November 21, 2012

Mr. Curtis Warner
Designated Representative
Arkansas Electric Cooperative Corporation
P.O. Box 194208
Little Rock, Arkansas 72219-4208

Re: Request for Approval of Alternative Monitoring Systems for Units G1 through G7 at the Arkansas Electric Cooperative Corporation's Harry L. Oswald Generating Station (Facility ID (ORISPL) 55221)

Dear Mr. Warner:

The United States Environmental Protection Agency (EPA) has reviewed the February 17, 2012 petition submitted by the Arkansas Electric Cooperative Corporation (AECC), in which AECC requested approval of predictive emission monitoring systems (PEMS) to continuously monitor nitrogen oxides (NO_x) emissions from seven combustion turbine units at the Harry L. Oswald Generating Station. EPA approves the petition, with conditions, as discussed below.

Background

AECC owns and operates the Harry L. Oswald Generating Station, which is a 510 megawatt (MW) combined-cycle combustion turbine plant located in Pulaski County, Arkansas. The plant consists of six General Electric LM6000 Aeroderivative combustion turbines (Units G1 through G6), one General Electric Frame 7EA combustion turbine (Unit G7) and two steam turbines. This plant configuration is commonly known as a 7 on 2, meaning that seven combustion turbines (CTs), or fewer, provide steam to one or both steam turbines depending on the power demand. Each CT combusts only natural gas and is equipped with a duct burner to provide supplemental heat. Units G1 through G6 use steam injection to control NO_x emissions and Unit G7 uses dry low NO_x (DLN) burners for NO_x control.

Units G1 through G7 are subject to the Acid Rain Program and to the Clean Air Interstate Rule (CAIR) Ozone Season NO_x Trading Program. Therefore, AECC is required to continuously monitor and report NO_x, sulfur dioxide (SO_2), and carbon dioxide (CO_2) emissions and heat input for these units, in accordance with 40 CFR Part 75. AECC has installed and certified continuous emission monitoring systems (CEMS) to meet the NO_x monitoring requirements. Each NO_x monitoring system consists of a NO_x concentration monitor and an oxygen (O_2) monitor. These monitoring systems provide NO_x and O_2 readings every minute, which are sent to a common data acquisition and handling system (DAHS). The DAHS calculates hourly NO_x emission rates for each

CT, in units of pounds per million Btu (lb/mmBtu). Each calendar quarter these NO_x emission rates and other required plant data are reported electronically to EPA. Each CEMS undergoes the periodic quality assurance testing required under Appendix B to Part 75, including daily calibration checks, quarterly linearity checks, and semiannual or annual relative accuracy test audits (RATAs).

In the February 17, 2012 petition, AECC requested permission to replace the hardware NO_x CEMS with PEMS. To obtain EPA approval of an alternative monitoring system (AMS) such as a PEMS, Subpart E of Part 75 requires the owner or operator to show that the AMS provides NO_x emission measurements of comparable precision, reliability, accessibility, and timeliness (PRAT) to measurements made with a CEMS. To achieve this, a 720 operating hour[1] demonstration is required, in which hourly NO_x emission rates predicted by the PEMS are compared directly against measurements made with either a certified CEMS or a reference method.

AECC installed Pavilion8® Software PEMS on Units G1 through G7 in July 2010. Each PEMS was "trained" to "learn" the combustion process[2], according to the manufacturer's instructions. A model for each combustion turbine was then developed from the training data. Next, the predictive capabilities of all seven PEMS were activated, and the PEMS and CEMS were operated concurrently during the third quarter of 2010 for the 720 operating hour Subpart E demonstrations. The start and end dates of the demonstrations varied from turbine to turbine, depending on the dates and hours of unit operation. In addition to these comparison tests, simultaneous RATAs of the PEMS and CEMS were performed in August 2010 and repeated in July 2011.

The results of the comparison tests and concurrent RATAs were included with the February 17, 2012 petition. AECC also documented the methods used to establish the relationship between the parametric inputs to the PEMS and the predicted NO_x emissions, and provided data to demonstrate the precision and reliability of the predictive measurements.

EPA's Determination

EPA reviewed the February 17, 2012 petition and the supplementary data provided by AECC to evaluate compliance with the requirements of Subpart E. As previously noted, Subpart E requires the owner or operator of an affected unit applying for approval of an AMS to perform a 720 operating hour (minimum) demonstration showing that the AMS has the same or better precision, reliability, accessibility, and timeliness (PRAT) as a CEMS. Sections 75.41 through 75.46 of Subpart E present the criteria for evaluating PRAT and specify quality assurance and missing data substitution requirements for the AMS. Section 75.48 details the information that must be included in the petition for approval of the AMS in order to demonstrate that the criteria in §§75.41 through 75.46 are met.

Regarding precision, §75.41 requires the owner or operator to provide valid paired AMS and CEMS data for at least 90 percent of the 720 (or more) unit operating hours in the demonstration. The data may be adjusted to account for any lognormality and/or time dependency autocorrelation. Three statistical tests must be passed, i.e., a linear correlation analysis (r-test), an F-test, and the one-tailed

[1] The demonstration period may be longer than 720 operating hours, at the discretion of the owner or operator.

[2] During the training, operational parameters (e.g., temperatures, pressures, flow rates) are input to the PEMS from various sensors, while NO_x emissions are measured concurrently. This enables the PEMS to predict NO_x emissions when familiar combinations of parameters are encountered during process operation.

t-test for bias described in Part 75, Appendix A, section 7.6.4. Further, the owner or operator must provide two separate time series plots for the AMS and CEMS data. Each data plot must have a horizontal axis representing the calendar dates and clock hours of the readings, and there must be a separate data point for every hour of the test period. One data plot must show CEMS and AMS readings versus time, and the other data plot must show the percentage difference between the AMS and CEMS readings versus time. Finally, a plot of the AMS concentrations (on the vertical axis) and CEMS concentrations (on the horizontal axis) must be provided.

