)^2}{n-1}$ the variance estimate of the log transformed data from the top performing sources

$z_{.99}$ is the 99^{th}-percentile of the log-normal distribution estimated using the trapezoidal rule approach from the following equation:

$$\int_0^{z_{.99}} \left(1 - \frac{\sqrt{\beta_{1z}}}{6}\left(3z - z^3\right) + \frac{\left(\beta_{2z} - 3\right)\left(3 - 6z^2 + z^4\right)}{24} \right) \phi(z) = .99$$

The calculation of this log-normal based UPL was performed using the following Excel® function:

Normal distribution: 99% UPL =
*EXP(AVERAGE(LN(Test Runs in Top 12%)) + VAR(LN(Test Runs in Top 12%))/2) + (99^TH-PERCENTILE LOGNORMAL DISTRIBUTION/m)**
*SQRT(m*EXP(2* AVERAGE(LN(Test Runs in Top 12%))+ VAR(LN(Test Runs in Top 12%)))*(EXP(VAR(LN(Test Runs in Top 12%)))-1)+*
m^2 EXP(2* AVERAGE(LN(Test Runs in Top 12%))+ VAR(LN(Test Runs in Top 12%)))*(VAR(LN(Test Runs in Top 12%))/n+ VAR(LN(Test Runs in Top 12%))^2/(2*(n-1)))*

The 99th percentile of the log-normal distribution was calculated following Bhaumik and Gibbons (2004).

Adjustment for Below Detection Level Emissions Data

To account for the effect of measurement imprecision associated with the data in the ICR databases (that include method detection level data), a protocol specified by the EPA was used. The procedure for determining a representative detection level (RDL) begins with identifying all of the available reported pollutant-specific method detection levels for the best performing units regardless of any subcategory (e.g., existing or new, fuel type, etc.). From that combined pool of data, we calculate the arithmetic mean value. By limiting the data set to those tests used to establish the floor or emissions limit (i.e., best performers), the EPA believes that the result is representative also of the best performing testing companies and laboratories. The EPA also believes that the outcome should minimize the effect of a test(s) with an inordinately high method detection level (e.g., the sample volume was too small, the laboratory technique was insufficiently sensitive, or the procedure for determining the detection level was other than that specified). The EPA then calls the resulting mean of the method detection levels the RDL, and the Agency considers it characteristic of accepted source emissions measurement performance.

The second step in the process is to calculate three times the RDL to compare with the calculated floor or emissions limit. We use the multiplication factor of 3 to approximate a 99 percent upper confidence interval for a data set of 7 or more values. For comparing to the floor, if three times the RDL were less than the calculated floor or emissions limit (e.g., calculated from the UPL), we would conclude that measurement variability was adequately addressed. The calculated floor or emissions limit would need no adjustment. If, on the other hand, the value equal to three times the RDL were greater than the UPL, we would conclude that the calculated floor or emissions limit does not account entirely for measurement variability. If indicated, we substituted the value equal to three times the RDL for the calculated MACT floor (UPL) emissions level.

The equation used to determine emission rates for these RDLs is located in the summary tab of each of the statistical analysis spreadsheets with the exception of the Hg statistical analysis spreadsheet. Method 30B mercury stack testing is a performance-based test method and as such is not compatible with the "3 x RDL" procedure described above. And, because the vast majority of emissions data from Hg testing collected under the ICR is derived from Method 30B testing, the procedure was not utilized at all in the Hg statistical analysis spreadsheet. The RDL equation that was utilized, in the appropriate spreadsheet, is either Equation 19-1 (if the F factor utilized is based on oxygen content, dry basis) or Equation 19-6 (if the F factor utilized is based on carbon dioxide content, dry basis) from the EPA's Method 19. Based on representative concentrations in the ICR data set, the EPA chose to use an oxygen concentration of 6 percent or a carbon dioxide concentration of 9 percent depending on the subcategory. Depending on the fuel type being analyzed (i.e., coal, liquid oil, solid oil, or syngas), a different F factor was utilized as shown in Table 1.

To convert the calculated RDL values from units of lb/MMBtu to units of lb/MWh, the EPA derived a conversion factor of 10 million Btu/MW from the 2010 ICR data. This is an average factor derived from data and was needed so the minimum RDL's calculated in accordance with Method 19 could be compared to the output based UPLs in units of lb/MWh.

We determined the RDL for each pollutant using data from tests of all the best performers for all of the final regulatory subcategories (i.e., pooled test data). We applied the same pollutant-specific RDL and emissions limit adjustment procedure to all subcategories for which we established emissions limits. The review cited above resulted in the existing and new MACT floors using three times the RDL value rather than the calculated UPL value for the pollutants listed in Table 2.

MACT Floor Analysis Data Set

In determining the MACT floor levels of performance for each subcategory, two types of statistical analyses were utilized depending on the amount of data available from the EGU ICR:

- The basic component of the variability analysis was used for all existing floor calculations to reflect variability between the emissions levels achieved by the top performers in the respective subcategory. For smaller data sets (e.g., Subcategories 3 and 7) run-by-run data were utilized. For larger data sets (e.g., Subcategories 1, 2, 4 and 6), the minimum test average was used.
- The extended component was added to the variability analysis for pollutants with sufficient data to quantify normal variations in unit performance due to various operating factors. These analyses always utilized test averages (i.e., no run-by-run emissions data sets were used).

Table 3 indicates by subcategory and pollutant the form of the variability analysis utilized. The additional data utilized in the extended analyses were filtered so that only those data from emissions tests with the same pollutant control configurations were included. For example, if a company supplied Hg emissions data (i.e., annual tests conducted on a unit from 2005 through 2009) and the air pollution control within the ICR survey, for example, indicated the installation of an activated carbon injection (ACI) system and a fabric filter on the unit in 12/2007, only data following installation of the most recent APCD upgrade was used.

After excluding each emissions test conducted on a unit prior to installation of the most recent air pollution control upgrade, all available data from the ICR was sorted to determine the lowest level of emissions control that was achieved for each unit within each subcategory. Available data for each unit reflecting emissions higher than the minimum value were utilized to determine the variability of emissions.

Table 1. F-Factor and Oxygen Content used in Each Representative Detection Level Equation by Fuel Type and Subcategory

Fuel Type	Dry F factor (F_d)/O_2 Content (%)	Carbon F factor (F_c)/CO_2 Content
Coal (Subcategories 1 and 2)	9,780 / 6	
IGCC (Syngas, Subcategory 3)		2,313 / 9
Liquid Oil (both Subcategories 4 and 6)	9,180 / 6	
Solid Oil (Subcategory 7)	9,830 / 6	

Table 2. Pollutants where EPA Substituted the 3 x RDL value for the Calculated RDLs by Subcategory

	Existing MACT Floors (lb/MMBtu)	Existing MACT Floors (lb/MWh)	New MACT Floors (lb/MWh)
Subcategory 1	Sb, Ni	Sb, Ni	fPM, Metal Total (non-Hg), HCl, Sb, As, Be, Co, Pb, Ni, Se
Subcategory 2	Sb, Ni	Sb, Ni	fPM, Metal Total (non-Hg), HCl, Sb, As, Be, Co, Pb, Ni, Se
Subcategory 3	Sb, Be, Ni	Sb, Be, Ni	Be, Co, Ni
Subcategory 4	None	None	HCl, HF, As, Be, Cd
Subcategory 6	None	None	None
Subcategory 7	Sb, Be	Sb, Be	HCl, Sb, As, Be, Co, Ni, Se

Table 3. Variability Analyses Used in Each MACT Floor Subcategory

	Basic Component of Variability Analysis (variability across units run-by-run)	Basic Component of Variability Analysis (variability across units test averages)	Extended Component of Variability Analysis (variability across best performers and unit level variability test averages)
Subcategories 1 and 2 (Coal)	N/A	Total and Individual Metals (non-Hg) and SO_2	fPM, HCl, Hg
Subcategory 3 (IGCC, Syngas)	All Pollutants	N/A	N/A
Subcategory 4 and 6 (Liquid Oil)	N/A	Total and Individual Metals including Hg HCl, HF	fPM
Subcategory 7 (Solid Oil)	All Pollutants	N/A	N/A

In addition to the initial scatter plot analysis conducted on submitted emissions data, another outlier analysis was performed once the data were entered into the UPL spreadsheet. This outlier analysis (to identify gross outliers) determined if the maximum test average in a unit's set of test averages was two orders of magnitude greater than the minimum value for the given unit. Such gross outliers were removed from floor consideration. The third and final level of outlier analyses was the use of Tukey's Exploratory Data Analysis Model.

Only four test averages were excluded from the data sets based on the second outlier analysis and no test averages were excluded based on the third outlier analyses. The four removed test averages were all associated with Hg emissions tests and were not used to calculate the Hg floors for Subcategory 1. All of these data were from Part II stack tests; two of the four excluded data points were submitted with no run-level data. Without run-level data, it was not possible to further evaluate the validity of these outliers. The two remaining averages reflect non-detect values from a Method 29 test on two units sharing a common stack. These units also submitted Method 30B run-level data under Part III with emission rates above the detection limit. Because the outlier was due to limitation of the sampling method, these test averages were removed from further analysis. The emission data averages excluded from each respective spreadsheet using the "two orders of magnitude" check and Tukey's Model are shown in Row 42 of their respective UPL spreadsheet's columns (where applicable).

