

August 27, 2008

Mr. Philip Grigsby  
Designated Representative and  
NO<sub>x</sub> Authorized Account Representative  
W. C. Beckjord Station  
Duke Energy Ohio  
139 E. Main Street, EA605  
Cincinnati, OH 45201

Re: Petition for Approval of Alternative Data Substitution Methodology for the W. C. Beckjord Station (Facility ID (ORISPL) 002830)

Dear Mr. Grigsby:

The United States Environmental Protection Agency (EPA) has reviewed the petition submitted under ' 75.66(a) by Duke Energy (Duke) on April 24, 2008, in which Duke requested approval to use an alternative data substitution methodology to replace SO<sub>2</sub>, NO<sub>x</sub>, and CO<sub>2</sub> concentration data from December 9, 2006 through March 11, 2007 for Unit 6 at W. C. Beckjord Station, in order to correct the data for a low bias that was caused by a suspected probe leak. EPA approves the petition, with conditions, as discussed below.

### Background

Unit 6 at Duke=s W. C. Beckjord Station in New Richmond, Ohio is a coal-burning, tangentially-fired 434 megawatt boiler. According to Duke, Unit 6 is subject to the Acid Rain and NO<sub>x</sub> Budget Programs and is required to monitor and report sulfur dioxide (SO<sub>2</sub>), nitrogen oxides (NO<sub>x</sub>), and carbon dioxide (CO<sub>2</sub>) emissions and heat input for the unit in accordance with 40 CFR Part 75. To meet the SO<sub>2</sub>, NO<sub>x</sub>, and CO<sub>2</sub> monitoring requirements of Part 75, Duke uses an in-stack dilution extractive continuous emissions monitoring system (CEMS).

On February 27, 2008, Duke received a notice from EPA that Unit 6 at the W. C. Beckjord Station had been identified in an Agency audit as possibly having a leak at the probe of the CEMS. Duke conducted an investigation and believes that the dilution probe at Unit 6 had developed a leak starting on December 9, 2006. Duke stated that a fitting on the calibration gas exhaust manifold was loose allowing ambient air to be sucked into the calibration gas line leading to the dilution probe. This influx of ambient air caused an increase in the dilution ratio and biased the pollutant gas concentration readings low. The monitors continued to pass daily calibrations and linearity checks because the calibration gases are injected under positive pressure, which pushed the ambient air out of the calibration gas line during the calibration

sequence. Duke discovered the loose fitting on March 18, 2007 and tightened it during a routine outage, but failed to realize that the pollutant concentrations had been affected until notified by EPA.

Duke claimed that using standard substitute data during most of the period of the probe leak (December 9, 2006 to March 11, 2007) results in substantial overreporting of the unit's emissions. Duke therefore requested to use alternative substitute data for this period. According to Duke, CEMS data for Unit 6 for December 9, 2006 to March 11, 2007 can be directly correlated with other operating parameters, such as unit load, making it possible to use a simple multiplier to correct the low bias in the CEMS data for that portion of the leak period. However, Duke stated that the CEMS data became too erratic after Unit 6 returned from outage on March 11, 2007 until the leak was fixed on March 18, 2007, due to an increase in the in-leakage rate, for any meaningful correlation to be determined. Duke agreed to substitute data using the standard missing procedures for March 12 through March 18, 2007.

For December 9, 2006 to March 11, 2007, Duke proposed to apply a bias correction factor to the SO<sub>2</sub>, NO<sub>x</sub>, and CO<sub>2</sub> data recorded during those days. To derive this correction factor, Duke first identified two distinct periods of time, one before the probe leak, and one after the leak, during which Unit 6 was operated in a similar manner. Duke recommended a load-bin based (with unit load divided into 10 equal bins) upward adjustment of the CEMS data, using a different correction factor for each load bin. The correction factors ranged from 1.168 for load bin 5 to 1.259 for load bin 9. Using the correction factors, Duke estimated that the SO<sub>2</sub> mass emissions in the fourth quarter of 2006 should be increased by 158 tons and in the first quarter of 2007 the SO<sub>2</sub> mass should be increased by 1544 tons, which increases are 3% and 25% of the quarterly total mass respectively.

