Texas Natural Resource Conservation Commission

30 TAC 117

Control of Air Pollution From Nitrogen Compounds

PEMS Protocol

DRAFT

May 16, 1994

Table of Contents

TNRCC 30 TAC 117 PEMS protocol

Background

The purpose of this document is to assist industry in complying with the certification requirements of predictive emissions monitoring systems (PEMS) to monitor nitrogen oxides (NOx), carbon monoxide (CO), and either oxygen (02) or carbon dioxide (CO2) emissions from major stationary sources, regulated under Texas Natural Resource Conservation Commission (TNRCC) 30 TAC Chapter 117, Control of Air Pollution From Nitrogen Compounds. On August 30, 1993 the Texas Air Control Board adopted provisions to Regulation VII (30 TAC 117) which allows owners or operators, complying with the rule under the source cap compliance option, to use PEMS in lieu of hardware continuous emissions monitoring systems (CEMS) for continuous demonstration of compliance. On May 25, 1994, TNRCC extended the use of PEMS for continuous demonstration of compliance utilized by the two other compliance options: direct compliance and emissions averaging.

TNRCC staff relied on the existing acid rain rules, 40 Code ofFederal Regulations (CFR) 75, Subpart E, for developing certification and quality assurance procedures by which equivalency of PEMS to CEMS can be demonstrated. Subpart E is currently specifically applicable to electric utility units required to monitor emissions under Title IV of the 1990 Federal Clean Air Act Amendments. The certification procedure under Subpart E requires a minimum of 720 paired hourly sample data to be collected before a demonstration of equivalency can be made. Staff found this requirement impractical, and as a result, modified the requirements of Subpart E to develop a more cost-effective, yet reliable method for demonstrating equivalency of PEMS to CEMS.

The purpose of this document is to clarify the requirements of the rule and provide assistance to owners or operators in developing unit-specific PEMS protocols.

PEMS Certification Procedure

A. PEMS can be used for demonstrating continuous compliance if they can be verified to have the same or better accuracy, precision, reliability, accessibility, and timeliness as that provided by a hardware CEMS. All PEMS shall be subject to the approval of the Executive Director. Owners or operators must petition the Executive Director for approval to use

PEMS. The petition must include results of tests conducted beforehand that demonstrate equivalent accuracy and precision of PEMS to that of a hardware CEMS. Demonstrating equivalency of PEMS to CEMS shall be met by instantaneously comparing data collected by PEMS with that collected by a United States Environmental Protection Agency (EPA) reference method. Data from a certified hardware CEMS may be used in lieu of data from an EPA reference method if the certification procedure of 40 CFR 75, Subpart E is followed in its entirety.

B. Demonstrating Accuracy

For each unit while firing its primary fuel:

Conduct three initial relative accuracy test audits (RATA) per 40 CFR 60 Appendix B, Performance Specification 2 (pertaining to NOx), Performance Specification 3 (pertaining to O_2 or CO_2), and Performance Specification 4 (pertaining to CO) at low, medium, and high levels of the key operating parameter affecting NOR. The selected test levels shall meet the following criteria:

1. Between the minimum safe and stable level and 50 percent of the maximum level;

2. Between 80 percent of the maximum level and the maximum level; and

3. At the normal operating level or an evenly—spaced interval between the minimum safe and stable level and the maximum level if the normal level is within a specified range (ten percent of the maximum level) of the minimum safe and stable level or the maximum level.

C. Demonstrating Precision

For each unit while firing its primary fuel:

Conduct statistical tests analysis at the three test levels described under Section B under PEMS Certification Procedure. To the extend practically possible, secondary operating parameters that affect NOx must be varied at each test level. A minimum of 30 successive paired data points which are either 15— minutes averages, 20—minutes averages, or hourly averages must be collected at each test level before a reliable statistical test can be performed. Data collection must be continuous at all times. RATA data may be used as part of the statistical data if the time gaps

between data points are documented and explained. The PEMS must remain online throughout the whole verification testing period and PEMS data for the entire period must be documented and reported. Continuous data collection is intended to prevent potential process tuning over the duration of the test and allow the monitoring systems to track and capture transient effects and process changes.