Tables 1 through 4, below show that for each of the seven units, the duration of the PEMS versus CEMS demonstration was at least 720 operating hours and the requirement to obtain valid, paired PEMS and CEMS data for at least 90% of the operating hours was met. Tables 1 through 4 also summarize the results of AECC's statistical analyses of the paired PEMS and CEMS data, which show that the NO_x lb/mmBtu output from each PEMS passed all three required statistical tests. AECC supplied two time series data plots for each unit, showing the PEMS and CEMS readings versus time and the percentage difference between the PEMS and CEMS versus time, as required under §75.41(a)(9), and provided a plot of PEMS concentrations versus CEMS concentrations for each unit, as required under §75.41(c)(2)(i).

Table 1. AECC Harry L. Oswald Generating Station Units G1 and G2
Pavilion8® Software PEMS

Unit G1 (lbs NO_x/mmBtu) Comparison Dates: July 8 – August 31, 2011	**Unit G2 (lbs NO_x/mmBtu) Comparison Dates: July 5 – August 31, 2011**
Days of Operation = 46 Hrs of Operation = 732 Hrs Used in Comparison Test = 664 % of Operating Hrs Used for Test = 90.7%	Days of Operation = 49 Hrs of Operation = 722 Hrs Used in Comparison Test = 665 % of Operating Hours Used for Test = 92.1%
n = 664	**n** = 665
t-test: mean difference, d = 0.001715 abs. value of confidence coefficient, cc = 0.001943 **Evaluation:** Because $\|cc\| \geq d$, the model passed.	**t-test:** mean difference, d = 0.001156 abs. value of confidence coefficient, cc = 0.001735 **Evaluation:** since $\|cc\| \geq d$, the model passed
Linear correlation: correlation coefficient (r) = 0.940436 **Evaluation:** Because $r \geq 0.8$, the model passed.	**Linear correlation:** correlation coefficient (r) = 0.917746 **Evaluation:** since $r \geq 0.8$, the model passed
F-test: variance of PEMS, ep = 0.104239 variance of CEMS, ev = 0.105954 F = 0.875659 $F_{critical}$ = 1.14 **Evaluation:** Because $F_{critical} \geq F$, the model passed.	**F-test:** Variance of PEMS, ep = 0.096441 Variance of CEMS, ev = 0.097597 F = 0.8612791 $F_{critical}$ = 1.14 **Evaluation:** Since $F_{critical} \geq F$, the model passed
Standard Deviation, Sd = 0.02556	**Standard Deviation, Sd** = 0.022828
CEMS/PEMS Relative Accuracy, RA = 2.01%	**CEMS/PEMS Relative Accuracy, RA** = 1.89%

Table 2. AECC Harry L. Oswald Generating Station Units G3 and G4
Pavilion8® Software PEMS

Unit G3 **(lbs NO_x/mmBtu)** **Comparison Dates: July 8 – August 31, 2011**	**Unit G4** **(lbs NO_x/mmBtu)** **Comparison Dates: July 8, 2010 – September 4, 2011**
Days of Operation = 47 Hrs of Operation = 721 Hrs Used in Comparison Test = 671 % of Operating Hrs Used for Test = 93.1%	Days of Operation = 50 Hrs of Operation = 723 Hrs Used in Comparison Test = 652 % of Operating Hours Used for Test = 90.2%
n = 671	**n = 652**
t-test: mean difference, d = -0.005357 abs. value of confidence coefficient, cc = 0.001586 **Evaluation:** since |cc| ≥ d, the model passed	**t-test:** mean difference, d = -0.003427 abs. value of confidence coefficient, cc = 0.002097 **Evaluation:** since |cc| ≥ d, the model passed
Linear correlation: correlation coefficient (r) = 0.934654 **Evaluation:** since r ≥ 0.8, the model passed	**Linear correlation:** correlation coefficient (r) = 0.876842 **Evaluation:** since r ≥ 0.8, the model passed
F-test: Variance of PEMS, ep = 0.103651 Variance of CEMS, ev = 0.098294 F = 1.048185 $F_{critical}$ = 1.14 **Evaluation:** Since $F_{critical} \geq F$, the model passed	**F-test:** Variance of PEMS, ep = 0.103185 Variance of CEMS, ev = 0.099758 F = 1.03135 $F_{critical}$ = 1.14 **Evaluation:** Since $F_{critical} \geq F$, the model passed
Standard Deviation, Sd = 0.020967	**Standard Deviation, Sd** = 0.027321
CEMS/PEMS Relative Accuracy, RA = 2.15%	**CEMS/PEMS Relative Accuracy, RA** = 2.44%

Table 3. AECC Harry L. Oswald Generating Station Units G5 and G6
Pavilion8® Software PEMS

Unit G5 **(lbs NO_x/mmBtu)** **Comparison Dates: July 7 – August 30, 2011**	**Unit G6** **(lbs NO_x/mmBtu)** **Comparison Dates: June 20 – August 24, 2011**
Days of Operation = 49 Hrs of Operation = 733 Hrs Used in Comparison Test = 681 % of Operating Hrs Used for Test = 92.9%	Days of Operation = 51 Hrs of Operation = 722 Hrs Used in Comparison Test = 652 % of Operating Hrs Used for Test = 90.3%
n = 681	**n = 652**
t-test: mean difference, d = - 0.003411 abs. value of confidence coefficient, cc = 0.002857 **Evaluation:** Because |cc| ≥ d, the model passed.	**t-test:** mean difference, d = 0.001293 abs. value of confidence coefficient, cc = 0.001293 **Evaluation:** Because |cc| ≥ d, the model passed.
Linear correlation: correlation coefficient (r) = 0.829225 **Evaluation:** Because r ≥ 0.8, the model passed.	**Linear correlation:** correlation coefficient (r) = 0.958814 **Evaluation:** Because r ≥ 0.8, the model passed.
F-test: variance of PEMS, ep = 0.104861 variance of CEMS, ev = 0.101451 F = 1.055714 $F_{critical}$ = 1.13 **Evaluation:** Because $F_{critical} \geq F$, the model passed.	**F-test:** variance of PEMS, ep = 0.101472 variance of CEMS, ev = 0.102748 F = 1.001167 $F_{critical}$ = 1.14 **Evaluation:** Because $F_{critical} \geq F$, the model passed.
Standard Deviation, Sd = 0.038042	**Standard Deviation, Sd** = 0.016844
CEMS/PEMS Relative Accuracy, RA = 3.15%	**CEMS/PEMS Relative Accuracy, RA** = 1.38%

