United States General Accounting Office

GAO

Report to Congressional Requesters

November 1989

AIR POLLUTION

National Air Monitoring Network Is Inadequate

GAO/RCED-90-15

GAO **United States**
General Accounting Office
Washington, D.C. 20548

Resources, Community, and
Economic Development Division

B-220184

November 2, 1989

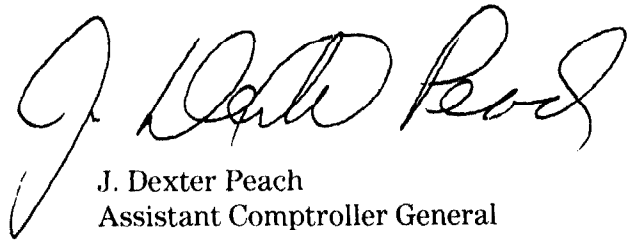
The Honorable Mike Synar
Chairman, Subcommittee on Environment,
Energy, and Natural Resources
Committee on Government Operations
House of Representatives

The Honorable John D. Dingell
Chairman, Subcommittee on
Oversight and Investigations
Committee on Energy and Commerce
House of Representatives

This report responds to your request that we review Environmental Protection Agency (EPA) efforts to collect and report complete, accurate, and reliable air monitoring data. The report discusses EPA's progress in establishing a national monitoring network, the condition of monitoring equipment, and the effectiveness of EPA quality assurance measures.

As agreed, unless you publicly release its contents earlier, we will make no further distribution of this report until 30 days from the date of this letter. At that time, we will send copies to the Administrator of EPA, Members of Congress, and other interested parties. We will make copies available to others upon request. If you have any questions about the report, please call Richard L. Hembra, Director, Environmental Protection Issues, at (202) 275-6111. Other major contributors are listed in appendix I.

Sincerely yours,



J. Dexter Peach
Assistant Comptroller General

Executive Summary

Purpose

The Environmental Protection Agency (EPA) reports that over 100 million people live in areas where air pollution exceeds one or more of the six national air quality standards. EPA's report is primarily based on the results of a nationwide network of air monitors that measure compliance with the standards.

Concerned about the nation's air quality and the need for complete, accurate, and representative air monitoring data, two House Subcommittees asked GAO to address two issues: (1) Are required air monitoring networks complete and are older monitors being identified and replaced? (2) How effective are EPA quality control measures in ensuring that national, state, and local air monitoring networks produce reliable data?

Background

In response to the Clean Air Act Amendments of 1977, EPA established and oversees the operation of a nationwide air monitoring network consisting of approximately 4,700 monitors. Among other things, these monitors are used to determine compliance with EPA's national air quality standards. Approximately 1,200 of the monitors are designated as National Air Monitoring Stations (NAMS) and are used to identify air quality trends in major metropolitan areas. EPA tries to ensure that these monitors are located in areas of greatest pollution concentrations and highest population exposure. The remaining monitors are located in areas that EPA and state officials determine necessary to adequately measure pollution levels.

Air monitors detect and record levels of six widespread pollutants: carbon monoxide lead, nitrogen dioxide, particulate matter, ozone, and sulfur dioxide. Monitoring information is stored in EPA's Aerometric Information Retrieval System. Readings that exceed established national air quality standards may prompt EPA to initiate ways to reduce pollution levels, such as instituting inspection and maintenance programs and restricting construction of new pollution sources.

Results in Brief

Although EPA regulations required EPA to have a national air monitoring network in place no later than July 1982, the network is still incomplete. According to EPA, insufficient funds at the federal, state, and local levels has been a major factor precluding the network from being completed. Because the population determines the required number of monitors, additional monitors are expected to be required after the 1990 census. Additionally, many monitors are old and need replacing. EPA estimates that 20 percent of the monitors need replacing immediately and about

50 percent will need replacing within 5 years. Additional funds are needed to complete the monitoring network and will continue to be needed to purchase additional monitors and replace aging equipment. While EPA and most states have had difficulties in funding the purchase of needed monitors, alternative funding sources, such as permit fees, are available and are being used by some state and local agencies.

EPA quality control measures, such as bi-annual reviews of state and local monitoring programs, have not met their objective of assuring that national, state, and local air monitoring networks provide accurate and reliable data. In some cases quality controls do not meet EPA criteria for frequency or thoroughness. For example, EPA regions are not reviewing some state monitoring programs every 2 years as required, and site visits by EPA have not always identified improperly sited monitors. Further, EPA's testing of the accuracy of state and local air monitors is questionable since the agencies are allowed to select specific monitors to be tested.

Principal Findings

Need for Additional Monitors

While some progress has been made in establishing a national air monitoring network, the results have not met either congressional requirements or EPA expectations. According to EPA, two main factors have contributed to the absence of further progress: (1) EPA officials' uncertainty about requiring state and local agencies to expand their networks and (2) insufficient funds at the federal, state, and local levels. A 1982 EPA analysis showed that 154 monitors were needed to complete the national monitoring network based on the 1980 census. A subsequent 1986 EPA analysis showed that number had been reduced to 61. However, our analysis of the networks for EPA Regions IV and IX in 1988 showed that 42 monitors were needed to complete the networks in these two regions. Further, population changes expected in the 1990 census are sure to require additional monitors.

About half of the equipment used in the nation's air monitoring networks has passed or is approaching the end of its useful life and needs replacing now or within a few years. While EPA estimates the useful life of most air monitors to be about 7 years, 68 percent of the monitors in 17 agencies GAO visited were 7 or more years old. Some EPA regions have worked with state and local agencies to identify equipment needs. However, EPA does not have an overall plan to identify and meet equipment

needs. Instead, EPA relies on state and local agencies to identify their needs, but most agencies GAO visited did not have a well-defined strategy for identifying and obtaining monitoring equipment.

Many state and local agencies need additional funds to complete their air monitoring networks and replace aging equipment. A March 1988 survey done for EPA estimated the costs of replacing aging state and local air monitors and support equipment at $7.1 million. Some states have implemented alternative programs to help fund their air monitoring efforts. For example, Florida adds 50 cents to its annual automobile license fee and designates it for state and local air monitoring programs, and some California agencies raise significant portions of their budgets through fees collected from construction and operating permits purchased by major industrial polluters.

Although authorized by the Clean Air Act, many states do not collect permit fees from major pollution sources or do not collect sufficient amounts to cover permitting costs. Some state and local officials believe that collecting permit fees would be a disincentive to attracting and retaining industry.

Quality Control Measures

Federal regulations require that EPA establish quality control measures to ensure the accuracy and reliability of monitoring data. While bi-annual reviews and annual accuracy tests have provided useful information, they have not met their full potential for ensuring that state and local agencies provide quality monitoring data. For example, EPA's bi-annual reviews of state and local monitoring programs have been inconsistent and in some cases incomplete. Because of limited resources, one EPA region had not reviewed a state or local program in 3 years, while another region reviewed local programs only once in 8 years. Further, site inspections performed during the bi-annual reviews have been ineffective in identifying improperly sited and operated monitors. Site inspections have not always identified monitors that do not meet EPA security and climate control requirements. For example, one monitor was operating in a textile factory where the temperature exceeded EPA allowances.

EPA's annual testing of the accuracy of air monitors may be biased because agencies select which monitors are to be tested rather than EPA independently making the selections. Further, state and local agencies are inconsistent in their use of the results of precision and accuracy

checks of air monitoring equipment. For example, some agencies invalidate monitoring data that is outside of EPA prescribed precision and accuracy ranges while other agencies consider the data to be valid and report it to EPA.

Recommendations

GAO makes a number of recommendations to the EPA Administrator to improve EPA's air monitoring program. Among these, GAO recommends that EPA develop a national strategy for completing the national monitoring network and replacing older monitors. As part of its strategy, EPA should work with state and local agencies to identify opportunities through existing Clean Air Act authorization or alternative sources to generate additional funds to purchase needed monitors. Specific attention should be given to either reducing the minimum population requirements for NAMS monitors or establishing criteria requiring monitors in cities with populations too small to require NAMS monitors but which are experiencing, or have the potential for, significant pollution problems. GAO also recommends that EPA perform its quality control measures as frequently and comprehensively as required by established guidelines and clarify the guidance for state and local quality control measures to ensure that the results are used properly to validate air monitoring data.

Agency Comments

GAO discussed its findings with EPA officials and their comments are included where appropriate. However, at the request of the House Committees, GAO did not obtain written comments on this report.

Contents

Abbreviations

AIRS	Aerometric Information Retrieval System
AREAL	Atmospheric Research Exposure and Assessment Laboratory
CAIR	Corrective Action Initiation Request
CARB	California Air Resources Board
CFR	Code of Federal Regulations
EPA	Environmental Protection Agency
GAO	General Accounting Office
NAAQS	National Ambient Air Quality Standards
NAAS	National Air Audit System
NADB	National Air Data Branch
NAMS	National Air Monitoring Stations
NPAP	National Performance Audit Program
OAQPS	Office of Air Quality Planning and Standards
OIG	Office of Inspector General
PARS	Precision and Accuracy Reporting System
SLAMS	State and Local Air Monitoring Stations
STAPPA/ ALAPCO	State and Territorial Air Pollution Program Administrators/ Association of Local Air Pollution Control Officials

Introduction

The question of "How clean is our air?" flows from growing concerns over the health and environmental effects of air pollution and the influence of air pollution on global climate changes. Health problems brought on or aggravated by air pollution range from eye, nose, and throat irritation to bronchitis, emphysema, and other serious lung diseases. Environmental problems associated with air pollution range from impaired visibility in national parks to crop and forest damage to increased acidity of lakes and the accompanying destruction of fish and other aquatic life. In addition, certain types of air pollutants may be producing long-term and perhaps irreversible changes to the climate.

The Environmental Protection Agency (EPA) reports that since 1978, federal, state, and local air quality programs have reduced the pollution levels of all six of the most common and widespread air pollutants, commonly referred to as "criteria pollutants." Specifically, EPA cites that the levels of lead in the air we breathe have declined by 88 percent, sulfur dioxide by 35 percent, particulate matter by 21 percent, and nitrogen dioxide by 12 percent. EPA reports that even though carbon monoxide and ozone levels have been reduced by 32 percent and 9 percent, respectively, these two pollutants remain the most pervasive and intractable air pollution problems facing the nation. After reviewing ozone monitoring results for 1986 through 1988, EPA added another 37 urban areas to the existing 64 areas exceeding the national ozone standard. Over 100 million people now live in areas where pollution levels exceed at least one of the six national air quality standards.