Other Data Excluded from MACT Floor Data Sets

There were five companies operating six of the oil-fired EGUs required to perform emissions testing by the 2010 ICR that requested permission from EPA to continue their normal operating practice of co-firing No. 6 residual fuel oil with natural gas (i.e., greater than 10 percent natural gas on a heat basis) while conducting their testing in order to meet the ICR reporting deadline. The EPA informed the companies in question that they should complete their testing and that EPA might use their emissions data in the final MACT floor calculations. The EPA ultimately chose to exclude emissions data reported for these EGUs from the data sets used for *Subcategory 4* and *5* MACT floor calculations because their emissions are not representative of other oil-fired EGUs under the ICR.

One Method 29 test on an oil-fired unit was excluded because the testing contractor expressed concerns that the testing had not been completed in accordance with the reference method. This excluded data was submitted for Florida Power and Light's Port Everglades Station, Unit 4.

The MACT floors for new sources are, according to the CAA, based on the emission control that is achieved in practice by the best-controlled similar source, as determined by the Administrator. In one case, the EPA determined that the unit with the lowest level of emissions for a particular HAP was not the best-controlled similar source. For the Subcategory 7 fPM lb/MMBtu floor limit, the EPA determined that a source with only a fabric filter and an SCR was not the best controlled source because a similar unit with a fabric filter, SCR, and a dry scrubber had a very similar level of emissions. Therefore, the EPA determined that the best controlled source was the unit with the most comprehensive set of air pollution controls. In other cases as in the new-source MACT floors for Subcategories 1 and 2, there were situations for some pollutants where only a single test average and no individual run-level data were available for the EGU identified as the best-controlled source. In these cases, no emission variability could be determined based on a single data point. Therefore, the next best-controlled similar source with sufficient data to account for variability was used to determine the new-source MACT standard as presented in Table 4.

Additionally, similar to the approach used in the HMIWI rulemaking, if the emission limit for new sources was less stringent than the emission limit for existing sources in the same subcategory, the EPA decided to use existing-source limits for new sources. Although the minimum average test run for the best performing source resulted in the lowest three-run average test, the 99 percent UPL-based limit incorporated variability between test runs. As the sample size—in this case the number of test runs—gets smaller, the t-statistic increases. When the sample size of test runs is small, and there is a large variability between test runs, the calculated limit using the UPL approach can be larger than the variability among a larger set of test runs from units in the best performing 12 percent, especially if the performance of the best performing units is comparable.

Finally, EPA determined that the best controlled Subcategory 1 unit for Hg emissions was Logan, Unit 1 (ORIS 10043) because the only units with lower emissions [Spruance Genco, LLC (ORIS 54081), Generators 2a and 2b or Spruance Genco, LLC, Generators 3a and 3b] are of an atypical design (stoker units) for the subcategory that does not represent the most recently permitted and constructed units reflected in the RACT/BACT/LAER clearinghouse.

MACT Floor Analysis Results

Tables 5, 6, 7, and 8 present the new-source and existing-source MACT floor values determined for the EGU source category. Attachment B presents the summary tables with mean, UPL, and floor values for new and existing sources. The data points removed due to being outliers are shown in Attachment C to this memorandum. Attachment D shows the outlier data removed via the scatter plot analysis method. It should be noted that all tables presented exclude reference to subcategory 5 because no numerical limits were calculated under the MACT floor analysis for this subcategory.

References

Bhaumik, D.K. and Gibbons, R.D. 2004. An Upper Prediction Limit for the Arithmetic Mean of a Lognormal Random Variable. Technometrics, 46(2):239-248.

Durrett, Richard (1996). Probability: Theory and Examples (Second edition).

Table 4. EU New-source MACT Floor Data Set Substitutions

Pollutant	Data Set Substitution
Hg (Subcategory 1)	Did not use the data for either Spruance Genco, LLC (ORIS 54081), Gen 2a and 2b or Spruance Genco, LLC, Gen 3a and 3b, are of an atypical design (stoker units) that does not represent the most recently permitted and constructed units reflected in the RACT/BACT/LAER clearinghouse. Therefore, the run-level data for Logan, Unit 001 (ORIS 10043) were used in the new MACT floor.
Chromium (Subcategory 1 and 2)	Did not use the data for Dallman, Unit 34 (ORIS 963) as no run-level data were available; used the run-level data for Cholla, Unit 3 (ORIS 113) in the new MACT floor.
SO_2 (Subcategory 1 and 2)	Could not use the data for Stanton, Unit 10 (ORIS 2824) or R. Gallagher, Unit 2 (1008) as no run-level data were available; used the run-level data for Port of Stockton District Energy Facility, Unit 1 (ORIS 54238) in the new MACT floor.
fPM (Subcategory 7)	Could not use the data for Manitowoc, Unit 9 (ORIS 4125) because its control configuration does not represent the most recently permitted and constructed units reflected in the RACT/BACT/LAER clearinghouse. Therefore, the run-level data for Northside, Unit 1A (ORIS 667) were used in the new MACT floor.

Table 5. Summary of Existing-source MACT Floor Results for Hg and Non-Hg Metal HAP

Subcategory	Parameter	Antimony (Sb)	Arsenic (As)	Beryllium (Be)	Cadmium (Cd)	Chromium (Cr)	Cobalt (Co)
1	No. in MACT floor	130	130	130	130	130	130
	99% UPL of top 12% (i.e., MACT floor; except where noted)	0.80 lb/TBtu[a] 0.0080 lb/GWh[a]	1.1 lb/TBtu 0.020 lb/GWh	0.20 lb/TBtu 0.0020 lb/GWh	0.30 lb/TBtu 0.0030 lb/GWh	2.8 lb/TBtu 0.030 lb/GWh	0.80 lb/TBtu 0.0080 lb/GWh
2	No. in MACT floor	130	130	130	130	130	130
	99% UPL of top 12% (i.e., MACT floor; except where noted)	0.80 lb/TBtu[a] 0.0080 lb/GWh[a]	1.1 lb/TBtu 0.020 lb/GWh	0.20 lb/TBtu 0.0020 lb/GWh	0.30 lb/TBtu 0.0030 lb/GWh	2.8 lb/TBtu 0.030 lb/GWh	0.80 lb/TBtu 0.0080 lb/GWh
3	No. in MACT floor	2	2	2	2	2	2
	99% UPL (i.e., MACT floor)	1.40 lb/TBtu[a] 0.020 lb/GWh[a]	1.5 lb/TBtu 0.020 lb/GWh	0.10 lb/TBtu[a] 0.0010 lb/GWh[a]	0.15 lb/TBtu 0.0020 lb/GWh	2.90 lb/TBtu 0.030 lb/GWh	1.20 lb/TBtu[b] 0.020 lb/GWh[b]
4	No. in MACT floor	3	3	3	3	3	2
	99% UPL of top 12% (i.e., MACT floor)	13 lb/TBtu 0.20 lb/GWh	2.8 lb/TBtu 0.030 lb/GWh	0.20 lb/TBtu 0.0020 lb/GWh	0.30 lb/TBtu 0.0020 lb/GWh	5.5 lb/TBtu 0.060 lb/GWh	21 lb/TBtu 0.30 lb/GWh
6	No. in MACT floor	2	2	2	2	2	2
	99% UPL of top 12% (i.e., MACT floor)	2.2 lb/TBtu 0.020 lb/GWh	4.3 lb/TBtu 0.080 lb/GWh	0.60 lb/TBtu 0.0030 lb/GWh	0.30 lb/TBtu 0.0030 lb/GWh	31 lb/TBtu 0.30 lb/GWh	113 lb/TBtu 1.4 lb/GWh
7	No. in MACT floor	5	5	5	5	5	5
	99% UPL of top 5 (i.e., MACT floor)	0.80 lb/TBtu[a] 0.0070 lb/GWh[a]	0.30 lb/TBtu 0.0050 lb/GWh	0.060 lb/TBtu[a] 0.00050 lb/GWh[a]	0.3 lb/TBtu 0.0040 lb/GWh	0.80 lb/TBtu 0.020 lb/GWh	1.1 lb/TBtu 0.020 lb/GWh