Table 4. AECC Harry L. Oswald Generating Station Unit G7
Pavilion8® Software PEMS

Unit G7 **(lbs NO_x/mmBtu)** **Comparison Dates: July 17 – August 26, 2011**
Days of Operation = 40 Hrs of Operation = 727 Hrs Used in Comparison Test = 691 % of Operating Hrs Used for Test = 95.0%
n = 691
t-test: mean difference, d = 0.000474 abs. value of confidence coefficient, cc = 0.000851 **Evaluation:** Because $\|cc\| \geq d$, the model passed.
Linear correlation: correlation coefficient (r) = 0.912537 **Evaluation:** Because $r \geq 0.8$, the model passed.
F-test: variance of PEMS, ep = 0.028010 variance of CEMS, ev = 0.028484 F = 1.061726 $F_{critical}$ = 1.13 **Evaluation:** Because $F_{critical} \geq F$, the model passed.
Standard Deviation, Sd = 0.011420
CEMS/PEMS Relative Accuracy, RA = 3.04%

Regarding reliability, §75.42 requires the owner or operator to demonstrate that the PEMS is capable of providing valid 1-hour averages for 95.0 percent or more of unit operating hours over a one-year period and that the system meets the applicable CEMS quality-assurance requirements of Part 75, Appendix B. For all seven units, valid PEMS data were collected by the DAHS for more than 95.0 percent of the operating hours in the Subpart E test period, indicating that the PEMS are capable of meeting the long-term data availability requirements of §75.42. However, the supplementary information provided by AECC to support the February 17, 2012 petition fails to provide a description of the on-going quality-assurance procedures that will be followed to meet the applicable requirements of Appendix B. Nevertheless, EPA will consider these requirements to be met if AECC implements the quality assurance and quality control (QA/QC) procedures described below under "Conditions of Approval" for each of the seven PEMS.

Regarding accessibility and timeliness, §§75.43 and 75.44 require the owner or operator to demonstrate that the PEMS can meet the requirements of Subparts F and G of Part 75; can provide a continuous record of emissions on an hourly basis; and can provide a data record for the previous day within 24 hours. In the February 17, 2012 petition, AECC showed that the PEMS can meet these requirements. The DAHS records all parameters needed to calculate the NO_x emission rate on an hourly basis. The DAHS provides the operator with a continuous display of real-time emission data, including raw NO_x and O_2 concentration data, calculated NO_x emission rates (lb/mmBtu), process operating parameters, and the status of the process as it relates to the PEMS. Data are evaluated for compliance within the operating "envelopes" established during the training period (see Tables 5 and 6, below). The data are then available to generate the required Part 75 quarterly electronic data reports and customized reports, if requested.

Conditions of Approval

The conditions of this approval are as follows:

1. AECC shall implement the following QA/QC procedures for each of the seven PEMS installed on the installed on the Harry L. Oswald combustion turbines:

(a) Each PEMS shall use the input parameters listed in Tables 5 and 6, below, to predict NO_x emission rates. Each parameter value shall be monitored as a one minute average. Each PEMS input parameter value must not fall more than 5 percent below the minimum or more than 5 percent above the maximum values (inclusive) shown in the applicable table below (referred to as "the PEMS operating envelope") and must not deviate from the combinations[3] of critical input parameter values that were represented in the historical training dataset, unless the PEMS has been retrained according to paragraph (g), below, in which case, the new minimum and maximum training values will supersede the values in Tables 5 and 6. If any PEMS input parameter value goes below the minimum or above the maximum table value by more than 5 percent, or deviates from the combinations of critical input parameter values that were represented in the historical training dataset for sufficient time to cause an invalid hour[4], the PEMS shall be considered out-of-control, and the maximum potential NO_x emission rate (MER) specified in paragraph (h), below, shall be reported starting with the first out-of-control hour and ending with the next valid hour. Data from each PEMS input parameter shall be maintained on-site for at least three years, in a form suitable for inspection.

Table 5. Harry L. Oswald Generating Station Units G1 through G6 Pavilion8® Software PEMS Operating Envelope

PEMS Input Parameter	Minimum Value	Maximum Value
Duct Burner (DB) Gas Flow (scfh)	0	200,000
CT Gas Flow (scfh)	0	504,000
CT Steam Injection (lb)	0	38,860
CT By-Pass Vane Position (%)	0	100
CT Sprint Water Flow (gal/min)	0	17
Relative Humidity (%)	0	100

[3] The PEMS shall additionally scan the historical training dataset to determine if the critical parameters contained in the current process vector correspond to any of the data previously collected (using a configurable tolerance or threshold that is maintained at 5% of the parameter range or less). A combination of critical input parameters that is not represented in the historical training dataset will invalidate the current minute record even if each of the individual critical parameters are within 5% of the minimum and maximum values established by the model envelope.

[4] Hourly averages must be computed using at least one valid set of inputs in each fifteen-minute quadrant of an hour in which the unit operates. However, an hourly average may be computed from at least two valid sets of inputs separated by a minimum of 15 minutes (where the unit operates for more than one quadrant of an hour) if data are unavailable as a result of: (1) the performance of calibration, quality assurance, or preventive maintenance activities pursuant to section 4 of this determination, (2) conducting backups of data from the DAHS, or (3) recertification, pursuant to paragraph (g), below. All valid data input to the PEMS during the hour must be used to calculate the hourly averages. All data points collected during an hour shall be, to the extent practicable, evenly spaced over the hour.

