November19, 2009

Mr. Alan Madewell
Designated Representative
Cape Fear Electric Generating Plant
Progress Energy Carolinas, Inc
P.O. Box 1551
PEB 4A
Raleigh, NC 27602

Re: Petition for Approval of Alternative Data Substitution Methodology for the Cape Fear Electric Generating Plant (Facility ID (ORISPL) 2708)

Dear Mr. Madewell:

The United States Environmental Protection Agency (EPA) has reviewed the petition submitted under §75.66(a) by Progress Energy Carolinas, Inc (Progress Energy) on July 13, 2009, in which Progress Energy requested approval to use an alternative data substitution methodology to replace $SO_2$, $NO_x$, and $CO_2$ concentration data from April 17 through June 29, 2009 for Unit 5 at the Cape Fear Electric Generating Plant (Cape Fear), in order to correct the data for a low bias caused by two probe leak events which the company identified and corrected. EPA approves the petition, with conditions, as discussed below.

Background

Cape Fear Unit 5 is a 159 megawatt coal-burning, tangentially-fired boiler. Progress Energy, Unit 5 is subject to the Acid Rain, NOx Budget, and Clean Air Interstate Rule (CAIR) NOx, SO2, and Ozone Season Programs. Therefore, Unit 5 is required to monitor and report sulfur dioxide ($SO_2$), nitrogen oxides ($NO_x$), and carbon dioxide ($CO_2$) emissions and heat input data for the unit in accordance with 40 CFR Part 75. To meet the $SO_2$, $NO_x$, and $CO_2$ monitoring requirements of Part 75, Progress Energy uses an in-stack dilution extractive continuous emissions monitoring system (CEMS).

According to the Progress Energy's petition, after a unit outage, a leak developed in the sampling system for the Unit 5 CEMS that reduced the $CO_2$, $NO_x$, and $SO_2$ concentrations measured by the respective analyzers and maintenance personnel reviewed the data and determined that the $CO_2$ concentration data was lower than expected. Suspecting a dilution ratio problem, the maintenance personnel performed a dilution ratio test that showed no problem with the dilution ratio, and so the problem continued from April 17 through June 9, 2009. On June 8, 2009 the lower than expected $CO_2$ readings were again questioned and maintenance personnel were instructed to swap to a backup umbilical line. This initially seemed to have corrected the

problem; however, after several days the readings again drifted low. In the end, the probe tip was replaced and the $CO_2$ readings have been at normal levels since the replacement on July 1, 2009 to the present.

Progress Energy proposes a correction factor for each of these two separate events. Progress Energy performed an analysis of the CEMS data using a methodology similar to the one described by EPA in presentations at the Electric Power Research Institute's (EPRI) CEMS Users Meeting. Progress Energy proposes to use a correction factor of 1.55 from April 17, 2009 hour 09 through June 9, hour 08, and 1.10 for June 18 through June 29, 2009.

EPA has evaluated the data separately using the procedures developed to handle similar situations. Specifically, EPA performed an analysis of the CEMS data focusing on the $CO_2$ concentration at a representative load for Unit 5. The $CO_2$ data are selected for the analysis because of the relatively low variability of $CO_2$ concentration in a given load range, as compared to other parameters that 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 analysis compared the low-biased $CO_2$ data recorded during each of the described periods to a baseline period of quality-assured $CO_2$ concentration data collected following the most recent $CO_2$ relative accuracy test audit (RATA). To eliminate operational variation, the analysis was focused on the load bin for which the unit was most often operated during the evaluated period (i.e., load bin "10"). The baseline period (November 11, 2008 through December 12, 2008) 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 $CO_2$ concentration for that load bin was calculated. Then the average daily average $CO_2$ concentration and standard deviation of the daily averages was calculated resulting in a baseline expected $CO_2$ concentration of 10.90 % $CO_2$ with a standard deviation of 0.16 % $CO_2$. Based on this information the three standard deviation lower control limit was calculated as 10.42 % $CO_2$.

Next, EPA compared the daily average $CO_2$ concentration for each day of the first and second quarters of 2009 to the baseline established following the November 2008 RATA. In doing so, EPA identifies three distinct periods of unusually low bias in the $CO_2$ data. The first period from April 3 through April 7, 2009, which preceded the unit shutdown, was not identified by Progress Energy. However, the daily average $CO_2$ calculated from data in load bin "10" for each of these days was less than the lower control limit of 10.42 % $CO_2$ calculated from the baseline period data. The second period included data from April 16 through Jun 8, 2009, and the third period included data from June 18 through June 29, 2009.

