TITLE V MONITORING TECHNICAL REFERENCE DOCUMENT

DRAFT
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PREFACE

This document was prepared by Midwest Research Institute (MRI) for the Office of Air Quality Planning and Standards (OAQPS), U. S. Environmental Protection Agency (EPA), under Contract No. W6-0048, Work Assignments No. 4-02 and 4-03. Mr. Dan Bivins is the work assignment manager; Mr. Peter Westlin is the task leader.

This document provides guidance to EPA Regional and State permitting authorities, as well as to industry and the general public, on how EPA intends to exercise its discretion in implementing the statutory and regulatory provisions regarding monitoring emissions from Title V sources.

The statutory provisions and EPA regulations described in this document contain legally binding requirements. This document does not substitute for those provisions or regulations, nor is it a regulation itself. Thus, it does not impose legally binding requirements on EPA, States, or the regulated community, and may not apply to a particular situation based upon the circumstances. We and State decision makers retain the discretion to adopt approaches on a case-by-case basis that differ from this guidance where appropriate. Any decisions regarding a particular facility will be made based on the statute and regulations. Therefore, interested parties are free to raise questions and objections about the substance of this guidance and the appropriateness of the application of this guidance to a particular situation. We will, and States should, consider whether or not the recommendations or interpretations in the guidance are appropriate in that situation. This guidance is a living document and may be revised periodically without public notice. EPA welcomes public comments on this document at any time and will consider those comments in any future revision of this guidance document.

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OVERVIEW

State and local agencies and Tribal authorities have begun the process of issuing operating permits. In many cases, satisfying the title V monitoring requirements as outlined in the Clean Air Act and our implementing regulations (sections 70.6(a)(3), (c)(1), and 71.6(a)(3) and (c)(1)) have been among the most challenging aspects of the permit process. This document is intended to provide technical reference materials to help in the selection of monitoring approaches that are sufficient to assure compliance with a permit's terms and conditions for various types of emissions units and their applicable requirements. While offering case examples, this document is **not** intended to prescribe or prohibit monitoring for any applicable requirements or emissions sources. The information in this document is intended solely as a source of technical information, does not represent final Agency action, and cannot be relied upon to create any rights enforceable by any party.

1.1 What Is the Purpose of this Document?

The purpose of the Title V Monitoring Technical Reference Document (TRD) is to provide technical information to help in applying the title V monitoring requirements and to present examples of monitoring that satisfy these requirements. Prescribing when or under what circumstances you are required to develop and conduct monitoring for your permit is **not** the purpose of this document. Those decisions are left to your permitting authority in addressing the requirements in parts 70 and 71 that implement title V.

We intend the primary audience for this document to be you, plant managers and engineers, as you develop the monitoring approaches appropriate to your situation. Note that you are not required to develop or propose monitoring requirements in your application for a permit to satisfy title V. Rather, the permitting authorities have the ultimate responsibility to ensure the monitoring requirements are incorporated into the final operating permits. Nevertheless, we encourage you to take the opportunity in preparing your permit application and prior to final permit issuance to provide additional information to the permitting authorities as to what monitoring is appropriate relative to your situation and emissions units. Furthermore, we suggest that you consult with your permitting authority early in the process of developing your monitoring approach; your permitting authority may have additional guidance or recommendations that are pertinent to your specific situation or to specific monitoring approaches.

The document also will be useful to State, local, and Tribal permit writers as they review or prescribe monitoring approaches. The public may find this document useful if they choose to review and comment on monitoring in proposed title V permits.

The understanding of the technical aspects of implementing monitoring for title V operating permits will continue to evolve over time as new source type and control approaches situations are encountered. As a result, this document is considered a "living" document in that it will be updated as new information becomes available.

1.2 What Is the Procedure for Updating this Document?

To keep this a "living document," we intend to revise it from time to time to make clarifications, reflect new knowledge about monitoring, include new information (such as new monitoring examples), and update other information as needed. The process for making revisions or additions to the document is an iterative one. We will continue to collect applicable monitoring information and examples and will compile that information into draft additions or revisions to the document.

We will notify you when we place draft versions of additions or revisions to the document as they are completed on EMC's web site (http://www.epa.gov/ttn/emc) for public review and comment. You should send comments on those drafts to Peter Westlin via email at *westlin.peter@epa.gov* or via regular mail at U. S. Environmental Protection Agency, MD-19, Research Triangle Park, NC, 27711. Approximately 2 months following the end of the public comment period, we will incorporate additions or revisions into the document, and publish the new version on the EMC web site. Each new version of the document will include a version number and date.

1.3 How Is this Document Organized?

Section 2 of this document presents the general principles of monitoring sufficient to assure compliance. This section includes a discussion of what title V monitoring is, how you should use such monitoring, and when you should conduct the monitoring. Section 3 presents the minimum criteria that are to be addressed by the monitoring and our interpretation of each of these criteria. Section 4 describes how to determine an appropriate approach to monitoring. Section 5 discusses various monitoring approaches that could be used for different types of applicable requirements/emissions units, and Section 6 discusses different types of monitoring approaches, in general. The appendices provide example monitoring approaches for selected emissions units, a list of acronyms, and a list of permitting web sites for your reference.

2.0 PRINCIPLES OF TITLE V MONITORING

2.1 What Is Title V Monitoring?

Monitoring is a term used in title V of the Clean Air Act of 1990 (the Act) and the implementing regulations, 40 CFR parts 70 and 71, to encompass the data collection, inspection, data recording, and related activities you should conduct to assure compliance with your permit terms and conditions. Such monitoring generally should be sufficient to yield *reliable data* from the *relevant time period* that are *representative* of your compliance with the permit. For purposes of this document, title V monitoring means the monitoring required under your applicable requirements and any additional monitoring included in your permit that you will use to assure compliance with your permit terms and conditions.

2.2 How Can I Use the Monitoring Results Aside from Day-to-Day Operation?

You can use the results of title V monitoring in a number of situations. First, title V monitoring data and other available information provide a basis on which the Responsible Official for your facility can certify periodically your emissions units' compliance status. As you know, under Section 114(a)(3) of the Act, you must, among other duties, periodically (at least annually) certify your compliance status for each of your applicable requirements. The Act also requires that you have knowledge of your emissions units' operations sufficient to enable you to certify compliance status. This usually means that you collect and record information on your process and control device operations, including emission data, parametric operating data, and other information that can be used to assess your facility's compliance status. As importantly, you can manage the information provided from your title V monitoring to identify and respond to unusual periods of process or control device operation, taking necessary corrective action in a timely manner before there is a compliance issue.

Data from title V monitoring also are important to permitting authorities and citizens for the purpose of assessing your emissions units' compliance with the applicable requirements.

2.3 How Does Monitoring Developed under Part 64, the Compliance Assurance Monitoring (CAM) Rule, Relate to Title V Monitoring?

Monitoring used to comply with the CAM rule satisfies the title V monitoring requirement for the <u>pollutant specific emissions unit (PSEU) to which part 64 applies</u>. You may still have to address monitoring for compliance with other applicable requirements, even those that apply to the same emissions unit. For example, consider a large boiler that is subject to both particulate matter and sulfur dioxide (SO_2) emission limits. The source owner uses a baghouse to comply with a particulate matter emission limit and, as a result, is subject to the CAM rule for monitoring compliance with that limit. The source owner uses low sulfur fuel, not an add-on control device, to comply with the SO_2 emission limit. As such, the boiler is not subject to part 64 for monitoring compliance with the SO_2 emission limit. The source owner would use monitoring as specified in the applicable requirement or another approved monitoring approach sufficient to assure compliance with the SO_2 limit to satisfy the title V monitoring requirement.

2.4 When Should I Begin Conducting Title V Monitoring?

You should conduct the required title V monitoring upon issuance of your title V permit and as defined by the permit requirements. We recognize that occasionally you may require some time from the issuance of a permit until you can fully implement the monitoring required by the permit. This could occur when a permit requires you to use monitoring equipment, such as a COMS for opacity, that you currently do not have installed at the source. In accordance with the requirements of 40 CFR 70.6(c)(3), we suggest permitting authorities include milestones in permits for implementing monitoring expeditiously in cases where implementing the required title V monitoring by the effective date of the permit is impractical, as well as ensure the other requirements of section 70.6(c)(3) and (4) are performed.

For technical reasons, you may wish to conduct monitoring as described in your permit application or as otherwise prescribed by rule in the period before your permit is issued. This will allow you to become familiar with the operation and utility of the monitoring and to identify any necessary improvements or changes before the final permit is issued.

3.0 MINIMUM REQUIREMENTS OF TITLE V MONITORING

As stated in Section 2, your title V permit will typically contain title V monitoring with the general requirement that it be sufficient to yield *reliable data* from the *relevant time period* that are *representative of your compliance* with your permit. This section describes what is meant by reliable data, relevant time period, and representative of compliance.

3.1 What Are *Reliable Data*?

Reliable data are measurements and information that are indicative of the performance of your emissions unit. Reliability of the data is related to the sensitivity and repeatability of the measurements in representing the emissions control performance of the emissions unit. To ensure data reliability, your monitoring approach, as defined in your permit, should address minimum performance criteria that assure the data you generate provide valid and sufficient information on the actual conditions being monitored. These performance criteria will vary based on the type of monitoring approach you use. For example, if your monitoring approach is based on measurements of parametric operating conditions, the monitoring requirements in your permit should include:

-- The sensor type and location specifications, installation requirements (if applicable), and minimum acceptable accuracy; and

-- Minimum quality assurance/quality control (QA/QC) activities that will be used to assure the continuing validity of the data, including the frequency of QA/QC activities and, where appropriate, the acceptable limits.

Minimum performance criteria for other monitoring approaches may not be as involved. For example, data representativeness specifications and QA/QC requirements may not be applicable to monitoring based on work practices or on inspection and maintenance activities. The factors affecting reliability for these types of monitoring include documentation of proper training of personnel conducting the inspections and documentation of the results of the inspections (e.g., in a log book). Section 6 of this document discusses various types of monitoring approaches that may be used to address title V monitoring requirements and the permit elements that should be included for each approach. For each of these approaches, a table in Section 6 presents the performance criteria that should be addressed to ensure that the data are reliable.

3.2 What Is the *Relevant Time Period*?

In general, the *relevant time period* is the averaging period of the applicable requirement. For example, the relevant time period for many opacity limits is 6 minutes. If an applicable rule requires a demonstration of compliance through the average of three 1-hour test runs, the relevant time period is 3 hours. In some cases, the relevant time period is continuous. As an example, an equipment design standard might require a lid to be free from holes or cracks at all times.

3.3 Should the Selected Monitoring Data Collection Frequency and Averaging Period Be the Same as the Relevant Time Period?

The data collection frequency and averaging period of your title V monitoring approach do not necessarily have to match the relevant time period associated with the applicable rule. However, the results of the monitoring should relate to the relevant time period and should be sufficient to assure compliance for each relevant time period. Your permit should address the data collection frequency and averaging period for the type of monitoring approach used. For example, if your monitoring approach is based on parametric monitoring, the monitoring requirements in your permit should include:

- The frequency at which the parameter or condition is measured and recorded (e.g., once per minute, four times per hour, once per day, etc.); and
- The averaging period, if applicable (e.g., hourly, daily, monthly, etc.).

If your monitoring approach was based on documentation of work practices performed, the data collection frequency would be specified in the permit (e.g., once per shift or once per day), and there would be no applicable averaging period.

In some cases, you may select a data collection frequency and averaging period for title V monitoring purposes that is the same as the relevant time period. For example, the operator of a small incinerator subject to a PM emissions limit with a 3-hour averaging time may monitor the charge rate to the incinerator as one relevant operational parameter and calculate 3-hour averages. However, in many instances you may select an averaging period for title V monitoring that differs from the relevant time period of the applicable requirement. Of course, the averaging period that you propose will be appropriate only to the extent that you can show that the data collected over that period are sufficient to demonstrate compliance with the permit terms and conditions. For example, the operator of a boiler subject to an SO_2 limit with a

1-hour averaging time may use a low-sulfur oil to assure compliance with the limit. One title V monitoring approach consists of testing the sulfur content of this oil because the fuel's sulfur content is stoichiometrically related to the boiler's SO_2 emissions. Although the relevant time period is 1 hour, given the expected homogeneity of an oil shipment, you may assume that the sampling and sulfur analysis of the oil need not occur every hour. The results of the sulfur content analysis for a representative sample of a shipment of oil will represent the SO_2 emissions for any averaging period during which oil from that shipment is used.

Another example is the measurement of opacity or visible emissions (VE) for a short-term period (e.g., 6 minutes) in lieu of monitoring over a longer time period or continuously. A periodic (e.g., daily) 6-minute opacity observation or VE check, coupled with other ongoing monitoring of a control device or process parameter, may be appropriate for monitoring compliance with a PM or an opacity emissions limitation, depending on site-specific factors, such as the margin of compliance and process and emissions variability. For the example of the monitoring appropriate for assuring that a tank lid remains free of leaks, lid inspections conducted quarterly or less frequently may be sufficient to address compliance status for a continuous requirement since lid degradation is gradual.

Section 4 contains more discussion on the process of selecting monitoring frequency and averaging periods.

3.4 What Is *Representative of Compliance*?

Data are typically *representative of compliance* if they allow you to make a reasonably supportable determination of the compliance status of the emissions unit with the applicable requirements for each relevant time period. That is, the data you collect should provide you clear indication that you have operated your emissions unit within established bounds of performance that is consistent with compliance with the applicable requirements. As importantly, the data should also allow you to identify periods during which your emissions unit has operated outside those established bounds and that may represent deviations from your permit requirements.