Table 6. Harry L. Oswald Generating Station Unit G7
Pavilion8® Software PEMS Operating Envelope

PEMS Input Parameter	Minimum Value	Maximum Value
Duct Burner (DB) Gas Flow (scfh)	0	270,000
HRSG High Pressure Steam Flow (klb)	0	546
CT HP Compressor Discharge Pressure (psia)	0	187
HP Compressor Discharge Temp (°F)	0	846
CT Gas Flow (scfh)	0	1,069,937
CT Combustion Reference Temp (°F)	0	2500
CT Inlet Guide Position (%)	0	94
Relative Humidity (%)	0	100

(b) QA/QC tests of the PEMS shall be performed according to Table 7. The sensor validation system procedures are described in paragraphs (c) and (d). The daily QA/QC test is described in paragraph (e). The RATAs, 3-run RAAs, and bias adjustment factors are discussed in paragraphs (f) and (g). Recertification, including training, of the PEMS is discussed in paragraph (g). The NO_x MER is discussed in paragraph (h).

Table 7. PEMS QA/QC Tests

Test	Performance Specification	Frequency
PEMS training (Linear correlation and F-test)	$r \geq 0.8$, and $F_{critical} \geq F$	[see paragraph (g)]
Sensor validation system		
• Failed Sensor alert	Alert operator of any failed sensors [see paragraphs (c) and (d)]	Hourly [see paragraphs (c) and (d)]
• OOC alarm system	Alert operator of any PEMS OOC [see paragraph (d)]	Hourly [see paragraph (d)]
• OOC alarm setup	[see paragraph (d)]	After each PEMS training [see paragraph (g)]
• Minimum data capture	At least 1 valid data point per 15 minutes [see paragraph (c)]	Hourly [see paragraph (c)]
Daily QA/QC	Absolute value of (unbiased PEMS output - PEMS output produced from RATA or PEMS training) ≤ 0.002 lb NO_x/mmBtu [see paragraph (e)]	Daily
3-run RAA	• Accuracy ≤ 10.0% or • For a low emitting source,* results are acceptable if the mean value for the PEMS is within ± 0.020 lb/mmBtu of the reference mean value	Monthly [see paragraph (f)]
	For semiannual RATA frequency:	Semiannual or annual (depending on

Table 7. PEMS QA/QC Tests

Test	Performance Specification	Frequency
RATA	• RA > 7.5% and ≤ 10.0% or • For a low emitting source,* results are acceptable if the mean value for the PEMS is within ± 0.020 lb/mmBtu of the reference method mean value For annual RATA frequency: • RA ≤ 7.5% or • For a low emitting source,* results are acceptable if the mean value for the PEMS is within ± 0.015 lb/mmBtu of the reference method mean value	the RATA results) for routine QA (see §75.74(c)(2)(ii)) Recertification RATA is required when a RAA or a RATA is failed or when operating conditions change. ≥ 9 test runs are required at normal operating level for annual or semiannual QA. ≥ 30 test runs are required at each of 3 operating levels for recertification. [see paragraphs (f) and (g)]
Bias adjustment factor	If $d_{avg} \leq \|cc\|$, bias test is passed	After each RATA. Perform bias test at the normal operating level [see paragraphs (f) and (g)].

* The unit is a low-emitting source if the mean reference value during the RATA or RAA is ≤ 0.200 lb/mmBtu NO_x.

(c) The sensors for the PEMS input parameters must be maintained in accordance with the manufacturer's recommendations. A sensor validation system is required to identify sensor failures hourly to the operator and to reconcile failed sensors by: comparing each sensor to several other sensors; determining, based on the comparison, if a sensor has failed; and calculating a reasonable substitute value for the parameter measured by the failed sensor. AECC must ensure that the sensor validation system validates sensor data in this way for every minute of PEMS operation. To comply with section 75.10(d)(1), hourly averages must be computed using at least one valid set of inputs in each fifteen-minute quadrant of an hour in which the unit operates.[5] All valid data input to the PEMS during the hour must be used to calculate the hourly averages. All data points collected during an hour shall be, to the extent practicable, evenly spaced over the hour. If the provisions of this paragraph are not met, the PEMS is out-of-control, and the missing data procedures in Subpart D of Part 75 shall be followed.

(d) The sensor validation system shall include an alarm to inform the operator when sensors need repair and when the PEMS is out-of-control. In setting up the alarm system, a demonstration shall be performed at a minimum of four different PEMS training conditions, which must be representative of the entire range of expected turbine operations. For each of the four or more training conditions, the demonstration shall consist of the following:

(1) For all of the sensors used in the PEMS model, input a set of reference sensor values that were recorded either during the training of the PEMS or during a RATA of the PEMS. These input values must all be within the PEMS

[5] However, an hourly average may be computed from at least two valid sets of inputs separated by a minimum of 15 minutes (where the unit operates for more than one quadrant of an hour) if data are unavailable as a result of performing required quality assurance or preventive maintenance activities, or during data backup from the DAHS.

operating envelope. Verify that these reference inputs produce the expected PEMS output (i.e., the expected NO_x emission rate);

(2) Perform one-sensor failure analysis, as follows. Artificially fail one of the sensors, and then, using the calculated replacement value for that sensor [see paragraph (c), above], assess the effect on the accuracy of the PEMS. Calculate the percent difference between the reference NO_x emission rate from step (1) and the PEMS output. Repeat this procedure for each sensor, individually;

(3) Identify the sensor failure in step (2) that results in the worst accuracy. If the highest percent deviation exceeds $\pm$ 10.0 percent, then set up the PEMS to alarm when any single sensor fails. If none of the percent difference values exceeds 10.0 percent, proceed to step (4);

(4) Perform two-sensor failure analysis, as follows: artificially fail the sensor from step (3) that produced the worst accuracy, and also fail one of the other sensors. Then, using the calculated replacement values for both sensors, assess the accuracy of the PEMS hourly average output, as in step (2). Repeat this procedure, evaluating each sensor in turn with the sensor from step (3); and

(5) Identify the combination of dual sensor failures that results in the worst accuracy. If the highest percent deviation exceeds $\pm$ 10.0 percent, then set up the PEMS to alarm when any two sensors fail. If none of the percent difference values exceeds 10.0 percent, then set up the PEMS to alarm with three sensor failures.

