Mr. Peter Norgeot
Designated Representative
Entergy Corporation
10055 Grogans Mill Road
Parkwood II Building, Suite 400
The Woodlands, TX 77380

Re: Petition to Adjust Reported CO_2 Concentration Data for Unit 6 at the Roy S. Nelson Generating Station (Facility ID (ORISPL) 1393)

Dear Mr. Norgeot:

The United States Environmental Protection Agency (EPA) has reviewed the petition submitted under 40 CFR 75.66 by Entergy Corporation (Entergy) dated October 27, 2010 (and amended on April 4, 2011) in which Entergy requested permission to adjust carbon dioxide (CO_2) concentration values measured and reported from hour 13:00 on January 19, 2010 until hour 22:00 on March 19, 2010, for Unit 6 at the Roy S. Nelson Generating Station. The requested adjustments to reported CO_2 concentration values in turn would cause adjustments to the values reported for CO_2 mass emissions, nitrogen oxides (NO_X) emission rate, and heat input. EPA approves the petition, in part, with conditions, as discussed below.

Background

Entergy operates and co-owns the Roy S. Nelson Generating Station (RS Nelson) in Westlake, Louisiana. RS Nelson Unit 6 is a coal-fired boiler serving a generator with a maximum generating capacity of 615 megawatts (MW). According to Entergy, Unit 6 is subject to the Acid Rain Program and during 2010 was also subject to the Clean Air Interstate Rule (CAIR) sulfur dioxide (SO_2) and NO_X emissions trading programs (as adopted in Louisiana's state implementation plan).[1] Entergy is therefore required to monitor and report SO_2, NO_X, and CO_2 mass emissions, NO_X emission rate, and heat input data for the unit in accordance with 40 CFR part 75. To meet these requirements, Entergy has installed and certified dilution-extractive

[1] Starting with emissions occurring in 2015, Unit 6 is no longer subject to requirements under CAIR but remains subject to similar requirements under the Acid Rain Program and the Cross-State Air Pollution Rule (CSAPR).

continuous emissions monitoring systems (CEMS) for SO_2, NO_X, and CO_2, as well as a stack gas flow rate monitor. In a dilution-extractive CEMS, flue gas samples are extracted from the stack through a sample probe, diluted with conditioned air in a known ratio, and sent through an umbilical line to gas concentration analyzers. A single dilution probe on the Unit 6 stack is used to obtain the diluted flue gas samples sent to the SO_2, NO_X, and CO_2 concentration analyzers serving the unit.

In the course of a data audit, EPA found anomalies in the CO_2 concentration data reported for Unit 6, suggesting the possibility of a leak in a component of the unit's dilution-extractive system (e.g., sample probe or umbilical line). EPA informed Entergy of this finding, and upon examination Entergy determined that the reported CO_2 emissions were biased low from January 19, 2010 to March 19, 2010. Under Entergy's monitoring plan for Unit 6, CO_2 concentration data are used directly in the computation of CO_2 mass emission rate (ton/hr) and mass emissions (tons), NO_X emission rate (lb/mmBtu), and heat input rate (mmBtu/hr), making the values previously computed for these variables in this time period suspect. Further, because the flue gas samples analyzed for SO_2 and NO_X concentrations were obtained through the same dilution probe, the measured SO_2 and NO_X concentration data and the previously computed values for SO_2 and NO_X mass emissions were also suspect for the same time period.

According to the petition, Entergy did not identify a specific cause of the apparent data bias issue. On the evening of March 19, 2010, RS Nelson Unit 6 was taken offline and remained in outage for more than two months. During the outage, routine preventative maintenance, including cleaning of the sample and calibration lines and replacement of filters, valves, and other components, was performed on the Unit 6 CEMS. When Unit 6 came back online in late May, 2010, the apparent issue was resolved.

In order to support the identification of the specific time period when the measured CO_2 concentration data were biased low, Entergy provided graphs (and associated data) presenting the computed CO_2 mass emission rate (ton/hr), heat input rate (mmBtu/hr), and stack flow rate (scfh) plotted on the y-axis and the hourly unit load (MW) plotted on the x-axis during four distinct time periods. The first time period included 720 unit operating hours immediately after the date of completion of the 2009 CO_2 RATA (June 10, 2009 to July 10, 2009) and was intended to represent valid data used as a baseline. The second time period (November 1, 2009 to January 19, 2010) was intended to represent valid data immediately prior to the period of low-biased CO_2 concentration data. The third time period (January 19, 2010 to March 19, 2010) was the period identified as having low-biased CO_2 concentration data. The fourth time period (May 28, 2010 to June 30, 2010) was intended to represent valid data immediately after the period with low-biased CO_2 concentration data.

Entergy also provided graphs and tables intended to demonstrate that the issue which resulted in low-biased CO_2 data did not affect the measured stack gas flow rate (scfh), SO_2 concentration (ppm), or NO_X concentration (ppm) data or the computed SO_2 or NO_X mass

emission rate (lb/hr) data. Entergy also stated that while the data analysis did indicate a low-bias SO_2 concentration during the January 19, 2010 to March 19, 2010 timeframe, the low-bias could be attributed to the variability of the sulfur in the fuel.