Subcategory	Parameter	Lead (Pb)	Manganese (Mn)	Nickel (Ni)	Selenium (Se)	Total Non Hg HAP Metals	Filterable PM	Mercury (Hg)
1	No. in MACT floor	130	130	130	130	130	130	47[c]
	99% UPL of top 12% (i.e., MACT floor; except where noted)	1.2 lb/TBtu 0.020 lb/GWh	4.0 lb/TBtu 0.050 lb/GWh	3.5 lb/TBtu[a] 0.040 lb/GWh[a]	5.0 lb/TBtu 0.060 lb/GWh	0.000050 lb/MMBtu 0.50 lb/GWh	0.030 lb/MMBtu 0.30 lb/MWh	1.2 lb/TBtu 0.013 lb/GWh
2	No. in MACT floor	130	130	130	130	130	130	2[d]
	99% UPL of top 12% (i.e., MACT floor; except where noted)	1.2 lb/TBtu 0.020 lb/GWh	4.0 lb/TBtu 0.050 lb/GWh	3.5 lb/TBtu[a] 0.040 lb/GWh[a]	5.0 lb/TBtu 0.060 lb/GWh	0.000050 lb/MMBtu 0.50 lb/GWh	0.030 lb/MMBtu 0.30 lb/MWh	4.0 lb/TBtu[e] 0.040 lb/GWh[e]
3	No. in MACT floor	2	2	2	2	2	2	2
	99% UPL (i.e., MACT floor)	189 lb/TBtu[b] 1.80 lb/GWh[b]	2.5 lb/TBtu 0.030 lb/GWh	6.5 lb/TBtu[a] 0.070 lb/GWh[a]	22 lb/TBtu 0.30 lb/GWh	0.000060 lb/MMBtu 0.50 lb/GWh	0.040 lb/MMBtu 0.40 lb/MWh	2.5 lb/TBtu 0.030 lb/GWh
4	No. in MACT floor	3	3	3	3	2[f]	4	3
	99% UPL of top 12% (i.e., MACT floor)	8.1 lb/TBtu 0.080 lb/GWh	22 lb/TBtu 0.30 lb/GWh	109 lb/TBtu 1.1 lb/GWh	3.3 lb/TBtu 0.040 lb/GWh	0.00080 lb/MMBtu 0.0080 lb/MWh	0.030 lb/MMBtu 0.30 lb/MWh	0.20 lb/TBtu 0.0020 lb/GWh
6	No. in MACT floor	2	2	2	2	1[f]	2	2
	99% UPL of top 12% (i.e., MACT floor)	4.9 lb/TBtu 0.080 lb/GWh	20 lb/TBtu 0.30 lb/GWh	465 lb/TBtu 4.1 lb/GWh	9.8 lb/TBtu 0.20 lb/GWh	0.00060 lb/MMBtu 0.0070 lb/MWh	0.030 lb/MMBtu 0.30 lb/MWh	0.040 lb/TBtu 0.00040 lb/GWh
7	No. in MACT floor	5	5	5	5	5	5	5
	99% UPL of top 5 (i.e., MACT floor)	0.80 lb/TBtu 0.020 lb/GWh	2.3 lb/TBtu 0.040 lb/GWh	9.0 lb/TBtu 0.20 lb/GWh	1.2 lb/TBtu 0.020 lb/GWh	0.000040 lb/MMBtu 0.60 lb/GWh	0.0080 lb/MMBtu 0.090 lb/MWh	0.20 lb/TBtu 0.0020 lb/GWh

[a] Based on 3x the specific test method's recommended detection limit.
[b] Based on a log normal UPL calculation method.
[c] Subcategory 1 used the top 47 data averages to calculate the MACT floor for mercury.
[d] Subcategory 2 used the top 2 data averages to calculate the MACT floor for mercury.
[e] Beyond the floor.
[f] Subcategory 4 and 6's Total Non Hg HAP Metals value includes Hg emissions in the floor value.

Table 6. Summary of Existing-source MACT Floor Results for Acid Gases HAP Sources

Subcategory	Parameter	HCl	HF	SO_2
1	Number in MACT floor	130	N/A	130
	99% UPL of top 12% (i.e., MACT floor; except where noted)	0.0020 lb/MMBtu 0.020 lb/MWh	N/A	0.20 lb/MMBtu 1.5 lb/MWh
2	Number in MACT floor	130	N/A	130
	99% UPL of top 12% (i.e., MACT floor; except where noted)	0.0020 lb/MMBtu 0.020 lb/MWh	N/A	0.20 lb/MMBtu 1.5 lb/MWh
3	Number in MACT floor	2	N/A	N/A
	99% UPL (i.e., MACT floor)	0.00050 lb/MMBtu 0.0050 lb/MWh	N/A	N/A
4	Number in MACT floor	3	3	N/A
	99% UPL of top 12% (i.e., MACT floor)	0.0020 lb/MMBtu 0.010 lb/MWh	0.00040 lb/MMBtu 0.0040 lb/MWh	N/A
6	Number in MACT floor	2	2	N/A
	99% UPL of top 12% (i.e., MACT floor)	0.00020 lb/MMBtu 0.0020 lb/MWh	0.000060 lb/MMBtu 0.00050 lb/MWh	N/A
7	Number in MACT floor	5	N/A	5
	99% UPL of top 5 (i.e., MACT floor)	0.0050 lb/MMBtu 0.080 lb/MWh	N/A	0.30 lb/MMBtu 2.0 lb/MWh

[a] Based on 3x the specific test method's recommended detection limit.

Table 7. Summary of New-source MACT Floor Results for Hg and Non-Hg Metal HAP

Subcategory	Parameter	Antimony (Sb)	Arsenic (As)	Beryllium (Be)	Cadmium (Cd)	Chromium (Cr)	Cobalt (Co)
1	**99% UPL of top performer (test runs)**	0.0080 lb/GWh[a]	0.0030 lb/GWh[a]	0.00060 lb/GWh[a]	0.00040 lb/GWh	0.0070 lb/GWh[b]	0.0020 lb/GWh[a]
2	**99% UPL of top performer (test runs)**	0.0080 lb/GWh[a]	0.0030 lb/GWh[a]	0.00060 lb/GWh[a]	0.00040 lb/GWh	0.0070 lb/GWh[b]	0.0020 lb/GWh[a]
3	**99% UPL of top performer (test runs)**	0.020 lb/GWh	0.020 lb/GWh	0.0010 lb/GWh[a]	0.0020 lb/GWh	0.040 lb/GWh	0.0040 lb/GWh[a]
4	**99% UPL of top performer (test runs)**	0.010 lb/GWh	0.0030 lb/GWh[a]	0.00050 lb/GWh[a]	0.00020 lb/GWh[a]	0.020 lb/GWh	0.030 lb/GWh
6	**99% UPL of top performer (test runs)**	0.0080 lb/GWh	0.060 lb/GWh	0.0020 lb/GWh	0.0020 lb/GWh	0.020 lb/GWh	0.30 lb/GWh
7	**99% UPL of top performer (test runs)**	0.0080 lb/GWh[a]	0.0030 lb/GWh[a]	0.00060 lb/GWh[a]	0.00070 lb/GWh	0.0060 lb/GWh	0.0020 lb/GWh[a]

Subcategory	Parameter	Lead (Pb)	Manganese (Mn)	Nickel (Ni)	Selenium (Se)	Total non-Hg HAP Metals	Filterable PM	Mercury (Hg)
1	**99% UPL of top performer (test runs)**	0.0020[a] lb/GWh[a]	0.0040 lb/GWh	0.040 lb/GWh[a]	0.0060 lb/GWh[a]	0.060 lb/GWh[a]	0.0070 lb/MWh[a]	0.00020 lb/GWh[e]
2	**99% UPL of top performer (test runs)**	0.0020[a] lb/GWh[a]	0.0040 lb/GWh	0.040 lb/GWh[a]	0.0060 lb/GWh[a]	0.060 lb/GWh[a]	0.0070 lb/MWh[a]	0.040 lb/GWh
3	**99% UPL of top performer (test runs)**	0.0090 lb/GWh	0.020 lb/GWh	0.070 lb/GWh[a]	0.30 lb/GWh	0.40 lb/GWh	0.080 lb/MWh	0.040 lb/GWh
4	**99% UPL of top performer (test runs)**	0.0080 lb/GWh	0.020 lb/GWh	0.090 lb/GWh	0.020 lb/GWh	0.00020 lb/MWh[c]	0.070 lb/MWh	0.00010 lb/GWh
6	**99% UPL of top performer (test runs)**	0.030 lb/GWh	0.10 lb/GWh	4.1 lb/GWh[d]	0.020 lb/GWh	0.0070 lb/MWh[c]	0.20 lb/MWh	0.00040 lb/GWh[d]
7	**99% UPL of top performer (test runs)**	0.020 lb/GWh[d]	0.0070 lb/GWh	0.040 lb/GWh[a]	0.0060 lb/GWh[a]	0.60 lb/GWh[d]	0.020 lb/MWh[f]	0.0020 lb/GWh

[a] Based on 3x the specific test method's recommended detection limit.
[b] EPA chose to use an alternative unit for new MACT floor because it was the lowest emitting tested unit with run-by-run data.
[c] Subcategory 4 and 6's Total Non Hg HAP Metals value includes Hg emissions in the floor value.
[d] Used existing MACT Floor's limit as the new MACT floor calculated would have been less restrictive than the existing MACT floor.
[e] EPA chose to use an alternative unit for new MACT floor because of boiler size and design.
[f] EPA chose to use an alternative unit for new MACT floor because it was characteristic of the control technology that a newly built unit will employ.