The results of this demonstration shall be maintained on-site in a form suitable for inspection. For every hour of PEMS operation, the PEMS shall check for failed sensors and provide an alarm to alert the operator of any sensors needing repair. When the PEMS alarms, the PEMS is out-of-control, and AECC shall report the NO_x MER specified in paragraph (h), below, starting with the hour when the sensor validation alarm system alarms and ending with the hour when all sensor values are back within the expected range.

(e) The following daily QA/QC test must be performed whenever the unit operates for any portion of the day. AECC shall input to the PEMS a set of turbine operating parameters used by the PEMS during a passed PEMS RATA or the most recent PEMS training. (**Note:** It is important that the same number of decimal places for the PEMS inputs be used here as was used in the passed PEMS RATA or most recent PEMS training.) The resulting PEMS NO_x lb/mmBtu output, if bias-adjusted, shall be divided by the bias adjustment factor (BAF) currently in use; this removes the BAF by resetting it to 1.000, as it was during the passed PEMS RATA or most recent PEMS training. Then, the unbiased PEMS output shall be compared to the corresponding PEMS NO_x lb/mmBtu output produced at the time of the RATA or PEMS training. If the difference between the two PEMS NO_x outputs is within $\pm$ 0.002 lb NO_x/mmBtu, the daily QA/QC test is passed. If a daily QA/QC test is failed or not performed, the PEMS is out-of-control. Subpart D missing data

procedures shall be followed starting with the hour of the failed test or, if the test was not performed, the hour after the test due date, and ending with the hour in which a daily QA/QC test is passed. No grace periods are allowed. The results of this check (pass/fail) shall be reported in the Daily Test Summary Records. See Section 2.2 of the Emissions Collection and Monitoring Plan System (ECMPS) Emissions Reporting Instructions. (**Note:** Report code "PEMSCAL" as the Test Type Code for the daily QA/QC check.)

(f) Ongoing semi-annual or annual RATAs shall be performed at the normal operating level according to the procedures in Part 75, Appendix B, section 2.3.1 and shall be calculated on a lb/mmBtu basis. The reference method traverse point selection shall be consistent with Part 75, Appendix A, section 6.5.6. Notification of ongoing RATAs shall be provided according to §75.61(a)(5). Immediately prior to a RATA, the BAF shall be set to 1.000. Before each RATA, AECC shall ensure that the sensor validation system is set to provide at least one valid set of inputs per 15 minute period, as discussed in paragraph (c), above. After the RATA, AECC shall calculate and apply a bias adjustment factor at the normal operating level according to Part 75, Appendix A, section 7.6.4. Report the RATA and bias test data and results as described in Section 2.4 of the ECMPS Quality Assurance and Certification Reporting Instructions.

Monthly, 3-run (minimum) relative accuracy audits (RAAs), described below, shall be performed in every calendar month of the year in which the unit operates for at least 56 hours, except for a month in which a full 9-run RATA or PEMS recertification is performed.

All required RAAs shall be done on a lb NO_x/mmBtu basis and shall be performed using either EPA Reference Methods 7E and 3A in 40 CFR Part 60, Appendix A-4 or portable analyzers. To the extent practicable, each RAA shall be done at different operating conditions from the previous one. Follow the portable analyzer manufacturer's recommended maintenance procedures.

The minimum time per RAA run shall be 20 minutes. The reference method traverse point selection shall be consistent with Part 75, Appendix A, section 6.5.6. Alternatively, a single measurement point located at least 1.0 meter from the stack or duct wall may be used without performing a stratification test.

Results of the RAA shall be calculated using Equation 1-1 in Appendix F to Part 60. Bias-adjusted data from the PEMS (using the bias adjustment factor from the most recent RATA) shall be used in the calculations. The results of the RAA are acceptable if the performance specifications in Table 7, above, are met. If the RAA is failed, follow the provisions in paragraph (g), below. No grace periods are allowed.

Report the results of all RAAs using the ECMPS Client Tool, either prior to or concurrent with the appropriate quarterly electronic data report. As described in Section 4.0 of the ECMPS Quality Assurance and Reporting Instructions, report the results of each test as either "pass" or "fail". Report the Test Type Code as "PEMSACC" to indicate this is a 3 Run Relative Accuracy Audit (RAA) for a PEMS, performed with a reference method or portable analyzer.

If a portable chemiluminescent NO_x analyzer is used to perform the required RAAs, the procedures of Method 7E in 40 CFR Part 60, Appendix A-4 shall be followed. The analyzer performance specifications in Method 7E for calibration error, system bias, and calibration drift shall be met.

If a portable electrochemical analyzer is used to perform the required RAAs, ASTM Method D6522-00[6], as modified below, shall be followed. ASTM D6522-00 applies to the measurement of NO_x (NO and NO_2), CO, and O_2 concentrations in emissions from natural gas-fired combustion systems using electrochemical analyzers. The method was developed based on studies sponsored by the Gas Research Institute (GRI)[7]. It has also been peer-reviewed, approved by ASTM Committees D22.03 and D22, and accepted by EPA as a conditional test method (CTM-030). ASTM D6522-00 prescribes analyzer design specifications, test procedures, and instrument performance requirements that are similar to the checks in EPA's instrumental test methods (e.g., Method 7E). These checks include linearity, interference, stability, pre-test calibration error, and post-test calibration error.

Based on the results of EPA's portable analyzer study[8], the following modifications to ASTM D6522-00 are required to make the method more practical without sacrificing accuracy:

- NO_x analyzers must provide readings to 0.1 ppm to improve the likelihood of passing the performance specifications for sources with low NO_x levels;

- An alternative performance specification (i.e., $\pm$ 1.0 ppm difference from reference value) may be applied to take account of sources with low concentrations of NO_x; and

- The measurement system must be purged with ambient air between gas injections during the stability check to reduce degradation of electrochemical cell performance (see the footnote in Table 8 below).

The measurement system performance specifications, as modified by the EPA portable analyzer study, are shown in Table 8.

