# RULE 2012 PROTOCOL-
# ATTACHMENT G

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## SUPPLEMENTAL AND ALTERNATIVE CEMS PERFORMANCE REQUIREMENTS FOR LOW NOx CONCENTRATIONS

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Abbreviations used in this Attachment are:
- ✓ Low Level Spike Recovery/Bias Factor Determination (LLSR/BFD)
- ✓ High Level Spike Recovery/Bias Factor Determination (HLSR/BFD)
- ✓ Low Level RATA/Bias Factor Determination (LLR/BFD)
- ✓ Low Level Calibration Error (LLCE)
- ✓ Relative Accuracy Test Audit (RATA)
- ✓ Relative Accuracy (RA)
- ✓ Full Scale Span (FSS)
- ✓ National Institute of Standards Traceability (NIST)

## A. Applicability of Supplemental and Alternative Performance Requirements

The Facility Permit holder electing to use (B)(8)(d)(ii), in Chapter 2 of Rule 2012, Appendix A to measure $NO_x$ concentrations that fall below 10 percent of the lowest vendor guaranteed full scale span range, shall satisfy the performance requirements as specified in Table G-1 listed below.

**TABLE G-1**
**Alternative Performance Requirement(s)**

| **CEMS RECLAIM Certified per NOx Protocol, Appendix A** Yes or No | **Performance Requirements** | | | |
|---|---|---|---|---|
| | LLSR/BFD | HLSR/BFD | LLR/BFD | LLCE |
| Yes | **x** | | **+** | **x** |
| No | **x** | **x** | **+** | **x** |

1. + (plus) denotes an additional performance requirement that shall be conducted if the mandatory performance requirement(s) cannot be met.

2. If the concentration of the CEMS is such that the specifications for the low level spike recovery/bias factor determination cannot be met, the Facility Permit holder shall conduct a low level RATA/bias factor determination.

3. The provisions of Table G-1 do not apply to (B)(8)(c) or (B)(8)(d)(i), in Chapter 2.

## B. Test Definitions, Performance Specifications and Test Procedures

This section explains in detail how each performance requirement is to be conducted.

Low Level Calibration Error

The low level calibration error test is defined as challenging the CEMS (from probe to monitor) with certified calibration gases (NO in N2) at three levels in the 0-20 percent full scale span range. Since stable or certifiable cylinder gas standards (e.g. Protocol 1 or NIST traceable) may not be available at the concentrations required for this test, gas dilution systems may be used, with District approval, if they are used according to either District or EPA protocols for the verification of gas dilution systems in the field. The CEMS high level calibration gas may be diluted for the purpose of conducting the low level calibration error test.

1. Performance Specifications

   Introduce pollutant concentrations at approximately the 20 percent, 10 percent, and 5 percent of full scale span levels through the normal CEMS calibration system. No low level calibration error shall exceed 2.5 percent of full scale span.

2. Testing Procedures

   a. Perform a standard zero/span check; if zero or span check exceeds 2.5 percent full scale span, adjust monitor and redo zero/span check.

   b. After zero/span check allow the CEMS to sample stack gas for at least 15 minutes.

   c. Introduce any of the low level calibration error standards through the CEMS calibration system.

   d. Read the CEMS response to the calibration gas starting no later than three system response times after introducing the calibration gas; the CEMS response shall be averaged for at least three response times and for no longer than six response times.

   e. After the low level calibration error check allow the CEMS to sample stack gas for at least 15 minutes.

   f. Repeat steps c through e until all three low level calibration error checks are complete.

   g. Conduct post test calibration and zero checks.