Table 8. Summary of New-source MACT Floor Results for Acid Gases HAP Sources

Subcategory	Parameter	HCl	HF	SO_2
1	99% UPL of top performer (test runs)	0.00040 lb/MWh[a]	N/A	0.40 lb/MWh[c]
2	99% UPL of top performer (test runs)	0.00040 lb/MWh[a]	N/A	0.40 lb/MWh[c]
3	99% UPL of top performer (test runs)	0.0020 lb/MWh	N/A	N/A
4	99% UPL of top performer (test runs)	0.00040 lb/MWh[a]	0.00040 lb/MWh[a]	N/A
6	99% UPL of top performer (test runs)	0.0020 lb/MWh	0.00050 lb/MWh[b]	N/A
7	99% UPL of top performer (test runs)	0.00040 lb/MWh[a]	N/A	0.40 lb/MWh

[a] Based on 3x the specific test method's recommended detection limit.
[b] Used existing MACT Floor's limit as the new MACT floor calculated would have been less restrictive than the existing MACT floor.
[c] EPA chose to use an alternative unit for new MACT floor because it was the lowest emitting tested unit with run-by-run data.

ATTACHMENTS

Attachment A: Explanation of EPA's Calculation of the Final MACT Floor Values For New and Existing Sources

The EPA received emissions data from industry respondents under the 2010 EGU MACT ICR in a number of different units of measure and had to convert them to a common lb/MMBtu and lb/MWh basis shown in the statistical analysis spreadsheets. The emissions data could have been submitted under Part II of the ICR (historical stack testing conducted from 1/1/2005 to 12/31/2009) or from Part III of the ICR (testing done in 2010 or 2011 specifically for the EU MACT ICR). While the Part III data was submitted in the units of measure specified by the EPA, the Part II data came in a variety of units of measure. The procedures used for making these unit conversions on Part II ICR emissions data are explained in this Attachment. In addition, the EPA's procedure for converting a unit's stack emission data from a lb/MMBtu basis to a lb/MWh basis is also explained below.

Part II Emission Calculations

- The pollutant test results could be entered into the database as an emission factor (e.g., lb/MMBtu), an emission rate (e.g., lb/hr) and/or a concentration (e.g., µg/dscm) as a run or a test average. Because the MACT floor was calculated using an emission factor (lb/MMBtu), a hierarchy was selected to be able to use as much company-provided data as possible. The hierarchy was the following order:

  1. Company-provided emission factor
  2. Company-provided emission rate
  3. Company-provided concentration

- Calculations were used to calculate the emissions factor (lb/MMBtu) from the provided emission rate or concentration:

  - Using the **emission rate** required that one of the following two sets of data were provided per run:

    - The unit load (MW), or
    - The fuel flow rate (dry lb/hr) and the fuel heating value (Btu/lb)

  - The calculations were:

$$\frac{pollutant\,\frac{lb}{hr}}{unit\ load\ MW} * \ \text{unit heat rate } (\frac{1}{\text{MMBtu}}/\text{MWh}) = \text{emission factor lb/MMBtu}$$

$or,$

$$\frac{pollutant\,\frac{lb}{hr}}{fuel\ flow\ rate\ \frac{lb}{hr} * fuel\ heating\ value\,\frac{Btu}{lb} * \frac{1\ MMBtu}{1{,}000{,}000\ Btu}} = emission\ factor\,\frac{lb}{MMBtu}$$

- If the units are originally kg/hr, then the following equation is used to convert kg/hr to lb/hr

$$pollutant\ \frac{kg}{hr} * \frac{lb}{0.453593\ kg} = pollutant\ \frac{lb}{hr}$$

- Using the **concentration** required that one of the following two sets of data were provided per run:
  - Fuel type and flue gas oxygen content
  - Fuel type and flue gas carbon dioxide content, and
  - Flue gas moisture content, if concentration was provided on a wet basis.
- The F-factor method used in EPA Test Method 19 was used to calculate an emission factor for each run that provided the necessary data. The following equations were used:
  - Equation 19-1: when measurements are on a dry basis for both oxygen and pollutant concentrations
  - Equation 19-4: when the pollutant concentration is on a wet basis and oxygen concentration is on a dry basis
  - Equation 19-6: when measurements are on a dry basis for both carbon dioxide and pollutant concentrations
  - Equation 19-8: when pollutant concentration is measured on a wet basis and carbon dioxide is measured on a dry basis
- Concentration units were converted to lb/scf based on the following conversions

Concentration Conversions		
Concentration units	**Conversion to ng/scm**	**Conversion to lb/scf**
gr/scf	2.2883E+09	1.428571E-04
mg/scm	1000000	6.242797E-08
ng/scm *	1	6.242797E-14
µg/scm	1000	6.242797E-11

*Not used for particulate or mercury conversions.

- Calculated a Wet_Dry_O2_CO2_Factor
  - If dry O_2, factor = $\frac{20.9}{20.9-\%O2\ content}$
  - If wet O_2, factor = $\frac{20.9}{(1-\frac{fg\ moisture\ content}{100})*(20.9-dry\ \%O2\ content)}$
  - If dry CO_2, factor = $\frac{100}{\%CO2\ dry\ content}$

- If wet CO_2, factor = $\frac{100}{(1-\frac{fg\ moisture\ content}{100})*(\%CO2\ dry\ content)}$

  - F-factors**:
    - F_d = 9,780 dscf/MMBtu (bituminous and subbituminous coal)
    - F_c = 1,800 scf/MMBtu (bituminous and subbituminous coal)
    - F_d= 9,860 dscf/MMBtu (low rank virgin coal)
    - F_c = 1,910 scf/MMBtu (low rank virgin coal)
    - F_d = 9,190 dscf/MMBtu (fuel oil)
    - F_c = 1,410 scf/MMBtu (fuel oil)

**If a Part II test report showed a tested unit firing coal refuse only, and provided the unit's emissions in units of concentration only, an emission factor was not calculated. This was because Method 19 does not provide F factors for coal refuse-firing.

  - Completed the calculation as follows:

$$emission\ factor\frac{lb}{MMBtu} = concentration\frac{lb}{scf} * F - factor\frac{scf}{MMBtu} * Wet\_Dry\_O2\_CO2\_Factor$$

With the exception of the calculations for the output-based Hg MACT floor standard, the EPA converted a unit's reported emission rates from a lb/MMBtu basis to a lb/MWh basis using unit-specific heat rates to convert between the input- (lb/MMBtu) and output- (lb/MWh) based emission factors. Each unit's heat rate was calculated by dividing their maximum heat input by the gross summer generating capacity.

In response to public comments the EPA completed output-based Hg MACT floor calculations using a different methodology. The EPA received comments on the proposed rule that the output based Hg standard should reflect the heat rates of the most efficient units. One commenter stated that the "EPA should not assume a heat rate any higher than 9,854 Btu/kWh in developing a Hg MACT limit in terms of lb/GWh to comply with the goal of rewarding energy efficiency." Commenters had also stated that "... the EPA should simply convert the average Hg emission rate in lb/MMBtu to lb/MWh (or lb/GWh) based on a reasonable heat rate."

The EPA agrees with the commenters that Hg calculations should be completed using a different methodology because of the antagonistic relationship between low Hg emissions and high thermal efficiency in coal combustion that is evident at the lowest emitters in Subcategory 1. This antagonistic relationship is attributable to the high carbon content (i.e., high loss on ignition (LOI)) typical of inefficient combustion units and the affinity of this high-carbon flue gas stream for Hg. For example the units achieving the lowest level of Hg emissions in Subcategory 1 were largely stoker-fired units and fluidized bed combustors (FBCs). Many of the stoker-fired units and some of the FBCs had approximately 25 to 30 percent lower efficiencies than the most efficient pulverized coal-fired units in the floor pool. The best performing unit on a lb/MMBtu basis was a stoker unit with an emission factor half the value of the lowest emitting pulverized coal source. This disparity between thermal efficiency and Hg removal efficiency increases the intra-unit variability predicted by the UPL calculation.

For the conversion of the Hg emission rates for the best performing (lowest emitting) sources in Subcategory 1, EPA utilized the average heat rate for the sources in the input based floor pool (i.e., the 47 sources used to set the lbs Hg/MMBtu standard) and maintained the same units and their rankings between the input and output based standards. The numerical value of this average heat rate is 11.18 MMBtu/MWh.

In order to eliminate the mercury-specific statistical artifact resulting from the disparity between thermal efficiency and mercury removal efficiency exhibited in the lowest emitters in Subcategory 1, prior to completing the UPL calculation to set the lb/MWh alternative emission standard, EPA converted the lb/MMBtu emission rates for the lowest emitters to lb/MWh by multiplying by the average heat rate (11.18 MMBtu/MWh) for the sources in the input based floor pool (i.e., the 47 sources used to set the lbs Hg/MMBtu standard) and maintained the same units and their rankings between the input and output based standards.