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[6] ASTM D6522-00, "Standard Test Method for Determination of Nitrogen Oxides, Carbon Monoxide, and Oxygen Concentrations in Emissions from Natural Gas-Fired Reciprocating Engines, Combustion Turbines, Boilers, and Process Heaters Using Portable Analyzers."

[7] GRI (Gas Research Institute), "Topical Report, Development of an Electrochemical Cell Emission Analyzer Test Method," July, 1997.

[8] "Evaluation of Portable Analyzers for Use in Quality Assuring Predictive Emission Monitoring Systems for NO_x," The Cadmus Group, Inc., September 8, 2004.

Table 8. ASTM Method D6522-00 Measurement System Performance Specifications (as Modified by EPA Portable Analyzer Study)

Performance Check	Gas	Acceptance Criteria
Zero Calibration Error	NO, NO_2	≤ 3 percent of span gas value or ± 1.0 ppm difference (whichever is less restrictive)
	O_2	≤ 0.3 percent O_2
Span Calibration Error	NO, NO_2	≤ 5 percent of span gas value or ± 1.0 ppm difference (whichever is less restrictive)
	O_2	≤ 0.5 percent O_2
Interference	NO, NO_2, O_2	≤ 5 percent of average stack NO concentration for each test run (using span gas checks)
Linearity	NO, O_2	≤ 2.5 percent of span gas concentration or ± 1.0 ppm difference (whichever is less restrictive)
	NO_2	≤ 3.0 percent of span gas concentration or ± 1.0 ppm difference (whichever is less restrictive)
Stability*	NO, NO_2, O_2	≤ 2.0 percent of span gas concentration or ± 1.0 ppm max-min difference (whichever is less restrictive), for 30-minute period or ≤ 1.0 percent of span gas concentration or ± 1.0 ppm max-min difference (whichever is less restrictive), for 15-minute period
Cell Temperature		± 5 °F from initial temperature

* When conducting this check for three cells in an analyzer, the system must be purged with ambient air between gas injections to minimize the possibility of problems with the electrochemical cells. Otherwise, the cells will be exposed to high NO and NO_2 concentrations for prolonged periods of time, which can cause degradation in the cell's performance (i.e., the so-called "O_2-starved exposure").

(g) If a RAA or a RATA is failed due to a problem with the PEMS, or if circumstances occur that result in a significant change in NO_x emission rate relative to the previous PEMS training conditions (e.g., turbine degradation beyond manufacturer specifications, process modification, new process operating modes, or changes to emission controls), the following recertification tests and procedures shall be performed, in this order:

(i) Ensure that the Sensor Validation System meets the requirements of paragraph (c), above;

(ii) Re-train the PEMS according to the manufacturer's recommendations[9]; and

(iii) Ensure that the requirements in paragraph (d), above, are met.

[9] If a reference method is used to provide training data for the PEMS, the training data may be used to calculate the relative accuracy at each operating level and the normal level bias and to set up the alarm system.

(iv) Perform RATAs, following the procedures in Part 75, Appendix A, section 6.5, at three different operating levels (low, mid, and high) as defined in section 6.5.2.1 of Part 75, Appendix A. Use paired PEMS and reference method data to calculate the results on a lb NO_x/mmBtu basis. Calculations shall be based on a minimum of 30 runs at each operating level. AECC shall apply to each operating level the RATA performance specifications contained in Table 7, above. Report the RATA data and results of only the normal operating level as described in Section 2.4 of the ECMPS Quality Assurance and Certification Reporting Instructions, and keep the data and results for the other two operating levels on-site in a form suitable for inspection. The RATA result for the normal operating level determines when the next RATA is due.

(v) Ensure that requirements in paragraph (e), above, are met.

(vi) Conduct an F-test, and a correlation analysis (r-test), using Part 75, Subpart E equations at low, mid, and high operating levels.[10] The r-test shall be performed using all data collected at the three operating levels combined. However, when the mean value of the reference method NO_x data is less than 5 ppm for an operating level, data from that operating level may be removed before applying the r-test. The F-test is to be applied to data at each operating level separately. If the standard deviation of the reference method NO_x data at any operating level is less than either 3 percent of the span or 5 ppm, a reference method standard deviation of either 3 percent of span or 5 ppm may be used at that operating level when applying the F-test. Report the calculated F-value, and the critical value of F at the 95-percent confidence level with n-1 degrees of freedom, for each operating level. Report the calculated r-value (using Equation 27 in §75.41(c)(2)(ii)) for data from the three operating levels combined, in accordance with Section 4.0 of the ECMPS Quality Assurance and Certification Reporting Instructions.

(vii) Perform a bias test (one-tailed t-test) at the normal operating level according to Part 75, Appendix A, Section 7.6.4. If a bias test is failed, calculate and apply a BAF to the subsequent NO_x emission rate data. Report the bias test results as described in Section 2.4 of the ECMPS Quality Assurance and Certification Reporting Instructions.

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[10] In 2004, EPA performed a Subpart E statistical analysis of 720 hours of matched pairs of PEMS and CEMS data for a combustion turbine and 830 matched data pairs for another one and then performed the same statistics on 30-point subsets of these data. See "Evaluation and Field Testing of Nitrogen Oxide (NO_x) Predictive Emission Monitoring Systems (PEMS) for Gas-fired Combustion Turbines - Synthesis Report," The Cadmus Group, Inc., December 29, 2004. The results of these analyses showed that most of the 30-point subsets passed the same combination of statistical tests as the full data set. The field test data also illustrated the importance of testing a PEMS over the full operating range of the unit because of the strong correlation between NO_x emissions to certain unit operating parameters. Based on this evaluation, EPA believes that whenever a PEMS is recertified, a three load RATA (with a minimum of 30 paired data points at each load level) should be required in conjunction with input sensor failure checks and certain abbreviated Subpart E statistical tests, in particular, the F-test, the correlation analysis, and the t-test.