The basis for the improvements reported by EPA is a nationwide network of approximately 4,700 air monitors, primarily operated by state and local air monitoring agencies, that measure levels of six criteria pollutants: ozone, sulfur dioxide, particulate matter, nitrogen dioxide, lead, and carbon monoxide. For the network to be effective, the required number of monitors must be properly sited, in good working order, and producing accurate data. The question addressed in this report is how much reliability should be placed on air quality information generated by this network. Chapter 2 addresses the slow progress in establishing a national monitoring network. Chapter 3 discusses the fact that much of the air monitoring network is aging and in need of replacement. Chapter 4 raises questions about whether EPA's quality control measures provide assurance that accurate and reliable monitoring data are being collected and used for regulatory and policy decisions. Chapter 5 contains our conclusions and recommendations for improving EPA's air monitoring program.

Establishment of the Nation's Air Monitoring Program

The need for a reliable national air monitoring network has been recognized since the 1970s. In October 1975, an EPA task force was established to examine the nation's air monitoring activities. Among other things, the task force expressed concern that (1) many monitors were not properly sited, (2) quality assurance programs were not fully implemented, and (3) much air quality trend data were of unknown quality. In its 1977 report entitled Air Monitoring Strategy for State Implementation Plans, the task force emphasized the importance of complete, precise, accurate, comparable, and timely monitoring data and made several recommendations for improving the existing monitoring network.

After several hearings on the adequacy of air quality monitoring data, the Congress enacted the Clean Air Act Amendments of 1977 to establish, among other things, a standardized national air monitoring program. The amendments required that by August 1978, the EPA Administrator would promulgate regulations establishing a nationwide air quality monitoring system that

- uses uniform air quality monitoring criteria and methods,
- provides for air quality monitoring stations in major urban areas and other appropriate areas to supplement air quality monitoring carried out by state agencies, and
- provides for EPA to keep records of collected monitoring data on the nation's air quality, to periodically analyze the data, and to report them to the public.

In May 1979, the EPA Administrator promulgated regulations specifying the criteria to be followed by state and local monitoring agencies in establishing air monitoring networks. The regulations were intended to ensure that air monitoring data are reliable, that comparable data are collected, and that timely data are obtained for national assessment purposes.

The regulations provided for two monitoring networks. The first network, designated as State and Local Air Monitoring Stations (SLAMS), was designed so that monitors would be located in all areas where state and EPA officials decided monitoring is needed. Because EPA's criteria for SLAMS do not require specific numbers of monitors, the approximately 3,500 monitors in the SLAMS network have been determined by EPA regional offices and state and local agencies deciding jointly how many monitors are needed for each agency. SLAMS data are used, among other things, to determine if areas are in compliance with prescribed National Ambient Air Quality Standards (NAAQS).

A smaller group of monitors designated as National Air Monitoring Stations (NAMS) were to be selected from the SLAMS network to comply with the Clean Air Act's requirement for establishing a national network. While EPA criteria for NAMS monitors require that they be located in areas of greatest pollution concentrations and highest population exposure, they do not specify the specific number of monitors. Based on these citing criteria, about 1,200 monitors—27 percent of the SLAMS network—were chosen as NAMS monitors.

NAMS data are used in preparing national air quality trends analysis in the country's major metropolitan areas. However, EPA's 1979 regulations stated that air monitoring data would not be limited solely to those obtained from NAMS monitors but rather from all available data. The regulations required that NAMS and SLAMS monitors be properly sited and operational by January 1, 1981, and January 1, 1983, respectively.

Importance of Air Monitoring Data

EPA needs sound air monitoring data to determine where pollution problems are so that it can focus its efforts and determine the effect of its cleanup and control programs. Accurate air monitoring is essential to EPA in determining whether current regulations are achieving their intended objectives and in determining the viability of the states' control strategies. Without accurate, timely, comparable, and reliable data, EPA cannot effectively determine the level of pollutants in the air, assess whether its past policies have been effective, and provide sufficient scientific data for use in future policy decisions.

EPA uses air monitoring data to determine whether states and localities meet the prescribed National Ambient Air Quality Standards established under the Clean Air Act. Specific uses of air monitoring data include (1) determining state compliance with ambient air quality standards, (2) developing state implementation plans for achieving and maintaining air quality levels that meet EPA standards, (3) re-evaluating the national air quality standards, and (4) developing trends in air quality. States and localities not meeting these standards are required to develop control measures, such as instituting automobile inspection and maintenance programs and restricting the construction of new sources of pollution.

The Clean Air Act requires EPA to review the National Ambient Air Quality Standards every 5 years. Before EPA issues a revised standard, it considers various alternative standards. Each alternative may require the states to implement a different air pollution control strategy, and could

impose a different cost level on the states and the general public. EPA needs accurate air monitoring data to determine which alternative standard should be selected and how to revise the standard to obtain the greatest improvement in air quality.

Responsibility for Monitoring the Nation's Air Quality

Overall responsibility for EPA's national air monitoring program rests with EPA'S Office of Air Quality Planning and Standards (OAQPS), located in Durham, North Carolina. Among other things, OAQPS is tasked with (1) developing and distributing guidelines on air quality monitoring, (2) developing and evaluating alternative monitoring strategies, and (3) reviewing, validating, and reporting data.

While OAQPS has overall responsibility for managing EPA's national air monitoring program, many of the key decisions regarding the national and state and local networks are made by officials at EPA's regional offices. For example, decisions on establishing and/or relocating NAMS monitors are, in a practical sense, made by the regional offices since they are generally more knowledgeable about the NAMS network in terms of location, operation, movement of monitors, and any changes needed in the network. The regions have an important role in administering quality assurance programs and serve as a vital link in monitoring data transmissions between the state and local air monitoring pollution control agencies that generate the data and EPA's Aerometric Information Retrieval System (AIRS) in Durham, North Carolina, where the data are stored. Regions are also responsible for inspecting monitoring sites to ensure that monitors are sited correctly and being operated properly.

The Clean Air Act assigns primary responsibility for identifying and controlling air pollution to state and local agencies. EPA is to assist the agencies by providing technical guidance and partial funding of state and local air programs. While EPA regional offices and state and local agencies jointly decide on the number and location of monitors in the networks, the state and local agencies are responsible for operating and maintaining the monitors. State and local agencies are also required to have quality assurance programs to ensure the quality of the air monitoring data.

The Clean Air Act allows EPA to fund up to 75 percent of state and local agencies' costs to operate air pollution control programs, including monitoring programs. While the amount of federal funds is negotiated between EPA regional offices and the respective state and local agencies, the amount varies significantly, depending on state and local funding

initiatives. For example, federal funding for two local California agencies was about 5 percent in fiscal years 1987 and 1988, while the Kansas state agency received 73 percent of its funds from EPA in fiscal year 1988. Federal funds under Section 105 of the Clean Air Act have averaged around $95 million annually since fiscal 1985. Approximately $27 million a year, or 28 percent of the total, has been allocated to the operation and maintenance of air monitoring networks.

Objective, Scope, and Methodology

Because of concern over the nation's air quality and EPA's air monitoring efforts the Chairman, Subcommittee on Environment, Energy, and Natural Resources, House Committee on Government Operations, and the Chairman, Subcommittee on Oversight and Investigations, House Committee on Energy and Commerce, requested us to review EPA's air monitoring program. Our overall objective was to determine how EPA assures itself that its air monitoring program produces accurate and reliable information suitable for decision-making purposes. Specifically, we addressed the following three questions:

- Are the required air monitoring networks complete and are the monitors in the right locations to adequately depict the quality of the nation's air?
- How effective has EPA been in identifying and resolving state and local equipment needs, especially equipment needed to replace the aging air monitoring networks?
- How effective are EPA quality control measures in assuring that national and state/local air monitoring networks produce quality data?

We performed our work between February 1988 and March 1989 at the Office of Air Quality Planning and Standards in Durham; EPA regional offices in Philadelphia (Region III), Atlanta (Region IV), Dallas (Region VI), Kansas City (Region VII), San Francisco (Region IX), and Seattle (Region X); state monitoring offices in North Carolina, Tennessee, Maryland, Florida, Georgia, Louisiana, California, Arizona, and Washington; local monitoring offices in Philadelphia and Pittsburgh, Pennsylvania; Baltimore County, Maryland; Winston-Salem, North Carolina; Knoxville and Nashville, Tennessee; St. Louis and St. Louis County, Missouri; San Francisco and Fresno, California; Phoenix, Arizona; and Seattle, Washington. We selected the EPA regional offices to ensure maximum geographical coverage and to include a significant portion of the monitors in the networks. Further, we selected state and local agencies to ensure a mix of areas with large populations as well as smaller populations and large and small monitoring networks. Our selection also included state

and local agencies that EPA regional officials identified as being effective and ineffective in operating their monitoring programs.

To determine if the air monitoring networks are complete and properly distributed to adequately depict the quality of the nation's air, we obtained and analyzed EPA management information reports on the number, type, and location of monitors and discussed the completeness of the networks with officials from OAQPS, EPA regional offices, and selected state and local air monitoring agencies. We also visited air monitoring sites to verify information obtained from these sources. Further, we examined EPA criteria for NAMS and SLAMS monitoring networks and met with officials from two EPA task forces to assess whether current monitoring efforts provide accurate and reliable data.

In examining EPA efforts to identify and replace aging air monitoring equipment, we interviewed managers from OAQPS, the Atmospheric Research and Exposure Assessment Laboratory (AREAL), EPA regional offices, and state and local air monitoring programs. We analyzed reports and studies obtained from EPA and state and local agencies concerning the condition of air monitoring equipment. While making these analyses, we looked for examples of monitors in poor condition affecting the quality of air monitoring data, and opportunities for generating alternative revenues to supplement traditional federal and state funding of air programs. We discussed with the Executive Director of the State and Territorial Air Pollution Program Administrators/Association of Local Air Pollution Control Officials (STAPPA/ALAPCO) the results of two surveys concerning the condition of air monitoring equipment and the collection of permit fees by state and local agencies.

In assessing EPA's internal controls, we examined the effectiveness of EPA quality control measures and assessed the reliability of EPA's Automated Information Retrieval System (AIRS) for handling air monitoring data. Specifically, we (1) obtained and analyzed the results of selected National Air Audit System (NAAS) audits for fiscal years 1985-88 and discussed identified deficiencies and recommended actions with EPA and state air monitoring officials, (2) obtained copies of the National Performance Audit Program (NPAP) annual reports for fiscal years 1985-87 to determine the results of the audits and whether all state and local agencies participated as required by EPA, and (3) examined selected copies of Precision Accuracy Reporting System (PARS) reports to determined whether state and local agencies are performing audits in accordance with EPA requirements. In assessing the reliability of AIRS, we reviewed

EPA internal controls for the system and found that they provide reasonable assurance that data in the AIRS database are processed accurately and completely. However, we made no assessment of the validity or completeness of the data itself.

