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Report to the Chairman, Subcommittee on VA, HUD, and Independent Agencies, Committee on Appropriations, House of Representatives

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AIR POLLUTION

EPA's Actions to Resolve Concerns With the Fine Particulate Monitoring Program

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GAO

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Resources, Community, and
Economic Development Division

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August 12, 1999

The Honorable James T. Walsh
Chairman, Subcommittee on VA, HUD,
and Independent Agencies
Committee on Appropriations
House of Representatives

Dear Mr. Chairman:

In July 1997, the Environmental Protection Agency (EPA) established new ambient air quality standards for particulate matter smaller than 2.5 microns ($PM_{2.5}$)—fine particles about 1/30th of the thickness of a human hair and which, according to EPA, cause tens of thousands of premature deaths annually. These fine particles are a complex mixture of acids, metals, carbon, and other potentially harmful airborne substances. Because the health risks of the components comprising the $PM_{2.5}$ mixture are poorly understood, EPA is both implementing the $PM_{2.5}$ standards and investigating scientific uncertainties associated with these components. As part of implementing the new standards, in 1997 EPA announced plans for a more than $50 million nationwide network of 1,500 $PM_{2.5}$ monitoring sites to be deployed by December 31, 1999. EPA's plans also called for over 90 percent of these sites to use monitors that measure only the total mass of fine particles collected over a 24-hour period. Such "mass-only" monitors, while required for determining areas that exceed the $PM_{2.5}$ standards, provide limited data to address the scientific uncertainties about the health effects and health risks of the components comprising the $PM_{2.5}$ mixture. Other, more expensive and complex monitors are needed to help address these scientific uncertainties.

In March 1998, the National Academy of Sciences (Academy) issued a report[1] that questioned EPA's $PM_{2.5}$ monitoring plans, calling the agency's plans misdirected and insufficient to address important data gaps and scientific uncertainties. While EPA is currently fully funding the network, state and local agencies are responsible for establishing and operating the monitoring sites. In view of the Academy's report, you asked us to describe (1) EPA's actions in response to the Academy's concerns with the planned $PM_{2.5}$ monitoring program and (2) the challenges that state and local agencies face in establishing and operating the $PM_{2.5}$ monitoring program, as well as EPA's response to these challenges.

[1]Research Priorities for Airborne Particulate Matter: Immediate Priorities and a Long-Range Research Portfolio, Committee on Research Priorities for Airborne Particulate Matter, National Research Council, National Academy of Sciences (Mar. 1998).

Results in Brief

EPA has taken a number of actions to address the concerns raised in the Academy's March 1998 report, including allocating 57 percent of its monitoring budget to efforts designed to better understand $PM_{2.5}$ scientific uncertainties—a primary concern in the Academy's report. For example, EPA reduced the number of planned mass-only monitoring sites by more than 21 percent and substantially increased the number of sites and frequency of analyses at the more complex monitoring sites that identify the components of the $PM_{2.5}$ mixture. Although one of the Academy's concerns was that the agency was moving forward rapidly with too narrow a focus on mass-only monitors, EPA continued its rapid deployment of over 800 mass-only monitors by December 31, 1998, on the basis that 3 years of monitoring data were needed to determine attainment with the standards. Agency officials also explained that they deployed these monitors in response to presidential and congressional directives to expedite the monitoring network, as well as extensive public comments regarding the thousands of premature deaths and serious illnesses annually from $PM_{2.5}$ pollution. The officials also said that they deployed these monitors only after the monitors and the network design were peer-reviewed.

Largely due to EPA's rapid deployment of mass-only monitors, state and local agencies have encountered problems operating nearly one-third of their monitors—problems that have increased labor costs and impacted the agencies' ability to meet EPA's data quality requirements. For example, the six state and local agencies we contacted had monitors fail to operate in very cold weather, filters contaminated from leaky seals, and data lost due to monitor computer failures—problems they attribute to inadequate field testing of these monitors before deployment. The officials explained that, due to EPA-imposed time constraints, they had to purchase mass-only monitors based on prototype design and manufacturer specifications without full field evaluation under actual operating conditions. While deployment was rapid, EPA officials said the agency's monitor certification process was followed and that EPA has taken other actions to help states address these challenges, including requesting warranty extensions from the affected manufacturers and increasing funding for operation and maintenance activities. However, state and local agencies remain concerned that the future deployment of the more complex and costly speciation monitors without adequate field testing would present even greater challenges. As a result, EPA has reevaluated its monitoring plans and delayed deployment of the more complex and costly speciation monitors an additional year—to December 2000—to allow more time for field testing. While these are steps in the right direction, this report contains a recommendation that EPA ensure that future monitors

successfully pass full field testing before large-scale deployment is permitted.