(viii) Collect at least 24 successive unit operating hours of paired hourly PEMS and reference method data under startup and shutdown conditions[11] and conduct an F-test, a correlation analysis (r-test), and a bias test. If the bias test is failed, calculate and apply a BAF to the subsequent non-DLN NO_x emission rate data. Report the calculated F-value, the critical value of F at the 95-percent confidence level with n-1 degrees of freedom, and the calculated r-value (using Equation 27 in §75.41(c)(2)(ii)), in accordance with Section 4.0 of the ECMPS Quality Assurance and Certification Reporting Instructions. Maintain bias test results on-site for at least three years, in a form suitable for inspection.

The tests and procedures in this paragraph (g) shall be completed by the earlier of 60 unit operating days (as defined in 40 CFR 72.2) or 180 calendar days after the failed RAA or failed RATA or after the start of the circumstances that caused a significant change in NO_x emission rate. In accordance with §75.63(a)(2)(i), a recertification application for the PEMS shall be submitted no later than 45 days after successfully completing all of the required tests and procedures in this paragraph (g). Pursuant to §§75.63(a)(2)(ii), (b)(1)(ii), and (b)(2)(ii), the results of the tests shall be submitted: (1) to the Administrator in electronic format, using the ECMPS Client Tool, and also in hard copy; and (2) in hard copy to the applicable EPA Regional Office and to the appropriate State or local air pollution control agency (unless the requirement is waived by either or both of those offices).

In accordance with §§75.20(a)(3) and (a)(4), the PEMS shall be considered to be provisionally recertified, upon successful completion of the required tests, for a period not to exceed 120 days after a complete application has been received. Data from a provisionally recertified PEMS may be reported as quality-assured unless the Administrator issues a notice of disapproval of the recertification application within 120 days after receiving it. If the Administrator fails to issue either a notice of approval or disapproval within 120 days of receiving the application, the PEMS shall be deemed recertified. The loss of certification provisions of §75.20(a)(5) shall apply in the event that the Administrator issues a notice of disapproval of the recertification application within the 120 day review period.

For a failed RAA or RATA, AECC shall use the appropriate Part 75 missing data procedures (see Condition 2, below), starting from the hour of the failed RAA or RATA and ending with the hour of successful completion of the tests and procedures in steps (i) through (viii) above. For circumstances that cause a significant change in NO_x emission rate, AECC shall report the NO_x MER from paragraph (h), below, and shall use a Method of Determination Code (MODC) of "55", i.e., "Other substitute data approved through petition by EPA" to report NO_x emission rate (lb/mmBtu), starting with the first hour of the event(s) that caused a significant change in NO_x emission rate and ending with the hour of successful completion of the tests and procedures in steps (i) through (viii) above (see Section 2.5.2 of the ECMPS Emissions Reporting Instructions). Notification of recertification of the PEMS shall be provided according to §75.61.

[11] That is, unit operating hours where the dry low-NOx (DLN) premix combustion technology is outside of the low-NO_x or premixed mode. These are referred to as "non-DLN" hours.

(h) For the purposes of this approval, the maximum potential NO_x emission rate (MER) in lb/mmBtu for natural gas combustion in Units G-1 through G-7 shall be 0.700 lb/mmBtu, which is the default NO_x emission rate used for low mass emissions (LME) gas-fired turbine units (see Table LM-2 in 40 CFR 75.19) and which is a conservatively high value when compared to the historic reported NO_x emission rates for Units G-1 through G-7. The default MER shall be identified in each unit's monitoring plan. A Method of Determination Code "55", i.e., "Other substitute data approved through petition by EPA" shall be used when reporting the MER (see Section 2.5.2 of the ECMPS Emissions Reporting Instructions).

2. AECC must ensure that the DAHS will automatically provide appropriate substitute data values in accordance with Subpart D of Part 75 (except where alternate procedures are required in this approval), for each unit operating hour in which a quality-assured hourly average NO_x emission rate is not obtained. The Subpart D missing data substitution requirements for NO_x emission rate include, but are not limited to: the initial missing data procedures in §75.31; determination of the percent monitor data availability in §75.32; and the standard missing data procedures in §75.33. The missing data substitution requirements for fuel flow rate are found in Part 75, Appendix D, Section 2.4.

3. Any time changes are made to the PEMS operating envelope, AECC shall submit the complete, revised PEMS operating envelope to EPA by the applicable deadline in §75.62(a)(2).

4. To report emissions data from the PEMS, AECC shall follow the current published ECMPS reporting instructions in conjunction with the supplementary, PEMS-specific ECMPS reporting instructions attached to this approval.

EPA's determination relies on the accuracy of the information provided by AECC in the February 17, 2012 petition and is appealable under Part 78. If there are any further questions or concerns about this matter, please contact Travis Johnson of my staff at (202) 343-9018 or at johnson.travis@epa.gov. Thank you for your continued cooperation.

Sincerely,

/S/
Reid Harvey, Director
Clean Air Markets Division

cc: Travis Johnson, CAMD
Joyce Johnson, EPA Region VI
Thomas Rheaume, Arkansas DEQ

Attachment

Attachment A
Supplementary Reporting Instructions for PEMS

For a unit with an approved petition to use a predictive emissions monitoring system (PEMS), use the following PEMS-specific supplementary instructions, in conjunction with the ECMPS reporting instructions, to prepare the required submittals. Unless otherwise noted, for fields or data elements not specifically addressed in these instructions, you should follow the ECMPS reporting instructions. These guidelines are organized by the three ECMPS submittal types: 1) Monitoring Plan, 2) Quality Assurance and Certification, and 3) Emissions Reporting.

I. Monitoring Plan Reporting Instructions

Section 6.0---Monitoring Method Data

Parameter Code. Report a "NOXR" for NO_x Rate.

Monitoring Method Code. Report "PEM" to indicate NO_x rate is calculated using a petition approved PEMS methodology.