Attachment B: Summary Tables with Mean, Upper Prediction Limit, and Final MACT Floor Values for New and Existing Sources

Table B-1. Subcategory 1 Existing Sources - Summary of UPLs using emission averages

Pollutant	Mean (lb/MMBtu)	UPL (lb/MMBtu)	Number of units in the floor	UPL (lb/TBtu)	Floor value	Units
Filterable PM	0.00216	0.0278	130		0.030	lb/MMBtu
Metal total	0.0000179	0.0000453	130		0.000050	lb/MMBtu
Antimony (Sb)	2.1004E-07	5.5482E-07	130	0.554824085	0.80[a]	lb/TBtu
Arsenic (As)	3.9963E-07	1.0021E-06	130	1.002124046	1.1	lb/TBtu
Beryllium (Be)	4.2310E-08	1.1305E-07	130	0.113047058	0.20	lb/TBtu
Cadmium (Cd)	9.7248E-08	2.0328E-07	130	0.203278401	0.30	lb/TBtu
Chromium (Cr)	1.1594E-06	2.7159E-06	130	2.715890762	2.8	lb/TBtu
Cobalt	2.8382E-07	7.2317E-07	130	0.723171199	0.80	lb/TBtu
Lead (Pb)	5.0430E-07	1.1530E-06	130	1.15298026	1.2	lb/TBtu
Manganese (Mn)	1.6328E-06	3.9917E-06	130	3.991746516	4.0	lb/TBtu
Nickel (Ni)	1.3248E-06	3.0971E-06	130	3.097081415	3.5[a]	lb/TBtu
Selenium (Se)	1.4124E-06	4.6602E-06	130	4.660200683	5.0	lb/TBtu
Mercury (Hg)	1.9429E-08	1.1324E-06	47	1.132429224	1.2	lb/TBtu
HCl	0.000190	0.001586	130		0.0020	lb/MMBtu
SO_2	0.063421	0.144796	130		0.20	lb/MMBtu

[a] Based on 3x the specific test method's recommended detection limit.

Pollutant	Mean (lb/MWh)	UPL (lb/MWh)	Number of units in the floor	UPL (lb/GWh)	Floor value	Units
Filterable PM	0.021	0.285	130		0.30	lb/MWh
Metal total	0.000187	0.000472	130		0.50	lb/GWh
Antimony (Sb)	2.1488E-06	5.6182E-06	130	0.00561823	0.0080[a]	lb/GWh
Arsenic (As)	4.1470E-06	1.0434E-05	130	0.01043371	0.020	lb/GWh
Beryllium (Be)	4.3912E-07	1.1778E-06	130	0.00117776	0.0020	lb/GWh
Cadmium (Cd)	1.0015E-06	2.1479E-06	130	0.00214787	0.0030	lb/GWh
Chromium (Cr)	1.2091E-05	2.9125E-05	130	0.02912466	0.030	lb/GWh
Cobalt	2.9352E-06	7.6633E-06	130	0.00766334	0.0080	lb/GWh
Lead (Pb)	5.0486E-06	1.1398E-05	130	0.01139832	0.020	lb/GWh
Manganese (Mn)	1.7012E-05	4.1872E-05	130	0.04187177	0.050	lb/GWh
Nickel (Ni)	1.4058E-05	3.3263E-05	130	0.03326290	0.040[a]	lb/GWh
Selenium (Se)	1.5062E-05	4.9694E-05	130	0.04969358	0.060	lb/GWh
Mercury (Hg)	2.1717E-07	1.2658E-05	47	0.01265789	0.013	lb/GWh
HCl	0.001918	0.016199	130		0.020	lb/MWh
SO_2	0.642155	1.444099	130		1.5	lb/MWh

[a] Based on 3x the specific test method's recommended detection limit.

Table B-2. Subcategory 2 Existing Sources - Summary of UPLs using emission averages

Pollutant	Mean (lb/MMBtu)	UPL (lb/MMBtu)	Number of units in the floor	UPL (lb/TBtu)	Floor value	Units
Filterable PM	0.00216	0.0278	130		0.030	lb/MMBtu
Metal total	0.0000179	0.0000453	130		0.000050	lb/MMBtu
Antimony (Sb)	2.1004E-07	5.5482E-07	130	0.554824085	0.80[a]	lb/TBtu
Arsenic (As)	3.9963E-07	1.0021E-06	130	1.002124046	1.1	lb/TBtu
Beryllium (Be)	4.2310E-08	1.1305E-07	130	0.113047058	0.20	lb/TBtu
Cadmium (Cd)	9.7248E-08	2.0328E-07	130	0.203278401	0.30	lb/TBtu
Chromium (Cr)	1.1594E-06	2.7159E-06	130	2.715890762	2.8	lb/TBtu
Cobalt	2.8382E-07	7.2317E-07	130	0.723171199	0.80	lb/TBtu
Lead (Pb)	5.0430E-07	1.1530E-06	130	1.15298026	1.2	lb/TBtu
Manganese (Mn)	1.6328E-06	3.9917E-06	130	3.991746516	4.0	lb/TBtu
Nickel (Ni)	1.3248E-06	3.0971E-06	130	3.097081415	3.5[a]	lb/TBtu
Selenium (Se)	1.4124E-06	4.6602E-06	130	4.660200683	5.0	lb/TBtu
Mercury (Hg)	1.0672E-06	1.0574E-05	2	10.5740272	4.0[b]	lb/TBtu
HCl	0.000190	0.001586	130		0.0020	lb/MMBtu
SO_2	0.063421	0.144796	130		0.20	lb/MMBtu

[a] Based on 3x the specific test method's recommended detection limit.

[b] Beyond the floor.

Pollutant	Mean (lb/MWh)	UPL (lb/MWh)	Number of units in the floor	UPL (lb/GWh)	Floor value	Units
Filterable PM	0.021	0.285	130		0.30	lb/MWh
Metal total	0.000187	0.000472	130		0.50	lb/GWh
Antimony (Sb)	2.1488E-06	5.6182E-06	130	0.00561823	0.0080[a]	lb/GWh
Arsenic (As)	4.1470E-06	1.0434E-05	130	0.01043371	0.020	lb/GWh
Beryllium (Be)	4.3912E-07	1.1778E-06	130	0.00117776	0.0020	lb/GWh
Cadmium (Cd)	1.0015E-06	2.1479E-06	130	0.00214787	0.0030	lb/GWh
Chromium (Cr)	1.2091E-05	2.9125E-05	130	0.02912466	0.030	lb/GWh
Cobalt	2.9352E-06	7.6633E-06	130	0.00766334	0.0080	lb/GWh
Lead (Pb)	5.0486E-06	1.1398E-05	130	0.01139832	0.020	lb/GWh
Manganese (Mn)	1.7012E-05	4.1872E-05	130	0.04187177	0.050	lb/GWh
Nickel (Ni)	1.4058E-05	3.3263E-05	130	0.03326290	0.040[a]	lb/GWh
Selenium (Se)	1.5062E-05	4.9694E-05	130	0.04969358	0.060	lb/GWh
Mercury (Hg)	1.1464E-05	1.1213E-04	2	0.11213482	0.040[b]	lb/GWh
HCl	0.001918	0.016199	130		0.020	lb/MWh
SO_2	0.642155	1.444099	130		1.5	lb/MWh

[a] Based on 3x the specific test method's recommended detection limit.
[b] Beyond the floor.

Table B-3. Subcategory 3 Existing Sources - Summary of UPLs using emission averages

Pollutant	Mean (lb/MMBtu)	UPL (lb/MMBtu)	Number of units in the floor	Floor value	Units
Filterable PM	1.0772E-02	3.5195E-02	2	0.040	lb/MMBtu
Metal total	2.3539E-05	5.0551E-05	2	0.000060	lb/MMBtu
Antimony (Sb)	1.1454E-07	4.2298E-07	2	1.4[a]	lb/TBtu
Arsenic (As)	6.3633E-07	1.4137E-06	2	1.5	lb/TBtu
Beryllium (Be)	1.1236E-08	2.5025E-08	2	0.10[a]	lb/TBtu
Cadmium (Cd)	5.9005E-08	1.4769E-07	2	0.15	lb/TBtu
Chromium (Cr)	1.2311E-06	2.8173E-06	2	2.9	lb/TBtu
Cobalt (Co)	1.3523E-07	1.1354E-06	2	1.2[b]	lb/TBtu
Lead (Pb)	5.9758E-06	1.8860E-04	2	189[b]	lb/TBtu
Manganese (Mn)	1.0094E-06	2.4143E-06	2	2.5	lb/TBtu
Nickel (Ni)	2.0434E-06	4.9097E-06	2	6.5[a]	lb/TBtu
Selenium (Se)	1.2342E-05	2.1355E-05	2	22	lb/TBtu
Mercury	9.1481E-07	2.4877E-06	2	2.5	lb/TBtu
HCl	1.8795E-04	4.4175E-04	2	0.00050	lb/MMBtu

[a] Based on 3x the specific test method's recommended detection limit.
[b] Based on a log normal UPL calculation method.