We met with officials from EPA's Office of Inspector General (OIG) to coordinate our review with two simultaneous OIG reviews of EPA's air monitoring program. We obtained copies of two OIG reports and evaluated their findings and their potential implications for our work.

We discussed the national air monitoring program with EPA officials and have incorporated their comments where appropriate. However, as requested, we did not obtain official EPA comments on a draft of the report. Our work was conducted in accordance with generally accepted government auditing standards.

National Monitoring Network Is Incomplete

While EPA has established a national air monitoring network, shortages of monitors continue to exist approximately 7 years after the network was to be complete. Further, these shortages are based on 1980 population statistics and are expected to increase for some areas when the 1990 population statistics become available. Reasons cited by EPA for the national network not being complete include uncertainty about EPA's authority to require state and local agencies to expand their networks and insufficient funds to purchase needed monitoring equipment.

Additionally, questions exist about whether state and local monitoring networks provide adequate coverage of smaller cities. EPA's practice of relying on negotiations between EPA regional offices and state and local agencies to determine the number and location of monitors has resulted in monitors not being in areas of highest pollution concentrations and/or in less populated areas experiencing pollution problems.

All Necessary Monitors Not in Place

EPA regulations, 40 CFR Part 58, required a network of National Air Monitoring Stations for carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), sulfur dioxide (SO_2), and total suspended particulates (TSP)[1] to be in place by January 1, 1981. A lead (Pb) monitoring network was required to be completed by July 1, 1982.

The number of monitors required for each pollutant depends on urban population statistics and, for some pollutants, on projected pollution concentrations. For example, urban areas with populations of more than 1 million are required to have two nitrogen dioxide monitors, while areas with populations greater than one million combined with specified concentrations of sulfur dioxide have the flexibility of having up to 10 sulfur dioxide monitors. EPA regulations specify the minimum number of monitors required and that the actual number and locations of monitors are to be determined jointly by EPA and state and local monitoring agencies. Generally, monitors are to be located where pollution levels are the highest without being unduly influenced by a single source and where high population densities are present.

While progress has been made in completing the national monitoring network, it had not been completed as late as January 1989. EPA acknowledges that the networks are incomplete and have been for a number of years. A 1982 EPA analysis showed that an additional 154

[1]The standard for TSP was subsequently changed and monitors for the revised particulate matter network were required to be in place by August 1988.

NAMS monitors were needed. This figure was based on the 1980 census and 1979-81 pollution concentrations. A 1986 EPA analysis indicated that some progress had been made—the number of needed NAMS monitors had been reduced to 61.

We examined EPA's 1986 analysis and found it may have underestimated the number of NAMS monitors needed. For example, by comparing population statistics with EPA criteria for NAMS monitors, we determined that a sulfur dioxide monitor in Memphis, Tennessee, was missing from the network but had not been identified. After confirming this and other discrepancies with EPA Region IV officials, we used data compiled from a combination of EPA regional, state, and local information systems to conduct our own analysis of the NAMS networks in two EPA regions. We analyzed the NAMS networks in regions IV and IX to determine their degree of completeness in 1988. At the time of our analysis, 42 monitors were needed in these two regions (see table 2.1).

Table 2.1: Number and Type of NAMS Monitors Needed in Regions IV and IX

	Monitor type					
EPA region	**O3**	**Pb**	**SO2**	**NO2**	**CO**	**Total**
IV	14	9	4	2	1	**30**
IX	0	2	8	1	1	**12**
Total	**14**	**11**	**12**	**3**	**2**	**42**

EPA officials acknowledged that these shortages existed as late as January 1989, but told us that additional monitors had been purchased. In August 1989, EPA compiled information which showed that the number of additional monitors needed had been reduced from 42 to 16 for these two regions.

Factors Slowing NAMS Network Completion

Two factors have contributed to delays in getting the required NAMS monitors in place: (1) EPA officials believed that agency regulations were insufficient to require an expanded network because it specified a network based on the 1970 census rather than the most current census and (2) insufficient funds to acquire needed monitoring equipment.

First, EPA officials decided that initial regulations contained in the CFR were not specific enough to require an expanded NAMS network. The initial regulations required NAMS monitors based on populations from the 1970 census. However, approximately 4 years after identifying the need

for additional monitors, EPA amended the CFR to require monitors based on population figures from the most recent decennial census (1980).

Approximately 162 state and local air quality offices rely, to varying extents, on federal funds to purchase needed monitoring equipment and to administer the program. While existing criteria allow federal funds to pay for up to 75 percent of state and local air monitoring programs, the exact amount is negotiated between EPA and the agencies, and some agencies receive as little as 4 percent of their budgets from federal sources. According to federal, state, and local officials, federal funds are limited and have not significantly increased over the past few years; therefore, it is up to the states and local areas to finance the majority of air monitoring programs. For example, about 43 percent of Tennessee's air monitoring budget comes from federal funds.

Many agencies have been unable to obtain the necessary funding to complement federal funds through the conventional legislative appropriation process. For example, at the time of our review North Carolina did not have all the NAMS monitors required by EPA criteria. A state air monitoring official told us the state's current budget does not allow for purchasing needed monitors. Furthermore, they do not expect funds to be available within the next 2 years. According to Department of Health and Environment officials, Tennessee is required to justify monitoring equipment purchases already approved by EPA for the state. Tennessee air monitoring officials said that because of competing demands, they are having trouble getting the state to buy monitoring equipment with funds granted under Section 105 of the Clean Air Act. Such constraints make it difficult for the state and local agencies to complete and operate their air monitoring networks. While we recognize that funding is a serious problem, state and local agencies may be able to obtain additional funds through some or all of the alternative sources discussed in chapter 3.

Additional Monitors Required to Meet Expected Population Increases

While monitoring equipment is still needed in 1989 to meet NAMS requirements based on the 1980 census, some state and local agencies will need additional monitors as a result of population increases during the 10 years between the 1980 and 1990 censuses. For example, Florida air monitoring officials estimate that the state's air monitoring network will need to be increased by 20 percent based on 1990 census projections.

EPA officials told us that there are no formal plans for obtaining monitors currently needed to complete the national network or for obtaining

additional monitors that may be required by the 1990 census. Rather, EPA's strategy is to rely on state and local agencies to develop individual plans after the new census is published. Considering the fact that the NAMS network is not yet complete, it may be years after the census is complete before needed monitors are installed.

Inaccuracies in Site Information Hamper Planning

Inaccurate site information in EPA's management information system hamper planning for future monitoring needs because managers may not have an accurate picture of the number and location of monitors in their existing networks. The Aerometric Information Retrieval System (AIRS) is the current national database management system for ambient air quality. One of AIRS' functions is to provide information on the locations of monitors in the network. Although operational since July 1987, information in AIRS is still not complete. Basic, but essential, information, such as the quantity of monitors, type of monitors, and where they are actually located, is not always accurate and available for use by EPA managers, according to EPA officials.

One reason EPA officials gave for inaccuracies in the AIRS database is that monitor site information is not being updated in a timely manner. For example, in California, a NAMS monitor was shut down in 1982 but was still classified as a working monitor in the AIRS database as late as July 1988. Nine other NAMS sites were also identified as being misclassified in region IX. Additionally, two SLAMS monitors in Georgia were moved and converted to NAMS in 1985, according to Georgia air monitoring officials. However, 3 years later the AIRS system continues to classify these monitors as SLAMS. There are also cases of NAMS monitors being converted to SLAMS, but not showing up on the AIRS data base as SLAMS 3 years later. In all of these cases, EPA and state and local agency officials cited as the cause of this problem communication breakdowns between OAQPS and field staff over who was responsible for initiating changes in the AIRS database.

EPA managers recognize their responsibility for approving monitor classification changes, but told us that changes are sometimes made by state and local agencies without their knowledge. Several NAMS coordinators at OAQPS told us that because of limited resources and other work priorities they are unable to identify all monitor changes made, approve those changes, and incorporate them in the AIRS database. The coordinators recognize that AIRS is not as accurate as it should be and are currently attempting to update and correct information in the database.

Uncertainties About Current Monitoring Efforts

Questions have been raised by both EPA and state and local air monitoring officials about the ability of the current air monitoring networks to provide an accurate picture of the nation's air quality. They question whether the current network designs accurately measure pollution levels. Specific questions include whether some monitors are sited in areas of highest pollution concentrations and whether smaller cities are adequately monitored.

Concern over the adequacy of the monitoring networks prompted EPA to establish task forces in 1988 to examine the adequacy of two of the criteria pollutants—carbon monoxide and particulate matter. The carbon monoxide task force was assembled because of the disparities arising from monitoring data obtained from the nation's carbon monoxide monitoring network. Questions involve the ability of the current carbon monoxide network to adequately characterize the carbon monoxide problems in U.S. cities. Among other things, EPA officials want to know how well the current carbon monoxide monitors follow EPA's siting criteria, and what tools or approaches are being used to determine where monitors should be placed. Specifically, they want to know if carbon monoxide exceedances in cities are a result of monitors placed in hot spots (areas of unusually high readings), or if there are more widespread problems.

Task Force and Others Question Siting Criteria

Like other NAMS monitors, carbon monoxide monitors are required to be located in areas of maximum pollution concentrations and high population density. Maximum concentrations of carbon monoxide are usually found near heavily traveled streets (street canyons) and intersections with high traffic density and poor air ventilation. Monitoring results from these sites should be representative of high concentrations occurring at similar locations within the same urban area. Monitors should not be located near atypical areas such as toll gates on turnpikes or metered freeway ramps. Questions have been raised about whether EPA's requirement for placing monitors in high concentrations (hot spots) results in cities reporting a worse picture of carbon monoxide levels than is actually the case.

The EPA task force has raised questions about the existing carbon monoxide monitoring network not being adequate to fully depict the nation's carbon monoxide situation. However, task force members caution that to require additional monitors without additional funding would not be helpful. Therefore, some task force members believe it is doubtful that

their work will recommend any major changes to the carbon monoxide network.

Additional questions have been raised about EPA's criteria for determining the required number of NAMS monitors. Some EPA and state and local officials believe the criteria for carbon monoxide, ozone, nitrogen dioxide, and lead should be re-evaluated. They believe the criteria for these four pollutants should be based on anticipated pollution levels in addition to the population statistics currently used. The revised criteria would be similar to EPA's current criteria for sulfur dioxide and particulate matter, which allow the flexibility of having between 0 and 10 monitors in urbanized areas based on a combination of anticipated pollution level and population. EPA and state and local officials believe the combined pollution/population approach would allow EPA the flexibility needed to shift some monitors from less polluted areas to problem areas, thereby saving valuable resources.

