



Acid Rain Program Continuous Emission Monitoring (CEM)

In order to reduce acid rain in the United States and Canada, Title IV of the Clean Air Act Amendments of 1990 established the Acid Rain Program. The program will cut sulfur dioxide emissions in half and substantially reduce nitrogen oxides emissions from electric utility plants. This fact sheet discusses the continuous emission monitoring requirements of the Acid Rain Program and is one of a series containing information about the program.

The overall goal of the Acid Rain Program is to achieve significant environmental benefits through reductions in emissions of sulfur dioxide (SO_2) and nitrogen oxides (NO_x), the primary causes of acid rain. To achieve this goal at the lowest cost to society, the program employs both traditional and innovative, market-based approaches for controlling air pollution. In addition, the program encourages energy efficiency and pollution prevention.

Title IV of the Clean Air Act sets as its primary goal the reduction of annual SO_2 emissions by 10 million tons below 1980 levels. To achieve these reductions, the law requires a two-phase tightening of the restrictions placed on fossil fuel-fired power plants.

Phase I begins in 1995 and affects 110 mostly coal-burning electric utility plants located in 21 eastern and midwestern states. Phase II, which begins in the year 2000, tightens the annual emissions limits imposed on these large, higher emitting plants and also sets restrictions on smaller, cleaner plants fired by coal, oil, and gas. The program affects existing utility units with an output capacity of 25 megawatts or greater and new utility units

under 25 megawatts that use fuel with a sulfur content greater than 0.05 percent.

The Act also calls for a 2 million-ton reduction in NO_x emissions by the year 2000. A significant portion of this reduction will be achieved by coal-fired utility boilers that will be required to install low NO_x burner technologies and to meet new emissions standards.

The innovative, market-based SO_2 allowance trading component of the Acid Rain Program allows utilities to adopt the most cost-effective strategy to reduce SO_2 emissions at units in their system. The Acid Rain Program operating permit outlines the specific program requirements and compliance options chosen by each source. Affected utilities also will be required to install systems that continuously monitor emissions of SO_2 , NO_x , and other related pollutants in order to track progress, ensure compliance, and provide credibility to the trading component of the program. In any year that compliance is not achieved, excess emissions penalties will apply, and sources will be required to submit a plan to EPA that specifies how the excess SO_2 emissions will be offset.

Introduction

Continuous emission monitoring (CEM) will be instrumental in ensuring that the mandated reductions of SO_2 and NO_x are achieved. While traditional emissions limitation programs have required facilities to meet specific emissions rates, the SO_2 portions of the Acid Rain Program require an accounting of each ton of emissions from each regulated unit. Compliance is then determined through a direct comparison of total annual SO_2 emissions reported by CEM and allowances held for the unit.

CEM is the measurement on a continuous basis of pollutants emitted into the atmosphere in exhaust gases from combustion processes or as the by-product of industrial processes. EPA has established requirements for the continuous monitoring of SO_2 , NO_x , volumetric flow, opacity, and diluent for units regulated under Phase I and Phase II of the Acid Rain Program. In addition, procedures for monitoring or estimating carbon dioxide (CO_2) are specified. The rule also contains requirements for equipment performance specifications, certification procedures, and record-keeping and reporting.



Why Is CEM Necessary?

The Acid Rain Program establishes an allowance trading system as a market-based approach to reduce SO₂ emissions in a cost-effective manner. (One allowance is an authorization to emit 1 ton of SO₂ during or after a specified calendar year; a utility may buy, sell, or hold allowances as part of its compliance strategy.) Complete and accurate emissions data are key to implementing this market-based approach.

An essential feature of smoothly operating markets is a method for certifying the existence of the commodity being traded. The CEM data will, in effect, supply the "gold standard" to back up the paper currency of emissions allowances. The CEM requirements, therefore, will instill confidence in the market-based approach by certifying the existence and value of the traded commodity (the allowance).

What Are the Monitoring Requirements?

The owner or operator of a unit regulated under Phase I or Phase II and any new unit must install a CEM system on the unit unless otherwise specified in the regulation. A CEM system includes:

- An SO₂ pollutant concentration monitor
- A NO_x pollutant concentration monitor
- A volumetric flow monitor
- An opacity monitor
- A diluent gas (oxygen or CO₂) monitor
- A data acquisition and handling system (computer-based) for recording and performing calculations with the data

Table 1 summarizes the CEM requirements of the Acid Rain Program. In all cases, a data acquisition and handling system must be used to collect and report the data.