Pollutant	Mean (lb/MWh)	UPL (lb/MWh)	Number of units in the floor	Floor value	Units
Filterable PM	1.0886E-01	3.5661E-01	2	0.40	lb/MWh
Metal total	2.3485E-04	4.9940E-04	2	0.50	lb/GWh
Antimony (Sb)	1.1355E-06	4.1735E-06	2	0.020[a]	lb/GWh
Arsenic (As)	6.3263E-06	1.3906E-05	2	0.020	lb/GWh
Beryllium (Be)	1.1164E-07	2.4580E-07	2	0.0010[a]	lb/GWh
Cadmium (Cd)	5.8654E-07	1.4564E-06	2	0.0020	lb/GWh
Chromium (Cr)	1.2376E-05	2.8575E-05	2	0.030	lb/GWh
Cobalt (Co)	1.3574E-06	1.1257E-05	2	0.020[b]	lb/GWh
Lead (Pb)	5.8991E-05	1.7941E-03	2	1.8[b]	lb/GWh
Manganese (Mn)	1.0156E-05	2.4517E-05	2	0.030	lb/GWh
Nickel (Ni)	2.0345E-05	4.8367E-05	2	0.070[a]	lb/GWh
Selenium (Se)	1.2365E-04	2.1639E-04	2	0.30	lb/GWh
Mercury	9.0777E-06	2.4576E-05	2	0.030	lb/GWh
HCl	1.8909E-03	4.4910E-03	2	0.0050	lb/MWh

[a] Based on 3x the specific test method's recommended detection limit.
[b] Based on a log normal UPL calculation method.

Table B-4. Subcategory 4 Existing Sources - Summary of UPLs using emission averages

Pollutant	Mean (lb/MMBtu)	UPL (lb/MMBtu)	Number of units in the floor	Floor value	Units
Filterable PM	1.3314E-03	2.4893E-02	4	0.030	lb/MMBtu
Metal total (including Mercury)	2.4825E-05	7.8679E-04	2	0.00080	lb/MMBtu
Antimony (Sb)	1.4555E-06	1.2398E-05	3	13	lb/TBtu
Arsenic (As)	4.2018E-07	2.7038E-06	3	2.8	lb/TBtu
Beryllium (Be)	4.0680E-08	1.3306E-07	3	0.20	lb/TBtu
Cadmium (Cd)	3.8431E-08	2.0859E-07	3	0.30	lb/TBtu
Chromium (Cr)	1.1867E-06	5.4468E-06	3	5.5	lb/TBtu
Cobalt	7.0384E-07	2.0771E-05	2	21	lb/TBtu
Lead (Pb)	1.1334E-06	8.0993E-06	3	8.1	lb/TBtu
Manganese (Mn)	3.3671E-06	2.1030E-05	3	22	lb/TBtu
Mercury (Hg)	1.9933E-08	1.8671E-07	3	0.20	lb/TBtu
Nickel (Ni)	1.6894E-05	1.0802E-04	3	109	lb/TBtu
Selenium (Se)	7.4541E-07	3.2101E-06	3	3.3	lb/TBtu
HCl	1.3813E-04	1.0360E-03	3	0.0020	lb/MMBtu
HF	5.9000E-05	3.9720E-04	3	0.00040	lb/MMBtu

Pollutant	Mean (lb/MWh)	UPL (lb/MWh)	Number of units in the floor	Floor value	Units
Filterable PM	1.3315E-02	2.5344E-01	4	0.30	lb/MWh
Metal total (including Mercury)	2.4851E-04	7.8059E-03	2	0.0080	lb/MWh
Antimony (Sb)	1.3953E-05	1.1513E-04	3	0.20	lb/GWh
Arsenic (As)	4.1225E-06	2.6934E-05	3	0.030	lb/GWh
Beryllium (Be)	4.0527E-07	1.2688E-06	3	0.0020	lb/GWh
Cadmium (Cd)	3.7605E-07	1.9946E-06	3	0.0020	lb/GWh
Chromium (Cr)	1.2081E-05	5.8542E-05	3	0.060	lb/GWh
Cobalt	7.0479E-06	2.0588E-04	2	0.30	lb/GWh
Lead (Pb)	1.1062E-05	7.8478E-05	3	0.080	lb/GWh
Manganese (Mn)	3.5511E-05	2.2775E-04	3	0.30	lb/GWh
Mercury (Hg)	1.8441E-07	1.6744E-06	3	0.0020	lb/GWh
Nickel (Ni)	1.6341E-04	1.0106E-03	3	1.1	lb/GWh
Selenium (Se)	7.3915E-06	3.1453E-05	3	0.040	lb/GWh
HCl	1.3620E-03	9.8579E-03	3	0.010	lb/MWh
HF	5.8726E-04	3.5975E-03	3	0.0040	lb/MWh

Table B-5. Subcategory 6 Existing Sources - Summary of UPLs using emission averages

Pollutant	Mean (lb/MMBtu)	UPL (lb/MMBtu)	Number of units in the floor	Floor value	Units
Filterable PM	1.2700E-02	2.1977E-02	2	0.030	lb/MMBtu
Metal total (including Mercury)	4.5871E-04	5.6896E-04	1	0.00060	lb/MMBtu
Antimony (Sb)	4.4789E-07	2.1463E-06	2	2.2	lb/TBtu
Arsenic (As)	2.6443E-06	4.2902E-06	2	4.3	lb/TBtu
Beryllium (Be)	7.6624E-08	5.0492E-07	2	0.60	lb/TBtu
Cadmium (Cd)	6.6022E-08	2.5659E-07	2	0.30	lb/TBtu
Chromium (Cr)	1.3835E-06	3.0666E-05	2	31	lb/TBtu
Cobalt	1.9783E-05	1.1270E-04	2	113	lb/TBtu
Lead (Pb)	8.5809E-07	4.8932E-06	2	4.9	lb/TBtu
Manganese (Mn)	6.6888E-06	1.9361E-05	2	20	lb/TBtu
Mercury (Hg)	2.1831E-08	3.5917E-08	2	0.040	lb/TBtu
Nickel (Ni)	4.0120E-04	4.6425E-04	2	465	lb/TBtu
Selenium (Se)	9.4374E-07	9.7515E-06	2	9.8	lb/TBtu
HCl	1.2095E-04	1.8416E-04	2	0.00020	lb/MMBtu
HF	2.1756E-05	5.2130E-05	2	0.000060	lb/MMBtu

Pollutant	Mean (lb/MWh)	UPL (lb/MWh)	Number of units in the floor	Floor value	Units
Filterable PM	1.3185E-01	2.1372E-01	2	0.30	lb/MWh
Metal total (including Mercury)	5.0411E-03	6.2527E-03	1	0.0070	lb/MWh
Antimony (Sb)	4.8254E-06	1.6104E-05	2	0.020	lb/GWh
Arsenic (As)	2.6572E-05	7.7602E-05	2	0.080	lb/GWh
Beryllium (Be)	7.9423E-07	2.1190E-06	2	0.0030	lb/GWh
Cadmium (Cd)	6.3449E-07	2.3752E-06	2	0.0030	lb/GWh
Chromium (Cr)	1.4080E-05	2.7391E-04	2	0.30	lb/GWh
Cobalt	2.1952E-04	1.3569E-03	2	1.4	lb/GWh
Lead (Pb)	9.0902E-06	7.6756E-05	2	0.080	lb/GWh
Manganese (Mn)	6.9665E-05	2.1207E-04	2	0.30	lb/GWh
Mercury (Hg)	2.1573E-07	3.6387E-07	2	0.00040	lb/GWh
Nickel (Ni)	3.5305E-03	4.0854E-03	2	4.1	lb/GWh
Selenium (Se)	9.9111E-06	1.3208E-04	2	0.20	lb/GWh
HCl	1.2018E-03	1.8604E-03	2	0.0020	lb/MWh
HF	2.0860E-04	4.9981E-04	2	0.00050	lb/MWh

Table B-6. Subcategory 7 Existing Sources - Summary of UPLs using emission averages

Pollutant	Mean (lb/MMBtu)	UPL (lb/MMBtu)	Number of units in the floor	Floor value	Units
Filterable PM	2.4854E-03	7.7373E-03	5	0.0080	lb/MMBtu
Metal total	1.6248E-05	3.3086E-05	5	0.000040	lb/MMBtu
Antimony (Sb)	3.8154E-08	8.7808E-08	5	0.80[a]	lb/TBtu
Arsenic (As)	1.4149E-07	2.8119E-07	5	0.30	lb/TBtu
Beryllium (Be)	1.8805E-08	4.9371E-08	5	0.060[a]	lb/TBtu
Cadmium (Cd)	9.9768E-08	2.1618E-07	5	0.30	lb/TBtu
Chromium (Cr)	3.4205E-07	7.2031E-07	5	0.80	lb/TBtu
Cobalt (Co)	3.4111E-07	1.0863E-06	5	1.1	lb/TBtu
Lead (Pb)	4.0216E-07	7.4535E-07	5	0.80	lb/TBtu
Manganese (Mn)	9.7323E-07	2.2392E-06	5	2.3	lb/TBtu
Nickel (Ni)	3.5824E-06	8.9021E-06	5	9.0	lb/TBtu
Selenium (Se)	5.0506E-07	1.1126E-06	5	1.2	lb/TBtu
Mercury	8.2310E-08	1.5996E-07	5	0.20	lb/TBtu
HCl	1.0296E-03	4.0628E-03	5	0.0050	lb/MMBtu
SO_2	8.0859E-02	2.1346E-01	5	0.30	lb/MMBtu

[a] Based on 3x the specific test method's recommended detection limit.