Questions have also been raised about whether the lack of criteria for the number and locations of SLAMS may be contributing to these monitors not being in areas of highest pollution concentration. During our site visits we noted several instances where SLAMS carbon monoxide monitors did not appear to be in the area of highest pollution concentration. For example, a carbon monoxide monitor in Philadelphia was sited on a street that had been closed for years to all vehicular traffic except buses. A local air monitoring official told us that the site was being considered for closing due to low readings.

On another visit we noted a new carbon monoxide monitor in Knoxville, Tennessee, that did not appear to be in a high traffic area. EPA Region IV officials agreed. After inspecting the site, region IV officials disagreed with Knox County air monitoring officials on their choice of the site. However, without criteria to require that the monitor be located in the area of highest carbon monoxide concentration, region IV officials approved the monitoring site.

The importance of properly siting carbon monoxide monitors is evidenced by an independent study of carbon monoxide levels in Tucson, Arizona. Monitoring data collected from the local monitoring agency's carbon monoxide monitor indicated that the city was in compliance with the federal carbon monoxide standard. However, the local association of governments sponsored a study of carbon monoxide levels at several sites in Tucson that were not being monitored. The study showed carbon monoxide levels in excess of the national air quality standard.

Air Monitors Not Always Located in Smaller Cities

A concern expressed by some state and local air monitoring officials is that monitors are not always located in smaller cities with pollution concentrations that exceed national air quality standards. For example, EPA criteria do not require carbon monoxide monitors in cities of less than 500,000 or ozone monitors in cities of less than 200,000. Of the 52 areas listed in the June 6, 1988, Federal Register as being in nonattainment for carbon monoxide, 13, or 25 percent, are in areas that are below the population threshold at which NAMS carbon monoxide monitors are required. EPA's nonattainment listing also showed that 66 areas failed to meet national ozone standards. At least 10, or 15 percent, of the 66 areas have a population below that required for NAMS ozone monitors.

Factors such as traffic patterns and air stagnation can cause small urban areas to exceed the carbon monoxide standard while larger cities may be in compliance. For example, Raleigh, North Carolina, is in nonattainment for carbon monoxide even though the urban area population is only about 206,000, well below the 500,000 population threshold required for a carbon monoxide monitor. Raleigh's situation is not unique. Other smaller cities have also identified carbon monoxide problems. For example, the state of Washington, in conjunction with EPA, has identified cities with populations as small as 50,000 that are in nonattainment of the carbon monoxide standard.

A similar situation exists for ozone. For example, Winston-Salem, North Carolina, population about 172,000, reported ozone exceedances during the summer of 1988. Asheville, North Carolina, a city of 102,000, periodically exceeded or came close to exceeding the ozone standard until the city's one SLAMS monitor broke in 1987. EPA has been able to identify these exceedances because state or local agencies in consultation with the 10 EPA regions had installed SLAMS monitors or because one-time special studies have been completed. However, without requirements for monitors in cities not meeting NAMS population criteria, EPA has no assurance that other small cities are not experiencing similar pollution problems.

Considering the widespread ozone and carbon monoxide problems in the United States, minimum population requirements of 200,000 and 500,000, respectively, may result in a monitor network that is too limited to accurately depict air pollution problems.

Special Studies Could Identify Monitoring Needs

One method that has been used to determine if monitors are needed in smaller cities is to make special studies of the area's air quality. Because of concerns that some areas experiencing pollution problems may be going undetected, EPA Region X, in conjunction with state and local monitoring agencies, has completed about 55 studies to determine levels of carbon monoxide, sulfur dioxide, lead, and particulate matter in the four states in its region. These studies have identified a number of additional monitoring needs, and similar studies are planned for other pollutants, including ozone.

Region X officials told us that the studies are a relatively inexpensive way of obtaining valuable air monitoring data. For example, a typical study methodology for measuring carbon monoxide levels would be to analyze an area's automobile traffic and topography as a basis for selecting a limited number of locations at which to take air samples over a short time period.

In one such study, air samples were taken at 11 sites over a 19-day period in a small Washington State town that did not have a permanent monitoring site. On the basis of the study, it was concluded that the town had legitimate potential to exceed the carbon monoxide standard. A permanent monitoring site was recommended for the town, and the state subsequently located a monitor there.

Region X officials told us that limited resources have resulted in many monitoring needs identified through these studies being unmet. The regional NAMS coordinator believes the number of particulate matter nonattainment areas might double in region X if the resources were available to establish additional monitoring sites.

In summary, the nation's air monitoring networks are incomplete and questions exist about whether the networks present a realistic picture of air quality. Recommendations for re-evaluating EPA's criteria for the number and location of air monitors and developing a strategy for obtaining additional monitors to complete the networks are discussed in chapter 5.

Aging Air Monitoring Equipment Needs Replacing

In addition to an incomplete national air monitoring network, much of the monitoring equipment being used has passed or is approaching the end of its useful life and needs replacing. Monitors in poor condition affect data quality and failure to replace older monitors will aggravate the situation. EPA is aware that over half of all monitors will need replacing within 3 to 5 years, but it does not have a strategy for meeting state and local equipment needs. Limited resources necessitate that EPA work closely with state and local air monitoring agencies in determining their specific equipment needs and identifying funding alternatives.

Air Monitoring Equipment Used by Many Agencies Is Beyond Its Useful Life

Approximately one-fifth of the continuous monitors used in national air monitoring networks need replacing immediately,[1] according to a survey conducted by the State and Territorial Air Pollution Program Administrators and the Association of Local Air Pollution Control Officials (STAPPA/ALAPCO). Further, EPA and state and local air monitoring officials estimate that about 50 percent of all monitors will need replacing within 3 to 5 years.

According to the March 1988 STAPPA/ALAPCO survey, about 20 percent of the 2,403 monitors included in the survey were classified as being in poor condition.[2] The survey estimated cost to replace these monitors is $4.1 million. Table 3.1 shows the results of the survey.

Table 3.1: Results of STAPPA/ALAPCO Survey

Pollutant	Number of monitors	Condition		
		Good	Fair	Poor
Nitrogen Dioxide	320	109	119	92
Ozone	828	450	293	85
Sulfur Dioxide	687	311	191	185
Carbon Monoxide	568	293	173	102
Total	**2,403**	**1,163**	**776**	**464**
Percent	100.0	48.4	32.3	19.3

[1]Continuous monitors are automated, electronically sensitive pieces of equipment used to measure concentrations of ozone, carbon monoxide, sulfur dioxide, and nitrogen dioxide. The STAPPA/ALAPCO survey included only continuous monitors. Thus, for clarity in this chapter, we refer to continuous monitors as monitors.

[2]The survey guidance allowed state and local agencies considerable flexibility in determining the criteria by which they rated their equipment. The guidance suggested that the state and local agencies consider the age of the equipment, as well as other factors such as maintenance requirements and data recovery in rating the equipment as "good", "fair", or "poor."

Although the survey guidance stated that monitors rated "poor" should be considered for replacement, state and local officials interpreted the survey guidance differently. Thus, the number of monitors that need to be replaced in some agencies is substantially greater than what they rated as "poor." For example, an official of the Environmental Protection Division of the Georgia Department of Natural Resources told us that it needs to replace 68 percent of the state's monitors, but responded to the STAPPA/ALAPCO survey that only 15 percent of its monitors were in poor condition. According to the Georgia official, only monitors that were unusable were rated as poor. Similarly, Arizona rated 5 percent of its monitors in the STAPPA/ALAPCO survey as being in poor condition, but actually needs to replace 26 percent of its monitors. According to the OAQPS NAMS Coordinator who compiled the survey results and the Executive Director of STAPPA/ALAPCO,[3] the survey may understate the real equipment need. They estimate that about half of the equipment rated fair may also need replacing. Thus, the number of monitors that need replacing is about 36 percent instead of the 20 percent indicated in the STAPPA/ALAPCO survey.

EPA and state and local officials estimate the useful life of most air monitors to be 5 to 7 years. According to EPA and state air monitoring officials, most of the monitors rated poor or fair in the STAPPA/ALAPCO survey (52 percent) will reach the end of their useful life and need replacing within 5 years. For 17 of the 21 agencies we visited, 68 percent of the monitors are 7 or more years old. An additional 11 percent are between 5 and 7 years old. Table 3.2 shows a breakdown by age of the 488 monitors used by 17 state and local agencies we visited.

Table 3.2: Age of Monitors Used by 17 Agencies GAO Visited

Years	Number of monitors	Percent
0 to 2.9	59	12.1
3 to 4.9	45	9.2
5 to 6.9	54	11.1
7 +	330	67.6
Total	**488**	**100.0**

Operating older air monitors that are in poor condition presents several problems. First, older monitors tend to break down or lose calibration,[4]

[3]STAPPA/ALAPCO administered the questionnaire to the state and local air monitoring agencies, but OAQPS tabulated and summarized the results.

[4]Air monitors may "drift," or lose calibration, requiring a technician to recalibrate the monitor. EPA considers air monitoring data from monitors that drift excessively to be unreliable and invalid.

resulting in lost or invalid air monitoring data. Additionally, keeping older monitors operational may require technicians to repair and recalibrate the equipment. According to EPA and state air monitoring officials, in some instances it may be cost-effective to purchase new and more reliable equipment. For example, an official of the Maricopa County Department of Health (Phoenix, Arizona) told us that his agency is using carbon monoxide and nitrogen dioxide monitors that require expensive replacement parts. According to the official, it would be cost-effective for the agency to replace the monitors rather than continually purchasing the replacement parts. According to an Oregon official, EPA Region X encourages the state agency to move equipment in poor condition to sites that are less likely to exceed the standard. According to the Executive Director of STAPPA/ALAPCO, the aging monitoring networks may shrink if equipment in poor condition is not replaced soon.

Some state and local air monitoring agencies are able to prolong the useful life of their monitors. For example, California Air Resources Board (CARB) officials told us that they prolong the useful life of their equipment through rigorous testing of new equipment and extensive maintenance. Although over half the equipment currently used by CARB is 10 or more years old, officials estimate that they need to replace less than 20 percent of their equipment.

Support Equipment Is Needed to Improve the Network

The results of the STAPPA/ALAPCO survey also showed that about 14 percent of all support equipment used in air monitoring networks is in poor condition and needs replacing at an estimated cost of $2.97 million. Support equipment includes such items as strip charts, calibration equipment, shelters, air conditioners, and computers.