TABLE 1. CEM MONITOR COMPONENTS REQUIRED FOR ACID RAIN MONITORING REGULATIONS

Monitoring Requirement (units required)	Required CEM Monitoring Component					
	SO ₂	NO _x	Flow	Opacity	Diluent Gas	Data Handling
SO ₂ (lbs/hr)	Yes		Yes			Yes
NO _x (lbs/mmBtu) ¹		Yes			Yes	Yes
Opacity (%)				Yes		Yes
CO ₂ (lbs/hr) ²			Yes		Yes	Yes

¹Heat input in mmBtu/hr is also required.

²Alternative methods may be used to monitor CO₂.

To monitor SO₂ emissions using a CEM system, a facility must use both an SO₂ pollutant concentration monitor and a volumetric flow monitor to measure the emissions in pounds per hour.

To measure NO_x emissions, both a NO_x pollutant concentration monitor and a diluent gas monitor are required to calculate an emissions rate in pounds per million British thermal units (lbs/mmBtu).

Opacity monitoring, which measures the percentage of light that can be seen through flue gas, requires only an opacity monitor. Under the CEM Rule gas-fired units that combust natural gas for at least 90 percent of their total heat input during the 3 previous calendar years, and diesel and dual-fuel reciprocating internal combustion engine units are exempt from opacity monitoring requirements.

The rule does not require a utility to use a CEM system to measure CO₂. If a utility chooses to use a CEM system, however, a CO₂ diluent monitor plus a flow monitor would be used to compute emissions in pounds per hour.

If a CEM system is installed in such a way that any portion of the flue gases from an affected unit can bypass the monitoring system, a separate CEM system is required on the bypass flue gas stream.

All CEM systems must be in continuous operation and must

be able to sample, analyze, and record data at least every 15 minutes. All emissions and flow data will be reduced to 1-hour averages. The rule specifies procedures for converting the hourly emissions data into the appropriate units of measure.

Who Do These Requirements Apply To?

All units over 25 megawatts and new units under 25 megawatts that use fuel with a sulfur content greater than 0.05 percent by weight are required to measure and report emissions under the Acid Rain Program. The new units under 25 megawatts using clean fuels are required to certify their eligibility for an exemption every 5 years. A unit that formally commits to retirement before December 31, 1994, will be exempt from the requirements of the rule. The following is a summary of monitoring method requirements and options.

- All existing coal-fired units greater than 25 megawatts and all new coal units must use CEM for SO₂, NO_x, flow, and opacity.
- Units burning natural gas exclusively are exempt from SO₂ monitoring requirements.
- Units burning oil may monitor SO₂ mass emissions by one of the following three methods: (1) daily manual oil

sampling and analysis plus oil flow meter (to continuously monitor the amount of oil consumed), (2) automatic continuous oil sampling plus oil flow meter, or (3) SO₂ and flow CEM.

- Gas-fired and oil-fired base-loaded units must use NO_x CEM.
- Gas-fired peaking units and oil-fired peaking units may either estimate NO_x emissions by using site-specific emission correlations and periodic stack testing to verify continued representativeness of the correlations, or use NO_x CEM.
- All gas-fired units using natural gas for at least 90 percent of their annual heat input, and diesel and dual-fuel reciprocating internal combustion engine units are exempt from opacity monitoring.
- For CO₂, all units can use either (1) a mass balance estimation, (2) CO₂ CEM, or (3) oxygen CEM in order to estimate CO₂ emissions.

If a unit's utilization or fuel use changes so that excepted monitoring methods no longer apply, the unit would become subject to CEM requirements in the following calendar year.

How Will Emissions Be Calculated for Periods of Missing Data?

Four or more data points are needed to compile a valid 1-hour average for emissions flow data, except during calibration, maintenance, repair, or other required quality-assurance activity periods, where two or more data points may compose a valid hour. Failure of the system to acquire the data points would result in the loss of data for the hour. The rule contains procedures for filling in data when no valid hour

or hours of data have been recorded by the SO₂ monitor, the flow monitor, and the NO_x CEM system consisting of the NO_x monitor and the diluent gas monitor. The rule uses a conservative approach to substituting for missing data. This offers an incentive to keep monitor down-time to a minimum, giving the most accurate and reliable results. The procedures are summarized in Table 2.

What Are the Requirements for Units Using a Phase I Qualifying Technology?

The CEM Rule specifies additional monitoring requirements for units that are implementing an optional compliance method specified under the Permits Rule that allows a unit to use a Phase I

qualifying technology (a system that achieves a 90-percent reduction in SO₂ emissions). Each such unit must be equipped with pollutant and diluent gas monitors to measure SO₂ emissions at the inlet to the control device, in addition to the monitors required for measuring SO₂ emissions discharged to the atmosphere.

What Are the Requirements for Multiple Units with a Common Stack?

