

December 15, 2014

Raymond L. Evans
Designated Representative
FirstEnergy Generation, LLC
76 South Main Street
Akron, Ohio 44308

Re: Petition for Approval of an Alternative Data Substitution Methodology for Units 5, 6, and 7 at the W.H. Sammis Plant (Facility ID (ORISPL) 2866)

Dear Mr. Evans:

The United States Environmental Protection Agency (EPA) has reviewed the December 13, 2013 petition submitted under 40 CFR 75.66 by FirstEnergy Generation, LLC (FG) requesting approval to use an alternative data substitution methodology to replace certain hourly sulfur dioxide (SO₂), nitrogen oxides (NO_x), and carbon dioxide (CO₂) concentration values recorded from March 13 to November 1, 2013, at Common Stack B (CSB) at the W.H. Sammis Plant. EPA approves the petition in part, with conditions, as discussed below.

Background

FG owns and operates the W.H. Sammis power plant (Sammis), which is located in Stratton, Ohio. Sammis Units 5, 6, and 7 are coal-fired boilers serving generators with a combined nameplate capacity of 1,694 megawatts. The units exhaust through two common stacks known as CSA and CSB. To control NO_x emissions, Unit 5 uses a selective non-catalytic reduction (SNCR) system and Units 6 and 7 use selective catalytic reduction (SCR) systems. After being treated by these NO_x controls, the exhaust gases from the three individual units flow into common ductwork. From there, the combined exhaust gases are separated into two streams, each of which passes through a flue gas desulfurization (FGD) system to control SO₂ emissions before being exhausted through one of the two common stacks. FG is required under the terms of a consent decree to continuously operate all of these NO_x and SO₂ emission control systems consistent with good engineering practices.¹

According to FG, Units 5, 6 and 7 are subject to the Acid Rain Program and the Clean Air Interstate Rule (CAIR) SO₂ and NO_x emissions trading programs. FG is therefore required to continuously monitor and report SO₂, NO_x, and CO₂ emissions and heat input for these units in accordance with 40 CFR Part 75. To meet these monitoring requirements, FG has installed and certified dilution-extractive continuous emission monitoring systems (CEMS) for SO₂, NO_x, and CO₂, as well as stack gas flow rate monitors, on CSA and CSB. In a dilution-extractive CEMS, flue

¹ See Consent Decree, *United States v. Ohio Edison Company*, No. 2:99-CV-1181 (S.D. Ohio entered July 11, 2005), available at <http://www2.epa.gov/sites/production/files/documents/ohioedison-cd.pdf>.

gas samples are extracted from the stack, diluted with conditioned air in a known ratio, and sent to gas concentration analyzers. A single dilution probe on each of the common stacks at Sammis is used to obtain the diluted flue gas samples sent to the set of SO₂, NO_x, and CO₂ concentration analyzers serving that stack.

In late October 2013, a technician from FG's environmental group noticed that the CO₂ concentration readings from the CO₂ CEMS installed on CSB were erratic and lower than expected. FG personnel conducted an investigation and determined that (1) the dilution probe eductor bypass was partially plugged, and (2) air in-leakage was occurring around the probe's critical orifice, which would be expected to cause a low bias in measured pollutant concentrations. The problems were corrected and an investigation was conducted to determine the effect of the probe problems on the historical emissions and heat input data. Based on this investigation, FG determined that the measured CO₂ concentration data were suspect for the time period extending from March 13, 2013, hour 20, until November 1, 2013, hour 16. Under FG's monitoring plan for CSB, CO₂ concentration data are used directly in the computation of both CO₂ emissions and heat input, making the previously computed CO₂ mass emissions and heat input values for this time period suspect. Further, because the flue gas samples analyzed for SO₂ and NO_x concentrations were obtained through the same dilution probe, FG recognized that the measured SO₂ and NO_x concentration data and the previously computed SO₂ and NO_x mass emissions values were also suspect for the same time period. According to FG, during that time interval the CEMS on CSB were maintained and quality-assured in accordance with Part 75. However, due to the nature of the leak (i.e., air in-leakage under negative pressure), the daily calibration error tests and quarterly linearity checks, which flood the probe with calibration gas under positive pressure, failed to detect the leak.