Pollutant	Mean (lb/MWh)	UPL (lb/MWh)	Number of units in the floor	Floor value	Units
Filterable PM	2.6840E-02	8.3421E-02	5	0.090	lb/MWh
Metal total	1.9811E-04	3.6323E-04	5	0.60	lb/GWh
Antimony (Sb)	4.1331E-07	7.6573E-07	5	0.0080[a]	lb/GWh
Arsenic (As)	1.6539E-06	4.0507E-06	5	0.0050	lb/GWh
Beryllium (Be)	2.1359E-07	4.8671E-07	5	0.00060[a]	lb/GWh
Cadmium (Cd)	1.4616E-06	3.2344E-06	5	0.0040	lb/GWh
Chromium (Cr)	5.6987E-06	1.4692E-05	5	0.020	lb/GWh
Cobalt (Co)	4.3110E-06	1.0409E-05	5	0.020	lb/GWh
Lead (Pb)	5.5763E-06	1.1608E-05	5	0.020	lb/GWh
Manganese (Mn)	1.4346E-05	3.4025E-05	5	0.040	lb/GWh
Nickel (Ni)	4.7150E-05	1.2121E-04	5	0.20	lb/GWh
Selenium (Se)	6.3226E-06	1.3132E-05	5	0.020	lb/GWh
Mercury	8.4520E-07	1.6051E-06	5	0.0020	lb/GWh
HCl	1.8168E-02	7.8803E-02	5	0.080	lb/MWh
SO_2	8.3935E-01	1.9019E+00	5	2.0	lb/MWh

[a] Based on 3x the specific test method's recommended detection limit.

Table B-7. Subcategory 1 New Sources - Summary of UPLs using emission averages

Pollutant	Mean (lb/MWh)	UPL (lb/MWh)	Number of units in the floor	UPL (lb/GWh)	Floor value	Units
Filterable PM	0.00224	0.00414	1		0.0070[a]	lb/MWh
Metal total	0.0000135	0.0000191	1		0.060[a]	lb/GWh
Antimony (Sb)	2.9040E-08	1.5157E-07	1	0.00015157	0.0080[a]	lb/GWh
Arsenic (As)	2.4741E-07	7.9714E-07	1	0.00079714	0.0030[a]	lb/GWh
Beryllium (Be)	1.8323E-08	2.2213E-08	1	0.00002221	0.00060[a]	lb/GWh
Cadmium (Cd)	7.3840E-08	3.6937E-07	1	0.00036937	0.00040	lb/GWh
Chromium (Cr)	1.3085E-06	6.3194E-06	1	0.00631940	0.0070[b]	lb/GWh
Cobalt	1.3748E-07	7.1620E-07	1	0.00071620	0.0020[a]	lb/GWh
Lead (Pb)	8.9650E-07	1.4190E-06	1	0.00141905	0.0020[a]	lb/GWh
Manganese (Mn)	1.3326E-06	3.0511E-06	1	0.00305110	0.0040	lb/GWh
Nickel (Ni)	1.0770E-06	3.1608E-06	1	0.00316076	0.040[a]	lb/GWh
Selenium (Se)	1.1974E-07	2.7349E-07	1	0.00027349	0.0060[a]	lb/GWh
Mercury (Hg)	4.6691E-08	1.9899E-07	1	0.00019899	0.000020[c]	lb/GWh
HCl	0.000113	0.000239	1		0.00040[a]	lb/MWh
SO_2	0.0912	0.3883	1		0.40[d]	lb/MWh

[a] Based on 3x the specific test method's recommended detection limit.
[b] EPA chose to use an alternative unit for new MACT floor because of the best unit having a single average value (i.e., no run-by-run data).
[c] EPA chose to use an alternative unit for new MACT floor because of boiler size and design.
[d] EPA chose to use an alternative unit for new MACT floor because it was the lowest emitting tested unit with run-by-run data.

Table B-8. Subcategory 2 New Sources- Summary of UPLs using emission averages

Pollutant	Mean (lb/MWh)	UPL (lb/MWh)	Number of units in the floor	UPL (lb/GWh)	Floor value	Units
Filterable PM	0.00224	0.00414	1		0.0070[a]	lb/MWh
Metal total	0.0000135	0.0000191	1		0.060[a]	lb/GWh
Antimony (Sb)	2.9040E-08	1.5157E-07	1	0.00015157	0.0080[a]	lb/GWh
Arsenic (As)	2.4741E-07	7.9714E-07	1	0.00079714	0.0030[a]	lb/GWh
Beryllium (Be)	1.8323E-08	2.2213E-08	1	0.00002221	0.00060[a]	lb/GWh
Cadmium (Cd)	7.3840E-08	3.6937E-07	1	0.00036937	0.00040	lb/GWh
Chromium (Cr)	1.3085E-06	6.3194E-06	1	0.00631940	0.0070[b]	lb/GWh
Cobalt	1.3748E-07	7.1620E-07	1	0.00071620	0.0020[a]	lb/GWh
Lead (Pb)	8.9650E-07	1.4190E-06	1	0.00141905	0.0020[a]	lb/GWh
Manganese (Mn)	1.3326E-06	3.0511E-06	1	0.00305110	0.0040	lb/GWh
Nickel (Ni)	1.0770E-06	3.1608E-06	1	0.00316076	0.040[a]	lb/GWh
Selenium (Se)	1.1974E-07	2.7349E-07	1	0.00027349	0.0060[a]	lb/GWh
Mercury (Hg)	1.0726E-05	3.4543E-05	1	0.03454321	0.040	lb/GWh
HCl	0.000113	0.000239	1		0.00040[a]	lb/MWh
SO_2	0.0912	0.3883	1		0.40[c]	lb/MWh

[a] Based on 3x the specific test method's recommended detection limit.
[b] EPA chose to use an alternative unit for new MACT floor because of the best unit having a single average value (i.e., no run-by-run data).
[c] EPA chose to use an alternative unit for new MACT floor because it was the lowest emitting tested unit with run-by-run data.

Table B-9. Subcategory 3 New Sources- Summary of UPLs using emission averages

Pollutant	Mean (lb/MWh)	UPL (lb/MWh)	Number of units in the floor	UPL (lb/GWh)	Floor value	Units
Filterable PM	1.5233E-02	7.3966E-02	1		0.080	lb/MWh
Metal total	2.0439E-04	3.5845E-04	1	0.35844614	0.40	lb/GWh
Antimony (Sb)	5.3304E-07	1.6941E-05	1	0.01694051	0.020	lb/GWh
Arsenic (As)	3.7662E-06	1.3169E-05	1	0.01316932	0.020	lb/GWh
Beryllium (Be)	6.1049E-08	1.5247E-07	1	0.00096255	0.0010[a]	lb/GWh
Cadmium (Cd)	3.4277E-07	1.6018E-06	1	0.00160182	0.0020	lb/GWh
Chromium (Cr)	6.7312E-06	3.1134E-05	1	0.03113404	0.040	lb/GWh
Cobalt	8.9184E-07	3.1390E-06	1	0.00360955	0.0040[a]	lb/GWh
Lead (Pb)	2.3758E-06	8.6936E-06	1	0.00869363	0.0090	lb/GWh
Manganese (Mn)	4.8551E-06	1.7680E-05	1	0.01768028	0.020	lb/GWh
Nickel (Ni)	1.4376E-05	2.7198E-05	1	0.06497191	0.070[a]	lb/GWh
Selenium (Se)	9.9489E-05	2.9550E-04	1	0.29549610	0.30	lb/GWh
Mercury (Hg)	4.0666E-06	3.2809E-05	1	0.03280946	0.040	lb/GWh
HCl	9.0994E-04	1.0743E-03	1		0.0020	lb/MWh

[a]Based on 3x the specific test method's recommended detection limit.

Table B-10. Subcategory 4 New Sources-Summary of UPLs using emission averages

Pollutant	Mean (lb/MWh)	UPL (lb/MWh)	Number of units in the floor	Floor value	Units
Filterable PM	9.9560E-03	6.5380E-02	1	0.070	lb/MWh
Total Metals (including Mercury)	1.1139E-04	1.4413E-04	1	0.00020	lb/MWh
Antimony (Sb)	3.3944E-06	9.1970E-06	1	0.010	lb/GWh
Arsenic (As)	1.6590E-06	1.7190E-06	1	0.0030[a]	lb/GWh
Beryllium (Be)	2.8769E-07	2.9925E-07	1	0.00050[a]	lb/GWh
Cadmium (Cd)	1.4385E-07	1.4963E-07	1	0.00020[a]	lb/GWh
Chromium (Cr)	8.6940E-06	1.7775E-05	1	0.020	lb/GWh
Cobalt	3.4404E-06	2.0932E-05	1	0.030	lb/GWh
Lead (Pb)	2.3853E-06	7.8272E-06	1	0.0080	lb/GWh
Manganese (Mn)	8.4398E-06	1.3215E-05	1	0.020	lb/GWh
Mercury (Hg)	6.4837E-08	9.3613E-08	1	0.00010	lb/GWh
Nickel (Ni)	4.9223E-05	8.6803E-05	1	0.090	lb/GWh
Selenium (Se)	4.0341E-06	1.4859E-05	1	0.020	lb/GWh
HCl	1.5213E-04	1.6682E-04	1	0.00040[a]	lb/MWh
HF	1.5661E-04	1.7130E-04	1	0.00040[a]	lb/MWh

[a] Based on 3x the specific test method's recommended detection limit.