The Maryland Air Management Administration identified a need to purchase support equipment, including telemetry systems, calibrators, and air conditioners, at an estimated replacement cost of over $76,000. Additionally, according to officials of the Arizona Department of Environmental Quality, the Department loses air monitoring data because air conditioners break down and allow temperatures to exceed recommended operating range for the monitors. The state has indicated a need for several air conditioners, as well as telemetry system equipment. According to EPA and state and local monitoring officials, data produced by monitors that operate in temperatures outside the ranges allowed by EPA is suspect and may not be useful for making decisions.[5]

[5]EPA guidance specifies that the temperature be maintained between 72 and 82 degrees Fahrenheit.

Telemetry systems, unlike strip charts,[6] are computerized data recording instruments that allow state and local agencies to automatically collect air monitoring data from monitors and translate the data. State and local agencies are replacing strip chart equipment with the more technically advanced telemetry system equipment. The systems also allow air monitoring agencies to detect inoperative monitors from a central location and to get them operational quicker than if an operator visits the sites once or twice a week. Additionally, these systems are considered cost- effective because monitoring sites have to be visited less frequently and the air monitoring data do not have to be manually interpreted and transcribed. However, the STAPPA/ALAPCO survey did not include projections for acquiring support equipment such as telemetry systems.

According to the Program Manager, Air Quality Division of the Louisiana Department of Environmental Quality, Louisiana does not have telemetry systems. Therefore, technicians must travel to each NAMS site daily to manually read pollutant concentrations to compute pollution indexes that are reported to the local media. Telemetry systems would allow these readings to be made from a central location and eliminate the need for the daily trips by the technicians. Additionally, the Department employs three full-time scientists to manually transcribe the strip charts to obtain hourly averages. Similarly, an official of the Nashville/Davidson County Metropolitan Health Department (Nashville, Tennessee) said that his monitoring network does not have telemetry systems, thus requiring staff to visit all monitoring sites daily and manually transcribe strip chart data.

Equipment in Poor Condition Can Affect Data Quality

Monitors in poor condition tend to break down or lose calibration, thus lessening the reliability of the data they produce. Data completeness,[7] a critical attribute of quality air monitoring data, can be affected because data are lost when monitors are not working properly or shut down. EPA requires that air monitoring data be 75 percent complete before they can be used to show attainment of the national ambient air quality standards.

[6]Strip charts are graphic representations of the pollutant readings of a monitor. These charts must be manually collected by monitor operators and translated to obtain pollutant concentrations.

[7]Completeness refers to the proportion of valid data collected with respect to the opportunities available. For example, a continuous monitor should collect 75 percent of the possible hourly readings per quarter to attain acceptable completeness.

Some state and local agencies are unable to meet EPA's data completeness goal because of equipment problems. For example, South Carolina's 1987 air monitoring data has generally been less than 75 percent complete. An EPA systems audit found that the state's data recovery at all SLAMS sites had generally been less than the required 75 percent because of aging equipment that was inoperable or producing inaccurate data. The systems audit report recommended that the state replace the old equipment as soon as possible within budgetary constraints. EPA's review of the Tennessee Department of Air Pollution Control's 1988 air quality data disclosed that the agency had several monitors that needed replacing. Because of the equipment's age, break downs have increased, resulting in lost air monitoring data. According to the EPA Region IX NAMS Coordinator, the Maricopa County Bureau of Air Pollution Control (Phoenix, Arizona) reports incomplete data because it has only a few monitors to replace ones that break down.

New Equipment Does Not Work Properly

In replacing aging air monitoring equipment, it is important that state and local agencies purchase equipment that works properly. However, several agencies have complained about new monitoring equipment not working properly.

According to state officials, California rejects 75 percent of all new monitors during its rigorous initial testing program. California's acceptance testing is more rigorous than the requirements set by EPA, but California officials said that the testing ensures that monitors work properly initially and thereby extends the average useful life.

Several state and local agencies have also complained that equipment manufacturers are not responsive to their concerns. We discussed this issue with officials from the Methods Standardization Branch, AREAL, who are responsible for assuring that equipment manufacturers comply with EPA monitor specifications. According to the Branch Chief, AREAL is willing to assist state and local agencies in dealing with manufacturers who are unresponsive to complaints about equipment. He admitted, however, that state and local agency officials may not be aware of AREAL's willingness to assist in this area. In February 1989 AREAL added a statement to its listing of approved monitors apprising state and local agencies of AREAL's willingness to assist them in resolving problems with monitor manufacturers. However, EPA has not published and disseminated a list of monitors with which state and local agencies have had problems because of concern that manufacturers would challenge EPA's basis for such a listing.

EPA Does Not Have a National Strategy and Funding to Replace Aging Monitoring Equipment

While EPA recognizes the need to replace much of the monitoring equipment in the national air monitoring network, it does not have a national strategy for assisting state and local agencies in identifying which equipment needs replacing and obtaining the necessary funds. Generally, OAQPS and the EPA regional offices rely upon state and local air monitoring agencies to identify monitors and support equipment that need replacing. According to Oregon officials, region X has requested state and local agencies to develop schedules for replacing their monitoring equipment. According to regional officials, the schedules are not always followed because funds are not available.

Most state and local agencies that we visited needed monitors and support equipment to replace aging equipment in their monitoring networks, but few had a strategy addressing how they would meet these needs. Generally, monitoring agencies replace monitoring equipment only when resources are appropriated specifically for purchasing equipment. In contrast, the South Coast Air Quality Management District in California has an equipment replacement plan that identifies the equipment the agency needs to replace.

Alternative Funding Sources Are Available to State and Local Air Monitoring Agencies

While most state and local agencies need additional revenue to meet air program responsibilities, including purchasing newer equipment, few agencies have made full use of opportunities for revenue enhancement through programs such as permit fees. The Clean Air Act amendments of 1977 require state and local air monitoring agencies to issue construction and operating permits to industries. The amendments require state and local agencies to collect fees to cover the reasonable costs of issuing permits. This was intended to transfer the cost of permitting to the regulated sources.

Despite the act's requirement that state and local agencies recover the cost of issuing permits, many agencies have no fee program. Further, the fees that are collected vary significantly. According to a memorandum to the Assistant Administrator for Air and Radiation from the Office of Program Management Operations, there are extreme variations in state permit fee programs with some agencies charging fees as low as $25 per permit and others charging thousands of dollars. Furthermore, 19 states have no fee programs, and according to a STAPPA/ALAPCO survey, 22 of the 31 states that do collect permit fees receive less than 10 percent of their air program budgets from such fees. Reasons cited for not collecting permit fees include: (1) revenues would be very small and the agencies would not benefit from such permit fees, (2) issuance of permits is

considered a public service that does not require reimbursement, and (3) disincentive that fees would impose in attracting and retaining industry.

EPA's OAQPS estimates the cost of issuing permits to be between $80 million and $90 million annually. However, state and local agencies that assess permit fees collected only $47 million in 1986. California and its local agencies collected almost $29 million of this amount. While state and local agencies, excluding California, recovered an average of only 20 percent of their permitting costs, California's South Coast Air Quality Management District funded 58 percent of its 1987 budget with permit and emission fees, and the Bay Area Air Quality Management District received 32 percent of its budget from permit fees. EPA estimates that if agencies were to collect permit fees equal to only 25 percent of their budgets, they would generate an additional $30 million annually.

Collecting permit fees as required by the Clean Air Act would transfer the cost of issuing permits to industry and allow agencies to better use their limited resources in meeting program responsibilities such as equipment replacement. EPA recognizes the potential for generating revenues from alternative sources such as permit fees. In 1987 EPA's Office of Air and Radiation established a task force to examine the potential for state and local agencies to expand their revenues from permit fees. While the task force has not completed its study, the proposed revisions to the Clean Air Act include requirements to collect permit fees.

In addition to permit fees, state and local agencies have opportunities to supplement their air monitoring program with revenues from other sources. According to EPA and Florida officials, Florida assesses an additional 50 cents fee for annual automobile license fees. These funds are designated specifically for state and local air programs. In fiscal year 1986 the Hillsborough County agency received $342,000, or 25 percent of its air program budget, from license fees. Similarly, the Palm Beach County agency received $362,000, or 61 percent of its fiscal year 1986 budget, from license fees.

As early as 1970 the Nixon administration proposed a national sulfur tax as a way of reducing sulfur emissions and generating additional revenues. Subsequently, New Mexico and California also considered adopting a tax on sulfur emissions in 1977. In 1987 new interest in pollution taxes emerged in the House and Senate as a way of generating new revenues. Legislation was introduced in the House in May 1987 to tax sulfur

and nitrogen emissions but it did not pass. The staffs of the Joint Committee on Taxation and the House Ways and Means Committee have estimated that a tax of 45 cents per pound on sulfur and nitrogen dioxide emissions would produce annual revenues of $6.3 billion. A Public Policy Study dated December 1988 that was sponsored by Senators Wirth and Heinz also identified various environmental initiatives, such as pollution taxes and user fees, for the newly elected president. In June 1989, the President acknowledged the contributions of the 1988 Public Study and announced an environmental plan that addresses five of the six ambient pollutants and proposes that polluters assume more responsibility for a clean environment by implementing and paying for various clean-up initiatives.

In summary, the nation's air monitoring networks are aging and a significant number of monitors need replacing now or will need replacing during the next few years. The need for a national strategy for replacing aging monitoring equipment is discussed in chapter 5.

EPA's Quality Control Measures Could Provide Greater Assurance of Data Quality

EPA relies on three quality control measures to ensure that reliable air monitoring data are used to support regulatory and policy decisions. While these measures have different objectives, they are inter-related and complement each other in ensuring quality air monitoring data. Although these measures provide useful information to EPA managers, they have not reached their full potential for assuring data quality.

For example, the National Air Audit System (NAAS), a bi-annual review by the EPA regional offices, has not been effective in identifying and correcting problems in state and local monitoring programs. The NAAS is designed to provide a uniform and comprehensive assessment of state and local agencies' collection, analysis, validation, and reporting of air monitoring data. However, the absence of audits of some state and local agencies and inconsistencies in the frequency and thoroughness of audits of other agencies have resulted in some problems not being identified and other problems being identified but not corrected.

The National Performance Audit Program (NPAP), an annual audit managed by EPA's AREAL, is designed to ensure the accuracy of air monitoring data and provide air monitoring agencies a means of assessing their operation of air monitors. State and local agencies use test gases and equipment provided by AREAL to test the accuracy of their air monitors. However, because some agencies do not participate in the checks and EPA does not have a systematic process for selecting monitors to be tested, EPA's ability to project the accuracy of monitoring data is limited.