Background

Unlike most other pollutants that EPA regulates, $PM_{2.5}$ is a complex mixture of airborne particles and gases that interact physically and chemically, vary significantly by region and locality, and can be transported hundreds of miles by the wind. $PM_{2.5}$ particles are primarily formed by the combustion of coal, oil, gasoline, diesel, and wood from such sources as power plants, industrial facilities, cars, trucks, and wood stoves. According to EPA, adverse health effects have been linked statistically to exposure to the aggregate, or "mass," of fine particles smaller than 2.5 microns, but many scientists are concerned that one or more components of the $PM_{2.5}$ mixture may be more toxic than others or that certain physical or chemical characteristics of the components may be more important to human health than the total particle mass. As a result, EPA is faced with the dual tasks of both implementing the 1997 standards[2] for particle mass and simultaneously investigating the health, exposure, and atmospheric uncertainties associated with the $PM_{2.5}$ mixture. According to the Director of EPA's Emissions, Monitoring, and Analysis Division, this was an ambitious technical challenge unprecedented in EPA's history.

Different types of monitors are required to address these different regulatory and research goals, and, according to EPA, all of the currently available monitors have limitations if used alone; however, the agency believes that collectively these various monitors provide appropriate and useful information. Table 1 provides information on the five types of monitors EPA plans to use in its revised $PM_{2.5}$ monitoring network.

[2]On May 14, 1999, a three-judge panel of the U.S. Court of Appeals for the District of Columbia vacated the PM_{10} standard for coarse particles and remanded to EPA the $PM_{2.5}$ standards for fine particles (American Trucking Ass'ns, Inc. v. EPA, Nos. 97-1440 & 97-1441 (D.C. Cir. May 14, 1999)). After further briefing, on June 18, 1999, the court decided not to vacate the $PM_{2.5}$ standards at this time. On June 28, 1999, EPA appealed the May 14 decision to the full court of appeals and hopes to sustain the standards that were remanded. As of the date of issuance of this report, EPA's $PM_{2.5}$ standards are still in place, and EPA is continuing with the deployment and operation of the $PM_{2.5}$ fine particle monitoring program.

Table 1: Types of Particulate Matter ($PM_{2.5}$) Monitors

Monitor type	Description	Number of sites planned[a]	Capital costs[b]	Annual operation and maintenance costs[c]
Mass-only (Compliance)	Agencies weigh filters in laboratory before and after a 24-hour sampling period to collect total $PM_{2.5}$ mass; particles collected in accordance with EPA-approved method; primary focus on population centers.	1,094	$17,000 to $22,200	$11,900 for 1-in-6 day sampling to $36,900 for daily sampling
Speciation	Use several different inlet tubes and different filters to collect suspected harmful components of the $PM_{2.5}$ mixture, such as acids, metals, and organic carbon; subsequent analysis of fine particles in laboratory.	301	$23,000	$30,200 for 1-in-6 day sampling to $137,200 for daily sampling
IMPROVE[d]	Similar to speciation monitors in design (collects particles on three different filters); monitors located in national parks and wilderness areas; monitors collect background readings and transport data for $PM_{2.5}$ program.	108	$23,000	$30,200
Continuous	In lieu of filters, this design uses an internal analytical apparatus to instantaneously analyze the particles passing through the sampler.	137[e]	$20,000	$6,000 to $8,000
Supersite[f]	Uses prototype and research-grade monitors, as well as one or more of the above monitors, to conduct intensive fine particle analyses of the complex $PM_{2.5}$ mixture, population exposure patterns, and emissions source characterization and identification.	4 to 9[g]	$1.0 to $3.5 million, (includes O&M costs and data analyses)	(included in prior column)[h]
Total		**1,500**		

(Table notes on next page)

[a]Figure based on revised ambient air monitoring network plans as of May 1999 (range of planned mass-only compliance sites nationwide is 1,050 to 1,100).

[b]Capital costs for speciation, IMPROVE (defined below), and Supersite monitors are best estimates as of May 1999, including one-time site setup costs such as those for utility hookups.

[c]Operation and maintenance (O&M) costs include the estimated costs of site operations, filters, laboratory analysis, and data reporting (all O&M costs are estimates since 1 full year of operation will not be completed until Dec. 31, 1999).