Spike Recovery and Bias Factor Determinations

Spiking is defined as introducing know concentrations of the pollutant of interest (gas standard to contain a mixture of NO and NO2 is representative of the ratio of NO and NO2 in stack gas) and an appropriate non-reactive, non-condensable and non-soluble tracer gas from a single cylinder (Protocol 1 or NIST traceable to 2 percent analytical accuracy if

no Protocol 1 is available) near the probe and upstream of any sample conditioning systems, at a flow rate not to exceed 10 percent of the total sample gas flow rate. The purpose of the 10 percent limitation is to ensure that the gas matrix (water, CO2, particulates, interferences) is essentially the same as the stack gas alone. The tracer gas is monitored in real time and the ratio of the monitored concentration to the certified concentration in the cylinder is the dilution factor. The expected pollutant concentration (dilution factor times the certified pollutant concentration in the cylinder) is compared to the monitored pollutant concentration.

*High Level Spike Recovery/Bias Factor Determination*

The high level spike recovery/bias factor determination is used when it is technologically not possible to certify the CEMS per the standard RECLAIM requirements. The spiking facility/interface shall be a permanently installed part of the CEMS sample acquisition system and accessible to District staff as well as the Facility Permit holder.

1. Performance Specifications

   The CEMS shall demonstrate a RA </= 20 percent, where the spike value is used in place of the reference method in the normal RA calculation, as described below. The bias factor, if applicable, shall also be determined according to Attachment B.

2. Testing Procedures

   a. Spike the sample to the CEMS with a calibration standard containing the pollutant of interest and CO or other non-soluble, non-reacting alternative tracer gas (alternative tracer gas) at a flow rate not to exceed 10 percent of the CEMS sampling flow rate and of such concentrations as to produce an expected 40-80 percent of full scale span for the pollutant of interest and a quantifiable concentration of CO (or alternative tracer gas) that is at least a factor of 10 higher than expected in the unspiked stack gas. The calibration standards for both pollutant of interest and CO (or alternative tracer gas) must meet RECLAIM requirements specified in Attachment A.

   b. Monitor the CO (or alternative tracer gas) using an appropriate continuous (or semi-continuous if necessary) monitor meeting the requirements of Method 100.1 and all data falling within the 10-95 percent full scale span, and preferably within 30-70 percent full scale span.

   c. Alternate spiked sample gas and unspiked sample gas for a total of nine runs of spiked sample gas and ten runs of unspiked sample gas. Sampling times

should be sufficiently long to mitigate response time and averaging effects.

d. For each run, the average CEMS reading must be between 40 percent full scale span and 80 percent full scale span. If not, adjust spiking as necessary and continue runs; but expected spike must represent at least 50 percent of the total pollutant value read by the CEMS.

e. Calculate the spike recovery for both the pollutant and the CO (or alternative tracer gas) for each run by first averaging the pre- and post-spike values for each run and subtracting that value from the spiked value to yield nine values for recovered spikes.

f. Using the CO (or alternative tracer gas) spike recovery values for each run and the certified CO (or alternative tracer gas) concentration, calculate the dilution ratio for each run. Multiply the certified pollutant concentration by the dilution factor for each run to determine the expected diluted pollutant concentrations. Using the expected diluted concentrations as the "reference method" value calculate the Relative Accuracy as specified in Appendix A. The RA shall be </= 20 percent. Determine the bias factor, if applicable, according to Attachment B.

*Low Level Spike Recovery/Bias Factor Determination*

The low level spike recovery/bias factor determination is used to determine if a significant bias exists at concentrations near the 10 percent full scale span level. The spiking facility/interface shall be a permanently installed part of the CEMS sample acquisition system and accessible to District staff as well as the Facility Permit holder.

1. Performance Specifications

There are no pass/fail criteria with respect to the magnitude of the percent relative accuracy. There are performance criteria for the range of concentration on the CEMS and the extent to which the spike must be greater than the background pollutant level.