#### EPA=s Determination

To assess the appropriateness of Duke=s proposed correction factor, EPA performed an analysis of the CEMS data focusing on the CO<sub>2</sub> concentration at a representative load. The CO<sub>2</sub> data were selected for the analysis because of the relatively low variability of CO<sub>2</sub> concentration in a given load range, as compared to other parameters that vary more due to fuel variability or due to other factors in the combustion process. Therefore, differences in CO<sub>2</sub> concentration may be used to derive an appropriate bias correction factor when a uniform bias can be detected. EPA's analysis compared the low-biased CO<sub>2</sub> data recorded from December 9, 2006 to March 18, 2007 to a baseline period of quality-assured CO<sub>2</sub> concentration data collected following the most recent CO<sub>2</sub> relative accuracy test audit (RATA). To eliminate operational variation, EPA focused its analysis on the load bin for which the unit was most often operated during the evaluated period (i.e., load bin "9"). The baseline period (May 4 through June 29, 2006) was selected to give 30 days worth of data where at least six hours of quality-assured data per day were collected when the unit was operated within the desired load bin for the analysis. For each day where these criteria were met, the average CO<sub>2</sub> concentration for that load bin was calculated. Then the average daily average CO<sub>2</sub> concentration and standard deviation of the daily averages was calculated resulting in a baseline expected CO<sub>2</sub> concentration of 12.38 %CO<sub>2</sub>

with a standard deviation of 0.21 %CO<sub>2</sub>.

Next, EPA calculated daily average CO<sub>2</sub> concentrations in load bin “9”, for each day in the period of the probe leak (December 9, 2006 through March 18, 2007). EPA was then able to identify by graphical means three distinct populations of data where the bias seemed to be different. A bias correction factor was calculated for each of these time periods by dividing the baseline daily average CO<sub>2</sub> value by the daily average CO<sub>2</sub> concentration calculated for each of the three time periods. To account for the uncertainty of the calculated correction factor and any additional variability caused by the leak, EPA calculated the standard deviation of the daily averages during each of the three time periods and used these values in combination with the standard deviation calculated for the baseline data to calculate an overall uncertainty for the correction factors calculated. This uncertainty was then added to the base correction factor to derive the final correction factors. The following formula demonstrates how these calculations were made.<sup>1</sup>

$$CF = \frac{x \pm dx}{y \pm dy} = \frac{x}{y} \left( 1 \pm \sqrt{\left(\frac{dx}{x}\right)^2 + \left(\frac{dy}{y}\right)^2} \right)$$

Where;

*CF* = correction factor to correct for the low bias during the in-leakage

*x* = average baseline CO<sub>2</sub> concentration value (12.38 %CO<sub>2</sub>)

*dx* = standard deviation of the baseline CO<sub>2</sub> concentration values (0.21 %CO<sub>2</sub>)

*y* = average CO<sub>2</sub> concentration value during the biased time period

*dy* = standard deviation of the CO<sub>2</sub> concentration value during the biased time period

The three correction factors were determined to be 1.204 for December 9, 2006 to February 1, 2007, 1.361 for February 2 to February 28, 2007, and 1.733 for March 1 to March 18, 2007. See Table 1 below. One of these correction factors (1.204) was slightly lower than the correction factor for load-bin 9 that Duke proposed (1.259), one was slightly higher (1.361), and the third (1.733) was substantially higher. The same correction factors should be used for all three gases, SO<sub>2</sub>, NO<sub>x</sub>, and CO<sub>2</sub>, because air in-leakage at the probe of a dilution-extractive CEMS lowers the concentrations of all components of a stack gas sample by an equal percentage.<sup>2</sup>

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<sup>1</sup>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, e.g., John R. Taylor, An Introduction to Error Analysis at 56-57 (1982).

<sup>2</sup> The assumption of equal dilution of the three gases is based on the fact that the concentrations of SO<sub>2</sub>, NO<sub>x</sub>, and CO<sub>2</sub> in the in-leaked gas are insignificant.

**Table 1 – Derivation of Correction Factors by Period**

| Time Period      | Average CO <sub>2</sub> | Standard Deviation (uncertainty) | Base Correction Needed | Base Correction Uncertainty | Final Correction Factor |
|------------------|-------------------------|----------------------------------|------------------------|-----------------------------|-------------------------|
| 12/9/06 - 2/1/07 | 10.86                   | ±0.58                            | 1.140                  | ±0.064                      | 1.204                   |
| 2/2/07 – 2/28/07 | 9.55                    | ±0.44                            | 1.297                  | ±0.064                      | 1.361                   |
| 3/1/07 – 3/18/07 | 8.01                    | ±0.96                            | 1.545                  | ±0.188                      | 1.733                   |

Although the gas monitoring systems installed on W. C. Beckjord Unit 6 passed all of the required daily and quarterly quality assurance tests in the period from December 9, 2006 through March 18, 2007, data analyses performed by Duke and EPA have shown that the actual emission measurements made during that time interval were invalid (i.e., biased low). EPA notes that the only Part 75 quality assurance tests that will detect a low bias caused by a probe leak are a RATA and bias test, which are typically performed just once a year.