The third measure, the Precision and Accuracy Reporting System (PARS), requires state and local air monitoring agencies to perform bi-weekly precision and annual accuracy checks of the air monitoring equipment. However, inconsistencies in how state and local agencies report PARS results to EPA and use them to invalidate air monitoring data significantly reduces PARS effectiveness in ensuring the quality of air monitoring data.

The Systems Audit Is Not Fully Utilized as a Quality Control Measure

The NAAS is a crucial part of EPA's quality assurance package. The air monitoring segment of the NAAS is an on-site review and inspection of a state or local agency's air monitoring program to assess its compliance with established regulations governing the collection, analysis, validation, and reporting of air monitoring data.[1] EPA initiated the NAAS in 1984 as a quality control measure to ensure uniformity among regional offices in evaluating state and local air monitoring agencies and identifying obstacles to effective air monitoring management. It offers an opportunity for an independent regional audit team to perform a comprehensive on-site evaluation of a monitoring agency's performance. The systems audit requires a comprehensive review of an agency's operations, to include interviews with agency officials, inspections of monitoring sites and equipment, examination of the agency's data handling procedures, and the use of a standardized questionnaire.

All Monitoring Agencies Are Not Covered by the Systems Audit

The NAAS guidance requires that all state and selected local air monitoring agencies be audited bi-annually. Further, the regional audit team should spend sufficient time at the monitoring agency to accurately evaluate the monitoring program. However, EPA does not ensure that the regional offices audit all states bi-annually as required. Additionally, some regional offices do not audit local agencies and others do not audit them as frequently as state agencies, even though local agencies produce much of the monitoring data. Some regional offices also rely on states to audit local agencies, but they do not oversee these audit efforts or provide guidance on how to conduct them.

According to the region IX NAMS Coordinator, the region has not conducted a complete systems audit in the last 3 years because of limited resources. Monitors in region IX comprise 16 percent of the nation's air monitoring network. Although the region has established a Compliance and Oversight Group to coordinate future systems audits, the regional NAMS Coordinator plans to perform the air monitoring section of the audit. She plans to audit 17 agencies in the next 2 years, but doubts that she will have enough time to be thorough in the audits.

EPA's NAAS guidance does not require the regional offices to audit the local agencies every 2 years like the state agencies. Therefore, regional

[1]The NAAS includes other environmental programs such as State Implementation Plans and stationary sources. However, for clarity in this report, we refer to the air monitoring segment of the NAAS as the NAAS or systems audit.

offices did not audit local agencies or audited them less frequently during the 1986-87 audit cycle because of limited personnel and travel resources. However, the audit coverage of local agencies is important because they operate 38 percent of the nation's air monitors. With the systems audits of local agencies not being performed bi-annually and thoroughly, EPA misses an opportunity to assess the quality of the monitoring data coming from these agencies. Only 9 of the 104 local agencies were audited by the regional offices in 1988. For example, region IX did not audit any of its 38 local agencies in 1988, and based on region IV's audit schedule local agencies will be audited only once every 8 years. This limited coverage of local agencies may lead to problems remaining unidentified and uncorrected.

The absence of a systems audit of one local agency may have allowed a serious problem with data accuracy to go undetected. According to region VI officials, in February 1988, during an Oklahoma State audit of a local air monitoring agency, auditors found a bird nest in the air intake of one particulate matter monitor and indications that other monitors had been inoperative for several months. A check of the filter archives for these monitors showed filters were not collected from particulate matter and lead monitors between October 1987 and March 1988. A further investigation by the state showed that old filters were substituted in place of current filters and, therefore, 5 years of air monitoring data could not be substantiated. The state concluded that the agency had not followed good quality assurance procedures. A subsequent investigation by region VI recommended invalidating monitoring data from 1983 to 1988. Regional officials believe that (1) limited supervision of one employee, (2) inadequate quality assurance procedures, and (3) absence of systems audits by the region and state contributed to the data-tampering problem. We believe that a thorough systems audit could have identified and corrected a problem such as this.

Some regional offices rely on state agencies to conduct systems audits of the local agencies in lieu of a regional system audit because they do not have the resources and staff. Even though the regions sometimes rely upon the results of the state audits, they do not provide guidance or oversee the state audits, and, therefore, EPA cannot be assured of the thoroughness and consistency of these audits. The OAQPS official responsible for preparing the 1986-87 NAAS National Report believes the regions should be responsible for ensuring the quality of state audits of local monitoring agencies. Furthermore, some regional offices do not use the result of the state audits of local agencies to identify problems that may need correcting. For example:

- According to the regional NAMS Coordinator, three of the four states in region VII conduct audits of the local agencies. However, these audits are not as comprehensive as EPA's because the coverage is limited and does not go into as much detail. To illustrate, in 1988 one state did not identify problems with a local agency's operation of sulfur dioxide monitors that affected the quality of the air monitoring data. Furthermore, region VII does not routinely review the states' audits of local agencies to identify problems that need follow-up.
- According to region VI officials, the region does not provide guidance to states for auditing local agencies. Regional officials agreed that guidance should be provided in light of the recent data-tampering problems found in the Oklahoma local agency. Furthermore, regional officials believe the states in the region vary in their ability to conduct thorough systems audits. According to region VI officials, the problems identified by audits of local agencies are not used as indicators of problems which need to be pursued when the regional systems audits are performed.
- According to region IV officials, the quality of state audits varies significantly, ranging from some audits being conducted by telephone to others being comprehensive, on-site inspections.

Limited quality assurance practices at some local agencies is another reason for the systems audits coverage to be performed bi-annually. EPA recommends that agencies separate responsibility for quality assurance and monitoring activities. However, in some instances, such as in Oklahoma, air monitoring agencies cannot follow this practice because it may require adding a staff person to a small air monitoring program with a limited budget. Therefore, it becomes even more important that the regional offices perform systems audits of local agencies to identify any problems.

Inconsistencies in Systems Audits Raise Questions About Their Effectiveness

The NAAS guidance emphasizes consistency in the regional office audit teams performing systems audits to ensure complete and adequate coverage of state and local agencies. However, the systems audits are not being performed consistently because the regional offices spend insufficient time and do not complete all aspects of the audits. Specifically, regional offices have not (1) completed the systems audit questionnaire, (2) inspected monitoring sites and equipment, and (3) reviewed the agency's data handling and processing procedures to verify data accuracy and reliability. Inconsistencies in regional office systems audits are primarily due to resource constraints and other programs receiving

higher priority. Weaknesses in these audits reduce EPA's ability to evaluate the agencies' air monitoring program or ensure the reliability of the air monitoring data.

Absence of Thorough Systems Audits Affects Quality of Monitoring Data

The NAAS guidance requires the audit team to complete a standard questionnaire that examines various aspects of an agency's program, such as identifying the number of required monitors, the actual number and location of NAMS monitors in place, and whether the agency participates in the NPAP program. However, some regions do not complete the questionnaire portion of the systems audit and thereby limit the audit's comprehensiveness. For example, 8 of the 75 systems audits performed in 1986-87 were incomplete because the questionnaire was not completed.[2] According to the OAQPS official who summarized the results of all the audits and prepared the NAAS National Reports, the questionnaire is an important part of the systems audit. He believes a questionnaire that is completed properly will identify deficiencies with an agency's monitoring program. Thus, for the eight audits that did not have the questionnaire completed, it is possible that some deficiencies were not identified.

NAAS guidance recommends that an audit team spend 4 staff days when performing an audit of an agency that operates 10-20 monitors; however, some regional offices spend significantly less time. For example, region III systems audits are performed in 1 day and by only one person. Region X limited the comprehensiveness of its 1986-87 systems audits by not performing required segments of the audits. Similarly, region IX, which has not performed a complete systems audits in the last 3 years, plans to limit the scope of the audits it performs in 1989. Regional officials acknowledged they do not spend enough time on the systems audit, because other environmental programs, such as toxic air pollutants, have a higher regional priority.

Inadequate Site Inspections Affect Quality of Systems Audits

The NAAS guidance suggests the audit team review a representative number of air monitoring sites and equipment to identify and correct problems. Specifically, the team should use a checklist to ensure uniformity and consistency of site inspections. However, three of the five regions we visited that performed systems audits did not inspect monitoring sites and equipment during the systems audit, and the other two regions' inspections were limited. Site inspections are important because they may be the only opportunity to independently inspect the monitoring sites and equipment since other site inspections are very limited.

[2]EPA summarizes the results of the systems audits bi-annually. The 1986-87 report was the most current systems audit report available at the time of our review.

However, the regions that performed site inspections did not always identify problems with security and climate control equipment for the monitor sites and the condition of the monitoring equipment.

A March 1988 region IV systems audit of the Knox County, Tennessee Department of Air Pollution Control concluded that two ozone monitors were properly sited. Subsequently, the region IV NAMS Coordinator visited the two monitoring sites in April 1988 and also identified no problems with the sites. However, we visited the same sites in July of 1988 and found the two ozone monitors operating in unair-conditioned rooms with the temperature estimated at about 100 degrees Fahrenheit—considerably higher than the 82 degrees allowed by EPA. The two monitors recorded ozone exceedances in 1988. According to a Knox County official, the monitors broke down several times in 1988 because of the heat, which resulted in the agency's losing monitoring data during the peak ozone season. Regional officials said they overlooked the absence of climate control equipment because they visited the monitors when air-conditioning was not needed.

Similarly, during a November 1986 systems audit, the region VII NAMS Coordinator visited a carbon monoxide monitor in St Louis, Missouri, and determined the monitor was sited properly. However, we visited the monitor in September 1988 and found the monitor located in a textile factory where the temperature was estimated at about 95 degrees Fahrenheit. Further, the telemetry system was dismantled to help dissipate some of the heat, and a back-up strip chart had been added to the site to capture data when the telemetry system failed. The agency plans to move the monitor to another room that is air-conditioned. OAQPS officials determined that the monitor violates siting requirements and they plan to follow-up to assure that the agency relocates the monitor.

Three of the five regional offices that perform systems audits conduct site inspections separately from the systems audit. However, such site inspections may not be appropriate substitutes for systems audit site inspections because they may not be as comprehensive as the NAAS guidance requires. For example:

- Region III officials do not make site inspections during the systems audit; instead they use regional office site inspections as input to the systems audit. Although the regional officials reported they try to inspect 20 to 25 percent of the sites annually, they inspected no sites in 1988 because of higher priorities within the region's air program.

- In contrast, region VI also uses regional site inspections as input to the systems audits. The region has a site inspection program that attempts to cover each NAMS monitoring site once in 5 years and some SLAMS sites. Furthermore, to ensure uniformity the regional office has developed a standardized checklist as recommended by the NAAS guidance.

