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RESOURCE MANUAL FOR IMPLEMENTING THE NSPS CONTINUOUS MONITORING REGULATIONS

Manual 4 - Source Operating and Maintenance Procedures for Continuous Monitoring Systems

U.S. ENVIRONMENTAL PROTECTION AGENCY
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RESOURCE MANUAL FOR IMPLEMENTING THE NSPS CONTINUOUS MONITORING REGULATIONS
Manual 4 - Source Operating and Maintenance Procedures for Continuous Monitoring Systems

by

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STATIONARY SOURCE ENFORCEMENT SERIES

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A. INTRODUCTION

Manual 4 of the "Resource Manual for Implementing the NSPS Continuous Monitoring Regulations" is written to help the Agency provide technical advice or assistance to the sources and acquaint agency personnel with good maintenance and operating practices. As has been pointed out in previous Manuals in this series, proper maintenance and operation of the monitoring system by the source is a critical factor in an effective monitoring program. As the Agency implements a widespread continuous monitoring program, one of the major tasks will be to educate source operators to maintain and operate monitoring systems correctly. This Manual will familiarize the observer with the Regulations as they relate to maintenance, with key components of a sound maintenance program and with required and otherwise helpful operational checks.

Other Manuals in the "Resource Manual for Implementing the NSPS Continuous Monitoring Regulations" are:

- Manual 1 Source Selection and Location of Continuous Monitoring Systems
- Manual 2 Preliminary Activities for Continuous Monitoring System Certification (Installation, Notification and Performance Evaluations)
- Manual 3 Procedures for Agency Evaluation of Continuous Monitor Data and Excess Emission Reports

B. REGULATIONS

The regulations generally require a source owner or operator to install, calibrate, operate and maintain a monitoring system suitable for that particular facility. Monitor systems are also required to be checked for zero and calibration at least daily. However, other than this rather general requirement, there are no specific requirements concerning how or by what procedures a source should operate or maintain its equipment. However, a good monitoring program cannot be conducted without a minimum of regular maintenance and sound operating procedures.

C. OPERATION AND MAINTENANCE PROCEDURES

Several key factors will determine the effectiveness of maintenance procedures -- and ultimately the effectiveness of the monitoring system itself.

The major factors in an effective maintenance program are:

- Trained personnel
- Commitment to keep the system operating properly
- Spare parts
- Supporting equipment
- Access to expert advice
- Followup to maintenance problems
- Periodic review and resolution of problem areas

1. Trained Personnel

Personnel can be trained in several ways. The usual procedure is to cross-train source employees as measurement equipment technicians. At least one of the employees should have several years of electronic maintenance experience and be familiar with such process measurement equipment as pressure transducers, flowmeters, and strip chart recorders. The other employee should have a working knowledge of valves, sample piping, pumps, filters, etc. In most cases, it is unlikely that a plant mechanic or electrician can be cross-trained to do all maintenance and repair on a continuous monitoring system effectively.

Sources that do not employ skilled instrumentation maintenance personnel usually have some sort of on-call and periodic maintenance contract with the nearest vendor's field office or another company that specializes in this kind of service. Under these circumstances, in-house personnel only need to be trained to recognize whether the monitor is operating or not. A major advantage of this type of arrangement for the source is that the service vendor can be held responsible for supplying replacement parts. For the Agency, however, this shared responsibility may complicate any enforcement action that it might wish to take.

The major drawback of contract maintenance service is response time. It will frequently take several days to get the maintenance contractor out to the source and get the monitoring systems running right. Since the Agency only requires data summaries on a quarterly basis, the absence of 4 or 5 days' data is normally not catastrophic. However, if the system continues to be unreliable and has frequent downtime, the total amount of data obtained may not be adequate to assess the effectiveness of the source's emission control program. This may not be a serious problem for a source whose emission records show a very steady, well controlled operation that is generally within the emission limitation. But for sources that frequently exceed the standards or have a difficult time controlling their facilities or their pollution control equipment, the Agency should consider taking corrective action.

2. Commitment to Get and Keep the Device Operating Properly

One of the major problems facing the local Agency will be creating a real commitment on the part of the source for keeping the monitoring system operating correctly. The source owner, the operator, and all involved personnel must ultimately be convinced that it is in their best interest to keep the system operating. Once the basic commitment is there, the rest is largely education and practice.

3. Spare Parts and Supplies

Whoever is responsible for maintaining the monitor should have a ready supply of spare parts, as well as tools and support equipment. The spare parts required are generally specified to some extent by the equipment vendor. At the minimum, the ready supply should include chart paper, spare pens or ink, a box of four or five spare fuses of each type and size used in the equipment, a box of nuts, bolts, allen screws, and other screws of the sizes used, spare air and sample filters, calibration or other gas fittings, and any other fittings which are frequently connected and disconnected. Instrument spares should include a spare light source for UV, visible, or opacity monitors, and a spare infrared source of each type used.