3.5 How Do I Justify a Selected Monitoring Approach?

You should make the rationale for the selected monitoring method clear, usually in a written document submitted with your permit application. In many cases, the appropriateness of monitoring will be obvious, as in the case of CEMS, and little or no additional documentation will be necessary. In other cases, a more detailed justification may be necessary to demonstrate that the monitoring method is adequate for title V monitoring purposes. Your permitting authority is responsible for incorporating all such documentation into the permit record as appropriate rationale.

4.0 MONITORING EVALUATION PROCESS

4.1 How Do I Know What Monitoring I Need in My Title V Permit?

First, you should identify each emissions unit/process and determine whether monitoring currently is required by each applicable requirement for each emissions unit. You will probably want to review the periodic testing or instrumental or non-instrumental monitoring (including recordkeeping designed to serve as monitoring) that is typically specified for each regulated pollutant and determine whether that monitoring is consistent with your current practices. You should also evaluate whether the specified monitoring will be sufficient for you to determine whether the emissions unit is in compliance with the applicable emission limitations or standards. If your evaluation shows that the specified monitoring accurately represents what you are doing and also provides you the information you need to determine compliance status, then you can propose this monitoring in your permit application to satisfy the general permit monitoring requirements. If not, then you may want to propose monitoring in addition to the monitoring specified in the applicable requirement to satisfy the general title V monitoring requirements and your particular needs. You can not replace, eliminate, or change the monitoring already required in an underlying requirement without approval from your permitting authority and EPA.

If the applicable requirement for your emissions unit does not specify periodic testing or monitoring, you should consider what you could do to satisfy title V monitoring sufficient to assure compliance with your permit terms and conditions. You may wish to contact your permitting authority to determine if there are established monitoring requirements or guidelines as you develop a site-specific monitoring approach. You also may wish to review the monitoring you currently conduct for your emissions unit. In most cases, even if you are currently conducting monitoring, you may want to evaluate different monitoring approaches that may afford you better compliance assurance data, improved ease of implementation, or more useful process operation data. In the end, the title V monitoring approach should be consistent with the general requirements of the permit program as outlined in Section 3 and satisfactory for your particular needs. Once you complete this evaluation and selection, you may propose that monitoring in your permit application.

4.2 What Factors Should I Consider When I Evaluate Monitoring Approaches?

If you need to develop a new monitoring approach or modify your current monitoring approach, you should consider all possible monitoring approaches, including:

- continuous emissions monitoring systems (CEMS) or continuous opacity monitoring systems (COMS);
- predictive emissions monitoring systems (PEMS);
- operational parametric monitoring;
- raw material pollutant content/measurement mass balance;
- documentation of work practice(s);
- inspection and maintenance/recordkeeping;
- periodic testing; or
- a combination of two or more of these approaches.

The next step is to identify the monitoring approaches that may be appropriate for your emissions unit and evaluate each approach. There are several factors to consider in evaluating whether a monitoring approach satisfies the title V monitoring criteria, including:

- The format (e.g., emission or operating limit, process rate limit, equipment design specification, work practice, raw material or fuel composition specification, etc.) of the standard ;
- The initial compliance method;
- The likelihood of violating the applicable requirements (i.e., the margin of compliance relative to the applicable requirement);
- The variability of emissions from the unit over time;
- Whether an add-on emissions control technology is necessary for the unit to meet the emissions limit;
- The type of monitoring, process, maintenance, or control equipment data already available for the emissions unit;
- The technical and economic considerations associated with the range of possible monitoring methods; and
- The kind of monitoring applied to similar emissions units.

The following sections explain what we mean by these factors. Other factors also may apply on a case-by-case basis.

4.2.1 Why Are the Format of the Standard and the Initial Compliance Method Important?

Understanding what the emission standard requires of you in the way of compliance (e.g., an emissions or operating limit, process rate limit, equipment design specification, work practice, raw material or fuel composition specification, etc.) and how initial compliance with the applicable requirement is demonstrated will provide you with insight into factors that are expected to have an impact on compliance. For example, if a coating facility's applicable requirement limits the VOC content of all primer coatings to less than 6 lb/gallon, the only monitoring component that has an impact on compliance is the VOC content of the coating. If, on the other hand, the applicable requirement limits the VOC emissions to 200 lb/day, then the amount of coating used also has an impact on compliance and should be considered when developing a monitoring approach.

While your permit must incorporate the compliance methods specified by applicable requirements, it may not be appropriate to use the initial compliance method for ongoing monitoring. Rather, you should use the method of demonstrating initial compliance and the format of the emission limitation or emission standard as a starting point to identify factors to consider and possible monitoring approaches. For example, if your wet scrubber operated with a pressure drop between 8 and 12 inches of water during the initial performance test and the unit demonstrated a large margin of compliance with the PM emissions limit, your monitoring approach could make use of scrubber pressure drop monitoring as in an indicator sufficient to assure compliance with your permit terms. You may not be required to develop a statistical or absolute correlation between scrubber pressure drop and actual PM emissions. In some cases, it may be appropriate to repeat the initial compliance demonstration method itself on a periodic basis as part of the monitoring approach (e.g., periodic emissions testing combined with parametric monitoring).

4.2.2 Why Should I Consider the Margin of Compliance and Variability of Emissions?

The margin of compliance describes how your unit operates in relation to its emissions limit (or other applicable requirement). To determine your margin of compliance, you could, for example, compare the emission rate you measured during a performance test to the applicable emissions limit while operating your unit and control device at representative conditions. For raw materials or fuel pollutant content limits, you could compare the average and individual measured pollutant content of the process materials or fuels you use to the emissions limit (e.g., lb VOC/gal of coating, lb S/MMBtu in a fossil fuel) imposed by the applicable requirement. A finding that the measured values during representative operation are significantly less than the applicable limit (e.g., a 5 ppm NOx measured value relative to a 75 ppm NOx limit) could help in deciding between the adequacy of two monitoring approaches.

When you are considering a unit's margin of compliance to evaluate the adequacy of a particular monitoring approach, you also should consider the accuracy of the emission estimation method. For example, source-specific data are more reliable than emissions estimates based on published source category-based emission factors (e.g., AP-42) .

You also should consider variability in emissions to assess how the variability may impact the compliance status of the emissions unit. You should consider whether the expected variability in emissions provides the potential for the emissions unit to exceed the applicable emission limitation. The insight gained by considering these two factors together can be used to evaluate the extent and frequency of monitoring suitable to assure compliance with the permit terms and conditions over all anticipated operating conditions. A large margin of compliance combined with low expected variability in emissions would provide a high level of confidence that the emissions unit will continue to operate in compliance with the applicable requirement. This scenario would result in the need for less rigorous and less frequent monitoring. Likewise, a small margin of compliance (e.g., measured emissions values within 20 percent of the emissions limit) combined with high expected variability (e.g., a fluctuation of 30 percent or more) in emissions would provide a lower level of confidence that the unit will continue to operate in compliance. In this scenario, there may be a need for more rigorous and more frequent monitoring suitable to assure compliance with the permit terms and conditions over all anticipated operating conditions.

You may not always have information sufficient to quantify margin of compliance and it is not a requirement to do so. Nonetheless, knowledge of the margin of compliance and variability of emissions is helpful in evaluating monitoring approaches, especially if you desire to justify a less rigorous (e.g., less frequent, less precise) monitoring approach. For example, if your existing monitoring is not very extensive (e.g., you rely on formulation data to determine coating VOC content) but you have a very large margin of compliance combined with a low expected variability in emissions, you may be able to justify this level of monitoring in lieu of a more rigorous approach (e.g., conducting Method 24 analyses of the coatings). On the other hand, if you were proposing to use a CEMS to satisfy title V monitoring, knowledge of the margin of compliance would not be relevant when evaluating the proposed monitoring approach.

You can determine the expected margin of compliance and variability of emissions using recent performance test results, engineering and design information (e.g., from vendor-supplied technical studies), comparison with similar sources, and site-specific historical data. When margin of compliance and variability of emissions are used as part of the rationale for your selected monitoring approach, you should document your evaluation with supporting information prepared as part of your permit application.

4.2.3 Why Should You Consider the Emissions Control Technology?

If an emissions control technology is necessary for compliance, the monitoring, at a minimum, should be based on ensuring that you continue to operate and maintain the control technology properly and the emissions unit remains in compliance with applicable requirements. The title V monitoring then should be consistent with the type of control technology and sufficient to assure compliance with the permit terms and conditions. One of the underlying principles of part 64, the Compliance Assurance Monitoring (CAM) rule, is the diligent monitoring of control measures to assure ongoing compliance; you should determine whether you are subject to the CAM rule now or in the future. The principle of monitoring to verify that control measures continue to operate as necessary to assure compliance applies equally to other title V monitoring.

Our *"Technical Guidance Document: Compliance Assurance Monitoring"* [CAM Technical Guidance Document],[1] provides guidance on monitoring approaches for certain emissions units with active control devices. The illustrations and examples of monitoring provided in the CAM Guidance Document are not prescriptive, nor all-inclusive; they simply are examples of possible monitoring approaches. The CAM Guidance Document provides a good source of information for evaluating title V monitoring for control devices. You are not constrained to the use of the guidance or monitoring approaches presented in the CAM Guidance Document in complying with part 64 or otherwise in conducting monitoring sufficient to assure compliance with permit terms or conditions.

[1]U.S. Environmental Protection Agency. Technical Guidance Document: Compliance Assurance Monitoring, August 1998. Available on the EPA web site at http://www.epa.gov/ttn/emc/cam.html.

4.2.4 What Role Do Available Data Play?

Your title V monitoring approach can be based on data collection procedures currently used at your facility, such as process data, maintenance information, control equipment monitoring data, or other data. The use of existing data collection mechanisms may lessen your burden and reduce the need for additional monitoring equipment or new inspection procedures.

Process data can help characterize the emissions unit's operation by identifying representative process loads and capacities and how they vary over time. Emissions data provide documentation of compliance under representative conditions and can be used to determine your emissions unit's margin of compliance with the applicable requirement(s). You can use monitoring data to assess the reliability of your current approach. Historical monitoring data for the parameters being measured (e.g., process, control device, raw materials used) can be useful in establishing appropriate indicator ranges that are sufficient to assure compliance with permit terms and conditions.

4.2.5 What Other Factors Should I Consider?

For each monitoring approach under review, you may want to consider the following questions:

-- Is the monitoring equipment readily available and technically feasible for the unit/process in question?

-- Is the monitoring approach currently being conducted elsewhere at my facility? If not, what is necessary to initiate this approach (e.g., will staff need training)?

-- Are qualified personnel available to conduct the monitoring and evaluate the results?

-- Is the type of monitoring in question already in use (or permitted) for units that are similar in terms of size and applicable requirements at other facilities?

-- Can I find reliable technical resource materials or guidance on the use of the monitoring equipment, data acquisition system, or other technology?

The answers to these types of questions may assist you in developing a monitoring approach that is cost-effective and meets the title V monitoring requirements. You can find information on the feasibility and availability of different monitoring approaches on our web site at http://www.epa.gov/ttn/catc/products.html or http://www.epa.gov/ttn/emc.

4.2.6 Where Can I Find Information About Monitoring Used by Similar Sources?

This document presents examples of monitoring approaches that satisfy title V monitoring requirements for various types of emissions units. Other sources of information include monitoring requirements for same or similar sources specified in Federal, State, Tribal, and/or local regulations, State guidance, in-house expertise, already-issued title V permits, and manufacturers' recommendations. Appendix G contains a listing of State, Regional, and local agency web sites that contain draft and/or final operating permits and other permitting guidance.

4.3 How Is an Indicator Range Selected for a Parametric Monitoring Approach?

You should select a parameter indicator range that is sufficient to assure that the emissions unit is in compliance with the permit terms and conditions when operated within that range. You may use parameter data collected during performance testing and other relevant information, such as engineering assessments, manufacturers' design criteria, and historical monitoring data to establish indicator ranges for a parametric monitoring approach. Parameter data collected during performance testing are key in establishing indicator ranges. These data provide documentation that the emissions unit was in compliance with the emissions limit when operating within the proposed indicator range. You should support your selected indicator range with this type of data whenever possible.

You are not required to set the indicator range such that an excursion from the range will prove the associated emissions limit has been exceeded. However, your permit should specify what happens when a parameter exceeds the established range. For example, your permit should specify whether an excursion from the established range is considered a violation or whether it will instead trigger corrective action and/or additional monitoring or testing requirements to determine the compliance status of the source. The CAM Technical Guidance Document, available on our web site at http://www.epa.gov/ttn/emc/cam.html, contains a detailed discussion on the selection of indicator ranges.

4.4 How Do I Know When the Monitoring Data Collection Frequency and Averaging Period Are Adequate?

The data collection frequency and averaging period should be sufficient to assure compliance during the relevant time period of the applicable requirement. Generally, the appropriate averaging period is one short enough to detect a change in the emissions control or process operation that could affect compliance, but not so short as to cause frequent and unnecessary operator responses. Depending on the type of control measures used (e.g., add-on control devices, equipment design features, work practices), the monitoring data collection frequency and averaging period can be significantly different from the relevant time period for the permit terms or conditions (see Section 3.3).

Most of all, the frequency and averaging period should be representative and practical. You should consider the margin of compliance and variability of emissions when evaluating and selecting an appropriate data collection frequency and averaging period for your situation (how likely are emissions to change from one relevant time period to the next and what is the effect of this variability on the unit's compliance status?).