Table B-11. Subcategory 6 New Sources-Summary of UPLs using emission averages

Pollutant	Mean (lb/MWh)	UPL (lb/MWh)	Number of units in the floor	Floor value	Units
Filterable PM	9.7155E-02	1.3453E-01	1	0.20	lb/MWh
Total Metals (including Mercury)	5.0411E-03	6.2527E-03	1	0.0070	lb/MWh
Antimony (Sb)	4.6207E-06	7.7015E-06	1	0.0080	lb/GWh
Arsenic (As)	2.5646E-05	5.2717E-05	1	0.060	lb/GWh
Beryllium (Be)	7.7019E-07	1.0080E-06	1	0.0020	lb/GWh
Cadmium (Cd)	6.0290E-07	1.0847E-06	1	0.0020	lb/GWh
Chromium (Cr)	9.3654E-06	1.2084E-05	1	0.020	lb/GWh
Cobalt	1.9888E-04	2.5213E-04	1	0.30	lb/GWh
Lead (Pb)	7.8624E-06	2.3734E-05	1	0.030	lb/GWh
Manganese (Mn)	6.7081E-05	9.3682E-05	1	0.10	lb/GWh
Mercury (Hg)	1.6618E-07	1.8700E-06	1	0.00040[a]	lb/GWh
Nickel (Ni)	3.5205E-03	7.4115E-03	1	4.1[a]	lb/GWh
Selenium (Se)	7.6945E-06	1.7693E-05	1	0.020	lb/GWh
HCl	9.5001E-04	1.1240E-03	1	0.0020	lb/MWh
HF	2.0082E-04	7.1472E-04	1	0.00050[a]	lb/MWh

[a] Used existing MACT Floor's limit as the new MACT floor calculated would have been less restrictive than the existing MACT floor.

Table B-12. Subcategory 7 New Sources - Summary of UPLs using emission averages

Pollutant	Mean (lb/MWh)	UPL (lb/MWh)	Number of units in the floor	Floor value	Units
Filterable PM	4.4581E-03	1.7873E-02	1	0.020[a]	lb/MWh
Total Metals	1.3441E-04	5.5697E-04	1	0.60[b]	lb/GWh
Antimony (Sb)	2.1008E-07	8.4167E-07	1	0.0080[c]	lb/GWh
Arsenic (As)	4.8046E-07	1.2775E-06	1	0.0030[c]	lb/GWh
Beryllium (Be)	6.7508E-08	7.0105E-08	1	0.00060[c]	lb/GWh
Cadmium (Cd)	2.3972E-07	6.2101E-07	1	0.00070	lb/GWh
Chromium (Cr)	1.2450E-06	5.9693E-06	1	0.0060	lb/GWh
Cobalt (Co)	6.3762E-07	1.5659E-06	1	0.0020[c]	lb/GWh
Lead (Pb)	3.9369E-06	1.3036E-05	1	0.020[b]	lb/GWh
Manganese (Mn)	1.6067E-06	6.1877E-06	1	0.0070	lb/GWh
Nickel (Ni)	1.9944E-06	6.3292E-06	1	0.040[c]	lb/GWh
Selenium (Se)	7.0615E-07	8.2187E-07	1	0.0060[c]	lb/GWh
Mercury	7.1153E-07	1.0105E-06	1	0.0020	lb/GWh
HCl	2.1559E-04	2.7169E-04	1	0.00040[c]	lb/GWh
SO_2	2.4601E-01	3.6175E-01	1	0.40	lb/MWh

[a] EPA chose to use an alternative unit for new MACT floor because it more characteristic on the control technology that a newly built unit will employ.

[b] Used existing MACT Floor's limit as the new MACT floor calculated would have been less restrictive than the existing MACT floor.

[c] Based on 3x the specific test method's recommended detection limit.

Attachment C: Data Excluded from the Analysis for Existing Sources using the Gross Outlier Method or Tukey Exploratory Data Analysis Model

The following data were excluded from the MACT floor calculations via the Gross Outlier Method or the Tukey Exploratory Data Analysis Model (see memorandum text for details of these data exclusions):

HAP	Plant name and unit ID	Emission value test average excluded
Hg	Spruance Genco, LLC (ORIS Code 54081) / Spruance Genco Unit 4A	1.62×10^{-6} lb/MMBtu
Hg	Spruance Genco, LLC (ORIS Code 54081) / Spruance Genco Unit 4A	2.10×10^{-5} lb/MWh
Hg	Spruance Genco, LLC (ORIS Code 54081) / Spruance Genco Unit 4B	1.62×10^{-6} lb/MMBtu
Hg	Spruance Genco, LLC (ORIS Code 54081) / Spruance Genco Unit 4B	2.10×10^{-5} lb/MWh
Hg	TIFD VIII-W, Inc. (ORIS Code 10143) / Colver Power Project Unit AAB01	4.07×10^{-6} lb/MMBtu
Hg	TIFD VIII-W, Inc. (ORIS Code 10143) / Colver Power Project Unit AAB01	3.74×10^{-5} lb/MWh
Hg	Cedar Bay Generating Company L.P. (ORIS Code 10672) / Cedar Bay Station Unit CBA1	2.48×10^{-6} lb/MMBtu
Hg	Cedar Bay Generating Company L.P. (ORIS Code 10672) / Cedar Bay Station Unit CBA1	2.87×10^{-5} lb/MWh

Attachment D: Outlier Data Removed From MACT Floor Consideration after The Scatter plot Method of Outlier Identification

Using the scatter plot method of outlier identification (described above), ten data averages were removed from MACT floor consideration. These averages are listed below.

HAP	Plant name and unit ID and Report ID	Emission value test average excluded
Hg	Interstate Power and Light / Burlington, Unit 1 (ORIS Code 1104), Report ID: BGS-Hg-20071010	3.62×10^{-3} lb/MMBtu
Hg	Basin Electric Power Cooperative/ Leland Olds, Unit 1 (ORIS Code 2817), Report ID: LOS Mercury Alstom Demo	5.26×10^{-3} lb/MMBtu
Hg	Basin Electric Power Cooperative/ Antelope Valley Station, Unit 1 (ORIS Code 6469), AVS Mercury Demo	5.09×10^{-3} lb/MMBtu
Hg	Wisconsin Power and Light / Columbia, Unit 1 (ORIS Code 8023), Report ID: COL1-Hg-20071023	6.99×10^{-3} lb/MMBtu
HCl	Allegheny Energy Supply Company LLC / Harrison Power Station, Unit 1 (ORIS Code 3944), Report ID: 9	9.00×10^{-1} lb/MMBtu
HCl	Public Service Enterprise Group (PSEG) / Hudson Generating Station, Unit 2 (ORIS Code 2403), Report ID: EG08009	3.94×10^{-4} lb/MMBtu
HCl	Public Service Enterprise Group (PSEG) / Hudson Generating Station, Unit 2 (ORIS Code 2403), Report ID: EG07044	4.59×10^{-4} lb/MMBtu
fPM	Arizona Public Service Company / Cholla, Unit 3 (ORIS Code 113), Report ID: 21	9.21×10^{0} lb/MMBtu
fPM	Allegheny Energy Supply Company LLC / Harrison Power Station, Unit 1(ORIS Code 3944), Report ID: Report ID: 9	9.76×10^{1} lb/MMBtu
fPM	Wisconsin Electric Power Company / South Oak Creek, Unit 7 (ORIS Code 4041), Report ID: OCPP-PM-B7B8-6.2005	1.52×10^{1} lb/MMBtu
fPM	Wisconsin Electric Power Company / South Oak Creek, Unit 8 (ORIS Code 4041), Report ID: OCPP-PM-B7B8-6.2005	8.63×10^{0} lb/MMBtu
fPM	Indiantown Cogeneration L.P./ Indiantown Cogeneration L.P., Unit AAB01 (ORIS Code 50976), Report ID: 10669-3	2.44×10^{1} lb/MMBtu
fPM	Indiantown Cogeneration L.P./ Indiantown Cogeneration L.P., Unit AAB01 (ORIS Code 50976), Report ID: from Part III testing	3.22×10^{-6} lb/MMBtu
SO_2	Public Service Enterprise Group (PSEG) / Hudson Generating Station, Unit 2 (ORIS Code 2403), Report ID: HUDU2E2PT2OS1-Coal	1.83×10^{-1} lb/MMBtu