With solid state equipment, the replaceable electronic modules are larger, so that it may not be economical to stock them as spares. However, solid state equipment should be more reliable, so that the primary spare parts requirements should come from the mechanical portions of the system.

The requirements for spare parts should be reviewed periodically to determine which problems occur most frequently and how long replacement/repair takes. Any part that needs to be replaced routinely as part of normal operation should be stocked. Parts that do not normally need to be replaced except once every 2 to 3 years probably do not need to be kept on hand. Price and delivery time are other factors to consider. There is no particular advantage to stock up nonroutine items that can be obtained in 24 to 48 hours from the vendor.

The last major considerations that affect parts stocking are reliability and mean time to failure. If a system has six valves with an operating life of 20,000 hours (2.2 years of continuous use), the source can expect to replace one of these valves every 4-1/2 months. One valve, therefore, should probably be kept in stock. At the same time, a typical analyzer has a mean time between failures of 2500 hours. This means that some type of failure that will cause downtime can be expected at least every 2 months.

If each repair takes 1 week for diagnosis, parts delivery, and repair, the effectiveness of the system will be 88 percent maximum, assuming that no other data losses occur. Since we can assume that additional data losses will normally happen, it will not take many failures, data losses, or extended repair times to reduce the effectiveness level of the monitoring system to 60 percent or lower. In this event, the Agency must decide whether this level of effectiveness and quality of data is enough for adequate environmental protection, or if back-up parts and systems should be required.

4. Supporting Equipment

The support equipment required by different types of monitoring equipment varies widely according to the operating principle involved.

All monitoring systems require a good mechanical tool kit with wrenches, screwdrivers, allen wrenches, etc. Since most monitors have a number of small nuts, bolts, or screws, a good maintenance kit also includes jeweler's screwdrivers, small needle-nose pliers, and other equipment useful for working with very small parts.

Several electronic hobby companies and electronic supply houses have packaged $200 to $300 tool assortments that have all the small tools, inspection mirrors, soldering equipment, etc. required for monitoring system maintenance. One of these tool kits is a good initial investment in supporting equipment.

For electrical troubleshooting, a good instrumentation multimeter, either digital or analog, is recommended. As a rule, the multimeter used by the plant electrician in working with 440-volt, 3-phase, 100-amp power circuits will not be particularly useful in servicing the monitoring sytem. Good, general purpose multimeters can be obtained for about $100 and up. Portable multimeters with battery power packs can be very useful. Most monitoring system instruction manuals will suggest measurement equipment for their particular monitors.

Supporting equipment also includes the calibration materials required for the daily zero and calibration check. Extractive monitoring systems will require both zero and calibration gases. With the exception of the oxygen monitors, the ambient air can serve as the simplest source of a sample stream containing "zero" pollutant. In most cases an SO_2 monitor will be calibrated at 1000 or 1500 ppm, so 0.5 ppm of SO_2 in the air will not affect accuracy. Greater accuracy can be obtained by running the air through an activated charcoal filter. Most calibration gas vendors can also supply bottles of zero gas. In general, however, this precaution is not required.

For an oxygen monitor, the base (and least expensive) zero gas is a bottle of commercially pure nitrogen gas, which can be readily obtained with less than 0.1 percent oxygen from almost any vendor. This zero gas is perfectly usable to "zero" any other monitors in the system, so it is not necessary to have two zero gas systems. However, if a sensitive (1 to 5 ppm) hydrocarbon monitor is included in the system, water or liquid pumped nitrogen must be used. Sources should not accept oil pumped gases.

Calibration gases are readily available from a number of vendors. The source can either buy certified gases from vendors or perform reference method tests to verify the calibration gas mixtures. EPA is working with NBS and the gas-producing companies to establish a traceability and reliability program for stationary source calibration gases. In purchasing vendor-certified gases, it would be wise to deal with vendors of known reliability until EPA's traceability program is completed and operational. For those sources wishing to provide their own gas analysis, less expensive gases may suffice.

Calibration gases must be rechecked every 6 months. But unless gases are bought in quantity, a typical cylinder of calibration gas will be used up in less than 6 months, so that the recheck requirements may be unnecessary.

As a general rule, it is not effective to mix several pollutants into one calibration gas. This procedure is usually more costly, makes analysis more difficult, and adds to the uncertainty of the usable lifetime of the mixture. The source should be advised to use individual calibration gases

Performance Specification 2 specifies the calibration gas requirements for various pollutants. Ambient air may be used to calibrate oxygen monitors.

In situ monitors, including opacity monitors, do not have a common external source of zero or calibration concentrations. Zero and calibration functions are usually built into these monitors by the manufacturers. Most vendors supply some type of calibration cell or filter which will produce defined upscale reading for checking calibration. The zero check is generally an artificial one, since a true zero reading can only be obtained when the source is inoperative.