Part 75 includes provisions for determining substitute data to be reported when quality-assured CEMS data are missing.² However, in situations where a CEMS is operating properly in most respects but where a uniform measurement bias is detected, correction of the measured data through the use of appropriate bias correction factors may be a reasonable alternative to application of the otherwise applicable Part 75 missing data substitution procedures. Based on its analysis of the measured CO₂ concentration data and other information related to operations at the Sammis plant during the period in question, FG believes that the CSB dilution probe problems can be addressed through the use of appropriate bias correction factors. Accordingly, on December 13, 2013, FG submitted a petition to EPA describing its analysis and requesting approval to apply a bias correction factor to the pollutant concentration data measured by the CSB CEMS and to treat the resulting adjusted data as valid, quality-assured data under Part 75. The petition also describes steps FG is taking to prevent future occurrences of extended probe leak incidents, including additional operator training and weekly and monthly data evaluations designed to help identify potential probe leaks.

Discussion

According to the petition, FG began its investigation by interviewing operating personnel and examining operating records for Units 5, 6, and 7 to determine whether any other factors besides the identified probe leak might have affected the data measured at CSB during the probe leak period. No unusual operating conditions were identified, and FG confirmed that the units' NO_x and SO₂ controls

² Standard data substitution procedures generally applicable to units without add-on emission controls are set out in §75.33, while §75.34 sets out alternative procedures that are available in cases where an owner or operator can demonstrate that add-on emission controls were operating during the period of missing data.

were operated normally throughout the period. FG's records also showed that the CSB CEMS passed all required daily calibration error tests and quarterly linearity checks during the period, apparently indicating normal CEMS operations other than the probe leak. FG therefore concluded that its remaining analysis could be focused on the identified probe leak.

The approach FG followed to analyze the potential bias in the CSB concentration data was based on a methodology that EPA uses to evaluate data in cases of suspected dilution probe leaks.³ FG appropriately chose to analyze CO₂ concentration data rather than SO₂ or NO_x concentration data, because CO₂ concentration for a given unit generally has relatively low variability in a given load range compared with SO₂ and NO_x concentrations, which are affected by fuel variability or other factors in the combustion process. When a uniform bias is detected in CO₂ concentration measurements over a given period relative to quality-assured reference measurements, the two sets of measurement data can be used in combination to derive an appropriate bias correction factor. In cases where gas samples analyzed for SO₂, NO_x, and CO₂ concentrations are obtained using a common dilution probe that is experiencing a leak, if appropriate factors can be derived to correct the identified bias in the measured CO₂ concentration data, the same factors can generally also be used to correct for bias in the simultaneously measured SO₂ and NO_x concentration data.

Data and computations from FG's analysis of the CSB CO₂ concentration data are shown in Table 1 below, along with additional computations performed by EPA. FG began its analysis by examining the trends in the hourly CO₂ concentration measurements at CSB across the period from completion of the most recent relative accuracy test audit (RATA) on February 6, 2013 to the time when the probe leak was corrected on November 1, 2013. Based on that examination, FG identified a period of quality-assured baseline data extending from the February 6 RATA to March 13, hour 19, and a period of suspect data extending from March 13, hour 20, to November 1, hour 16. In order to control for variations in CO₂ concentration attributable to possible changes in the degree of air in-leakage, as well as variations in the level of operation of Units 5, 6, and 7, FG then divided the overall probe leak period into six distinct evaluation periods. The dates of the six evaluation periods are shown in column (a) of Table 1.

For each evaluation period, FG determined the range of load bins most representative of the combined operations of Units 5, 6, and 7 during that period. (FG used load bin ranges rather than single load bins in order to increase the number of days for which sufficient hourly data measurements were available.) The identified load bin ranges were used to select the most appropriate quality-assured data from the baseline period to compare to the data from each evaluation period. For four of the evaluations periods the most representative range of load bins was 17 to 19, and for the remaining two evaluation periods the most representative range of load bins was 10 to 12. The load bin ranges for each evaluation period are shown in column (b) of Table 1.