For example, consider several emissions units subject to opacity limits. Many emissions units are subject to opacity limits with 6-minute averaging times; however, monitoring data collection frequency and averaging period can range widely depending on the emissions unit type and control approach. First, consider the case of a boiler fired on pipeline-quality natural gas. There generally is little possibility that the emissions from a properly operated natural gas-fired boiler will exceed a generic opacity limit of 20 percent. Where opacity monitoring for a gas-fired boiler is not required or otherwise conducted, title V monitoring for the unit's opacity limit could consist of a permit condition specifying the use of gaseous fuel only and requiring records of fuel use (note that there would be no need to monitor fuel use records if the source were physically incapable of burning alternative fuels).

Next, consider the case of a large coal-fired utility boiler controlled with an electrostatic precipitator (ESP). The opacity of emissions from a large coal-fired, ESP-controlled utility boiler can vary significantly as load parameters and ESP performance change. This variability can result in excess opacity. Therefore, you would consider very frequent, even continuous, opacity monitoring.

Finally, consider the case of a product handling process (e.g., crushed stone) with a fabric filter control. A fabric filter is unlikely to exceed most opacity limits over the short term (e.g., periods less than 1 day). On the other hand, you need to monitor fabric filter operations regularly, perhaps with daily or weekly visible emissions or opacity observations supplemented by an inspection and maintenance program, to detect significant degradation. The use of a bag leak detection system, in lieu of periodic visual observations, is another monitoring option for baghouses. The bag leak detector provides information on a more frequent basis (essentially continuous) and is more sensitive than periodic visual observations.

You also may establish monitoring frequencies based on the emissions unit's operating time or fuel consumption. For example, you can specify the monitoring frequency in terms of the number of hours of operation (e.g., an inspection every X hours of operation, an emissions test every Y hours of operation). This option may be appropriate for units that operate periodically. If the unit combusts fuel, you can specify the monitoring frequency based on the amount of fuel combusted (e.g., emissions testing with a portable analyzer every X gallons of oil combusted, a visual observation every Y gallons of diesel fuel combusted).

Tiered monitoring frequencies (i.e., monitoring frequencies that vary based on performance results) also are an option. For example, consider a VOC leak detection and repair program based on 40 CFR 60, Subpart VV. Normally, a monthly inspection of each valve is required. However, any valve for which a leak is not detected for two successive months may be monitored only once per quarter until a leak is detected. When a leak is detected, the monitoring frequency reverts to monthly until a leak is not detected for two successive months. Another example of the use of tiered monitoring frequencies is visible emissions observations for a baghouse. Assume the normal monitoring frequency is weekly. The permit might state that if visible emissions are not observed for six consecutive weeks, the observation may be conducted once per month until visible emissions are observed. If visible emissions are observed, the frequency reverts to weekly until no visible emissions are observed for six consecutive weeks.

4.5 What Role Does Periodic Emissions Testing Play in a Monitoring Approach?

In some cases, periodic emissions tests (i.e., performance tests) should be considered as an option for title V monitoring. The issue to be considered is the frequency of testing that will be sufficient to assure compliance over all anticipated operating conditions for each relevant time period. You should consider the margin of compliance and variability of emissions to determine how frequently to conduct a performance test to satisfy the title V monitoring requirements. Typically, infrequent (e.g., annual or biannual) emissions testing will be sufficient only in cases with a large margin of compliance and/or little variability in emissions. In many cases, when used in conjunction with other monitoring (e.g., routine parametric monitoring or inspections), periodic emissions testing provides an excellent means of assuring compliance is maintained. Periodic testing also can be used to verify that your monitoring approach is still adequate, particularly where the monitoring is not directly measuring emissions or the relationship between the monitoring and the emissions is not robust or is subject to change.

Methods other than compliance or performance test methods also can play an important role in title V monitoring. Lower-cost portable instruments, for example, may be very useful in frequent reverification that other ongoing inspection or parametric monitoring remains effective.

You may want to consider a tiered frequency of testing (e.g., allowing less frequent tests if consecutive tests show operation with a large margin of compliance). For instance, instead of conducting an annual performance test, a tiered frequency could be incorporated by allowing an emissions test to be conducted only once during each permit term if two consecutive annual tests showed that the unit operates with emissions less than X percent of the standard. Alternatively, the emissions testing frequency can be based on the initial performance test results, as the example in the following table shows.

Initial performance test result	Subsequent testing frequency
Emissions are more than 90 percent of the most stringent emissions limit and have high variability.	Perform an emissions test every 12 months.
Emissions are between 60 and 90 percent of the most stringent emissions limit and have low variability.	Perform an emissions test every 36 months.
Emissions are less than 60 percent of the most stringent emissions limit and have low variability.	Perform an emissions test every 60 months.

4.6 When Should I Consult With My Permitting Authority?

We recommend you consult with your permitting authority early in the process of developing title V monitoring. Your permitting authority may have additional guidance or recommendations that are pertinent to your specific situation or to specific prescribed monitoring approaches. Consulting with the permitting authority in the early stages of development will help to avoid expending resources on an approach that ultimately may not be acceptable to the permitting authority.

5.0 COMPONENTS OF MONITORING APPROACHES

This section presents a summary of the components that should be included in the various types of monitoring approaches. Examples of monitoring approach components include the basis for the monitoring approach, data reliability/representativeness, measurement frequency, parameter indicator ranges, recordkeeping, averaging period, and QA/QC. This section is organized according to the basic monitoring approaches that are likely to be used for title V monitoring in operating permits. If you choose to propose monitoring to your permitting authority, you should evaluate what components to address in your monitoring approach on a unit-specific basis. The examples in this section are not intended to be comprehensive. The Appendices provide detailed examples of monitoring approaches for various types of emissions units.

5.1 What Types of Monitoring Approaches Can I Use for Title V Monitoring?

Several different types of monitoring approaches may be used for title V monitoring. As discussed in Section 4, the monitoring that you select depends on the applicable requirement and on what information you decide should be collected. Most monitoring approaches fall under one or more of the following categories:

- Continuous emissions monitoring systems (CEMS);
- Continuous opacity monitoring systems (COMS);
- Predictive emissions monitoring systems (PEMS);
- Parametric monitoring;
- Raw material or fuel pollutant content/mass balance;
- Documentation of work practices;
- Inspection and maintenance/recordkeeping for equipment and design standards; or
- Periodic testing as a supplement to other monitoring or alone.

Table 5-1 presents some specific examples of monitoring for each of these general monitoring approaches. The following paragraphs provide a brief discussion of each approach, and the components that should be included in each type of approach.

Table 5-1. Examples of Types of Monitoring Approaches

Monitoring approach	Specific examples
CEMS/COMS	• NO_x, SO_2, CO, PM, VOC CEMS • COMS
PEMS	• NO_x protocol in Part 75, App. E
Parametric Monitoring	• Bag-leak detector on baghouse • Breakthrough detector on carbon bed • Boiler exhaust O_2 content • Dryer temperature • Water flow to dust suppression system • Air-to-fuel ratio • Mass flow to determine feed/production rate • Gas flow through each hood in capture system • N_2 content of fuel fired, fuel consumption, water-to-fuel ratio for turbines using water injection to control NO_x • CAM-like APCD/process operating parameters (e.g., temperature of incinerator, pressure drop across scrubber, etc.)
Raw Material or Fuel Pollutant Content/Mass Balance	• Fuel sampling and analysis • Fuel supplier certifications • Product data sheets and purchase records • VOC content of coatings, coating and solvent usage records • Feed or production rate records and emission factors/computer models • Mass balance using raw material analyses, usage, and product recovery records
Documentation of Work Practice	• Leak detection and repair program, records of leaks or spills • Dust suppression measures and frequency • Records of operating hour or material usage restrictions • Records of liquid stored, period of storage, maximum true vapor pressure (TVP) during storage • Vapor tightness documentation for tank trucks • Restrictions on type of equipment used (e.g., coating application spray equipment, filters, tank fittings/seals)
Inspection and Maintenance/ Recordkeeping	• Periodic seal checks on floating roof tanks • Visual inspection of fixed roof tanks • Inspection of low-NO_x burner and fuel supply equipment • Inspection of total enclosure or closed vent system • APCD inspections (e.g., fan, damper, VE, opacity, etc.)
Periodic Testing	• Visible emissions (M22) observation • Opacity (M9 observation) • Portable VOC monitor on VOC source or APCD • Portable NO_x monitor on combustion sources • Method 24 or Method 311 coatings analysis

1.1 What Components Should I Include in a Monitoring Approach Based on CEMS or COMS?

You may decide that continuous emissions or opacity monitoring is the most effective and practical method for you to use to demonstrate compliance with an applicable requirement. If the CEMS or COMS meets established performance specifications and operating procedures (e.g., the performance specifications in 40 CFR 60, Appendix B; the general provisions at 40 CFR 60.13) you may simply cite these regulations. Otherwise, your monitoring approach should address the following components:

- Data reliability (CEMS/COMS performance specifications);
- Frequency of measurements;
- Averaging period; and
- QA/QC practices.

Furthermore, you may need to identify the indicator range (i.e., the acceptable range or limit for the monitored parameter). If you are using CEMS or COMS that provide data in units of the applicable standard (e.g., CEMS used to show compliance with a NO_x, SO_2, or VOC concentration limit; COMS used to indicate compliance with an opacity limit), you will not need to establish a numerical indicator range because the level of the standard is the level at which excess emissions occur. However, if you are using a COMS to monitor opacity as an indicator of compliance with a PM emission limitation, the indicator (percent opacity) is not in terms of the standard (e.g., gr/dscf). In this case, you can develop an indicator range for opacity that is sufficient to assure compliance with the PM limit over all anticipated operating conditions. Consequently, if you have both an applicable PM standard and an applicable opacity limit and you choose opacity as the indicator (or one of multiple indicators) for PM, it is conceivable (and probable) that you would select an opacity indicator range for demonstrating PM control at a different (lower) opacity level and a different averaging time (e.g., hourly average) than the opacity limit. Note that, even in cases where a COMS is required by the applicable rule for demonstrating compliance with an opacity limitation, you are not required to use the COMS to indicate compliance with the PM emission limitation; you may select other appropriate indicators of PM emissions that satisfy title V monitoring requirements.

Similarly, if a CEMS is being used to monitor compliance for a standard that is not in the units provided by the CEMS (e.g., VOC monitor providing concentration data [ppm] being used to comply with an emission limit in the form of mg VOC per liter loaded), then you need to select an indicator value or range in the units provided by the CEMS (e.g., ppm concentration, instead of mg/liter loaded in this case).

Tables 5-2 and 5-3 present brief examples of monitoring approaches for emissions units using CEMS and COMS, respectively.

Table 5-2. Example Monitoring for an Emissions Unit Using a VOC CEMS[a]

Monitoring approach components	Continuous emissions monitoring
Numerical indicator range	Less than 20 ppm benzene.
Data reliability	VOC analyzer installed at the outlet vent. Minimum accuracy is ± 1 percent of span.
Frequency of measurements	Continuous (VOC concentration measured every 15 minutes).
Averaging period	None.
QA/QC requirements	• Daily zero/span calibration check. • Quarterly calibrations using calibration gas (benzene). • Maximum calibration drift is ± 2 percent of span.

[a] Emissions limit: 20 ppm benzene.

Table 5-3. Example Monitoring for an Emissions Unit Using COMS to Demonstrate Compliance with Particulate Matter and Opacity Limits[a]

Monitoring approach components	Continuous opacity monitoring
Numerical indicator range	Not to exceed 15 percent opacity in any 6-minute period.
Data reliability	System meets 40 CFR 60 Appendix B, Performance Specification 1 criteria (COMS).
Frequency of measurements	Continuous (per 40 CFR 60.13); opacity measured every 10 seconds.
Averaging period	6 minutes.
QA/QC requirements	• Per 60.13 and Appendix B of 40 CFR 60. • Annual calibration using test filters.

[a] Compliance limits: PM: 0.1 gr/dscf; opacity: 20 percent

1.2 What Components Should I Include in a Monitoring Approach Based on PEMS?

Predictive emissions monitoring systems (PEMS) predict emissions using an established correlation (a predictive “model”) between the monitored parameter(s) and emissions. If your monitoring approach is based on a PEMS, you typically would consider the following components:

- Principle of predictive model (e.g., neural network, linear regression);
- Data reliability:
  - -- Data and information used to establish PEMS correlation;
  - -- Information on sensors that will be used for parameter input to the model (e.g., location, minimum accuracy); and
  - -- Results of precision and accuracy tests for model;
- Frequency of parameter measurements;
- Averaging period for calculation; and
- QA/QC requirements (including periodic check for accuracy of PEMS):
  - -- For parameter sensors; and
  - -- For model validation.

Table 5-4 presents a brief example of a monitoring approach using PEMS.

Table 5-4. Example Monitoring for a 50 MW Oil-Fired Boiler Using a PEMS for NO_x

Monitoring approach components	Predictive emissions monitoring
Principle of model	• A linear correlation is established for NO_x emission rate (lb/mmBtu) and heat input at normal excess air levels. • Fuel feed rate is continuously monitored and the hourly heat input rate is determined using F-factors. • Hourly NO_x emission rate is calculated based upon the established correlation. • Excess air levels (O_2) are maintained within manufacturer's recommended specifications.
Data reliability	• Series of NO_x emission/O_2 tests conducted at four boiler load levels and normal excess air level (three tests at each load level). • Oil feed rate measured with in-line mass flow meter; minimum accuracy ±0.1 lb. • Fuel heat content measured per Method 19. • Validation of correlation at two load levels after 6 months resulted in accuracy of ±6 percent.
Frequency of measurements	• Fuel feed rate is continuously monitored; measured value is recorded every 15 minutes. • O_2 is continuously monitored; value is measured and recorded every 15 minutes.
Averaging period	• 1-hour; hourly fuel flow rate used to calculate hourly NO_x emission rate, lb/mmBtu.
QA/QC requirements	• Fuel flow meter calibrated annually. • Daily zero/calibration checks for O_2 meter; annual calibration audit. • Validation of correlation every 5 years.

