1/19/2012

Mr. David H. Schavey
Designated Representative
Tennessee Valley Authority
1101 Market Street
Chattanooga, TN 37402-2801

Re: Petition for Alternative Data Substitution for Common Stack CSGA12 at the Gallatin Fossil Plant (Facility ID (ORISPL) 3403)

Dear Mr. Schavey:

The United States Environmental Protection Agency (EPA) has reviewed the September 28, 2011 petition submitted under 40 CFR 75.66(a) by the Tennessee Valley Authority (TVA), in which TVA requested approval of an alternative data substitution methodology for common stack CSGA12 at the Gallatin Fossil Plant, to replace certain hourly sulfur dioxide (SO_2), nitrogen oxides (NO_x), and carbon dioxide (CO_2) concentration data recorded during the 2nd, 3rd, and 4th quarters of 2010 and the 1st quarter of 2011. EPA approves the petition, with conditions, as discussed below.

Background

TVA owns and operates the Gallatin Fossil Plant (Gallatin), which is located near Chattanooga, Tennessee. The Gallatin facility has four tangentially-fired boilers (Units 1, 2, 3, and 4) that share two common stacks. Common stack CSGA12 is used by Units 1 and 2 and common stack CSGA34 is used by Units 3 and 4. These coal-fired units have a combined maximum capacity of 1255 MW. According to TVA, the units are subject to the Acid Rain Program and the Clean Air Interstate Rule (CAIR) NO_x and SO_2 Trading Programs. Therefore, TVA is required to continuously monitor SO_2, NO_x, and CO_2 emissions and heat input for these units in accordance with 40 CFR Part 75. To meet the SO_2, NO_x, and CO_2 monitoring requirements of Part 75, TVA uses in-stack dilution extractive continuous emission monitoring systems (CEMS).

On March 25, 2011, TVA was preparing to conduct relative accuracy test audits (RATAs) of the CEMS on common stack CSGA12. During the setup/calibration of the testing equipment, the operator noticed that the readings from the CO_2 CEMS were significantly lower than the readings from the testing group’s instrumentation. When this was brought to the attention of Gallatin personnel, the CO_2 monitor was immediately placed in maintenance mode to investigate the cause of the discrepancy in the CO_2 readings. As part of the troubleshooting process, representatives from Spectrum Systems were consulted and they recommended that the inner and outer gaskets of the sample probe be inspected. An inspection was conducted and it revealed a crack in one of the gaskets, which was causing ambient air to be pulled into the sampling system, diluting the stack gas concentrations.

To correct the problem, Gallatin personnel replaced the ruptured probe gasket and also replaced the o-rings and the coarse filter. Immediately after the maintenance activity, the CEMS CO_2 concentration readings returned to normal levels and were consistent with the concentration measurements made by the test team. Probationary calibration error tests, alternative system response tests, and abbreviated linearity checks of the gas monitors were then performed and passed, and the next day the RATAs were successfully completed.

Since the gasket that malfunctioned is not listed in the manufacturer's operation and maintenance (O&M) manual as an item that should be inspected or changed out at a certain frequency, Gallatin has begun tracking CO_2 concentration versus boiler load as an indicator of possible probe leaks. EPA's Control Chart Methodology[1] has also been programmed into Gallatin's data acquisition and handling system (DAHS), to serve as an additional audit tool.

TVA examined the historical SO_2, NO_x and CO_2 concentration data in the time period extending from the date of the 2010 RATAs (i.e., March 25, 2010) to March 24, 2011, in an attempt to identify the point at which the probe gasket ruptured. A continuous downward trend in the data was observed, from June 30, 2010 onward. TVA therefore concluded that June 30, 2010 is when the probe leak started; consequently, the CEMS data recorded from June 30, 2010 to March 24, 2011 are suspect. During the probe leak incident, there appear to be three distinct time periods in which the data exhibited a constant, unidirectional bias. TVA refers to these as three "tiers". The first tier extended from June 30 through August 19, 2010; the second tier extended from August 20 through December 23, 2010; and the third tier extended from December 24, 2010 through March 24, 2011.

Invalidating the SO_2, NO_x and CO_2 concentration data recorded during the probe leak incident would require nearly 9 months of missing data substitution to be used. TVA believes that using the standard Part 75 missing data routines grossly overstates the actual emissions during the incident, chiefly because the percent monitor data availability (PMA) would be reduced below 80.0% for an extended period of time, requiring maximum potential concentrations and emission rates to be reported. Therefore, on September 28, 2011, TVA petitioned EPA for permission to use an alternative method to calculate and report SO_2, NO_x and CO_2 emissions during the probe leak incident.