Absence of Data Reviews Decreases EPA's Assurance That Monitoring Data Are Reliable

According to the NAAS guidance, a complete systems audit should include a review of an agency's data handling and processing procedures to ensure that the agency is handling monitoring data properly. The guidance also specifies the minimum amount of data that should be reviewed to detect major data- handling problems. However, some regions do not perform this crucial step and others perform only limited reviews. Without a thorough data review, EPA cannot be assured that the agencies produce reliable data.

According to region VI officials, the region does not perform data reviews during its systems audits. Regional officials said that with the advent of telemetry systems they no longer trace the air monitoring data back to the source because they believe it would be a difficult process. However, not all agencies in region VI use telemetry systems and the region does not perform data reviews on these agencies either. Region VI officials believe a thorough data review might have detected the data-tampering problems found in the Oklahoma local agency. They also believe a review of data generated by the telemetry systems would improve their systems audit. Similarly, region III said that the region did not conduct data reviews in 1988, because regional officials are familiar with the agencies and trust their operations. Regional officials maintain that they would conduct a data review if they had problems with the way an agency handles the air monitoring data.

In contrast, the region IV NAMS Coordinator said that the region emphasizes the use of data reviews and goes beyond what the systems audit requires to ensure the quality of the air monitoring data. The region retrieves selected monitoring data; traces the data back to the monitors; accounts for missing data points, exceptional events, and exceedances[3] ; and ensures that the agencies can document every step of the data. Although such checks are not explicitly required by the NAAS guidance, region IV also checks data values within 80 to 100 percent of the standard to guard against "creative reading" or deliberate misinterpretation

[3]Missing data points are periods where no monitoring data were reported. Exceptional events are instances where unusual events such as dust storms or forest fires cause air monitoring readings to be uncharacteristically high. Exceedances are instances where the air monitoring reading exceeds the national ambient air quality standards for that pollutant.

of the data values. In this manner, regional officials believe they can better ensure the quality of the air monitoring data.

According to OAQPS officials, another independent check of the air monitoring data is OAQPS's data review, which consists of computerized edit checks[4] and a manual data review by the OAQPS NAMS Coordinators. EPA officials acknowledge that some errors do get through the computerized edit checks and therefore some manual review of the data is necessary. However, the NAMS Coordinators' data reviews are limited since they examine as few as 5 out of a possible 2,000 NAMS data values per quarter and they do not systematically review missing data periods, modified data values, SLAMS data, and air monitoring data associated with unacceptable precision and accuracy readings. The NAMS Coordinators limit their data reviews because they believe the AIRS provides quality assurance of the data and because of competing demands for their time. Since there is limited independent review of air monitoring data by OAQPS' NAMS Coordinators, the data review during the systems audit is even more important to ensure that the data are properly collected, analyzed, validated, and reported to EPA.

Information on Audit Deficiencies Are Not Communicated to EPA

For major deficiencies, regional offices are required to prepare Corrective Action Implementation Requests (CAIRs), which identify the actions necessary to correct identified deficiencies. A CAIR identifies the deficiency, the agreed-upon corrective action and time frames, and the people responsible for the corrective action. Completed CAIRs are required to be forwarded to OAQPS to track and ensure that deficiencies are corrected. However, EPA's procedures for correcting deficiencies found during the systems audits are generally informal and ineffective. The regional offices do not use CAIRs to identify and correct major deficiencies because they believe state and local agencies are more receptive to informal methods. However, not using CAIRs raises concerns that deficiencies may not be corrected by the monitoring agencies. For the 75 systems audits performed during 1986-87, no CAIRs were forwarded to OAQPS. Further, EPA does not have an effective mechanism for tracking and providing oversight to headquarters and regional managers on deficiencies found during the systems audits.

The five regional offices that we visited that perform systems audits prefer to use methods other than CAIRs to ensure that deficiencies are

[4]Computerized edit checks verify the monitors' identification numbers, identify unusually high and low values, and identify missing data.

corrected, such as informal discussions with managers and provisions in the agency's 105 grant agreement. Four of the five regions make corrective actions a condition of the grant agreement. Officials in one region were concerned that issuing CAIRs would hurt the region's working relationship with the monitoring agencies. The OAQPS official responsible for preparing the 1986-87 NAAS National Report, believes that the informal correction methods are not as effective as issuing a CAIR because state and local agencies do not take corrective actions seriously unless they have to sign a formal agreement.

While making corrective actions a condition of the 105 grant agreement or using other less formal methods may result in the deficiencies being corrected, it does not necessarily provide information to OAQPS for tracking deficiencies identified by the systems audit. Thus, OAQPS may not have the information it needs to manage the systems audit process and adequately inform EPA managers about problems with the national air monitoring program. A tracking system that relies upon CAIRs would enable EPA to better manage the air monitoring program as well as ensure that deficiencies are corrected. OAQPS plans to issue a memorandum to regional offices to use the CAIR forms and forward them to OAQPS for tracking purposes, but as of August 1989 no memorandum had been issued.

The National Performance Audit Program Is Not Used Effectively

According to EPA's Quality Assurance Handbook, the purposes of the NPAP are to provide: (1) air monitoring agencies a means of assessing their operation of air monitors and (2) EPA a continuing index of the quality of air monitoring data reported by these agencies. While the NPAP provides air monitoring agencies an assessment of their operation of air monitors, EPA cannot rely on the NPAP results to project the accuracy of air monitoring data because EPA does not have a systematic process for selecting the monitors that are tested. Furthermore, all state and local agencies do not participate in the NPAP even though federal regulations require participation. EPA officials cite their past problems with identifying all state and local agencies as the reason for not requiring their participation.

While the Research and Monitoring Evaluation Branch, AREAL, manages the NPAP, the audits of the monitors are performed by the state and local agencies. These agencies use the samples of pollutant gases and test equipment provided by AREAL to test the accuracy of the monitors in their networks. Because the gas concentrations and equipment settings are known only to AREAL, the NPAP audits provide an external check of

the monitoring network and the state and local agencies' ability to operate the monitors.

The NPAP, as currently implemented, does not provide EPA an adequate assessment of how well the monitoring network operates and the quality of the monitoring data, because AREAL allows the state and local agencies to select the monitors which they audit. Thus, the NPAP results do not provide a representative picture of the accuracy of the national monitoring network or the air monitoring data. The Chief of the Research and Monitoring Evaluation Branch, AREAL, believes the results of the NPAP audits are valid even though EPA allows state and local agencies to select monitors to be audited. According to the Branch Chief, the primary purpose of the program is to assess how well state and local agencies operate the monitors rather than a quality control check of the monitoring data. Therefore, he does not believe it is necessary for AREAL to select the monitors that are audited.

Some state and local agencies select the monitors that are convenient and the ones that are more likely to test accurately. For example, officials from the Georgia Department of Natural Resources and the California Air Resources Board said they perform the NPAP audits on the monitors that are closer to their office and easiest to reach. The Georgia Quality Assurance Coordinator also said the less reliable monitors are generally excluded from the audits. Similarly, officials from the Tennessee Department of Health and Environment said they perform the NPAP audits on the monitors that are convenient and more reliable. State and local agencies' preferences in selecting the monitors they audit diminishes NPAP's effectiveness as a quality control measure. In January 1988, AREAL issued guidance that identified the minimum number of monitors the state and local agencies should audit each year. While this new guidance may result in more monitors being audited, the state and local agencies are still allowed to select which monitors they audit.

Additionally, some state and local agencies have not performed the NPAP audits even though they are required to participate in the program. The Research and Monitoring Evaluation Branch, AREAL, maintains a list of air monitoring agencies. They also rely upon EPA regional offices to help identify new agencies to ensure all state and local agencies participate in the NPAP. The Branch Chief believes that AREAL has identified the agencies that should participate in the NPAP and that most of them are participating, but it will be late 1989 before he knows for sure.

Precision and Accuracy Audit Results Are Not Used Effectively

Federal regulations require state and local air monitoring agencies to perform bi-weekly precision and annual accuracy checks of air monitoring equipment. For the precision checks, the percent differences between the test gases and the concentrations indicated by the monitor determine the precision of the monitors. Accuracy checks measure the closeness of the monitoring data to a known gas concentration. EPA's acceptable ranges for the precision and accuracy readings are ± 15 percent and ± 20 percent, respectively. Monitors that test outside of these ranges should be checked to determine whether they need to be repaired and/or calibrated. The results of these checks are reported to EPA, which uses the PARS information to determine whether the state and local agencies perform the required precision and accuracy checks and to measure the quality of the national air monitoring data. Thus, the PARS data provide EPA additional assurance of the quality of the air monitoring data it uses for policy and regulatory decisions.

Unclear Guidance on Using Precision and Accuracy Results Skews Monitoring Data

EPA's guidance is unclear on how state and local agencies should use precision and accuracy results to validate the air monitoring data. EPA's Quality Assurance Handbook states that the results of precision and accuracy checks should not be used to invalidate air monitoring data. However, a subsequent section of the handbook states that if precision and accuracy readings are used to invalidate air monitoring data, then all of the data from that particular site should be invalidated back to the last precision and accuracy check.

Absence of clear guidance on using PARS data to validate air monitoring data has resulted in varying practices by state and local agencies, which leads to inconsistencies in data quality. Several agencies invalidate the air monitoring data associated with precision and accuracy results that are outside of the acceptable ranges because they consider these monitoring data to be of unacceptable quality. In contrast, according to region VII officials the region does not permit the state and local agencies to use precision and accuracy results to invalidate air monitoring data since they consider them to be insufficient evidence of unacceptable monitoring data.

The Chief of the Research and Monitoring Evaluation Branch, AREAL, acknowledged that agencies vary in their use of PARS results for invalidating air monitoring data. The Branch Chief noted there are differing opinions within EPA on whether an agency should invalidate air monitoring data when the precision and accuracy results are outside acceptable

ranges. The Branch Chief also cautioned that any guidance on invalidating air monitoring data should address various situations, such as determining what piece of equipment malfunctioned and when it began to malfunction. For example, it is sometimes possible to determine the point at which the monitor's calibrations became unacceptable. Thus, it would only be necessary to invalidate the air monitoring data back to that point. In other instances it may be necessary to invalidate all data back to the last valid calibration if the exact time that the monitor malfunctioned cannot be determined. AREAL officials also said it is important to determine which part of the monitoring system caused the precision or accuracy results to exceed the acceptable ranges. For example, problems with the monitor or the calibration instrument would probably justify invalidating the air monitoring data, but problems with the test gases or the equipment operator would not be reasons for invalidating the data. AREAL and OAQPS officials plan to work together to review the current guidance on validating precision and accuracy data and determine whether additional guidance should be issued.