1.3 What Components Should I Include in a Monitoring Approach Based on Parametric Monitoring?

You may choose to use parametric monitoring that is sufficient to assure compliance with the permit terms and conditions. If you elect to use this type of monitoring approach, you typically would consider the following components in your monitoring approach for each parameter you choose to monitor:

- The numerical indicator range for the selected parameter;
- Data reliability:
  - -- Sensor type (e.g., thermocouple) and location specifications;
  - -- Installation requirements (if applicable);
  - -- Minimum acceptable accuracy;
  - -- How data will be recorded;
- Frequency of measurements;
- Averaging period; and
- QA/QC requirements (e.g., annual sensor calibration).

You should select the parameter indicator range that will be sufficient to assure that the emissions unit is in compliance with the permit when operated within that range. Wherever possible, you should support the proposed range by documenting that the emissions unit was in compliance with the emission limitation when operating within the selected indicator range. You are not required to establish a range such that an excursion beyond that range indicates the emission limit has been exceeded. On the contrary, you should select an indicator range that prompts you to take corrective action before you exceed your emissions limit. Emissions data with concurrent site-specific parameter measurements are key in establishing indicator ranges. However, you may use other relevant information, such as engineering assessments, historical monitoring data, and vendor data. The CAM Technical Guidance Document, available on EMC's web site, also contains a detailed discussion on parametric monitoring and indicator ranges.

You should consider supplementing parametric monitoring with periodic emissions testing. Periodic emissions testing will verify the validity of the relationship between the parameter(s) selected and emissions and the appropriateness of the selected indicator range(s). The use of periodic testing is especially important when the relationship between the parameter(s) and emissions is not robust or well-known. Consider the strength of the parametric relationship (i.e., whether the relationship is based upon a known technical principle), the available documentation for the indicator range selection, the margin of compliance, and the variability of the process and emissions when selecting a periodic testing frequency. See Section 5.8 for additional information on how periodic emissions testing may be used to satisfy title V monitoring requirements.

Table 5-5 presents an example of the specific information that should be included in the monitoring approach for a facility monitoring gas temperatures at a veneer dryer as part of its monitoring for particulate matter emissions. Several factors, including dryer temperature, affect the composition of wood dryer exhaust. The rate of aerosol formation is lower at lower dryer temperatures; small increases in the inlet dryer temperature can result in large increases in the PM mass emission rate. Excess drying temperatures also can cause the wood to burn.

Table 5-5. Example Monitoring Using a Parametric Monitoring Approach for a Veneer Dryer with No Add-on Control[a]

Monitoring approach components[a]	Continuous parametric monitoring
Parameter indicator range	When drying Douglas Fir (0.100 in. thickness): • Green end: less than 320°F • Dry end: less than 320°F When drying Douglas Fir (>0.228 in. thickness): • Green end: less than 345°F • Dry end: less than 345°F
Data reliability:	• Thermocouples located in green and dry ends of dryer. • Minimum accuracy: ±0.75 percent or 4°F, whichever is greater. • Data acquisition system (DAS) records temperature data.
QA/QC requirements	Annual calibration check and inspection (acceptance criteria ±5°F at 400°F).
Frequency of measurements	Continuous.
Averaging period	None.
Affirmation of relationship between temperature and PM	Annual PM emissions test.[b]

[a]Compliance limit is 0.1 gr/dscf PM.
[b]A periodic emissions test should be included as a part of this monitoring approach unless a large margin of compliance with the PM emissions limit has been demonstrated.

1.4 What Components Should I Include in a Monitoring Approach Based on Raw Material and Fuel Pollutant Content Measurements?

The raw materials or fuels used in a process can be analyzed to determine the pollutant content or other properties of the material. Examples of sample analyses include measuring the sulfur content and heat content of fuel used in a boiler and determining the VOC content of coatings used in a coating operation. Once the raw material has been analyzed for pollutant content, this information, along with usage and product recovery records, can be used to estimate emissions of the pollutant of concern.

If you elect to monitor compliance by measuring the pollutant content of raw materials, your monitoring approach probably would consider the following components:

- The numerical compliance limit;
- The sampling/measurement method to be used;
- The frequency of sampling;
- Emission calculation procedures;
- The averaging period;
- QA/QC procedures; and
- Recordkeeping procedures.

Table 5-6 presents examples of monitoring for two types of emissions units using measurement of raw material pollutant content as the monitoring approach.

Table 5-6. Example Monitoring for Two Types of Emissions Units Using Measurement of Raw Material Pollutant Content as the Monitoring Approach

Monitoring approach components	Coal-fired boiler monitoring	Coating line monitoring
Numerical compliance limit	3.10 lb SO_2/mmBtu actual heat input.	33 tons VOC/year.
Sampling/measurement method	• ASTM methods for sulfur content of coal (per M19). • ASTM methods for heat content of coal (per M19).	• Method 24 for VOC content of coatings. • Records of coatings usage.
Frequency of measurements	Per lot composite coal sample for sulfur and heat content.	• Analysis of each coating used. • Monthly inventory of usage.
Emission calculation procedures	Use fuel analysis records and the applicable equations in M19.	(Monthly coating usage [gal/month]) multiplied by (VOC content of each coating [lb VOC/gal, less water]).
Averaging period	Monthly.	Monthly.
QA/QC procedures	As specified in ASTM fuel sampling and analysis methods.	As specified in Method 24.
Recordkeeping procedures	Monthly records of total quantity of coal received, results of sulfur and heat content analyses, and calculated emission rate based on a volume-weighted average of the calculated rates for all coal shipments during a calendar month.	Monthly records of coatings usage, VOC content of coatings used, and supplier identification for coatings used.

1.5 What Components Should I Include in a Monitoring Approach for a Work Practice Standard?

Work practice standards require you to perform certain activities at the emissions unit to minimize air emissions. Examples of work practice activities include dust suppression measures and leak detection and repair (LDAR) programs. Your monitoring approach for work practice standards typically would consider the following components:

- A detailed description of the work practice, including the frequency of conducting the work practice;
- Recordkeeping procedures (documentation of work practice activities); and
- Any applicable QA/QC procedures.

Table 5-7 presents an example of monitoring for fugitive emissions at a wood products facility complying with a work practice standard.

Table 5-7. Example Monitoring for Fugitive Emissions at a Wood Products Facility Complying with Work Practice Requirement

Monitoring approach components	Inspections and recordkeeping
Detailed description of work practice, including frequency ~~of work practice~~	• Clean all accessible paved areas with street sweeper or water spray, daily; • Remove spillage resulting from material transfer or baghouse/cyclone maintenance, weekly inspections.
Recordkeeping of work practice activities	• Record and maintain daily records of each activity on maintenance log sheets; initial and date the log sheets.

1.6 What Components Should I Include in a Monitoring Approach Based on Inspection and Maintenance/Recordkeeping?

If your facility must use certain types or designs of equipment, adequate monitoring will consist of periodic inspections to verify that the specified equipment is intact and operating as required and records that document the inspections were performed. If you select a monitoring method based on inspection and maintenance/recordkeeping, your monitoring approach would likely consider the following components:

- Detailed description of inspection procedures;
- Frequency of inspections; and
- Procedures for recording inspection results and any maintenance performed.

Table 5-8 presents example monitoring for an emissions unit using records of inspection and maintenance as the title V monitoring.

Table 5-8. Example Monitoring for an External Floating Roof Tank (Storing Gasoline or Crude Oil) Using an Inspection and Maintenance Monitoring Approach

Monitoring approach components	Inspections and recordkeeping
Detailed description of inspection	• Inspect seal system: check for holes, tears, or other openings in the seal or seal fabric. • Inspect fittings on floating deck: check for tight fit on gaskets and damage to access doors and other openings in the deck.
Frequency of inspections	Perform rim seal and fitting inspections annually.
Recordkeeping	Maintain records of all inspections and any maintenance performed in a log book.

In some cases, it may be appropriate to include a "tiered" inspection frequency in the permit; that is, the frequency of inspections is dependent upon the historical performance results of the inspections. An example of tiered inspection monitoring is allowing less frequent leak checks if no or few leaking components are found during consecutive checks. Subpart VV of 40 CFR 60 allows for skipping a quarterly leak detection period if less than 2 percent of valves in gas/vapor or light liquid service are found to leak after two consecutive quarterly inspections. If, after five consecutive quarterly inspections, less than 2 percent of those valves leak, three quarterly inspections may be skipped.

1.7 How May Periodic Testing Be Used to Satisfy Title V Monitoring Requirements?

Periodic testing of emissions may be used to satisfy title V monitoring requirements alone, if performed frequently enough, or in conjunction with inspection/maintenance programs or parametric monitoring. (See Sections 5.4 and 5.7 for information on these types of monitoring approaches.) Examples of periodic testing include portable monitors used to detect pollutant emissions (e.g., portable VOC, CO, or NO_x monitors), periodic sampling (e.g., Method 24 for VOC content of coatings), or periodic emissions testing (e.g., performance test for pollutant of concern).

You typically consider the following components in a monitoring approach that includes periodic testing:

- Test methods/procedures;
- Frequency of testing;
- Recordkeeping; and
- QA/QC practices.

If the test method spells out this information, you can simply reference the procedures outlined in the test method. Table 5-9 presents example monitoring comprised of periodic testing and an inspection/maintenance program for a low-NO_x boiler.

You may consider an emissions test schedule that uses a variable ("tiered") test frequency based on performance results. For the example presented in Table 5-9, the periodic testing frequency for NO_x is quarterly. The permit could be written to incorporate a tiered test schedule (i.e., less frequent testing if the results of consecutive quarterly tests indicate a high margin of compliance and low variability). For example, if two consecutive quarterly tests show that the emissions are less than X percent (e.g., 75 percent) of the standard, the next required periodic test will be in six months. At any time that the periodic tests show the emissions are greater than 75 percent of the standard, quarterly periodic testing would be restarted.

Table 5-9. Example Monitoring Using Periodic Testing to Supplement an Inspection and Maintenance Program for a Packaged Boiler Using Low-NO_x Burners

Monitoring approach components	Emissions testing and inspections	
Test methods and procedures	Portable NO_x monitor (draft methods).[a]	Inspection and maintenance program
Frequency of testing	Quarterly.	Daily: Check flame failure detection system, low water level cutout and alarm. Weekly: Check ignitor and burner operation. Monthly: Check fan, fuel safety shutoff valve for leakage, low fire start interlock, high steam pressure interlock, fuel pressure interlocks. Annually: Check burner components, combustion air supply system, flame failure system components, piping, wiring, valve and interlock connections, combustion control system. Calibrate indicating and recording instruments.
Recordkeeping	Documentation of test results.	Records of inspections, repairs.
QA/QC practices	Per CTM-022 or CTM-030.	Qualified personnel perform inspections and repairs.

[a] Gas Research Institute Method GRI-96/0008, EPA/EMC Conditional Test Method (CTM-030). *Determination of Nitrogen Oxides, Carbon Monoxide, and Oxygen Emissions from Natural Gas-Fired Engines, Boilers, and Process Heaters Using Portable Analyzers.* EPA/EMC Conditional Test Method (CTM-022). *Determination of Nitric Oxide, Nitrogen Dioxide, and NO_x Emissions from Stationary Combustion Sources by Electrochemical Analyzer.*

APPLICABLE RULE FORMATS AND MONITORING APPROACHES

This section describes types of applicable requirements and lists monitoring approaches that are consistent with the general title V monitoring methodology described in Section 4 for various pollutants and emissions sources. The section addresses monitoring for VOC and organic HAP, visible emissions and opacity, PM, NO_X, SO_2, and CO rules.

The primary focus of this technical reference document is on sources not addressed by the CAM Technical Guidance Document.[2] That document concerns monitoring applications for emissions units with active air pollution control devices (APCD); review it if you have questions about those kinds of sources. The discussion in this section focuses on applicable rules for units without active air pollution control devices.

6.1 What Are the Different Formats of Applicable Requirements?

As mentioned in Section 4, the format of the applicable requirement is basic to establishing a monitoring approach, because the objective of the monitoring is to assure compliance with the applicable requirement. How initial compliance is determined also is important when establishing a monitoring approach. In this section, we describe the basic formats typically used by Federal, State, and local regulators for applicable requirements.

The section is organized by pollutant and/or source type. Summary tables of representative rules and example monitoring approaches for different types of emissions sources for the pollutants also are presented throughout this section.

Types of monitoring approaches include:

- Continuous Emissions Monitoring Systems (CEMS);
- Continuous Opacity Monitoring Systems (COMS);
- Predictive Emissions Monitoring Systems (PEMS);
- Parametric monitoring;
- Raw material or fuel pollutant content/mass balance;
- Documentation of work practice;
- Inspection and maintenance/recordkeeping for equipment and design standards; or
- Periodic testing, either as a supplement to other monitoring or alone.

[2] U.S. Environmental Protection Agency, Emission Measurement Center. Technical Guidance Document: Compliance Assurance Monitoring, August 1998. Available on EPA's web site at http://www.epa.gov/ttn/emc/cam.html.

6.2 VOC and Organic HAP Rules

This section discusses the types of applicable requirements found in VOC and Organic HAP rules and presents examples of appropriate monitoring approaches.