If two or more units share a common stack, the CEM Rule allows the owner or operator to combine SO₂ allowances according to the procedures outlined in the Allowance System Rule and to install one monitoring system. If a Phase I and Phase II unit share a common stack, the owner or

TABLE 2. SUMMARY OF CEM SUBSTITUTION CRITERIA FOR ESTIMATING VALUES FOR MISSING DATA PERIODS

Annual availability (%) of monitor or system ¹	Number of hours missing (N)	Value substituted for each missing hour
Greater than or equal to 95%	N ≤ 24 hours	Average of the hour recorded before missing period and the hour recorded after missing period
	N ≥ 24 hours	90th percentile value recorded in previous 30 ² days of service or the before/after value, whichever is greater
Less than 95% but greater than or equal to 90%	N ≤ 8 hours	Average of the hour recorded before missing period and the hour recorded after missing period
	N > 8 hours	95th percentile value recorded in previous 30 ² days of service or the before/after value, whichever is greater
Less than 90%	N > 0 hours	Maximum value recorded in previous 30 days of service or the before/after value, whichever is greater

¹SO₂ and flow monitors are individually evaluated for missing data. For NO_x, the NO_x pollutant concentration monitor and diluent gas monitor are considered in combination. NO_x and flow monitoring data are correlated to unit gross operating load before selecting the percentile values.

²NO_x CEM systems review the previous 90 days of service.

operator must either (1) install a separate CEM system in each duct leading to the stack, (2) declare the Phase II unit as a substitution unit in accordance with the requirements of the Permits Rule, or (3) obtain the Administrator's approval to differentiate between the units parametrically.

If a regulated unit and a nonregulated unit share a common stack, the owner or operator must either (1) install a separate CEM system in the duct leading to the stack of each regulated unit, (2) declare the nonregulated unit as an opt-in unit under the Opt-in Rule, or (3) obtain the EPA Administrator's approval to differentiate the units parametrically.

What Are the Certification Requirements?

The Acid Rain Program requires the following performance certification tests for CEM systems:

- A 7-day calibration error test for each monitor
- A linearity check for each pollutant concentration monitor
- A relative accuracy test audit (RATA) for each monitor
- A bias test for each pollutant concentration monitor and flow monitor
- A cycle time/response test for each pollutant concentration monitor

The EPA Administrator must approve the CEM system before it can be used in the Acid Rain Program. The owner or operator of a unit must conduct a certification test and submit the results to the EPA Administrator.

EPA will issue a notice approving or disapproving the request for certification within 120 days. If the proposed system is disapproved, the owner or operator must revise the equipment, procedures, or methods as necessary and resubmit a request for certification.

The operator also must perform periodic performance evaluations of the equipment, including daily calibration error tests, daily interference tests for flow monitors, and semi-annual (or annual) RATA and bias tests.

What Quality Assurance/Quality Control Procedures Are Required?

The owner or operator must develop and implement a written quality assurance/quality control plan for each system. The quality control plan must include complete, step-by-step procedures and operations for calibration checks, calibration adjustments, preventive maintenance, audits, and recordkeeping and reporting. The rule specifies procedures for assessment of calibration error, relative accuracy, and bias. The quality assurance plan must include relative accuracy test audits, calibration error tests, and bias tests.

Are Alternative Monitoring Systems Allowed?

The owner or operator of an affected unit may apply to the EPA Administrator for approval of an alternative monitoring system to determine hourly emissions data for SO₂, NO_x, and/or volumetric flow. An alternative system must provide the same or better precision, reliability, accessibility, and timeliness as a certified CEM system. The owner or operator must submit substantial information and data to demonstrate that the alternative system meets these criteria.

What Are the Recordkeeping, Reporting, and Notification Requirements?

The CEM Rule indicates a number of requirements for notification, recordkeeping, and reporting

for the Acid Rain Program. The requirements include:

- Submission of monitoring plans as part of the precertification testing form submittal
- Written notifications of monitor certification tests
- Report of certification test results in a "certification application"
- Daily recording and maintaining of hourly emissions data, flow data, and other information
- Quarterly reports of emissions, flow, unit operating status, and monitoring performance data

The rule also requires the owner or operator to report the CEM data electronically. EPA will use this information to determine compliance with the emissions reductions mandated by the Clean Air Act.

What Are the Deadlines for Compliance?

All required equipment must be installed, certified, and operational by November 15, 1993, for Phase I affected units, and by January 1, 1995, for any Phase II units. A new unit (a unit that begins commercial operation on or after November 15, 1990) must meet all requirements no later than 90 days after commencing commercial operations.

For More Information

Write to:

U.S. EPA
Acid Rain Division (6204J)
401 M Street, SW.
Washington, DC 20460

If you would like to receive other fact sheets on the Acid Rain Program, call the Acid Rain Hotline at 617-674-7377 or the EPA Public Information Center (PIC) at 202-260-2080.