5. Access to Expert Advice

No matter how proficient the source's personnel may become in operating and maintaining their equipment, there will come a day when a malfunction has them stumped and outside help will be needed to solve the problem. In most cases, the source will go to the original vendor for assistance, but the source of help is unimportant as long as the system is back online in a reasonable time. What the observer should ask is whether or not the source has specific guidelines and procedures to follow if a serious malfunction occurs. Do the maintenance people know how and from whom to get help? Have they set up the necessary contract/purchasing agreements so they can get help quickly?

6. Followup to Maintenance Problems

In any complex industrial facility, equipment failures and maintenance are an expected cost of doing business. The prudent plant engineer maintains records on the maintenance requirements of each machine. One file is a short-term reminder to check with his technicians about the cause of the last breakdown and the repairs required to fix it. When examining causes, the engineer should ask whether the failure is a random failure, one caused by some controllable stress, or one due to a design or installation problem. For example, an infrared light source should have a life of about 5000 hours under normal conditions. At a 10-percent higher line voltage, the life may by 50 percent shorter. Keeping accurate records of the maintenance performed throughout the plant will make it possible to identify these kinds of problems.

7. Periodic Review and Resolution of Problem Areas

Periodic review of maintenance problems is also very important. Records for a year or more should be examined to pinpoint trouble spots. For example, if a part that should last for a year or two is replaced twice within a year, it may well be because of misapplication or faulty installation rather than a defective part. Problems of misapplication generally call for solution by an engineer, as opposed to the maintenance technician or his foreman. These problems may be solved by use of different components or procedures, or may require major capital equipment changes.

D. OPERATION CHECKS OF THE MONITORING SYSTEM

According to regulation requirements, the source operator must perform zero and calibration checks on the monitoring system at least once each 24-hour period. If the unit is beyond the required 2 percent tolerance -- uncorrected by data adjustment -- the operator must adjust the unit until it is within the limits and note this in his log. If he cannot make the adjustment, the normal course of action is to call the maintenance man. This decision is relatively easy -- the system is either working or not working.

However, there are a number of malfunctions, both large and small, that may not be detected by the zero and calibration procedure. These malfunctions will either invalidate the data or cause the equipment performance to degrade rapidly leading to complete failure. For example, a leak in a sample extraction line which, because of a large stack filter pressure drop, pulls in outside air and dilutes the sample, may give a low reading that invalidates the data. If an oxygen or CO_2 monitor uses the same sample line, this leak may be indicated by very high or low O_2 to CO_2 readings. A simple $30 pressure-vacuum gage on the sample line will also detect this problem.

An example of a malfunction that may degrade the performance of the monitoring system is the failure of a window purge air blower on an opacity or in situ gas monitor. The failure of the blowers, the clogging of a filter, or a hose kink that cuts down the purge airflow will allow the particulate or, possibly, condensible gases in the stack to deposit on the optical windows and cut down the light transmission. In an opacity monitor, this may show up as an increasing baseline emission value or as an inability to provide sufficient zero adjustment. In a gas monitor, the dirty window may attenuate the reference and sample light beams badly enough to interrupt the signal that the detector and electronics needs to operate correctly. In this case, the unit will become very sluggish and may not respond to source changes.

A unit that is out of zero or calibration gas or whose internal calibration and zero check cells and filters are inoperative will, of course, fail to zero or calibrate correctly.

Many of these functions and malfunctions can be readily observed by the addition of some simple pressure switches or gages. A $30 differential pressure gage across a fitting or a filter can indicate the presence of flow in a blower line. A low-pressure drop may signal a broken filter or a very low flow; a high-pressure drop may mean a clogged filter. Similarly, a pressure gage on a sample line can show whether a pump is operating correctly or incorrectly, whether or not valves are correctly positioned, or whether or not adequate flow of sample, zero, or calibration gas is being maintained.

It is not necessary that these gages be completely accurate, since, in most cases, only the fact of an abnormal reading is important, not its magnitude. If a sample line should be at 4 psig and shows 1 or 7 psig or even a vacuum, then something abnormal has occurred and should be investigated.

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16. ABSTRACT

Manual 4 - Source Operating and Maintenance Procedures for Continuous Monitoring Systems - is one of a series of four manuals that comprise the "Resource Manual for Implementing the NSPS Continuous Monitoring Regulations." The other manuals are:

Manual 1 - Source Selection and Location of Continuous Monitoring Systems

Manual 2 - Preliminary Activities for Continuous Monitoring System Certification Installation, Notification and Performance Evaluations)

Manual 3 - Procedures for Agency Evaluation of Continuous Monitor Data and Excess Emission Reports

Manual 4 provides information on good maintenance and operation practices for continuous monitoring systems. Purpose of the manual is to familiarize agency personnel with maintenance requirements of the NSPS regulations, with the key components of a sound maintenance program and with the required and otherwise helpful operational checks.

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