6.2.1 What Types of Applicable Requirements Are Typical for VOC and Organic Condensable HAP Sources?

Table 6-1 shows types of applicable requirements commonly found in permits and State and Federal rules for VOC and organic condensable HAP emission sources. The following sections describe the monitoring approaches that can be used for these types of applicable requirements. Emission sources covered by these types of requirements include:

- Process vents subject to closed vent and control requirements or subject to outlet concentration limits;
- Open sources subject to capture and control requirements;
- Sources such as tanks and wastewater treatment units subject to equipment design standards;
- Coating operations subject to as-applied VOC or HAP limits for each coating, average coating content limits, or mass emissions limits; and
- Sources subject to production-based (e.g., lb VOC per hour) emissions limits.

Table 6-2 presents a summary of representative rules and example monitoring approaches for various types of VOC emissions units. This table also references the detailed monitoring examples for VOC sources presented in Appendices B, C, and D.

6.2.2 What Are Examples of Monitoring Sufficient to Assure Compliance with VOC/HAP Mass Per Unit Time (lb/hr, lb/day, tons/yr) Limits?

Emissions limits in units of emission mass per unit time are also called mass emission rate standards. Title V monitoring for emissions units with these types of limits often are closely related to the compliance method. The compliance method for mass emission rate standards usually involves measurement of exhaust gas volumetric flow rate and the pollutant concentration. In cases involving extended compliance periods (e.g., lb/yr on a rolling 12-month basis), compliance determination involves summing data from records collected over the entire compliance period. In some cases, you can calculate emission rates from raw material or product information and estimate or determine directly the amount of the pollutant emitted to the air.

In many cases, especially for VOC emissions limits, the monitoring approach may constitute direct compliance monitoring. As an example, one approach involves keeping records of coating VOC content and coating usage. The monitoring of the VOC content would essentially provide the data necessary for directly determining compliance. If compliance is determined on an annual or rolling 12-month emissions basis, you would typically sum the pollutant emissions from coating VOC content and usage records over each 12-month period.

Table 6-1. Potential Monitoring Approaches for Various Types of Applicable Requirements for VOC and Organic Condensable HAP Sources[a]

VOC Sources	
Type of applicable requirement	Monitoring approach
Mass per unit time	Link monitoring to emission rate through emissions testing or calculation; CEMS; PEMS; process parameter or APCD parametric monitoring; periodic performance testing as a supplement to other monitoring.
Mass per unit product	Link monitoring to emission rate through source emissions testing or calculation and monitoring of production; CEMS; PEMS; process parameter or APCD parametric monitoring; periodic performance testing as a supplement to other monitoring.
As-applied coating VOC/HAP limit	Records of coatings' VOC/HAP content.[b]
Daily average coating VOC/HAP limits	Records of coatings' VOC/HAP content and material usage.[b]
Control efficiency	Capture system monitoring (such as periodic inspections of hoods and ducts and readings from pressure gauges) and process parameter or APCD parameteric monitoring (refer to CAM guidance); CEMS; periodic performance testing as a supplement to other monitoring.
Outlet concentration standard	Link monitoring to source emissions test data; process parameter or APCD parameteric monitoring (refer to CAM guidance); CEMS; PEMS; periodic performance testing as a supplement to other monitoring.
Equipment and design standard	Document inspection of equipment.
Total resource effectiveness (TRE)	Link monitoring to source emissions test data; process parameter or APCD parametric monitoring (refer to CAM guidance).
Closed vent system (CVS) to control device (percent control)	Document inspections of CVS; APCD parametric monitoring (refer to CAM guidance).

[a] This table does not comprise all possible applicable requirement types or monitoring approaches.
[b] Records should be sufficient to allow emissions calculations to be expressed in the same terms as the emissions limits.

In other cases, monitoring based on somewhat less precise data may be sufficient to assure compliance over all anticipated operating conditions by applying some assumptions about the process or operations. For example, you can use assumptions based upon the maximum design capacity, reasonably anticipated operational range, or enforceable restrictions on the process operation to allow the monitoring of alternative conditions or to reduce the amount of monitoring data collected.

Examples of the types of assumptions you can apply include:

- A maximum exhaust flow rate based on performance testing or process capacity (continuously monitoring fan speed or other flow rate parameter becomes unnecessary);
- 100 percent saturation at a measured temperature (temperature monitoring can be substituted for VOC emissions concentration monitoring); and
- 100 percent evaporation of pollutant content of product or raw material (monitoring of VOC emissions concentration monitoring becomes unnecessary).

Table 6-2. Potential Monitoring Options for VOC and HAP Sources[a]

Emissions unit	Applicable rule type	Monitoring option	Factors to consider	Reference to examples
Liquid storage tank	Equipment standard--internal floating roof (IFR), external floating roof (EFR).	Annual inspection of tank seal.[b]	Equipment life.	Nos. D.1 and D.2.
	Closed vent to control device.	Annual duct inspection and APCD monitoring.[b]		
Wastewater management	Equipment standard.	Annual inspections of covers, hatches, seals.[b]		

Table 6-2. (continued)

Emissions unit	Applicable rule type	Monitoring option	Factors to consider	Reference to examples
Loading	Limit emissions to X lb/hr.	Monitor loading rates, record materials loaded and quantities loaded.	Flow rates, temperatures, and composition of materials loaded.	
	Closed vent to control device.	Annual duct inspection and APCD monitoring.[b]		
	Equipment standard--submerged loading.	Periodic inspection.		
Oil/water separators	If partial pressure of VOC >X, closed vent to control device.	Initial sampling of wastewater. If between 50 and 100 percent of compliance limit, sample influent each month.[c]	Composition of influent wastewater.	
Solvent cleaning	Equipment standard.	Inspect equipment monthly and record in operations log.[d]		

Table 6-2. (continued)

	Emissions unit	Applicable rule type	Monitoring option	Factors to consider	Reference to examples
	Coatings application	As-applied VOC/HAP content limits for each coating (e.g., lb VOC/gal coating minus water, lb VOC/lb solids, lb HAP/gal solids, etc.).	Records of coating composition (as-applied).		Nos. C.1 and C.2.
		Daily average as-applied VOC/HAP limits for a coating operation.	Daily records of coating and solvent usage and composition.	Variability in daily coating and solvent usage.	
		Capture and control to X% Overall capture Y% Overall control Z%.	Capture system and APCD parametric monitoring.	Type of enclosure (i.e., PTE or other). Type of add-on control device.	
	Printing operations	X lb/day limit.	VOC content and usage.		No. C.1.

Table 6-2. (continued)

Emissions unit	Applicable rule type	Monitoring option	Factors to consider	Reference to examples
	Capture and control to X%.	Capture system and APCD parametric monitoring.	Type of enclosure (i.e., PTE or other). Type of add-on control device.	
	Fountain solution content max of X% alcohol.	Periodically check and record fountain solution composition.		
General emissions sources	Capture and control to X% Overall capture Y% Overall control Z%.	Capture system and APCD parametric monitoring.	Type of enclosure (i.e., PTE or other). Type of add-on control device.	No. D.3.
	X ppmv concentration at outlet of vent.	VOC CEMS or parametric monitoring.	Expected variation in concentration. Compliance margin.	
	Limit emissions to X lb/hr.	Periodic monitoring of flow, concentration.	Expected variation in flow and concentration.	

Table 6-2. (continued)

Emissions unit	Applicable rule type	Monitoring option	Factors to consider	Reference to examples
SOCMI, polymer equipment leaks	Leak detection and repair (LDAR) or closed vent to control device (compressors, pressure relief valves (PRV's)).	LDAR.		No. B.1.
Continuous vents Pharmaceutical manufacturing	Total resource effectiveness (TRE) limit: -- Meet TRE limit. -- Closed vent to control device. -- Outlet concentration standard.	Process parameter monitoring. APCD parameter monitoring. VOC CEMS.	If TRE index >4--no monitoring.	

Table 6-2. (continued)

Emissions unit	Applicable rule type	Monitoring option	Factors to consider	Reference to examples
-- Sources controlled by surface condensers.	Limit condenser exhaust temps.	Periodic temperature measurement.		
-- Air dryers.	Closed vent to control device.	Annual duct inspection and APCD monitoring.[b]		
Polystyrene process sources	Emissions limit X lb/lb production from materials recovery section.	Periodic flow, concentration, and production rate.		
Polyester resin product manufacturing	Monomer content limit of X% by weight as applied.	Periodic check and record of solution concentration.		
	Use of vapor-suppressed resin to meet emissions limit of 60 grams/m^2 of exposed surface during molding.	Documentation.		

Emissions unit	Applicable rule type	Monitoring option	Factors to consider	Reference to examples
	Equipment standard for spraying operations.	Documentation.		

[a] Note: This table may not present all applicable rule types. Other monitoring options not listed may exist and be appropriate.
[b] Inspection should be conducted at least annually; more frequent inspections may be appropriate based on site-specific factors (e.g., corrosivity of product stored, corrosivity of gas stream).
[c] More frequent sampling may be appropriate based on site-specific factors.
[d] More frequent inspection may be appropriate based on site-specific factors.

6.2.3 What Are Examples of Monitoring Sufficient to Assure Compliance with VOC/HAP Mass Per Unit Product (lb emission/lb product) Limits?

This type of requirement is similar to the one described above, except that a unit of production replaces the unit of time in the denominator (e.g., an emission limit might be in pounds of VOC per ton of product made). Emissions are based on flow rate and pollutant concentration per unit of product. This requirement has been used in some rules (Polymer Manufacturing NSPS [40 CFR 60, Subpart DDD] and the Polymers and Resins II MACT standard) for determining compliance with one or more emission streams associated with a particular process. Although the format accommodates the consideration of more than one emission stream, the components of the standard are essentially no different than the components in the mass per unit time requirement because production is also indexed on a unit of time (mass per unit time divided by production per unit time equals mass per unit production). Therefore, the same approach as described above is used in developing appropriate monitoring.

6.2.4 What Are Examples of Monitoring Sufficient to Assure Compliance with Coating VOC/HAP Limits?

Most coating rules are formatted such that the VOC or HAP content of a coating, as applied, is limited to a maximum mass of VOC or HAP per volume or mass of coating or coating solids (e.g., lb VOC/gal coating [less water], lb VOC/gal solids, or lb HAP/lb solids). You also may be subject to a daily, monthly, or yearly total VOC or HAP mass emissions limit (e.g., 100 lb/day, 1,000 lb/month, or 20 tons per year). These limits are based on the assumption that all of the VOC or organic HAP in the coating either flashes off at the point of application or evaporates as the coating dries or cures. Because the emission standard is based on the coating "as applied" and not "as supplied," you should take into account any thinning solvent that is added to the coating before it is used when calculating the coating's VOC or HAP content. If the rule applies a mass emissions limit or an average coating VOC or HAP content limit, you should measure the quantity of each different type of coating and thinner used and consider the VOC or HAP content of each coating as applied. The basic components of the initial compliance demonstration are the composition of the coatings and the amounts of each coating used.

Monitoring the "as-applied" coating composition and usage appears to be straightforward. However, there are issues related to the quality of the monitoring method to consider. We have developed test methods to provide you with a means to quantify a coating's VOC or organic HAP content. Method 24, 40 CFR Part 60, Appendix A, may be used to determine a coating's weight fraction VOC, weight fraction water, density, and weight fraction and volume fraction solids. These results can be used to determine the coating's VOC content in the desired units (e.g., lb VOC/lb solids). Similarly, Method 311, 40 CFR Part 63, Appendix A, may be used to determine a coating's organic HAP content. You can use these methods to provide reliable data for monitoring or to verify formulation data.

For many surface coating facilities, a Material Safety Data Sheet (MSDS) is the primary source of the coating VOC/HAP content information. However, the accuracy of the data contained in the MSDS may be questionable, since it was not designed to be a VOC/HAP emission limit compliance tool. If you choose to use an MSDS to document your coatings' VOC and HAP contents, it should contain the following information: total VOC and/or HAP content (weight fraction or some other units), density, and solids content (weight fraction, volume fraction, or both). You should not attempt to calculate the total VOC or HAP content from the component data in the hazardous ingredients section of the MSDS, since the concentrations of these components often are given as a range in percent (e.g., 20 to 30 percent xylene), and because all VOC's or HAP's may not be listed in the component data. As a preferred alternative to the use of MSDS, you may request that your coating supplier provide the product formulation data (for example, a Certified Product Data Sheet [CPDS]) with VOC/HAP component information presented with a certain agreed-upon precision (e.g., 0.1 percent). However, it is to your benefit to periodically audit some or all of the data provided by your coating supplier using the test methods discussed above.

Other factors to consider when developing a monitoring approach include the likelihood of violating the emissions limit and the technical and economic considerations associated with the range of possible monitoring methods. If your MSDS shows you are using coatings with VOC/HAP contents that fall well below your emissions limit (e.g., your limit is 1.0 lb HAP/lb solids, and your MSDS show the HAP content of your coatings is 0.4 lb HAP/lb solids), the accuracy of the MSDS may not be important, since you would not be violating your emissions limit even if the MSDS were in error by 100 percent. However, if you use multiple coatings and change coating formulations frequently, the assumption that there is a high margin of compliance may not hold true for future coating usage. You should consider realistic situations and changes that may occur when evaluating your margin of compliance. This is an example of where historical data on coating VOC content would be useful.

Options you might consider for monitoring coating VOC or HAP content include: (1) perform Method 24 or Method 311 analyses at regular intervals (e.g., for each new coating implemented, for all coatings on a yearly basis, or for 25 percent of your coatings once per quarter), (2) obtain Method 24 VOC and/or Method 311 HAP data from your supplier on a CPDS for each coating, (3) use manufacturer's formulation data to determine coating VOC/HAP content, or (4) use MSDS if the MSDS contain the coatings' total VOC/HAP content, solids content, and density and you have an adequate margin of compliance.