Substitute Data Code. Report "SPTS"

Section 7.0---Component Data

The PEMS monitoring system consists of either one or two data acquisition and handling system (DAHS) components. For single-component PEMS systems or for systems where the PEMS software and standard DAHS software have the same manufacturer/provider, model or version number, report one DAHS component. If the PEMS software and the standard DAHS software have different manufacturer/providers, model or version numbers, report two DAHS components. Otherwise report the DAHS components normally as you would according to Section 7.0 of the ECMPS Monitoring Plan Reporting Instructions. You may also report the additional components of "DL" to indicate a data logger or recorder or "PLC" to indicate a programmable logic controller.

Section 8.0---Monitoring System Data

Monitoring System ID. Assign a unique three character alphanumeric ID for each PEMS monitoring system.

System Type Code. Report system type code "NOXP" to indicate this is a NO_x emission rate PEMS system.

System Designation Code. Report "P" to indicate this is the primary monitoring system.

Section 8.2---Monitoring System Component Data

Associate each DAHS components with the NOXP system described as above. While you may associate additional components such as a data logger or a programmable logic controller with the system, a PEMS must have a minimum of one associated DAHS component.

Section 10.0---Monitoring Default Data

Parameter Code. Report "NOXR" as the parameter monitored. (You must report one default record for each fuel type.)

Default Value. Report the fuel specific maximum potential NO_x emission rate (MER), in units of lb/mmBtu.

Default Units of Measure Code. Report "LBMMBTU".

Default Purpose Code. Report "MD" for missing data.

Fuel Code. Report "NFS" to indicate Non-Fuel-Specific.

Operating Condition Code. Report "A" for any hour.

Default Source Code. Report "TEST" to indicate the value was determined from unit/stack testing.

II. Quality Assurance and Certification Instructions

Section 2.4.2---RATA Data

Number of Load Levels. Report "1".

***Note*:** On-going RATAs are performed at the normal operating level only. Recertifications are performed following procedures in Part 75, Appendix A, section 6.5, using three operating levels (low, mid, and high) as defined in section 6.5.2.1 of Part 75, Appendix A. Only the normal operating level data is reported; the data for the other two operating levels are kept on-site.

Relative Accuracy. Report the result of the relative accuracy test, as required and defined for the appropriate test method and in Part 75, Appendix A. Leave this field blank for a RATA that is aborted prior to completion due to a problem with the monitoring system.

RATA Frequency Code. Report "2QTRS" (for semiannual frequency) or "4QTRS" (for annual frequency), depending on the RATA results.

Overall Bias Adjustment Factor. Report the overall bias adjustment factor (BAF) for the system determined from the RATA data.

Section 2.4.3---RATA Summary Data

Mean CEM Value. Report the arithmetic mean of the PEMS values for the normal operating level.

Bias Adjustment Factor. Report the BAF at each operating level tested for each passing RATA.

Section 2.4.4---RATA Run Data

CEM Value. Report the average value recorded by the PEMS, for each RATA run.

Section 4.0---Miscellaneous Tests

Both the 3-run Relative Accuracy Audit (RAA) and the PEMS training (linear correlation and F-test) QA test results are reported using the miscellaneous test type. To report the 3-run RAA tests using the miscellaneous test type do the following:

Test Type Code. Report "PEMSACC" for a 3-run RAA performed with a reference method or portable analyzer.

Monitoring System ID. Report the PEMS NO_x monitoring system ID.

To report the PEMS training tests (linear correlation and F-tests) do the following:

Test Type Code. Report "OTHER".

Monitoring System ID. Report the PEMS NO_x monitoring system ID.

Test Reason Code. Report either "INITIAL" or "RECERT", as applicable.

Test Description. Report either "PEMS Initial Certification" or "PEMS Recertification", as applicable.

Test Comment. Report the results of the F-test and correlation analysis (r-test) as specified by the PEMS petition approval.

Section 5.0---QA Certification Event Data

Monitoring System ID. Report the monitoring system ID of the NO_x PEMS system.

QA Cert Event Code. Report the appropriate PEMS specific event code. (See Section 5.0, Table 47 of the ECMPS Quality Assurance and Certification Reporting Instructions for a list of appropriate event codes).

Required Test Code. Report the appropriate PEMS specific required test code. (See Section 5.0, Table 48 of the ECMPS Quality Assurance and Certification Reporting Instructions for a list of appropriate required test codes).

Conditional Begin Date. If conditional data validation is used, report the date and hour that the probationary PEMS daily QA/QC test was successfully completed according to the provisions of §75.20(b)(3)(ii).

Note: For PEMS, you may only use conditional data validation if the "event" in column 16 requires RATA testing. If you elect to use conditional data validation, you must complete the RATA within the allotted time in §75.20(b)(3)(iv).

Conditional Begin Hour. If applicable report the hour during which conditional data validation began.

III. Emissions Reporting Instructions

Section 2.2---Daily Test Summary Data

Monitoring System ID. Report the three character Monitoring System ID for the NOXP system.

Component ID. Report the PEMS software component ID.

Test Type Code. Report "PEMSCAL" for daily PEMS calibration tests.

Section 2.5.1---Monitor Hourly Value Data

Do not report a Monitor Hourly Value record. PEMS hourly data should be reported using the Derived Hourly Value records as discussed below.

Section 2.5.2---Derived Hourly Value Data

Parameter Code. Report "NOXR".

Unadjusted Hourly Value. Report the average unadjusted NO_x emission rate for the hour, rounded to three decimal places, as determined by the PEMS. For hours in which you use missing data procedures, leave this field blank.

Adjusted Hourly Value. For each hour in which you report NO_x emission rate in unadjusted hourly value, apply the appropriate bias adjustment factor (BAF) to the unadjusted average NO_x emission rate, and report the result rounded to three decimal places. If the bias test is passed, the BAF will be 1.000. For each hour in which you use missing data procedures, report the appropriate substitute value.

MODC Code. Report a MODC of "03" for each hour in which the PEMS provides a quality-assured NO_x emissions rate. Report a MODC of "55" when you report the fuel-specific maximum potential NO_x emission rate (MER). During hours when you use other missing data procedures, report the appropriate MODC listed in Section 2.5.2, Table 22 of the ECMPS Emissions Reporting Instructions.