2. Testing Procedures

a. Spike the sample to the CEMS with a calibration standard containing the pollutant of interest and CO or other non-soluble, non-reacting alternative tracer gas (alternative tracer gas) at a flow rate not to exceed 10 percent of the CEMS sampling flow rate and of such concentrations as to produce an

expected 10-25 percent of full scale span for the pollutant of interest and a quantifiable concentration of CO (or alternative tracer gas) that is at least a factor of 10 higher than expected in the unspiked stack gas. The calibration standards for both pollutant of interest and CO (or alternative tracer gas) must meet RECLAIM requirements specified in Appendix A.

b. Monitor the CO (or alternative tracer gas) using an appropriate continuous (or semi-continuous if necessary) monitor meeting the requirements of Method 100.1 and all data falling within the 10-95 percent full scale span, and preferably within 30-70 percent full scale span.

c. Alternate spiked sample gas and unspiked sample gas for a total of nine runs of spiked sample gas and ten runs of unspiked sample gas. Sampling times should be sufficiently long to mitigate response time and averaging effects.

d. For each run, the average CEMS reading must be below 25 percent full scale span and > 10 percent full scale span. If not, adjust spiking as necessary and continue runs; but expected spike must represent at least 50 percent of the total pollutant value read by the CEMS.

e. Calculate the spike recovery for both the pollutant and the CO (or alternative tracer gas) for each run by first averaging the pre- and post-spike values for each run and subtracting that value from the spiked value to yield nine values for recovered spikes.

f. Using the CO (or alternative tracer gas) spike recovery values for each run and the certified CO (or alternative tracer gas) concentration, .calculate the dilution ratio for each run. Multiply the certified pollutant concentration by the dilution factor for each run to determine the expected diluted pollutant concentrations. Using the expected diluted concentrations as the "reference method" value calculate the Relative Accuracy as specified in Appendix A. If the average difference is less than the confidence coefficient then no low level bias factor is applied. If the average difference is greater than the confidence coefficient and the average expected spike is less than the average CEMS measured spike, then no low level bias factor is applied. If the average difference is greater than the confidence coefficient and the average expected spike is greater than the average CEMS measured

spike, then a low level bias factor equal to the absolute value of the average difference is added to data reported at or below the 10 percent of full scale span.

Low Level RATA/Bias Factor Determination using Enhanced Reference Method 6.1

A low level RATA/bias factor determination is designed to determine if there exists a statistically significant bias at low level concentrations. It consists of nine test runs that measure the stack concentration and the CEMS concentration concurrently.

1. Performance Specifications

   There are no pass/fail criteria with respect to the magnitude of the percent relative accuracy. There are performance criteria for the special RATA with respect to the reference method and range of concentration on the CEMS.

2. Testing Procedures

   The reference method for the low level RATA/bias factor determination is Method 100.1

   a. Perform a minimum of nine runs of low level RATA for CEMS versus the reference method at actual levels (unspiked).

   b. The full scale span range for the reference method shall be such that all data falls with 10 - 95 percent of full scale span range.

   c. The reference method shall meet all Method 100.1 performance criteria.

   d. Calculate the average difference (d = CEMS - reference method, ppm) and confidence coefficient (cc = statistical calculated, ppm).

   e. If $d > 0$ then the bias = 0 ppm; if $d < 0$ and $|d| > cc$ then bias = d; if $d < 0$ and $|d| < cc$ then bias = 0 ppm.

## C. Testing Frequency

For each CEMS, perform the aforementioned performance requirements once semiannually thereafter, as specified below for the type of test. These semiannual assessments shall be completed within six months of the end of the calendar quarter in which the CEMS was last tested for certification purposes (initial and recertification) or within three months of the end of the calendar quarter in which the District sent notice of a provisional approval for a CEMS, whichever is later. Thereafter, the semiannual tests shall be completed within six months of the end of the calendar quarter in which the CEMS was last tested. For CEMS on bypass stacks/ducts, the assessments shall be performed once every two successive operating quarters in which the bypass stacks/ducts were operated. These tests shall be performed after the calendar quarter in which the CEMS was last tested as part of the CEMS certification, as specified below for the type of test.

Relative accuracy tests may be performed on an annual basis rather than on a semiannual basis if the relative accuracies during the previous audit for the $NO_X$ CEMS are 7.5 percent or less.

For CEMS on any stack or duct through which no emissions have passed in two or more successive quarters, the semiannual assessments must be performed within 14 operating days after emissions pass through the stack/duct.