Another factor to consider in developing your monitoring approach is the method you use to determine coating usage. If you have a monthly, semi-annual, annual, or rolling 12-month total VOC or HAP limit as your applicable requirement, inventory records may be sufficient for documenting and reporting usage. However, if you are required to meet a daily, as-applied VOC or HAP limit, you should record the amounts of each coating and thinner used at each coating line on a daily basis, rather than determining the amount from purchase records.

Other monitoring approaches also might be used, as appropriate. For example, the "*Protocol for Determining the Daily Volatile Organic Compound Emission Rate of Automobile and Light-Duty Truck Topcoat Operations*" (EPA-450/3-88-018) does not require daily coating usage records to comply with a daily emissions limit. It allows certain detailed daily production data to be used to prorate the total usage of each coating in a month to each of the production days in that month in lieu of directly monitoring and recording the usage of each coating each day. The daily emission rates are calculated at the end of each month using monthly coating usage records and daily production data. However, this approach was developed for use by automobile and light-duty truck manufacturers and is not generally applicable to coating sources with operations that vary greatly from day to day. In an automobile and light-duty truck production paint shop, the same coatings are used on the same limited number of body styles in the same manner each day (i.e., the coating operations are much the same from day to day for an extended period of time) and the coated area in square feet is known for each vehicle style.

There are several ways of measuring usage, all with differing degrees of accuracy and precision. For example, you can use a flow meter in the coating delivery system, a weigh scale, a level indicator, or a dip stick to calculate coating usage from large totes or drums. If coatings are supplied or used from smaller containers, you can record the number of these small containers used per day.

Appendix C provides an example of monitoring to comply with a monthly mass emissions limit (Example C.1) and an example of monitoring to comply with a coating VOC content limit (Example C.2).

6.2.5 What Are Examples of Monitoring Sufficient to Assure Compliance with Equipment and Design Standards for VOC/HAP Sources?

Some rules simply require that certain types or designs of equipment be used. For example, some storage tank regulations allow you to equip tanks with internal or external floating roofs, in lieu of demonstrating a percent reduction from an uncontrolled baseline. Similarly, requirements for degreasing operations or wastewater management units may take the form of an equipment standard which specifies vessel dimensions or certain physical characteristics of equipment (e.g., freeboard ratio for cold solvent cleaners, liquid seals on sewer reaches, vapor-tight covers on tanks). For these types of standards, your monitoring should consist of periodic (e.g., monthly, quarterly, or annually, as appropriate considering possibility for degradation) inspections to verify that the specified equipment is intact and operating as required. Examples D.1 and D.2 in Appendix D provide example monitoring approaches for equipment and design standards.

6.2.6 What Are Examples of Monitoring Sufficient to Assure Compliance with Work Practice Standards for VOC/HAP Sources?

Another requirement that is similar to the equipment and design standard is the work practice standard, which requires you to conduct certain operations to limit the potential for

VOC or HAP emissions or to conduct operations in certain ways. An example of a work practice standard is a required leak detection and repair (LDAR) program for process components (e.g., valves, pumps). In this case, monitoring is essentially built into the rule, and there typically are no additional monitoring requirements (i.e., the rule specifies the frequency of monitoring). This is not true for all work practice standards, however. For example, another type of work practice standard for limiting VOC emissions from cleaning operations might be to "place all used VOC-laden rags in sealed containers." Following the methodology described in Section 4, the approach for establishing monitoring for this type of rule would involve considering how frequently inspections should be conducted and documented sufficient to assure compliance over all anticipated operating conditions. For work practice standards, your monitoring should include methods (typically, periodic inspections or measurements) to verify that the emissions unit continues to be operated in accordance with the requirements of the work practice standard. Appendix B contains examples of monitoring to show compliance with work practice standards.

6.3 Visible Emissions (VE) and Opacity Rules

This section discusses the types of applicable requirements found in VE and opacity rules and presents examples of appropriate monitoring approaches.

6.3.1 What Types of Applicable Requirements Are Typical for VE Rules?

Table 6-3 shows typical applicable requirements commonly found in permits and State and Federal rules for PM emission sources with VE limits. The following sections describe the types of monitoring approaches that can be used for these types of requirements.

Table 6-3. Potential Monitoring Approaches for Various Visible Emissions Rule Types[a]

Applicable rule type	Monitoring approach
Percent opacity limit.	COMS, bag leak detector, periodic Method 9 or Method 22-like reading.
Equipment and design standard.	Document periodic inspection.
Visual observation (no VE beyond property line).	Document periodic inspection, visible emissions determination.
Work practice standard.	Document periodic inspection/measurements.

[a] This table does not comprise all possible applicable requirement formats or monitoring approaches.

Emission sources covered by these requirements include:

- All sources covered by generic opacity limits;
- Flares subject to VE limits; and
- Fugitive sources subject to VE limits or work practice standards.

Table 6-4 presents a summary of representative VE rules and example monitoring approaches for various types of PM emissions units. This table also references the detailed monitoring examples for VE presented in the Appendices.

Table 6-4. Potential Monitoring Approaches for VE Sources[a]

Emissions unit	Applicable rule type	Monitoring options	Factors to consider	Reference to examples	Comments
All emissions sources	Not to exceed X percent opacity in any Y minute period.	M9 opacity observation and notations in operational log (1) that source was observed and (2) recorded opacity reading.[b]	• Type of add-on control. • Expected variability as a result of process.	No. B.3.	• Certified opacity reader (for M9) required. • Less frequent observations (e.g., each shift, weekly) may be appropriate in some cases.
Flares	No visible emissions except for periods not to exceed a total of X minutes in any Y consecutive hours.	Notations in operational log (1) that flare was observed when operating, (2) whether or not VE were observed, using M22, and (3) duration of any VE.[c] Use video camera to continuously monitor flare appearance; control room operator notes and records periods of VE.		No. D.3.	• Uncertified observer is acceptable for daily VE reading. • Use of video camera for VE/smoking.
Boilers and other combustion sources burning nongaseous fuel	Not to exceed X percent opacity in any Y minute period.	COMS or M9.[b]	• Fuel type, boiler capacity. • Compliance margin.[d]	Nos. A.2 and A.3.	
Incinerators	Not to exceed X percent opacity in any Y minute period.	COMS or M9.[b]	Incinerator capacity, characteristics of charge or waste feed materials.		
Fugitive sources					
General	No visible emissions beyond property line.	Periodic monitoring and notation in operational log that VE are not occurring beyond property line.[b]	Weather, traffic patterns, vehicle types, road surface.		Uncertified observer is acceptable for daily VE reading.
Storage piles, conveyor loading, traffic areas, grain handling/drying	Equipment/work practice standards.	Periodic monitoring and notation in operational log that VE are not occurring beyond property line and that equipment used to limit VE is intact and operational; corresponds to owner/operator-generated operating log.[b]		No. B.2.	

[a]Note: This table may not present all applicable rule types. Other monitoring options not listed may exist and be appropriate.
[b]Frequency of monitoring dependent on site-specific factors (e.g., margin of compliance, variability of process operation/emissions, equipment design).
[c]Frequency of monitoring dependent on site-specific factors.
[d]Less rigorous or frequent periodic monitoring for sources for which compliance demonstration and anticipated variability based on engineering evaluations indicates a significant margin of compliance.

6.3.2 What Are Examples of Monitoring Sufficient to Assure Compliance with VE Standards?

Visible emissions standards can be based either upon measurement of percent opacity or the presence or absence of any VE. For example, a common format is to require a source not to exceed a certain opacity limit in a given time period (e.g., not to exceed an average of 15 percent opacity in any given 6-minute period). Opacity is measured using 40 CFR 60, Appendix A, Method 9 (M9), which is a visual observation made by a certified smoke reader and is the main component of the initial compliance determination to consider in developing the monitoring approach (the duration of VE, not percent opacity, is measured using 40 CFR 60, Appendix A, Method 22 [M22] for fugitive sources, or M22-like observations for stack effluent).

Evaluating the variability of visible emissions is important in developing a reasonable monitoring method. The variability of opacity is likely to depend upon the type of emission source or fuel. For example, the opacity of emissions from a large coal-fired boiler is more variable than the opacity of emissions from a natural gas-fired boiler (typically, there is no opacity from a properly operated natural gas-fired boiler). A COMS might be the best monitoring approach for a large coal-fired boiler, while records indicating the natural gas was the only fuel fired would generally be appropriate monitoring for the natural gas-fired boiler.

Monitoring approaches and data collection frequencies other than a COMS may provide data representative of a unit's compliance with a VE requirement; you can consider technical and economic factors during selection of the monitoring approach. Less frequent monitoring may be sufficient to assure compliance over all anticipated operating conditions when there is low variability of emissions and an ample margin of compliance. Appendix A contains several example monitoring approaches for visible emissions from combustion sources.

6.3.3 Should I Use EPA Method 22 for Monitoring of Stack Emissions?

You generally should not use Method 22 for monitoring of the opacity of stack emissions because Method 22 does not provide opacity values. However, in some cases, the approach used in Method 22 – identifying the presence or absence and duration of VE without regard to opacity level – may be sufficient to assure compliance over all anticipated operating conditions. If your source normally operates with no VE, you may elect to observe the source on a periodic basis and note whether VE are present. If no VE are present, you certainly have a reasonable assurance that you are in compliance with your opacity limit, regardless of the limit.

If VE are present, the information available would be sufficient only to state that you may not be in compliance with your opacity limit. At this point, you should take corrective action to eliminate the emissions. Also, you may want to arrange to have a certified Method 9 observer monitor the emissions to determine if you are in or out of compliance. Some States have written permits that require opacity readings be taken within a certain time period (e.g., within 24 hours) if corrective action has not fully eliminated the emissions. The advantage of this approach, in lieu of taking Method 9 observations on a routine basis, is that the observer need not be certified. The disadvantage, of course, is that if visible emissions are identified there is uncertainty as to your compliance status. Consequently, this approach really is practical only in cases where visible emissions are not normally expected. An example of this type of situation is small fabric filter systems controlling material handling operations. Normally, these fabric filters operate with no visible emissions. The appearance of visible emissions indicates a degradation in performance and the need for corrective action.

When using the Method 22-like approach for visible/no visible emissions, the permit should describe the procedures to be used (including frequency) rather than simply referring to Method 22. Example language is provided below. You also may refer to Example E.1 in Appendix E.

(a) The Permittee shall conduct daily visual emissions inspections during daylight hours. Visual inspections shall consist of a visual survey of each stack or process emissions point over a 2-minute period to identify if there are visible emissions. If any visible emissions are observed, the source owner or operator shall:

(1) Verify that the equipment and/or control device causing the visible emissions is operating according to manufacturer's specifications or other site-specific acceptable operating conditions. If the equipment or control device is not operating properly, the Permittee shall take corrective action immediately to eliminate excess emissions.

(2) Conduct an opacity test using a certified opacity reader in accordance with Method 9 (see Appendix A, 40 CFR 60) if the corrective action taken in (1) does not rectify the opacity problem within 24 hours. Conduct such a test at least once each daylight shift until corrective action successfully rectifies the opacity problem or until X consecutive Method 9 tests over Y period indicate no visible emissions.

(3) Report the observance of visible emissions and the substance of any corrective action, in accordance with the permitting authority's deviation reporting policy.

6.3.4 Should I Use EPA Method 22 for Monitoring of Fugitive Emissions that Must Comply with an Opacity Limit?

In some cases, you may use Method 22-like procedures for monitoring of fugitive emissions to provide an assurance of compliance with an opacity limit. This situation is essentially the same as that described in Section 6.3.3, above.

6.3.5 Should I Use EPA Method 9 for Monitoring of Fugitive Emissions to Assure Compliance with an Opacity Limit?

Method 9 does not establish procedures for reading opacity from fugitive sources; nonetheless, you could use Method 9-like procedures for measuring opacity from fugitive sources. In fact, some NSPS regulations (e.g., Subpart OOO--Standards of Performance for Nonmetallic Mineral Processing Plants) do specify Method 9 as the applicable test method for observing emissions from fugitive sources; however, additional procedures for use of the method are provided in the regulation. Furthermore, three draft test methods that include procedures for measuring opacity from fugitive sources are available through our Emission Measurement Center (EMC) web site.[3] In addition to providing procedures for observing opacity from fugitive sources, these methods provide procedures for determining compliance with three different types of regulatory formats: (1) time-averaged, (2) time-exception, and (3) instantaneous limitation. Although these methods are still in draft form, we are working to finalize these methods and the procedures established in these methods may be used for monitoring of opacity from fugitive sources. The methods are:

Method 203A – Visual Determination of Opacity of Emissions from Stationary Sources for Time-Averaged Regulations.

Method 203B – Visual Determination of Opacity of Emissions from Stationary Sources for Time-Exception Regulations.

Method 203C – Visual Determination of Opacity of Emissions from Stationary Sources for Instantaneous Limitation Regulations.

[3]You can access information on test methods on the EMC web site at the following address: http://www.epa.gov/ttn/emc/tmethods.html.

6.3.6 What Are Examples of Monitoring Sufficient to Assure Compliance with Visible Emissions Standards for Flares?

For flares, a typical reasonable monitoring method is to verify on a daily or more frequent basis that the flare is operating without smoking. Most applicable requirements for VE from flares are patterned after 40 CFR 60.18(c)(1)--VE shall not exceed 5 minutes in any 2-hour period. Your approach could be to take immediate corrective action if smoke occurs, and, at any time that you observe the flare to be smoking, to record the duration of smoking according to Method 22. Often, facilities employ the use of a video camera to continuously monitor VE from flares. Note that monitoring of VE for flares would be in addition to any monitoring required for compliance monitoring of VOC; continuously monitoring the presence of a pilot flame is the presumptively acceptable approach for compliance monitoring for VOC. Example D.3 in Appendix D provides one approach to monitoring for flares.