Next, EPA calculated the average daily average $CO_2$ concentrations in load bin "10", for each of the identified periods of system failure (April 3 through April 7, 2009; April 16 through June 8, 2009; and June 18 through June 29, 2009). A bias correction factor was calculated for each time period by dividing the baseline daily average $CO_2$ value by the average daily average $CO_2$ concentration calculated for each biased period. To account for the uncertainty of the

calculated correction factor and any additional variability caused by the leak, EPA also calculated the standard deviation of the daily averages during the biased period and used that value in combination with the standard deviation calculated for the baseline data to calculate an overall uncertainty for the calculated correction factor. This uncertainty was then added to the base correction factor to derive the final correction factor, which ensures that the corrections are conservative and that the corrected data will be reasonably overstated. The following formula demonstrates how this calculation was made.[1]

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

Where:

*CF* = correction factor to correct for the low bias during the in-leakage;
*x* = average baseline $CO_2$ concentration value (11.04 % $CO_2$);
*dx* = standard deviation of the baseline $CO_2$ concentration values (0.04 % $CO_2$);
*y* = average $CO_2$ concentration value during the biased period; and
*dy* = standard deviation of the $CO_2$ concentration value during the biased period.

The following table shows the results of the analysis performed using the above described methodology:

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

| Time Period | Average $CO_2$ | Standard Deviation (uncertainty) | Base Correction Needed | Base Correction Uncertainty | Final Correction Factor |
|---|---|---|---|---|---|
| 4/3/09 - 4/7/09 | 10.3 | ±0.07 | 1.058 | ±0.017 | 1.075 |
| 4/16/09 - 6/8/09 | 7.46 | ±0.58 | 1.462 | ±0.115 | 1.577 |
| 6/18/09 - 6/29/09 | 10.13 | ±0.12 | 1.076 | ±0.020 | 1.096 |

EPA's Determination

1. 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).

EPA approves the use of the three correction factors: 1.075 for the period of April 3 through April 7, 2009; 1.577 for the period of April 16 through June 8, 2009; and 1.096 for the period of June 18 through June 29, 2009. The same correction factors should be used for all three gas concentrations, $SO_2$, $NO_x$, and $CO_2$, 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.[2]

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 provide a strong incentive to ensure that monitoring systems (i.e., CEMS) are properly operated and maintained.

However, EPA finds that using standard substitute data, in this case, during the time periods identified grossly overstates the unit's emissions. As reflected in Tables 2a and 2b below, use of standard substitute data in this case would result in reported emissions equaling about 137% of EPA's estimate of Unit 5's likely $SO_2$ mass emissions[3] and 194% of the likely $NO_X$ mass emissions for the second quarter of 2009. Furthermore, the data analyses described above have demonstrated that there was a consistent, uni-directional bias in the data recorded by Unit 5's CEMS in the periods of April 3 through April 7, 2009; April 16 through June 8, 2009; and June 18 through June 29, 2009, and the correction factors reflecting this uniform bias results in reasonable but conservatively high emissions data. EPA therefore approves Progress Energy's petition to make an upward adjustment of the $SO_2$, $NO_x$, and $CO_2$ emissions data for each of these time periods, in lieu of using the standard Part 75 missing data routines. During this period 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. Progress Energy also needs to recalculate all mass, emissions rate, and heat input values using the adjusted pollutant concentrations.

**Table 2a: Impact of Standard and Alternative Missing Data on Reported 2nd Quarter $SO_2$ Emissions**

2. The assumption of equal dilution of the three gases is based on the fact that the concentrations of $SO_2$, $NO_x$, and $CO_2$ in the in-leaked gas are insignificant.

3. 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.

| $SO_2$ Calculation Method | Total $SO_2$ Emissions (tons) |
|---|---|
| Unadjusted data, as originally recorded | 897 |
| Adjusted data (estimate of likely actual emissions) | 1156 |
| Standard Part 75 missing data substitution | 1567 |
| Progress Energy's Requested correction | 1203 |
| Adjusted data (using EPA approved correction factor) | **1220** |

**Table 2b: Impact of Standard and Alternative Missing Data on Reported 2nd Quarter $NO_X$ Emissions**

| NOx Calculation Method | Total NOx Emissions (tons) |
|---|---|
| Unadjusted data, as originally recorded | 135 |
| Adjusted data (estimate of likely actual emissions) | 175 |
| Standard Part 75 missing data substitution | 340 |
| Duke Energy's Requested correction | 182 |
| Adjusted data (using EPA approved correction factor) | **185** |

Correcting the data will require a resubmission of the second quarter 2009 emissions reports for Unit 5. Progress Energy 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 Progress Energy's July 13, 2009 petition and the associated electronic data reports and is appealable under Part 78. If you have any questions regarding this correspondence, please contact Matthew Boze at (202) 343-9211.

Sincerely,

/s/
Sam Napolitano, Director
Clean Air Markets Division

cc: David McNeil, USEPA Region 4
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