FG computed the daily averages of hourly CO₂ concentration measurements for days within the February 6-March 13 baseline period for which valid measurements existed for at least six hours in one of the two appropriate ranges of load bins. FG then computed the mean and standard deviation of each set of daily values (one set for each of the two load bin ranges). The baseline

³ A presentation describing EPA's "Control Chart Methodology," an approach for evaluating potential CEMS data quality issues by examining the relationship over time of CO₂ concentration data to unit load data, can be found at <http://www.epa.gov/airmarkets/presentations/docs/epri09/Control%20Chart%20Methodology%20For%20Identifyin%20Decreases%20in%20Emissions.ppt>.

period mean and standard deviation for the load bin range relevant for comparison to the data for each evaluation period are shown in columns (c) and (d) of Table 1.

Similarly, for each evaluation period, FG computed the daily average of the hourly CO₂ concentration measurements for each day for which valid measurements existed for at least six hours in the appropriate range of load bins for that evaluation period. FG then computed the mean and standard deviation for the set of daily values for each evaluation period. The mean and standard deviation for each evaluation period are shown in columns (e) and (f) of Table 1.

The last three columns of Table 1 show three possible bias correction factors computed from the values in the earlier columns for each evaluation period using three different formulas. Column (g) shows the ratio of (1) the mean for the baseline period divided by (2) the mean for the evaluation period. These ratios were computed by EPA and can be viewed as the minimum bias correction factors for each evaluation period. The formula accounts for the difference between the means of the measurements from the baseline period and the evaluation period but does not account for uncertainty in those measurements.

Column (h) of Table 1 shows the ratio of (1) the sum of the mean and standard deviation for the baseline period divided by (2) the sum of the mean and standard deviation for the evaluation period.⁴ FG computed values using this formula for each of the six evaluation periods and presented those values in its petition. FG requested permission to use the highest of the six values as the bias correction factor for all six evaluation periods.

Finally, column (i) of Table 1 shows correction factors computed by EPA for each evaluation period using a formula for the upper bound of the uncertainty range for a quotient of two uncertain values. This formula has been used to compute bias correction factors approved by EPA for use in several other instances of probe leaks.⁵ The formula is:

$$CF = \frac{AvgCO2_{base}}{AvgCO2_{low}} \left[1 + \sqrt{\left(\frac{SD_{base}}{AvgCO2_{base}}\right)^2 + \left(\frac{SD_{low}}{AvgCO2_{low}}\right)^2} \right]$$

Where:

CF = correction factor for the evaluation period;

$AvgCO2_{base}$ = Average of daily average %CO₂ measured at the specified load bins during the baseline period;

SD_{base} = Standard deviation of daily average %CO₂ measured at the specified load bins during the baseline period;

⁴ Column (h) shows values EPA computed by applying this formula to the values shown in columns (c) through (f). Several of the values shown in column (h) differ in the last decimal place from the values for this computation provided by FG in its petition, but the highest value in column (h) in Table 1 (1.233) is also the highest value for this computation included in FG's petition.

⁵ See, e.g., EPA responses to petitions for the following power plants: Gallatin (Jan. 19, 2012), New Madrid (Jan. 6, 2012), Crystal River (July 13, 2011), Cape Fear (Nov. 19, 2009), Zimmer (June 26, 2009), Lansing (Feb. 2, 2009), Sioux (Feb. 2, 2009), Beckjord (Aug. 27, 2008), and Will County (Aug. 27, 2008). Copies of these responses are available at <http://www.epa.gov/airmarkets/emissions/petitions.html>.

$AvgCO_{2low}$ = Average of daily average %CO₂ measured at the specified load bins during the evaluation period; and

SD_{low} = Standard deviation of daily average %CO₂ measured at the specified load bins during the evaluation period.