Entergy submitted the graphs described above along with the following table, which provides a summary of emissions, heat input, and stack gas flow per MWh for the four distinct time periods. In Table 1, the bolded data period (January 19, 2010 to March 19, 2010) identifies the time period in which the measured CO_2 concentration data were biased low.

Table 1: Average ratios of emissions, heat input, and stack gas flow rate to hourly unit load, as measured or computed before correction

Data Period	Average Ratio				
	Tons CO_2 per MWh	**mmBtu per MWh**	**1000 SCF per MWh**	**lbs SO_2 per MWh**	**lbs NO_x per MWh**
June 10, 2009 to July 10, 2009	1.186	10.895	161.21	8.336	2.508
November 1, 2009 to January 19, 2010	1.139	10.465	157.90	7.999	2.284
January 19, 2010 to March 19, 2010	**1.067**	**9.797**	**159.42**	**7.466**	**2.418**
May 28, 2010 to June 30, 2010	1.180	10.839	164.79	8.910	2.144

In the October 27, 2010 petition and amended petition from April 4, 2011, Entergy stated that both tons of CO_2 per MWh and heat input per MWh for the period from January 19, 2010 to March 19, 2010 were 11.1 percent lower than the corresponding ratios measured during the baseline period following the June 2009 RATA (i.e., June 10, 2009 to July 10, 2009). Therefore, Entergy requested to apply a correction factor of 1.111 to the hourly CO_2 concentration data from hour 13:00 on January 19, 2010 through hour 22:00 on March 19, 2010. The corrected CO_2 concentration data would then be used to calculate revised CO_2 mass emissions, heat input, and NO_X emission rates (lb/mmBtu) for each operating hour in the affected time period. The recalculated data would be incorporated into Unit 6's first quarter 2010 emissions report and resubmitted to the Clean Air Markets Division of EPA.

EPA's Determination

EPA performed its own analysis of the low-biased CO_2 concentration data reported for Unit 6 using an established control chart procedure which is designed to identify possible CEMS

probe leaks.[2] Specifically, EPA's analysis focused on the reported CO_2 concentrations in a representative load bin for Unit 6. The control chart methodology uses CO_2 data for the analysis because of the relatively low variability of CO_2 concentration in a given load range as compared to other parameters that may vary more due to fuel variability or other factors in the combustion process. Therefore, differences in CO_2 concentration may be used to derive an appropriate bias correction factor when a uniform bias can be detected.

The Agency's analysis compared the low-biased CO_2 data recorded during the period from January 19, 2010 to March 19, 2010 to a baseline of quality-assured CO_2 concentration data collected in the period immediately following the 2009 CO_2 RATA (June 11, 2009 to July 10, 2009). To eliminate operational variation, the analysis was focused on the load bin in which the unit most often operated during the evaluation period (i.e., load bin 10). The baseline period consisted of the first 30 calendar days following the RATA during which at least six hours of quality-assured CO_2 concentration data per day were collected with the unit operating in load bin 10. The following procedure was used to determine a correction factor:

A) For each day in the baseline period, the daily average of quality-assured CO_2 concentration values for the hours where the unit was operating in load bin 10 was calculated;

B) Using the daily average CO_2 concentrations from step A, the baseline period average CO_2 concentration and standard deviation were calculated;

C) For each day in the low-bias period (i.e., January 19, 2009 to March 19, 2009) where the unit operated for at least 6 hours in load bin 10, the daily average of CO_2 concentration values for those hours was calculated;

D) Using the daily averages from step C, the low-bias period average CO_2 concentration and standard deviation were calculated;

E) The following equation was used to compute a correction factor that accounts for uncertainty in measurements during both the baseline period and the low-bias period and conservatively ensures that the corrected data will not result in under-reported emissions:[3]

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[2] A paper describing EPA's control chart methodology and approach for evaluating potential CEMS data quality issues by examining the relationship over time of CO_2 concentration data to unit load data can be found at https://www.epa.gov/airmarkets/control-chart-methodology-detecting-under-reported-emissions.

[3] Note that the uncertainty of a quotient is equal to the square root of the sum of squared fractional uncertainties for the individual input values times the quotient result. See, for example, Taylor, J.R., *An Introduction to Error Analysis: The Study of Uncertainties in Physical Measurements*, University Science Books, Mill Valley, CA, pp. 56-57 (1982).

Figure 1

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

Where:

CF	= Correction factor to be applied to the low-biased emissions data, including uncertainty adjustment;
$AvgCO2_{base}$	= Average of load-bin-10 daily average %CO_2 during the baseline period;
SD_{base}	= Standard deviation of load-bin-10 daily average %CO_2 during the baseline period;
$AvgCO2_{low}$	= Average of load-bin-10 daily average %CO_2 during the low-bias period; and
SD_{low}	= Standard deviation of load-bin-10 daily average %CO_2 during the low-bias period.

Table 2 below summarizes the data inputs and results of the correction factor calculations.