TVA proposed to use the SO_2, NO_x and CO_2 concentration data recorded by the CEMS during the 30-day period immediately following the March 25, 2010 RATAs to calculate a baseline average concentration and standard deviation for each parameter. Each baseline value would then be used together with the average concentration recorded in each of the three tiers to

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[1] A detailed description of this methodology is found on the Clean Air Markets Division web site, at the following address: http://www.epa.gov/airmarkets/emissions/other.html

determine parameter-specific correction factors. The following formula would be used to calculate the correction factor for each tier:

The proposed correction factors for Tier 1 would be 1.038 for CO_2, 1.033 for NO_x, and 1.031 for SO_2. For Tier 2 the correction factors would be 1.071 for CO_2, 1.074 for NO_x, and 1.087 for SO_2. For Tier 3, the correction factors would be 1.095 for CO_2, 1.082 for NO_x, and 1.205 for SO_2. The hourly SO_2, NO_x and CO_2 data recorded in each tier would then be adjusted upward, using the appropriate correction factor. TVA believes that this alternative emissions calculation approach is conservative and reasonable and meets the intent of the Acid Rain and CAIR regulations.

EPA's Determination

EPA approves TVA's request to adjust the SO_2, NO_x, and CO_2 concentration data recorded at common stack CSGA12 during the probe leak incident, using a three-tiered approach, as proposed by TVA. However, the manner in which TVA has determined the proposed correction factors is inconsistent with the methodology that the Agency has used to address similar issues in response to petitions from other sources and that, the Agency believes, for the reasons discussed below, provides more representative correction factors. Therefore, the approved correction factors for the three tiers (see Table 1, below) are based on the methodology established in responses to those other similar petitions, rather than TVA's proposed calculation method.

In deriving the approved correction factors, EPA analyzed the CO_2 concentration data at a representative load level for common stack CSGA12. In contrast with TVA's approach of analyzing pollutant-specific data, EPA analyzed only CO_2 data because CO_2 concentration has a relatively low variability within a given load range, unlike SO_2 or NO_x, which are less predictable due to fuel variability or other factors in the combustion process. Therefore, observed changes in CO_2 concentration can be used to derive an appropriate bias correction factor when a uniform bias is detected.

EPA's data analysis compared the low-biased CO_2 data recorded in each tier to quality-assured CO_2 concentration data collected in a 30-day baseline period, immediately after the March 25, 2010 CO_2 RATA. To eliminate operational variation, the baseline period included only data from load range ("load bin") 8, which was the most frequently used load bin during the probe leak incident, and days on which there were at least six hours of quality-assured data in load bin 8. For each day on which this criterion was met, the CO_2 data in load bin 8 were averaged. Then, the mean value of the daily averages and the standard deviation were calculated. The mean value and standard deviation were 10.78% CO_2 and 0.11% CO_2, respectively. Under EPA's Control Chart Methodology, the CO_2 percentage that is three standard deviations below the mean (referred to as the "lower control limit") is compared with the low-biased CO_2 data to calculate a correction factor. The lower control limit in this case was determined to be 10.45% CO_2.

EPA examined the CO_2 data in load bin 8 following the baseline period and observed that the daily average CO_2 concentrations (on days with at least six hours of valid data in load bin 8) began dropping below the lower control limit on June 30, 2010. Consistent with TVA's findings, a continual downward trend in the data was seen from June 30, 2010 until March 24, 2011, with three distinct periods in which there was a fairly constant, unidirectional bias. An adjustment factor was determined for each of these time periods (corresponding to the three tiers identified by TVA), using the following formula:

$$CF_i = \frac{x \pm dx}{y_i \pm dy_i} = \frac{x}{y_i}\left(1 \pm \sqrt{\left(\frac{dx}{x}\right)^2 + \left(\frac{dy_i}{y_i}\right)^2}\right)$$

Where:

CF_i = Correction factor for the low bias in a particular tier;
x = Average baseline CO_2 concentration value (10.78% CO_2);
dx = Standard deviation of the baseline CO_2 concentration values (0.11% CO_2);
y_i = Average CO_2 concentration value for the tier; and
dy_i = Standard deviation of the CO_2 concentration value for the tier.

Table 1 below summarizes the results of EPA's data analysis:

Table 1: Derivation of Correction Factors

Baseline	
10.78	Average baseline CO_2, x
0.11	Standard deviation of baseline, dx
30	Days of data used in baseline period
10.45	Lower control limit, $x - 3dx$
11.11	Upper control limit, $x + 3dx$
Tier 1	
10.30	Average biased CO_2, y_1
0. 13	Standard deviation of biased data, dy_1
1.047	Base correction factor
±0.016	Uncertainty
1.063	**Final correction factor for Tier 1**

Tier 2	
0.19	Standard deviation of biased data, dy_2
10.20	Average biased CO_2, y_2
1.061	Base correction factor
±0.022	Uncertainty
1.083	**Final correction factor for Tier 2**
Tier 3	
9.90	Average biased CO_2, y_3
0.21	Standard deviation of biased data, dy_3
1.084	Base correction factor
±0.026	Uncertainty
1.110	**Final correction factor for Tier 3**

Ordinarily, for any unit operating hour in which valid, quality-assured data are not obtained with a certified monitor, the applicable missing data provisions in §§75.30 through 75.37 are used to determine the appropriate substitute data values that must be reported. Substitute data tends to overstate emissions, particularly when the period of missing data consists of a large number of consecutive operating hours. The two main purposes of missing data substitution are to provide a conservative estimate of the actual emissions, so that emissions are not underreported, and to provide an incentive for affected sources to use good operation and maintenance practices to minimize CEMS downtime.