Table 1: Data and Potential Correction Factors Computed For Sammis CSB

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
Evaluation period	Load bin range	Relevant baseline period mean	Relevant baseline period standard deviation	Evaluation period mean	Evaluation period standard deviation	Minimum correction factors without uncertainty adjustment	Correction factors computed using formula used by FG	Correction factors with upper bound uncertainty adjustment
3/13/13-3/28/13	10-12	9.2	0.792	7.8	0.935	1.179	1.144	1.354
3/29/13-7/18/13	17-19	10.1	0.147	9.5	0.285	1.063	1.047	1.099
7/19/13-8/22/13	10-12	9.2	0.792	9.0	0.493	1.022	1.053	1.127
8/23/13-9/12/13	17-19	10.1	0.147	8.5	0.183	1.188	1.180	1.219
9/13/13-10/14/13	17-19	10.1	0.147	8.1	0.210	1.247	1.233	1.284
10/15/13-11/1/13	17-19	10.1	0.147	8.0	0.326	1.263	1.231	1.317

EPA views most of the steps in FG’s approach to development of bias correction factors for use at Sammis CSB as reasonable. FG has provided explanations for focusing on the identified probe leak rather than other possible causes of data issues and for selecting particular evaluation periods and load bin ranges for analysis. FG’s exclusion from the analysis of data for days when valid data were not available for at least six hours is consistent with EPA’s practice in similar analyses.⁶ EPA therefore considers the mean and standard deviation values presented in columns (c) through (f) of Table 1 (all of which were contained in FG’s petition) to provide a reasonable basis for computation of bias correction factors.

However, EPA does not consider the formula FG used in its petition to compute bias correction factors from the mean and standard deviation values shown in Table 1 to be reasonable. In a situation where a dilution probe has experienced air in-leakage, an appropriate bias correction factor should account for uncertainty in the measured data and should do so in a way that is conservative, in the sense that the correction factor should be increased to account for the possibility that the correction factor computed without any uncertainty adjustment is too small. A comparison of the values in columns (g) and (h) of Table 1 shows that the values in column (h) computed according to the formula presented in FG’s petition are not conservative in this sense. As explained above, the values in column (g) are computed as the ratio of the baseline period mean to the evaluation period mean. These values include no adjustment for uncertainty and therefore represent

⁶ See, e.g., EPA response to petition for New Madrid power plant (Jan. 6, 2012).

the minimum correction factors that could be viewed as appropriate for use with the given measurement data (i.e., if there were no uncertainty). Although the formula used to compute the values in column (h) attempts to adjust for uncertainty by using the standard deviations as well as the means of the measured data, the formula uses the standard deviations in a manner that is not conservative and in fact can produce negative rather than positive uncertainty adjustments. This shortcoming is evident in Table 1, where for five of the six evaluation periods the formula in column (h) produces a value lower than the minimum correction factor shown in column (g).

The correction factor formula EPA has used to produce the values in column (i) reflects a standard statistical approach for computing the range of uncertainty for the quotient of two means, each of which is uncertain.⁷ In order to ensure that the uncertainty adjustment is always positive and that the correction factor is therefore conservative in the required sense, EPA has selected the upper-bound form of the formula rather than the lower-bound form (i.e., by adding rather than subtracting the formula's uncertainty adjustment term). Thus, for each of the six evaluation periods, the value in column (i) is larger than the minimum correction factor shown in column (g). As noted above, EPA has approved the use of correction factors computed using this formula in responses to previous petitions under §75.66.

Although for each of the six evaluation periods the value in column (i) is higher than the corresponding value in column (h) computed using FG's formula, the values in column (i) for some evaluation periods are lower than the highest value in column (h), which is 1.233. As noted above, in its petition FG requested permission to use the highest correction factor value computed for any of the six evaluation periods as the correction factor for all six periods. However, in other dilution probe leak situations where distinct evaluation periods have been appropriately identified and where an appropriate correction factor for each evaluation period has been determined using a statistical formula that adequately accounts for uncertainty, EPA has not found it necessary to also use the highest correction factor value computed for any single evaluation period as the correction factor for all evaluation periods.