Table 2: Correction factor calculation summary (see equation above)

Description	Variable	Value
Average baseline CO_2	$AvgCO2_{base}$	13.10
Average low-bias CO_2	$AvgCO2_{low}$	11.88
Standard deviation of baseline data	SD_{base}	0.077
Standard deviation of low-bias data	SD_{low}	0.207
Correction factor including uncertainty adjustment	CF	1.123

Ordinarily, for any unit operating hour in which valid, quality-assured data are not obtained with a certified monitor, the standard missing data provisions in §§ 75.33 through 75.37 would be used to determine the appropriate substitute data values to be reported. 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.

However, in this instance, EPA finds that the use of the standard missing data substitution provisions would be unnecessarily conservative. Entergy's data analysis described above showed that there was a consistent, unidirectional bias in the CO_2 concentration data recorded by the CEMS installed at Unit 6 in the period extending from January 19, 2010 to March 19, 2010

attributable to a CEMS issue that was not specifically identified but that clearly was corrected by the CEMS maintenance procedures carried out during the unit's Spring 2010 outage. In circumstances of this nature, the Agency has previously found that use of a correction factor with an appropriate statistical adjustment to account for measurement uncertainty can provide reasonable, yet conservatively high emissions data. EPA therefore approves 1.123 (rather than 1.111 as requested by Entergy) as the appropriate final correction factor to make an upward adjustment to measured CO_2 concentration data from hour 13:00 on January 19, 2010 to hour 22:00 on March 19, 2010, in lieu of using the standard part 75 missing data routines.

In the petition, Entergy requests permission to apply a correction factor only to the originally measured and reported CO_2 concentration data and to make no adjustments to the contemporaneously measured SO_2 and NO_X concentration data. As noted above, the Nelson 6 CEMS for CO_2, SO_2, and NO_X share various equipment components, including the common dilution probe. In circumstances where a source has identified a CEMS bias issue and has been able to identify a specific equipment problem that would affect concentration measurements for one gas but not others, EPA has allowed the use of a correction factor (as an alternative to the use of the standard part 75 missing data substitution provisions) that would be applied only to the concentration data for that single gas.[4] In this instance, Entergy has not identified a specific equipment problem responsible for the apparent data bias problem, and as Entergy acknowledges in the petition, the measured SO_2 concentration data appear to indicate a low bias during the same period as the measured CO_2 concentration data. EPA finds that Entergy has not sufficiently demonstrated that the equipment problem (or problems) causing the apparent low bias in the measured CO_2 concentration data did not also affect the measured SO_2 and NO_X concentration data obtained through partially common equipment. Accordingly, EPA considers it appropriate for Entergy to apply the approved correction factor of 1.123 not only to the measured CO_2 concentration data but also to the measured SO_2 and NO_X concentration data for the same period.

In addition to adjusting and resubmitting the SO_2, NO_X, and CO_2 concentration data, it is also necessary for Entergy to recalculate and resubmit the hourly SO_2, NO_X, and CO_2 mass emission rate (lb/hr or ton/hr, as appropriate), heat input rate (mmBtu/hr), and NO_X emission rate data (lb/mmBtu), as well as the cumulative SO_2, NO_X, and CO_2 mass emissions data (pounds or tons, as appropriate).

Conditions of Approval

As conditions of this approval, Entergy must:

(1) Adjust the hourly SO_2, NO_X, and CO_2 concentration data recorded at Unit 6 during the low-bias period from hour 13:00 on January 19, 2010 through hour 22:00 on March 19, 2010, using the approved correction factor of 1.123.

[4] *See, e.g.*, EPA response to petition for Independence power plant (March 13, 2017).

(2) Recalculate and report all hourly SO_2, NO_X, and CO_2 mass emission rates (lb/hr or ton/hr), NO_X emission rate (lb/mmBtu), and heat input rate (mmBtu/hr) values for the low-bias period, as well as cumulative SO_2, NO_X, and CO_2 mass emissions values (pounds or tons), using the adjusted SO_2, NO_X, and CO_2 concentration data.

(3) Report each adjusted hourly SO_2, NO_X, and CO_2 concentration (ppm or %) and NO_X emission rate (lb/mmBtu) value using the method of determination (MODC) code "53", which means "other quality assured methodology approved through petition." These adjusted hourly values must be included in missing data lookbacks and are treated as available hours for percent monitor availability (PMA) calculations.

(4) Resubmit the quarterly electronic emission files for RS Nelson Unit 6 for all quarters of 2010.

(5) If necessary, resolve any allowance accounting issues for Unit 6 by contacting 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 Entergy's October 27, 2010 petition, as amended on April 4, 2011, and the associated electronic data reports previously submitted by Entergy; and is appealable under 40 CFR part 78. If you have any questions regarding this determination, please contact Mr. Travis Johnson at (202) 343-9018 or by e-mail at johnson.travis@epa.gov. Thank you for your continued cooperation.

Sincerely,

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

cc: Kermit Wittenburg, Louisiana DEQ
Raymond Magyar, EPA Region VI
Travis Johnson, CAMD
Craig Hillock, CAMD
Kenon Smith, CAMD