Statistical testing would only be reliable (unbiased) when the data collected is normally distributed and independent over time. When a complete set of paired data samples are collected, owners or operators are advised to screen the data to determine if it exhibits time dependency or lognormality distributions. If the data exhibits such characteristics, owners or operators are required to adjust the data in accordance with the procedure outlined under 40 CFR 75, Subpart E, §75.41(b).

The following three tests must be performed:

1. A t-test for bias per Appendix A, 40 CFR 75, §7.6. The t-test is a well established statistical test for detecting bias. It is designed to determine existence of any systematic error in the emissions monitoring system and provide a mechanism to adjust for that error. The test shall be performed using all paired data points collected at all three test levels.

2. An F—test per 40 CFR 75, §75.41(c)(1). The F-test is also a well established statistical procedure designed to determine if two sample variances differ more that might be expected on the basis of chance. Thus, it specifically addresses random error in the emissions monitoring system and assure comparable random variations between the two monitoring methods. The F-test must be performed separately at every test level.

3. A correlation analysis per 40 CFR 75,

   §75.41(c)(2). Calculation of the correlation coefficient (Equation 27) shall be performed using all paired data points collected at all three test levels. Please note the typographical error in Equation 27; e_p in the second bracket of the denominator should be replaced by e_v. The correlation coefficient equation should read as follows:

$$r = \frac{\sum e_p e_v - \left(\sum e_p\right)\left(\sum e_v\right)/n}{\left[\left(\sum e_p^2 - \left(\sum e_p\right)^2/n\right)\left(\sum e_v^2 - \left(\sum e_v\right)^2/n\right)\right]^{1/2}}$$

For either NOx or CO and for the purpose of conducting an F-test, if the standard deviation of the EPA reference method is less than either 3% of the span or five parts per million (ppm), use an EPA reference method standard deviation of either five ppm or 3% of span.

For the diluent CO_2 or O_2, and for the purpose of conducting an F-test, if the standard deviation of the reference method is less than 3% of span, use an EPA reference method standard deviation of 3% of span.

For either NOx or CO and at any one test level, if the mean value of the EPA reference method is less than either ten ppm or 5% of the standard, all statistical tests are waived for that emission parameter at that specific test level.

For the diluent O_2 or CO_2 and at any one test level, if the mean value of the reference method is less than 3% of span, all statistical tests are waived for that diluent parameter at that specific test level.

D. Demonstrating Reliability

Owners or operators shall demonstrate that the PEMS is capable of providing valid one—hour averages for 95 percent or more of the unit's operating hours over a one-year period and that the system meets the applicable requirements of the quality assurance procedures of 40 CFR 75, Appendix B.

E. Demonstrating Accessibility

Owners or operators shall provide reports and on—site records of emissions data to demonstrate that the PEMS system is capable of meeting all notification, recordkeeping, and reporting requirements of §l17.ll9, 117.219, 117.319, and 117.419; and any other additional applicable requirements under 40 CFR 75, Appendices F and G.

F. Demonstration Timeliness

Owners or operators shall demonstrate that the PEMS system can provide a continuous, quality assured, permanent record of certified emissions data on an hourly basis and can issue a record of data for the previous day within 24 hours. Owners or operators shall also demonstrate that all hourly emissions data can be produced with units equivalent to those of the emissions standards.

Petition to Use PEMS

Owners or operators shall submit the following information in the application for certification or recertification of a predictive emissions monitoring system. Approval to use PEMS will be limited to the specific unit and fuel type for which certification testing was conducted. Any future change in the type or composition of the fuel will require that the PEMS be recertified, unless the PEMS was initially constructed to account for different fuels types and/or compositions. In this case, fuel switching would be permitted without recertification. Owners or operators may attempt to justify that a slight change in fuel composition does not affect emissions and the PEMS does not need be recertified. The approval of such justification will be determined by the Executive Director.