However, EPA found that for Gallatin, using standard substitute data during the time periods in question grossly overstates the emissions from Units 1 and 2. As reflected in Tables 2a and 2b below, use of standard Part 75 missing data substitution would result in reported emissions of about 229% of EPA's estimate of the likely SO_2 mass emissions and 568% of the likely NO_x mass emissions during the probe leak period.[2] However, when the hourly SO_2, NO_x, and CO_2 data recorded during the probe leak incident are adjusted upward by applying the approved correction factors in Table 1 to the three tiers, the emissions estimates are much more reasonable, yet still conservatively high. Using a single correction factor in each tier to adjust the concentrations of all three gases is appropriate because a dilution probe leak lowers the concentrations of all components in the stack gas sample by an equal percentage.[3]

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[2] This estimate of the "likely emissions" was obtained by applying the base correction factor in Table 1, which assumes that SO_2, NO_x and CO_2 were all underreported by the same percentage in each time period but does not take into account the uncertainty of the averages used to calculate the factors.

[3] The assumption of equal dilution of the three gases is based on the fact the leaking of the probe caused a change in the effective dilution ratio such that less stack sample was collected per unit volume of dilution air. This error reflected in the true dilution ratio affects equally the measurement of all three parameters sampled by the CEMS.

Table 2a: Impact of Standard and Alternative Missing Data on Reported SO_2 Mass Emissions for Gallatin Fossil Plant CSGA12 (June 30, 2010 through March 24, 2011)

SO_2 Calculation Method	Total SO_2 Emissions (tons)
Unadjusted Data, as originally recorded	6,721
Estimate of likely actual emissions	7,080
Standard Part 75 Missing Data Substitution	16,249
Gallatin Fossil Plant's Requested Correction	7,723
Adjusted Data (using EPA-approved correction factor)	7,700

Table 2b: Impact of Standard and Alternative Missing Data on Reported NO_X Mass Emissions for Gallatin Fossil Plant CSGA12 (June 30, 2010 through March 24, 2011)

NO_X Calculation Method	Total NO_X Emissions (tons)
Unadjusted Data, as originally recorded	1,667
Estimate of likely actual emissions	1,686
Standard Part 75 Missing Data Substitution	9,586
Gallatin Fossil Plant's Requested Correction	1,844
Adjusted Data (using EPA-approved correction factor)	1,835

Conditions of Approval

As conditions of this approval, TVA shall:

(1) Use the approved correction factors in Table 1 to make upward adjustments of the hourly SO_2, NO_x, and CO_2 concentration data recorded during the probe leak incident. The Tier 1 correction factor shall be applied from June 30, 2010 through August 19, 2010; the Tier 2 correction factor shall be applied from August 20, 2010 through December 23, 2010; and the Tier 3 correction factor shall be applied from December 24, 2010 through March 24, 2011.[4]

(2) Throughout the entire probe leak period, the SO_2, NO_x, and CO_2 concentration data shall be reported using a special Method of Determination Code (MODC) of "53",

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[4] Note that, due to rounding issues, the adjusted emissions totals shown -- solely for purposes of illustration -- in Tables 2a and 2b may differ slightly from the values that will result from application of the data correction factors as approved by EPA in this letter.

which means “other quality assured methodology approved through petition.” These hours are to be included in the missing data lookbacks and are to be treated as available hours for percent monitor data availability (PMA) calculations.

(3) Recalculate the hourly values of all parameters derived from the adjusted gas concentrations (including SO_2, NO_x, and CO_2 emission rates and mass emissions, and heat input rate values).

(4) Recalculate the 2nd, 3rd, and 4th quarter 2010 emissions and the 2010 cumulative annual emissions for common stack CSGA12.

(5) Recalculate 1st, 2nd, and 3rd quarter 2011 emissions data for common stack CSGA12.

(6) Resubmit the 2nd, 3rd, and 4th quarter 2010 and 1st, 2nd and 3rd quarter 2011 electronic data reports (EDR) for common stack CSGA12. Coordinate resubmission of the data with Mr. Craig Hillock, who may be reached at (202) 343-9105 or by e-mail at hillock.craig@epa.gov.

(7) Resolve any outstanding 2010 SO_2 and NO_x allowance accounting issues for CSGA12 by coordinating with Mr. Kenon Smith, who may be reached at (202) 343-9164 or by e-mail at smith.kenon@epa.gov.

EPA’s determination relies on the accuracy and completeness of TVA’s September 28, 2011 petition and the associated electronic data reports and is appealable under Part 78. If you have any questions regarding this determination, please contact Carlos R. Martinez at (202) 343-9747 or by e-mail at martinez.carlos@epa.gov. Thank you for your continued cooperation.

Sincerely,

/s/
Richard Haeuber, Acting Director
Clean Air Markets Division

cc: David McNeal, USEPA Region IV
Barry Stephens, Tennessee DEC
Carlos R. Martínez, CAMD
Craig Hillock, CAMD
Kenon Smith, CAMD