6.3.7 What Are Examples of Monitoring Sufficient to Assure Compliance with Equipment and Design Standards to Limit Visible Emissions and PM?

As in the discussion of equipment and design standards for VOC sources, the monitoring generally associated with an equipment standard is a periodic inspection that the equipment is intact and in proper operation. Equipment standards for VE and PM sources can be as simple as requirements to install a hood to control fugitive emissions from the ash removal process at a small incinerator. For such a requirement, the appropriate monitoring would be to inspect that the hood is intact and in proper operation. In general, these inspections could be required daily, but should be based on the potential for variability, and more or less frequent monitoring could be warranted.

6.3.8 What Ares Examples of Monitoring Sufficient to Show Compliance with Work Practice Standards to Limit Visible Emissions and PM?

A work practice standard requires you to conduct certain operations at the emissions unit to limit the potential for emissions or to operate the emissions unit in certain ways. For example, a work practice standard to limit PM from material handling might include requirements to cover material storage piles. For these types of requirements, monitoring ensures that the work practice is followed. In this example, appropriate monitoring would consist of periodic inspections (e.g., daily) to ensure that the material storage piles are covered. See Appendix B for example monitoring approaches for work practice standards for fugitive emission sources.

6.4 PM Rules

This section discusses the types of applicable requirements found in PM rules and presents examples of appropriate monitoring approaches.

6.4.1 What Types of Applicable Requirements Are Typical for PM Sources?

Table 6-5 shows typical applicable requirements commonly found in permits and State and Federal rules for PM emission sources. Emission sources covered by these requirements include combustion and process sources subject to concentration or production-based limits. The following sections describe monitoring approaches for these types of requirements.

Table 6-5. Potential Monitoring Approaches for Various Applicable Requirements for PM Sources[a]

Applicable rule type	Monitoring approach
Concentration (gr/dscf) limit.	Link to source emissions test data and parameter monitoring, opacity, PM CEMS, periodic source test as a supplement to other monitoring.
Mass/heat input limit (~~kg/MW-hr~~lb/mmBtu heat input).	Link to source emissions test data and parameter monitoring, opacity, PM CEMS, periodic source test as a supplement to other monitoring.
Mass/unit production limit (~~kg~~lb/hr per ton feed).	Link to source emissions test data and parameter monitoring, opacity, PM CEMS, periodic source test as a supplement to other monitoring.

[a]This table does not comprise all possible applicable requirement formats or monitoring approaches.

Table 6-6 presents a summary of representative PM rules and example monitoring options (approaches) for various types of PM emissions units. This table also references the detailed monitoring examples for PM presented in the Appendices.

6.4.2 What Are Examples of Monitoring Sufficient to Assure Compliance with PM Concentration (gr/dscf) or Mass (lb/mmBtu or lb/ton of feed) Limits?

You generally should base monitoring for emissions units required to comply with PM concentration limits or mass limits (mass per heat input or mass per unit production) on the initial compliance demonstration method, which is usually an emissions test (e.g., Method 5 of 40 CFR Part 60, Appendix A). The monitoring approach might take the form of monitoring of process parameters based upon site-specific information. Monitoring of process conditions to ensure operation within established ranges can be used in conjunction with periodic checks of visible emissions (opacity or VE) as an indicator of particulate matter emissions control. An example of monitoring process conditions is monitoring charge rate and secondary chamber combustion temperature for a small incinerator. This monitoring would indicate good combustion practices and, if maintained within appropriate operating ranges, would be sufficient to assure compliance with a PM emissions limitation. Daily VE observations could be used in conjunction with monitoring process parameters sufficient to assure compliance over all anticipated operating conditions for this example. Another option would be to supplement the parametric monitoring with a periodic performance test.

Many existing applicable rules for PM have relied on continuous monitoring of opacity as a means of continuously monitoring for increases in PM (opacity is used as a surrogate for PM). However, developing a specific correlation between opacity and PM has proven to be difficult and costly. This option may not be technically or economically feasible for a source. Changes in

Table 6-6. Potential Monitoring for PM Sources[a]

Emissions unit	Applicable rule type	Monitoring options	Factors to consider	Reference to examples
Incinerators, boilers; no add-on control.	Not to exceed X gr/dscf, corrected for Y%O_2 (or CO_2).	Parametric monitoring (e.g., %O_2, feed rate). Opacity (e.g., daily M9). Periodic emissions testing.[b] PM CEMS.	Compliance margin and variability.[c] Fuel type.	
Miscellaneous sources--dryers; no add-on controls.	Not to exceed X gr/dscf.	Parametric monitoring (e.g., load, temperature, drying time). Opacity (e.g., daily M9). Periodic emissions testing.[b] PM CEMS.	Compliance margin and variability.[c]	No. E.2.
Processes with particulate collection equipment (e.g., baghouse).	Not to exceed X gr/dscf.	Parametric monitoring (e.g., load, pressure drop). Opacity (e.g., daily M9). Periodic emissions testing.[b] PM CEMS.	Compliance margin and variability.[c]	No. E.1.
Fuel combustion sources, coal-fired industrial boilers; no add-on controls.	Not to exceed X ~~kg PM/MW-hr~~ lb PM/mmBtu heat input ~~(lb/mmBtu/hr)~~.	Parametric monitoring. Opacity (e.g., daily M9). Periodic emissions testing.[b] PM CEMS.	Compliance margin and variability.[c]	No. A.1.
Coal-fired boiler >30 mmBtu/hr	Not to exceed X ~~kg PM/MW-hr~~ lb PM/mmBtu heat input ~~(lb/mmBtu/hr)~~.	COMS.[d] Periodic emissions testing.[b] PM CEMS.		No. A.1.
PM from process sources, e.g., catalytic regeneration, Portland cement kilns, coolers, sinter processes, blast furnaces, electric arc furnaces, basic oxygen furnaces, foundries, cyclones.	Allowable rate (~~kg~~lb/hr) based on process weight rate or ton feed.	Parametric monitoring. COMS. Opacity (e.g., daily M9). Periodic testing.[b] PM CEMS.	Compliance margin and variability.[c]	

[a]Note: This table may not present all applicable rule types. Other monitoring options not listed may exist and be appropriate.
[b]Periodic emissions testing used to supplement other monitoring.
[c]Less rigorous or frequent periodic monitoring for sources for which compliance demonstration indicates a significant margin of compliance (e.g., <50 percent of emissions limit) and low variability of emissions.
[d]Monitoring option is based upon NSPS monitoring requirement.

PM characteristics (e.g., size, shape, color, density) will affect the correlation between opacity and PM; collecting data to develop a reliable correlation can be excessively time consuming and expensive. Note that most emission sources that have PM emissions limits also have separate applicable requirements for opacity, so that even if a correlation between opacity and PM could be established, you still must comply with both an opacity limit and a PM limit.

An opacity/PM correlation might result in an opacity trigger level for corrective action to comply with the PM limit that is higher than the applicable opacity limit. You presumably would begin corrective action upon triggering the lower opacity limit, diminishing the need for the separate opacity/PM indicator ranges or trigger levels. In the opposite situation, where an opacity/PM correlation would result in a trigger level lower than the applicable opacity limit, the applicable opacity limit would be of little value as far as operating the process in compliance with the PM limit. Selection of an appropriate opacity trigger level and frequency of monitoring will be dependent upon the source type and characteristics, and available site-specific information on emission levels, variability of emissions, and the margin of compliance.

In recent years, advances in particulate monitoring based on light-scattering or beta radiation attenuation technologies have resulted in the availability of monitoring systems that are capable of continuously monitoring PM for some situations. The PM CEMS require development of a correlation between the instrument output and manual PM measurements. These systems may be preferable to developing correlations between opacity and PM. Generally, these PM CEMS are, because of cost and technical feasibility, intended for use on significant PM sources, such as coal-fired utility boilers. Currently, we are evaluating the feasibility of PM CEMS for regulatory application.[4] We have proposed a performance specification (PS) for PM CEMS, PS-11. These PM CEMS also are not to be confused with monitoring systems designed to indicate relative changes in PM emission levels (e.g., triboelectric or electrodynamic monitoring systems). Generally, these latter instruments do not quantify PM concentration, but are useful as indicators of PM control changes. These systems typically are used as bag leak detectors for fabric filters.

[4]U.S. Environmental Protection Agency. Current Knowledge of Particulate Matter (PM) Continuous Emission Monitoring. EPA-454/R-00-039. September 2000. Available on EPA's website at http://www.epa.gov/ttn/emc/cem.html.

6.4.3 What Are Examples of Monitoring Approaches to Assure Compliance with PM for Combustion Sources?

Particulate matter emissions from the combustion of oils depend predominantly on the type and grade of fuel fired. Combustion of lighter distillate oils (e.g., No. 1 fuel oil [kerosene] or No. 2 fuel oil [diesel]) generally results in significantly lower PM formation than does combustion of heavier residual oils (e.g., No. 6 fuel oil).[5] For combustion of coal, PM emission levels are related to the firing configuration, boiler operation, coal properties and pollution control equipment. Boiler load also affects the PM emissions as decreasing load tends to reduce PM emissions. However, the magnitude of the reduction varies considerably depending on boiler type, fuel, and boiler operation. Uncontrolled PM emissions from coal-fired boilers include the ash from combustion of the fuel as well as unburned carbon resulting from incomplete combustion. In pulverized coal systems, combustion is almost complete, thus, the emitted PM is primarily composed of inorganic ash residues.[6] Emissions of PM from the combustion of natural gas are typically low and relatively insignificant compared to emissions from other fuels.

For municipal waste combustors, the level of PM emissions depends on the waste characteristics, the physical nature of the combustor design, and the combustor's operation. For example, facilities that operate with high underfire/overfire air ratios or relatively high excess air levels may entrain greater quantities of PM. Also, the physical properties of the waste feed and the method of feeding influence PM levels; typically, refuse derived fuels (RDF) have higher PM carryover from the furnace due to the suspension-feeding of the RDF. However, controlled PM emissions from RDF plants do not vary substantially from other MWC because of the efficient collection in the APCD.[7]

Table 6-6 shows the monitoring approaches for PM regulations for combustion sources. You should consider the factors above in selecting parameters to monitor, data collection

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[5]U.S. Environmental Protection Agency. Compilation of Air Pollutant Emission Factors (AP-42), Volume I: Stationary, Point, and Area Sources. Fifth Edition. September 1998, p. 1.3-2.

[6]U.S. Environmental Protection Agency. Compilation of Air Pollutant Emission Factors (AP-42), Volume I: Stationary, Point, and Area Sources. Fifth Edition. September 1998, pp. 1.1-3; 1.1-27.

[7]U.S. Environmental Protection Agency. Compilation of Air Pollutant Emission Factors (AP-42), Volume I: Stationary, Point, and Area Sources. Fifth Edition. October 1996, pp. 2.1-12 through 2.1-13.

frequency, and the need for periodic testing for your application. Appendix A contains example monitoring approaches for combustion sources.

6.5 NO_X Rules

This section discusses the types of applicable requirements found in NO_X rules and presents examples of appropriate monitoring approaches.

6.5.1 What Types of Applicable Requirements Are Typical for NO_X from Combustion Sources?

Table 6-7 shows typical applicable requirements commonly found in permits and State and Federal rules for NO_X from combustion sources. The formats of the applicable requirements typically include:

- Concentration limits (ppm);
- Mass per unit time (lb/hr); or
- Mass per heat input rate (lb/mmBtu).

The following sections describe examples of potential monitoring approaches for these types of requirements.

6.5.2 What Are Example Monitoring Approaches Sufficient to Assure Compliance with Limits for NO_X from Combustion Sources?

Table 6-7 shows potential NO_X monitoring approaches; these monitoring approaches are discussed in more detail in the following sections. You also may refer to Appendix A for example monitoring approaches for combustion sources. Monitoring approaches include:

- CEMS for NO_X;
- PEMS correlated to NO_X emissions limits;
- Parametric monitoring of the process;
- Periodic stack testing using portable analyzers; and
- Implementation and documentation of standard operating procedures (SOP), and inspection and maintenance (I&M) (e.g., annual boiler tuneup).

Table 6-7. Potential Monitoring Examples for NO_X Sources[a]

Emissions unit	Applicable rule type[a]	Monitoring options	Factors to consider	Reference to examples
Boilers	lb/hr, lb/mmBtu, ppmv	CEMS.[b] PEMS.[b] Periodic emissions testing.[c] Parametric monitoring (e.g., flue gas O_2 and load). Implementation of SOP, annual inspection and maintenance.	Margin of compliance, fuel type, variability.	No. A.3.
Municipal waste combustors	ppmv	CEMS.[b] Parametric monitoring (e.g., flue gas O_2/CO_2 level, charge rate).[b]		
Stationary gas turbines	lb/hr, lb/mmBtu, ppmv	Parametric monitoring (e.g., water-to-fuel ratio, fuel-bound nitrogen, other turbine dependent parameters).[b] CEMS. PEMS. Periodic emissions testing (e.g., using portable analyzer).[c]	Margin of compliance. Turbine service.	No. A.4.
Internal combustion engines.	lb/hr, lb/mmBtu, ppmv	Parametric monitoring.[b] CEMS. PEMS. Periodic emissions testing (e.g., using portable analyzer).[c]	Margin of compliance. Engine service. Fuel type.	

[a] Note: This table may not present all applicable rule types. Other monitoring options not listed may exist and be appropriate.
[b] Monitoring options based upon NSPS monitoring.
[c] Periodic emissions testing used to supplement other monitoring.
[d] Not specified or regulated by NSPS.