Owners or operator shall submit the following:

A. Source identification information including unit description, heat rate, and fuel type.

B. A detailed description of the predictive emissions monitoring system. Identify all operational parameters or ambient conditions which are determined to have an effect on the predicted emissions. If the PEMS is developed on the basis of physical principles, identify any specific physical assumptions or mathematical manipulations made that justify suitability of the model. If the PEMS is developed on the basis of linear or nonlinear regression analysis, submit the paired raw data used in developing or training the model and specifically identify the tested operating range for every input parameter and the number of data points used in the development of the model.

C. A detailed description of the hardware CEMS or the reference method used during the testing period.

D. Data collection procedures including location of the sampling probe and methods to ensure accurate

representativeness of emissions being measured.

E. A description of all PEMS operation, maintenance, and quality assurance and control procedures to be implemented.

F. Identification of all sensors pertaining to the PEMS and description of the sensor validation procedure and calibration frequency for each sensor.

G. Results of monitor reliability, accessibility, and timeliness analysis.

H. A description of the method used to calculate heat input, if applicable.

I. Data, calculations, and results of the RATA test and the statistical tests performed at all three loads and fuel types as listed under 40 CFR 75, §75.48(a) (3).

J. Data plots as specified in 40 CFR 75, §75.41(a) (9) and §75.41(c) (2) (i)

K. A summary of all results and calculations which demonstrate that PEMS is equivalent in performance to that of the certified hardware GEMS or EPA reference method.

Quality Assurance Procedure for PEMS

The owner or operator must develop and implement a quality assurance and quality control (QA/QC) manual for the PEMS and its components. The manual should include daily, quarterly, and semiannually or annually assessment

procedures or operations to ensure continuous and reliable performance of the PEMS. The QA/QC manual should also include a ready and detailed specific corrective action plan that can be executed at times when the monitoring systems are inoperative. The QA/QC manual shall be placed in a readily accessible location on the plant site. Owners or operators must assign the responsibility of implementing the QA/QC manual to designated employees and must ensure at all times that these employees have the technical and practical training needed to execute this plan.

When an uncertified alternative fuel is fired in a unit, the PEMS must be recertified in accordance with the requirements under PEMS Certification Procedure. Owners or operators may justify to the satisfaction of the Executive Director that slight changes in fuel composition do not constitute an alternative fuel.

A. Daily Assessment

1. Identify any specific steps, measures, or maintenance plans that can be taken to ensure proper functioning of the monitoring systems. Develop a plan to detect any thermocouple, flow monitoring, and sensor failures. If the PEMS is developed to operate in a specific operating range, develop a plan that will ensure continuous operation within the specified operating range. It is the responsibility of the owner or operator to make sure that the model is trained over a wide range of operating parameters. Future operation outside any of the operating ranges will require that the model be retrained and recertified.

2. All applicable requirements pertaining to demonstrating reliability (Section D under PEMS Certification Procedure), accessibility (Section E under PEMS Certification Procedure), and timeliness (Section F under PEMS Certification Procedure) must be satisfied.

3. Missing data substitution: Owners or operators shall demonstrate that all missing data can be accounted for in accordance with the applicable missing data procedures of 40 CFR 75, Subpart D.

Quarterly Assessment

1. The owner or operator must develop and implement a plan that will ensure proper accuracy and calibration of all operational parameters that effect emissions and serve as input to the predictive monitoring system. All sensors must be calibrated as often as needed but never to exceed the time recommended by the manufacturers, for the specific applications these sensors are being used.

2. For each of the three successive quarters following the quarter in which initial certification was conducted, perform RATA and statistical testing for at least one unit in a category of units in accordance with the requirements under PEMS Certification Procedure.

3. The owner or operator of a unit representing a category of units shall provide the following information:

a. A description of the affected unit and how it appropriately represents the category of affected units; and

b. A description of all units that come under the category.