EPA's Precision and Accuracy Guidelines also specify that state and local agencies should not calibrate monitors prior to conducting the precision and accuracy checks because it effectively negates opportunities to identify monitors that are operating improperly. However, one state we visited recalibrates its monitors whenever the precision and accuracy readings show monitors are outside of acceptable precision and accuracy ranges. The state then submits the corrected precision and accuracy readings to AREAL rather than the original readings. Thus, submitting the corrected data does not provide an accurate representation of the precision of the monitors and reliability of the associated air monitoring data. This practice skews the PARS database and may cause decision makers to misjudge the quality of the air monitoring data for that period.

The Research and Monitoring Evaluation Branch, AREAL, is responsible for receiving the PARS data from the state and local agencies and reporting the information to OAQPS. However, AREAL only reviews the data for completeness before loading it into the PARS database and does not review the data for errors or exceedance of the precision and accuracy acceptable ranges.

Regional Offices Do Not Use Precision and Accuracy Results Effectively

The NAMS Network Procedural Manual requires the Regional Quality Assurance Coordinators to review the PARS data by comparing precision and accuracy results for individual sites over a period of time to identify irregularities and trends. Further, the Regional Quality Assurance Coordinator should determine the causes for such irregularities in the PARS data and initiate corrective actions. However, regions IX and X take different approaches in using the PARS data as a check on the performance of state and local agencies. For example:

- Region X quality assurance officials review and analyze site-specific PARS data to identify weaknesses that may exist in an agency's monitoring network. The officials analyze PARS data quarterly for certain sites and yearly for the entire network. Region X officials use the PARS data to identify problems with the state and local air monitoring agencies' programs and ensure that the problems are corrected.
- In contrast, the region IX Quality Assurance Coordinator is more concerned that the proper number of precision and accuracy checks are performed. The Coordinator reviews the summaries of the PARS data to ensure that each agency performs at least 75 percent of the required checks. According to the Coordinator, since the agencies usually clean up the data before reporting it to the region, the PARS data are useful only as a general indicator of an agency's performance. However, she does raise questions with the agencies when results are outside acceptable ranges.

In summary, while EPA has established quality control measures to ensure the reliability of air monitoring data, the measures have not met their full potential. Recommendations for improving each quality control measure are discussed in chapter 5.

Conclusions and Recommendations

EPA's success in identifying and controlling air pollution depends to a great extent on air monitoring data obtained from federal, state, and local monitoring programs. Because of the significant role that monitoring data play in EPA policy decisions that directly affect the nation's health and economic welfare, it is important that EPA be assured that monitoring data are accurate, complete, and representative. Because of needed improvements in EPA's monitoring program that we identified, we believe that EPA needs greater assurance that its air monitoring data are reliable and therefore appropriate for making policy decisions and determining whether cities are meeting national air quality standards.

Completeness of Air Monitoring Networks

While progress has been made toward completing a national monitoring network, monitor shortages continue for some pollutants 7 years after they should have been in place. Further, current shortages are based on urban population statistics compiled nearly 10 years ago. The 1990 census update is expected to compound the problem for some urban areas experiencing rapid growth. Because the national air monitoring network has not been completed, the agency's strategy of waiting until after the 1990 census before developing a plan for acquiring additional monitors may result in even more significant delays in obtaining needed monitors.

In addition to networks not being complete, questions exist about whether some monitors are located in areas of highest pollution concentrations and whether some smaller cites are adequately monitored. EPA does not have criteria specifying the number and location of monitors in cities with populations below those required for NAMS monitors. Instead, EPA relies upon negotiations between its regional offices and approximately 162 state and local monitoring agencies to ensure coverage of these areas.

Our work disclosed several instances where monitors did not appear to be located in areas of highest pollution concentrations or in less populated areas experiencing significant pollution problems. In some cases, EPA has been able to identify problems in these areas because of agreements with state and local agencies to install monitors. However, without criteria requiring monitors in areas with populations below NAMS requirements, EPA cannot be assured that other areas are not experiencing similar pollution problems. Considering the widespread problems with ozone and carbon monoxide, population thresholds of 200,000 and 500,000, respectively, may result in monitoring networks being too limited to accurately depict levels of these pollutants.

Questions about whether the current monitoring network provides an accurate picture of air quality have been raised by federal, state, and local officials. Concerns over the adequacy of the monitoring networks have prompted EPA to establish task forces to examine the effectiveness of carbon monoxide and particulate matter monitoring efforts. The carbon monoxide task force has raised questions about whether the monitoring network accurately depicts true levels of carbon monoxide. While we commend EPA's efforts, we believe a comprehensive evaluation of the effectiveness of the monitoring networks for all six pollutants is necessary.

Replacing Older Monitors

Not only are additional monitors needed to complete the networks, but many of the existing monitors are old and need to be replaced. About half of the monitors will need replacing within 3 to 5 years; many need immediate replacement. Sixty-eight percent of the monitors in 17 state and local agencies we visited were 7 or more years old and nearing the end of their useful life. Operating older monitors that are in poor condition presents problems for state and local agencies and EPA. For example, older monitors tend to break down or lose calibration, resulting in lost or invalid monitoring data. Additionally, keeping older monitors operational often requires technicians to spend significant time repairing and recalibrating the equipment.

While EPA is aware of the serious consequences of not updating the aging air monitoring networks, the agency does not have a national strategy for assisting state and local air monitoring agencies in meeting their equipment needs. Generally, EPA relies upon state and local agencies to identify monitoring equipment that needs replacing. However, few of the state and local agencies we visited had a strategy for identifying and purchasing needed equipment. In view of the limited efforts by state and local agencies to replace older monitoring equipment and the impact that older monitors have on the quality of air monitoring data, we believe that EPA needs to take the lead in developing a national strategy for identifying and replacing the aging monitoring equipment.

Alternative Funding Sources Are Available

While most state and local air monitoring agencies need additional revenue to complete their monitoring networks and replace aging equipment, few agencies have taken full advantage of opportunities for increasing revenues through programs such as permit fees, automobile license fees, and pollution taxes. When passing the Clean Air Act, the Congress provided for agencies to assess fees to recover the costs associated with

issuing operating permits to major sources of pollution. However, many agencies have no permit fee programs, and most of those that collect fees recover only a small portion of their permitting costs. In fact, 19 states have no permit fee programs, and some agencies that do have programs receive less than 10 percent of their air program budget from fees. State and local agencies, excluding California, recovered an average of only 20 percent of their permitting costs in 1987 through permit fees. Therefore, air program funds that could be used to complete the monitoring networks and replace aging monitors are being used to support the permitting process.

While other funding sources are available, their full potential has not been realized. For example, Florida adds an additional 50 cents to its annual automobile license fee and designates it for state and local air programs. In 1986 one local agency in Florida received 61 percent of its air monitoring budget from license fees.

Taxing major industrial polluters is another potential source of revenue to support state and local air programs. This concept has received strong congressional and administration interest in recent years. Legislation was introduced in the House in May 1987 to tax sulfur emissions, but it did not pass. A December 1988 Public Policy Study sponsored by Senators Wirth and Heinz also identified various environmental initiatives, such as pollution taxes and user fees, for the newly elected president. In June 1989, the President announced an environmental plan that addressed most of the ambient pollutants and proposed that polluters assume more responsibility for a clean environment by implementing and paying for various clean-up initiatives. The staffs of the Senate Committee on Taxation and the House Ways and Means Committee estimated that a tax of 45 cents per pound on sulfur and nitrogen dioxide emissions would produce annual revenues of $6.3 billion.

Because of congressional efforts to reduce the federal budget deficit and efforts faced by state and local governments to balance their budgets, obtaining funds to purchase needed air monitoring equipment will become more difficult in the future. Therefore, it is important that EPA and the state and local agencies look for opportunities to increase revenues through alternative means such as permit and automobile license fees and pollution taxes. Significant revenues that can be generated from these sources could go a long way in helping EPA and the state and local agencies purchase the monitors needed to complete the monitoring networks and replace aging equipment.

Quality Control Measures Offer Greater Potential

In addition to ensuring that the nation's air monitoring network is complete and that older monitors are replaced, it is important that EPA have effective quality control measures to ensure the reliability of monitoring data. While existing quality control measures provide useful information, they have not met their full potential for ensuring the accuracy and reliability of air monitoring data. For example, the National Air Audit System audits, designed to provide comprehensive assessments of state and local air monitoring programs, are not being performed as frequently or as comprehensively as EPA guidelines require. While the National Performance Audit Program is intended to ensure the accuracy of air monitoring data, the results cannot be used to assess the accuracy of the data because EPA allows agencies to select which monitors are audited and does not require all state and local agencies to participate. Another EPA quality control measure, the Precision and Accuracy Reporting System, is the bi-weekly precision and annual accuracy checks of monitoring equipment by state and local agencies to ensure the accuracy of monitoring data. However, absence of clear guidance from EPA has resulted in inconsistencies in how state and local agencies use the data and report them to EPA.

Recommendations to the Administrator, EPA

In order to increase EPA's assurance that air monitoring networks produce monitoring data that is as accurate, complete, and representative as possible, we recommend that the Administrator, EPA:

- Consider revising EPA criteria regarding the number and location of monitors in the national and state and local air monitoring networks. Specific attention should be given to either reducing the minimum population requirements for NAMS monitors or establishing criteria requiring monitors in cities with populations too small to require NAMS monitors but which are experiencing, or have the potential for, significant pollution problems.
- Develop a strategy for completing the national monitoring network, meeting future monitoring needs, and replacing aging monitoring equipment. As part of its strategy, EPA should work with state and local agencies to identify opportunities through existing Clean Air Act provisions (such as collecting permit fees) or through alternative sources (such as Florida's license fee assessments) to generate additional funds to purchase needed monitors.

In view of the importance of EPA's quality control measures and to ensure that EPA managers realize the full potential of these measures, we recommend that the Administrator, EPA:

- Direct EPA regional offices to comply with EPA requirements to audit all state and local monitoring agencies at least once every 2 years and to complete the audits in accordance with EPA guidance on site inspections, data reviews, and identification of corrective actions.
- Direct the Director of the Atmospheric Research Exposure and Assessment Laboratory to systematically select monitors for inclusion in the National Performance Audit Program and require all state and local agencies to participate in the program.
- Direct the Director of the Office of Air Quality Planning and Standards to clarify EPA guidance to state and local agencies on how the agencies are to use Precision and Accuracy Reporting Systems results for validating air monitoring data.

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