Tables 2 and 3 below summarize the estimated amounts of SO₂ emissions and NO_x emissions, respectively, that would be reported for Sammis CSB over the probe leak period if each of the various possible bias correction factors shown in Table 1 and discussed above were used. The first row in each table (after the headings) shows emissions computed using the measured SO₂ and NO_x concentration data as originally recorded before application of any correction factor. The second, third, and fourth rows show emissions assuming use of the measured data adjusted by individual correction factors for each evaluation period, using the correction factors shown in columns (g), (h), and (i) of Table 1, respectively. The fifth row shows emissions computed assuming use of the measured data adjusted by a single correction factor of 1.233 (the highest value in column (h) of Table 1) as requested by FG in the petition. Finally, the sixth row shows an estimate of emission amounts that would be reported under the standard Part 75 missing data substitution provisions.⁸

⁷ The formula computes the uncertainty adjustment for a quotient of two uncertain input values as the square root of the sum of the squared fractional uncertainties for the individual input values times the quotient. *See, e.g.*, John R. Taylor, *An Introduction to Error Analysis* at 61 (2nd ed. 1997).

⁸ FG indicates in the petition that records exist demonstrating that the emission controls on Units 5, 6, and 7 were operating normally during the entire probe leak period. For purposes of Tables 2 and 3, EPA has therefore assumed that FG would qualify to use the missing data substitution provisions in §75.34, where the substitute data values generally reflect operation of a unit's add-on emission controls (with certain adjustments for conservatism). In its petition, FG presented far more conservative values calculated assuming use of the missing data substitution provisions in §75.33, where the substitute data values do not reflect the operation of add-on emission controls.

Table 2: Estimated Impact of Standard and Alternative Substitute Data on Reported SO₂ Mass Emissions (March 13 through November 1, 2013) for Sammis CSB

SO ₂ Calculation Method	Total SO ₂ Emissions (tons)	Adjustment (%)
Unadjusted measured data, as originally recorded	1,003	-
Measured data adjusted using minimum correction factors from column (g) of Table 1 for each evaluation period	1,125	12%
Measured data adjusted using correction factors from column (h) of Table 1 for each evaluation period	1,113	11%
Measured data adjusted using correction factors from column (i) of Table 1 for each evaluation period	1,175	17%
Measured data adjusted using FG's requested single correction factor of 1.233 for all evaluation periods	1,236	23%
Standard Part 75 missing data substitution under §75.34	2,900	189%

Table 3: Estimated Impact of Standard and Alternative Substitute Data on Reported NO_x Mass Emissions (March 13 through November 1, 2013) for Sammis CSB

NO _x Calculation Method	Total NO _x Emissions (tons)	Adjustment (%)
Unadjusted measured data, as originally recorded	1,244	-
Measured data adjusted using minimum correction factors from column (g) of Table 1 for each evaluation period	1,398	12%
Measured data adjusted using correction factors from column (h) of Table 1 for each adjustment period	1,381	11%
Measured data adjusted using correction factors from column (i) of Table 1 for each evaluation period	1,464	18%
Measured data adjusted using FG's requested single correction factor of 1.233 for all evaluation periods	1,534	23%
Standard Part 75 missing data substitution under §75.34	6,436	417%

The values in Tables 2 and 3 show that data corrections calculated using the minimum correction factors without any uncertainty adjustments from column (g) of Table 1 would result in upward adjustments of approximately 12 percent to the SO₂ and NO_x emissions originally recorded from Sammis CSB. If the correction factors from column (h) of Table 1 computed using FG's formula were used, the upward adjustments would be less than this minimum, again clearly

demonstrating that the formula does not account for uncertainty in an appropriately conservative manner. In contrast, if the correction factors with uncertainty adjustments from column (i) of Table 1 were used, the upward adjustments would be 17 percent and 18 percent for SO₂ and NO_x emissions, respectively, and if the single correction factor requested by FG in the petition were used, the upward adjustments would be 23 percent. By comparison, the use of the standard missing data substitution procedures in §75.34 would result in adjustments to the originally recorded data of almost 200% for SO₂ and over 400% for NO_x.