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 75.30 through 75.33 would be used to determine the appropriate substitute data values to be reported. Substitute data tends to overstate emissions, particularly when the period of missing data is composed of a large number of consecutive hours. It is designed to provide a conservative estimate of the actual emissions and at the same time encourage good maintenance practices that increases data capture.

However, EPA finds that using standard substitute data in this case during the first two time periods identified grossly overstates the unit’s emissions. As reflected in Table 2 below, use of standard substitute data in this case would result in reported emissions equaling about 200% of EPA’s estimate of Unit 6’s likely emissions<sup>3</sup>. Furthermore, the data analyses described above have demonstrated that there was a consistent, uni-directional and quantifiable bias in the data recorded by Unit 6’s CEMS in the periods extending from December 9, 2006 through February 28, 2007. In addition, the correction factors reflecting this uniform bias results in reasonable but conservatively high emissions data. EPA therefore approves Duke’s petition to make an upward adjustment of the SO<sub>2</sub>, NO<sub>x</sub>, and CO<sub>2</sub> emissions data for most of this time period, in lieu of using the standard Part 75 missing data routines. The approved bias correction factors are 1.204 for December 9, 2006 to February 1, 2007 and 1.361 for February 2 to February

<sup>3</sup> This estimate of the “likely emissions” was obtained by applying the base correction factor in Table 1, which assumes that SO<sub>2</sub>, NO<sub>x</sub> and CO<sub>2</sub> 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.

28, 2007. During these periods the concentration data shall be using a special MODC code of “53”, which is to mean “other quality assured methodology approved through petition.” These hours are to be included in the missing data lookback and are to be treated as available hours for percent monitor availability calculations.

**Table 2: Impact of Standard and Alternative Missing Data on Reported SO<sub>2</sub> Emissions During Probe Leak**

| SO <sub>2</sub> Calculation Method                    | Total SO <sub>2</sub> Emissions for 4 Qtr '06 and 1 Qtr '07 Combined (tons) |
|---|---|
| Unadjusted data, as originally reported               | 5,910   |
| Adjusted data (estimate of likely actual emissions)   | 7,373   |
| Standard Part 75 missing data substitution            | 14,565  |
| Duke's requested correction                           | 8,454   |
| Adjusted data (using EPA approved correction factors) | <b>8,649</b>  |

EPA believes that it is inappropriate to apply a correction factor to the third time period in question (March 1 to March 18, 2007) because the leak seemed to be progressively getting worse day-by-day during that period. Use of a correction factor is only appropriate for a time period when the magnitude of a leak is reasonably stable, resulting in a uniform bias that can be reflected in a fixed correction factor. Therefore, for the hours from March 1, 2007 until the leak was repaired on March 18, 2007, Duke shall substitute SO<sub>2</sub>, NO<sub>x</sub>, and CO<sub>2</sub> concentration data based on the substitute data routines in ' ' 75.30 through 75.33. Duke also needs to recalculate all mass, emissions rate, and heat input values using the adjusted pollutant concentrations.

Correcting the data will require a resubmission of the fourth quarter, 2006 and first, second, third, and fourth quarter 2007 EDRs for Unit 6. EPA estimates that the correction will cause SO<sub>2</sub> mass emissions for 2006 and 2007 to increase by approximately 2,739 tons over what was originally reported for Unit 6 and be approximately 195 tons over the mass that would have resulted if EPA had granted Duke's suggested substitute data methodology in its petition. Duke should 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.

EPA=s determination relies on the accuracy and completeness of Duke=s April 24, 2008 petition and the associated electronic data reports and is appealable under Part 78. If you have any questions regarding this correspondence, please contact Louis Nichols at (202) 343-9008.

Sincerely,

/s/

Sam Napolitano, Director  
Clean Air Markets Division

cc: Constantine Blathras, USEPA Region 5  
Todd Brown, OHEPA  
Louis Nichols, USEPA CAMD  
Craig Hillock, USEPA CAMD