C. Semiannual or Annual Assessment

For each unit and semiannually thereafter, conduct RATA pursuant to 40 CFR 60, Appendix B, Performance Specification 2 (pertaining to NOR), Performance Specification 3 (pertaining to O_2 or CO_2), and Performance Specification 4 (pertaining to CO) at normal load operations. RATA may be performed on an annual basis if the relative accuracy during the previous audit for the NOx, CO, and CO_2 (or O_2) monitors is 7.5 percent or less.

PEMS Partial Certification

In certain cases, the owner or operator may not be able to adjust all of the parameters of the model over the entire desired range of operation at one time. In this case, the owner or operator may certify the PEMS in a restricted range of operation in accordance with the PEMS Certification

Procedure of the most important NOx parameter within that restricted range. For example, the key operating parameter affecting NOx may be dictated by production schedules that restrict operation between 80% and 100% and the initial three levels RATA and statistical tests may not include data below 80%. In this case, three levels RATA and statistical tests could be performed at 80%, 90%, and 100% load. If, at a later date, the owner or operator wishes to operate outside the demonstrated range of the certified PEMS, the owner or operator may extend the demonstrated range by certifying at a new range of the key parameter within 60 days of cumulative operation of the parameter at that range. For example, if the owner or operator wishes to operate within 60-80% of the key parameter level, then the owner or operator would be required to perform a RATA test and collect a 30 points statistical sample at the 60% test level. The certification at the new range is to be done by performing a single RATA test at the 60% test level and augmenting the original statistical data for the 80—100% levels with the new statistical data at 60%. Thus, in the above example, there would now be four parameter

regions used for the statistical tests, the 80%, 90%, and 100% parameter range of the initial tests plus the 60% parameter range.

Out of Order Periods

Cut of order periods for PEMS include the following:

A. Operating out of range of the significant operational parameters that affect NOx. Minor extrapolations to outside the operating range may be allowed if it can technically be justified. Such justification must be approved by the Executive Director.

B. One or more sensor failures unless justified in the QA/QC manual and the petition application.

C. Uncertified fuel switching or fuel composition changes unless approved.

D. Failing the RATA or any applicable statistical tests.

E. If a PEMS fails the RATA, the period from that time until passing the next RATA, will be considered out of order.

F. If any of the quarterly statistical tests for one unit in a category of units fails, and the problem is local to the PEMS of that first unit, only that one unit will be out of order. The problem must be corrected and RATA for that unit must be performed. The other units in that category shall be checked with portable analyzer and retrained if necessary. If the reason that the PEMS failed was due to fundamental problems requiring change in model inputs or architecture, all units in that category will be out of order. The adjustment must be reflected in all PEMS for that category and RATA must be performed for all units in that category.

PEMS Adjustments

PEMS adjustments and tuning are permissible provided that the date, reasons, and details of the PEMS adjustments are documented and placed in an accessible location on the plant site, suitable for inspection. Typical reason - concern over recent RATA with deteriorating relative accuracy. The TNRCC enforcement staff must be able to identify, at any time, that the PEMS for any unit has been inspected, the occurrence of the last PEMS adjustment, and the last RATA performed for that

unit. The PEMS must be retrained on an augmented set of data which includes the set of data used for training the model prior to adjustment and the newly collected set of data needed for adjustment of the model. When PEMS retraining is performed within the demonstrated range of certification, no RATA testing is required. No tampering with the PEMS is allowed during periods when no PEMS adjustments or tuning are being performed.

Notification. Recordkeeping. and Reporting

Owners or operators using predictive emissions monitoring systems shall maintain for each affected unit a file of all measurements, data, reports, and other information in a form suitable for inspection for at least two years from the date of each record.

A. Owners or operators must comply with the notification, recordkeeping, and reporting requirements of §ll7.119, 117.219, 117.319 and 117.419, as applicable.

B. Owners or operators must maintain detailed records of any daily, quarterly, and semiannually or annually quality assurance programs or monitoring plans.

C. Owners or operators must comply with the applicable recordkeeping requirements of 40 CFR 75, Subpart F, §75.50(d) and (e).

D. Owners or operators must comply with the certification, quality assurance and quality control record provisions of 40 CFR 75, Subpart F, §75.52(a)(5),(6), and (7).