EPA's Determination

EPA approves in part FG's petition to make upward adjustments to the SO₂, NO_x, and CO₂ concentration values recorded at Sammis Common Stack B during the period of a dilution probe leak from March 13, 2013 through November 1, 2013 using bias correction factors in lieu of using the standard Part 75 missing data substitution procedures. FG's investigation supports the use of bias correction factors in this instance, and FG's analysis of the measured data provides a basis for computation of appropriate correction factors. Further, comparison of the emission values computed using appropriate correction factors with estimates of the emission values that would be reported under the standard Part 75 missing data substitution provisions shows that the standard Part 75 provisions are unnecessarily conservative in this instance. The standard missing data substitution provisions are intended to provide a conservative estimate of actual emissions and to provide sources with an incentive to follow good operating and maintenance practices that will ensure high CEMS availability. In this instance, use of the standard missing data substitution provisions would result in reported emissions more than double the emissions that would be reported using bias correction factors that include reasonably conservative uncertainty adjustments.

However, EPA denies FG's request to use 1.233 as the value of the bias correction factor. Instead, EPA approves as the bias correction factors for each of the six evaluation periods identified above the values shown in column (i) of Table 1 above. Because the probe leak would have biased SO₂, and NO_x concentration measurements to the same extent that it biased CO₂ measurements, the same correction factors are approved for all three sets of concentration measurements. Following adjustment by the approved bias correction factors, FG may treat the adjusted data as valid, quality-assured data. The basis for disapproval of FG's requested correction factor and for approval of the alternative correction factors in column (i) is the treatment of uncertainty in the formulas used to compute the respective factors. As discussed above, EPA finds that the formula used by FG to develop its requested correction factor is not sufficiently conservative because the formula fails to adequately account for uncertainty in the measured data. In contrast, the formula used by EPA to compute the approved bias correction factors in column (i) accounts for uncertainty by using a standard statistical approach for computing the upper bound of an uncertainty range for the quotient of two uncertain values. EPA acknowledges that using the single value of 1.233 to adjust the measured data in all evaluation periods, as FG requested in the petition, would produce higher adjusted emissions than the approved correction factors. EPA nevertheless believes the approved correction factors, which have been developed following an approach approved in responses to several previous petitions addressing similar probe leak situations, are sufficiently conservative.

As conditions of this approval, FG must:

- (1) Adjust the hourly SO₂, NO_x, and CO₂ concentration data recorded at Sammis CSB during the probe leak incident as follows. For each time period listed in Table 1 above, multiply each hourly SO₂, NO_x, and CO₂ concentration by the approved correction factor for that time period. The

first adjusted hour in the probe leak period shall be hour 20 on March 13, 2013, and the final adjusted hour shall be hour 16 on November 1, 2013.

- (2) Report each adjusted hourly SO₂, NO_x, and CO₂ concentration using a special method of determination code (MODC) of “53”, which means “other quality assured methodology approved through petition.” These adjusted hourly concentrations must be included in missing data lookbacks and are treated as available hours for percent monitor data availability (PMA) calculations.
- (3) Recalculate all hourly emission rate, heat input, and mass emissions values for the probe leak period, using the adjusted SO₂, NO_x, and CO₂ concentrations.
- (4) Resubmit the 1st, 2nd, 3rd, and 4th quarter 2013 electronic data reports (EDRs) for Sammis CSB. 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.
- (5) Resolve any Acid Rain Program SO₂ allowance accounting issues and/or any CAIR NO_x annual or ozone season allowance accounting issues by contacting Mr. Kenon Smith, at (202) 343-9164, or by e-mail at smith.kenon@epa.gov.

EPA’s determination relies on the accuracy and completeness of FG’s December 13, 2013 petition, as supplemented in a December 4, 2014 email, and is appealable under 40 CFR Part 78. If you have any questions regarding this determination, please contact Louis Nichols at (202) 343-9008. Thank you for your continued cooperation.

Sincerely,
/s/

Reid P. Harvey, Director
Clean Air Markets Division

cc: Loretta Lehrman, EPA Region V
Sabrina Argentieri, EPA Region V
Todd Brown, Ohio EPA
Craig Hillock, CAMD
Kenon Smith, CAMD
Louis Nichols,
CAMD