6.5.3 What Parameters Affect NO_X Emissions?[8, 9, 10, 11, 12, 13]

NO_X formed in combustion processes are due either to thermal fixation of atmospheric nitrogen in the combustion air ("thermal NO_x"), or to the conversion of chemically bound nitrogen in the fuel ("fuel NO_X"). The formation of thermal NO_X is affected by four factors: (1) peak temperature, (2) fuel nitrogen concentration, (3) oxygen concentration, and (4) time of exposure to peak temperature. The emission trends due to changes in these factors are generally consistent for all types of boilers: an increase in flame temperature, oxygen availability, and/or residence time at high temperatures leads to an increase in NO_X production. The NO_X emissions from combustion sources, such as boilers and gas turbines, vary with load, typically increasing as load increases. Also, in general, lower excess combustion air results in lower NO_X emissions. For boilers, the chief means of limiting NO_X generation is to lower the temperature in the combustion zone, as well as to reduce the quantity of excess air in the combustion zone.

Fuel Nitrogen can account for up to 80 percent of the total NO_X from coal combustion. Fuel nitrogen conversion is the more important NO_X formation mechanism in residual oil boilers; thermal fixation, on the other hand, is the dominant NO_X formation mechanism in units firing distillate oils because of the negligible nitrogen content in these lighter oils. Due to the characteristically low fuel nitrogen content of natural gas, NO_X formation through the fuel NO_X mechanism is insignificant for gas-fired units.

For gas turbines, ambient conditions also affect emissions more than from external combustion systems (i.e., boilers). The operation at high excess air levels and high pressures increases the influence of inlet humidity, temperature, and pressure. Humidity acts to absorb

[8]U.S. Environmental Protection Agency. Compilation of Air Pollutant Emission Factors (AP-42), Volume I: Stationary, Point, and Area Sources. Fifth Edition. September 1998, p. 1.3-3.

[9]U.S. Environmental Protection Agency. Compilation of Air Pollutant Emission Factors (AP-42), Volume I: Stationary, Point, and Area Sources. Fifth Edition. September 1998, p. 1.1-4.

[10]U.S. Environmental Protection Agency. Compilation of Air Pollutant Emission Factors (AP-42), Volume I: Stationary, Point, and Area Sources. Fifth Edition. July 1998, p 1.4-2.

[11]U.S. Environmental Protection Agency. Compilation of Air Pollutant Emission Factors (AP-42), Volume I: Stationary, Point, and Area Sources. Fifth Edition. April 2000, p. 3.1-4.

[12]U.S. Environmental Protection Agency. Compilation of Air Pollutant Emission Factors (AP-42), Volume I: Stationary, Point, and Area Sources. Fifth Edition. October 1996, p. 2.1-14.

[13]P. Chattopadhyay, Boiler Operations Questions and Answers. pp. 597-598.

heat in the primary flame zone; as energy is used for water to steam conversion, the temperature in the flame zone will decrease resulting in a decrease of thermal NO_X formation. For a given firing rate, lower ambient temperatures lower the peak temperature in the flame, lowering thermal NO_X. The gas turbine operating loads affect NO_X emissions; higher NO_X emissions are expected for high operating loads due to the higher peak temperature in the flame zone.

Emissions of NO_X from solid waste incinerators can vary with the characteristics of the wastes being combusted. Because of the relatively low temperatures at which MWC incinerators operate, 70 to 80 percent of the NO_X formed in MWC's is associate with the nitrogen in the waste.

6.5.4 What Options Are Available for Monitoring NO_X Emissions?

The NSPS provide information on what types of sources are covered by these rules and on monitoring options allowed under the rules. The NSPS regulate NO_X emissions from boilers with a heat input of at least 29 MW (100 mmBtu/hr), municipal waste combustors located at sites having capacities of greater than 225 Mg waste/day, and gas turbines having heat input at peak load equal to or greater than 10.7 gigajoules per hour (10 mmBtu/hr). Under some conditions, boilers with a capacity between 100 and 250 mmBtu/hr are exempt from NO_X limits if operation is limited according to their capacity and the fuel-bound nitrogen content of their nongaseous fuels. In order to maintain this exemption, you should monitor these parameters.

The NSPS for large boilers (greater than 72.5 MW [250 mmBtu/hr]), requires a NO_X CEMS; however, parametric monitoring, correlated to NO_X emissions, is allowed for boilers with a heat input of less than 72.5 MW. The NSPS allow the use of parameter monitoring as well as CEMS for all municipal waste combustors. Parameters monitored are the flue gas CO_2 level correlated with the NO_X emission levels measured during the initial performance test. The rules also require that exhaust O_2 concentration be measured under all circumstances to normalize measured concentrations to 7 percent O_2.

For gas turbines, the NSPS allow parameter monitoring of the water-to-fuel ratio correlated to the initial performance test and the fuel-bound nitrogen content where emissions are controlled by water injection. Newer turbines are designed as "dry" low-NO_X turbines (i.e., they achieve low NO_X emissions through burner/turbine design). The NSPS do not specifically address monitoring for these units. Either CEMS, PEMS, parameter monitoring, or an inspection/maintenance program in conjunction with periodic testing would be appropriate monitoring approaches for these types of turbines. The selection of monitoring should consider the margin of compliance and the technical feasibility of the monitoring for the unit.

6.5.5 When May CEMS and PEMS Be Appropriate for Monitoring of NO_X Emissions?

Load, excess air, combustion temperature, and other variables affecting NO_X emissions are interdependent and typically are analyzed as a group to derive a predictive tool for estimating emissions of NO_X. This tool, called a PEMS, is used to demonstrate compliance with NO_X emission limits in much the same manner as a CEMS (i.e., the results are presented in units of the emissions standard [e.g., ppmv or lb/mmBtu]).

Generally, for sources meeting the size cutoffs described in the applicability sections of the NSPS and where the NSPS would require CEMS (e.g., for 250 mmBtu/hr boilers), we suggest the use of CEMS or PEMS for units of this size not currently required to comply with the NSPS. Alternatives for certain applications are provided below.

6.5.6 When Could Parametric Monitoring Be Appropriate to Assure Compliance for NO_X Emission Sources?

Parametric monitoring that is not directly correlated with NO_X emissions may be used to satisfy monitoring requirements for smaller combustion units (<100 mmBtu/hr heat input capacity for boilers, <225 Mg/day plant capacity for waste incinerators, <10 mmBtu/hr for stationary gas turbines). For example, monitoring of excess O_2 in the boiler flue gas can be used to assure proper operating conditions. This O_2 monitoring is generally expected to be sufficient to assure compliance with the NO_X emissions limit, but it will not by itself be adequate to estimate the actual NO_X emission rate. An acceptable monitoring approach would be to monitor and compare flue gas O_2 readings to an acceptable range established from an initial compliance test and supplemented with operating knowledge. Although this approach would not yield actual NO_X emission rates to compare against an applicable requirement, the monitoring approach would provide data representative of NO_X emissions levels and would yield reliable data that could represent compliance with the NO_X limit. As such, this approach may be acceptable for units for which a CEMS/PEMS is not cost-effective or for units operating well below the emissions limit. However, if the margin of compliance is small, this parametric monitoring approach may need to be supplemented with periodic testing as described below or replaced with more rigorous monitoring.

6.5.7 When May an Inspection/Maintenance Program Supplemented by Periodic Testing Be Appropriate for NO_X Emission Sources?

Another monitoring option is an inspection/maintenance program supplemented by periodic testing (e.g., monthly, quarterly, or semiannual) using portable analyzers. This option is appropriate for emissions units that rely on combustion modification designs (e.g., low-NO_X burner designs) that are not expected to exhibit much variability because there are few or no adjustments to be made to the burner controls. A test method for portable analyzers has been drafted and is currently available as an EPA conditional test method.[14]

The inspection/maintenance program would include documenting and following standard operating procedures for proper operation and maintenance, such as a semiannual boiler tuneup and thorough inspection for wear and corrosion. In some cases (e.g., low variability and large margin of compliance), the inspection/maintenance program may be adequate without the need for periodic testing.

6.6 SO_2 Rules

This section discusses the types of applicable requirements found in SO_2 rules and presents examples of appropriate monitoring approaches.

6.6.1 What Types of Applicable Requirements Are Typical for SO_2 from Combustion Sources?

Table 6-8 shows typical applicable requirements commonly found in permits and State and Federal rules for SO_2 from combustion sources. The formats of the applicable requirement typically include:

- Mass per unit heat input (lb/mmBtu);
- Mass per unit time (lb/hr); or
- Concentration (ppmv).

The following sections describe examples of potential monitoring approaches for these types of requirements.

[14]Gas Research Institute Method GRI-96/0008, EPA/EMC Conditional Test Method [CTM-30]: Determination of Nitrogen Oxides, Carbon Monoxide, and Oxygen Emissions from Natural Gas-Fired Engines, Boilers and Process Heaters Using Portable Analyzers.

6.6.2 What Are Examples of Monitoring Approaches Sufficient to Assure Compliance with SO_2 Limits from Combustion Sources?

Table 6-8 shows SO_2 monitoring approaches. Options for monitoring include the use of CEMS and analysis of fuel sulfur content. You also may refer to Appendix A for example monitoring approaches for SO_2 from combustion sources.

Table 6-8. Potential Monitoring Approaches for SO_2 Sources[a]

Emissions unit	Applicable rule type	Monitoring options	Factors to consider	Reference to examples
Boilers	lb/mmBtu, lb/hr	CEMS. Analysis of as-fired fuel for sulfur content. Periodic emissions testing.[b]	Fuel type, margin of compliance.	No. A.1, A.2.
Municipal waste combustors	ppmv	CEMS. Parametric monitoring for O_2/CO_2, charge rate. Periodic emissions testing.[b]		
Stationary gas turbines	percent volume (concentration)	CEMS. Analysis of as-fired fuel for sulfur content. Periodic emissions testing.[b]	Fuel type, margin of compliance.	No. A.4.

[a] Note: This table may not present all applicable rule types. Other appropriate monitoring options not listed may exist.

[b] Periodic emissions testing used to supplement other monitoring.

6.6.3 What Parameters Affect SO_2 Emissions?

The SO_2 emissions from combustion sources without add-on control devices are almost entirely dependent on the sulfur content of the fuel and are not affected by boiler size or burner design.

6.6.4 What Options Are Available for Monitoring SO_2?

It follows, therefore, that the only monitoring options are CEMS and fuel sulfur content analyses. The NSPS provide information regarding what types of sources are covered by these rules, and on monitoring options allowed under the rules. For boilers, the NSPS regulate

SO_2 emissions from boilers with heat input capacities of 10 mmBtu/hr or greater that burn nongaseous fuels. These rules require a CEMS for all boilers, unless you use very low-sulfur fuel (less than 0.5 percent sulfur by weight). You can monitor sulfur content in fuel on either an as-fired basis by taking periodic fuel samples or by obtaining a fuel certification from the supplier for each shipment.

The NSPS regulate municipal waste combustors located at facilities having a plant capacity of greater than 250 tons waste/day. The NSPS require CEMS. You also must monitor flue gas O_2 (or CO_2) continuously to enable normalization of the concentration according to the standards.

The NSPS regulate emissions of SO_2 from stationary gas turbines having heat input at peak load equal to or greater than 10.7 gigajoules per hour (10 mmBtu/hr) or greater and burning fuel with a sulfur content of greater than 0.8 percent by weight. The rule requires a CEMS or an analysis of as-fired fuel.

6.7 CO Rules

This section discusses the types of applicable requirements found in CO rules and presents examples of appropriate monitoring approaches.

6.7.1 What Types of Applicable Requirements Are Typical for CO from Combustion Sources?

Typical applicable requirements commonly found in permits and State and Federal rules for CO from combustion sources are expressed as concentration, ppmv.

6.7.2 What Are Examples of Monitoring Approaches for CO from Combustion Sources?

Table 6-9 shows possible CO monitoring approaches. Appendix A contains an example monitoring approach for CO from a gas turbine.

6.7.3 What Parameters Affect CO Emissions?

In waste combustion, CO emissions result from incomplete combustion. High levels of CO indicate that combustion gas temperatures were not held at a sufficiently high temperature in the presence of oxygen for a long enough time to convert CO to CO_2.[15] Adding too much air to the combustion zone will lower the local gas temperature and quench (retard) the oxidation reactions. If too little air is added, the probability of incomplete mixing increases. Both of the conditions would result in increased emissions of CO.

6.7.4 What Example Monitoring Options are Available for CO Emissions?

The NSPS regulate CO emissions from municipal waste combustors located at facilities having a plant capacity of greater than 250 tons of waste per day. Monitoring options include both CEMS and parametric monitoring for CO_2 correlated to CO emissions measured during an initial performance test. Periodic testing using portable analyzers also is an acceptable monitoring option for CO sources.

Table 6-9. Potential Monitoring Approaches for CO Sources[a]

Emissions unit	Applicable rule type	Monitoring options	Factors to consider	Reference to examples
Municipal waste combustors.	ppmv	CEMS. Parametric monitoring (e.g., CO_2/O_2). Periodic emissions testing.[b]		
Stationary gas turbine.	ppmv	CEMS. PEMS. Parametric monitoring (e.g., CO_2/O_2, load). Periodic testing.[b]	CO tends to increase as load decreases.	No. A.4.

[a] Note: This table may not present all applicable rule types. Other monitoring options not listed may exist and be appropriate.
[b] Periodic emissions testing used to supplement other monitoring.

[15] U.S. Environmental Protection Agency. Compilation of Air Pollutant Emission Factors (AP-42), Volume I: Stationary, Point, and Area Sources. Fifth Edition. pp. 2.1-13 through 2.1-14.