[d]The Interagency Monitoring of Protected Visual Environments (IMPROVE) program is a joint effort with the Department of the Interior, Federal Land Managers, and state and local agencies.

[e]Continuous and speciation monitors are generally colocated with other monitors.

[f]These sites actually use a combination of advanced monitoring techniques to understand the complex $PM_{2.5}$ mixture.

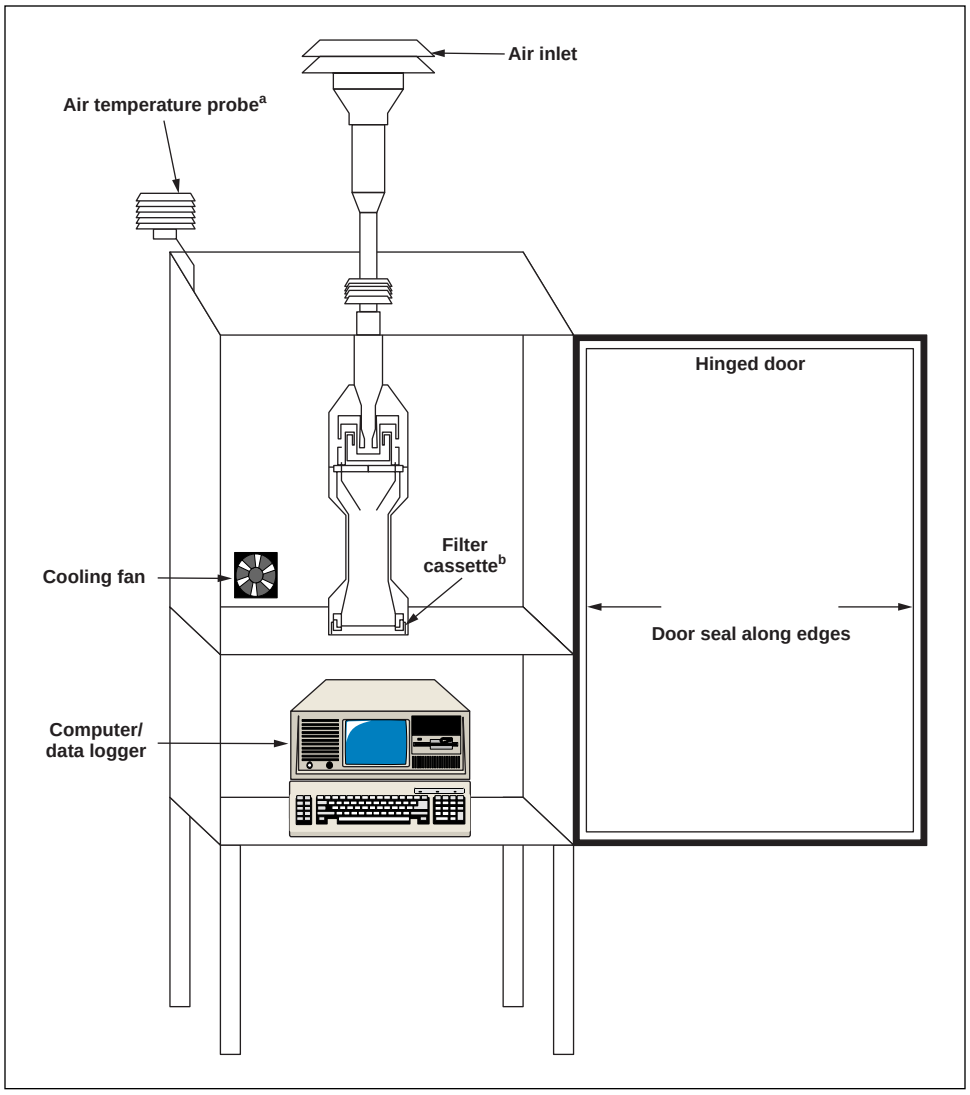
[g]Supersites will be coordinated with ongoing state and local agency monitoring efforts to optimize data uses.

[h]Detailed estimates of O&M costs for these monitoring sites are still under development.

While mass-only monitors are essential for measuring total particle mass—which is necessary to determine if a state or local area is in compliance with the $PM_{2.5}$ mass standards—they provide limited data to help address scientific uncertainties. For example, mass-only monitors, by themselves, are insufficient for a comprehensive assessment of the sources contributing to fine particle pollution. However, EPA officials noted that data on $PM_{2.5}$ mass does help with some scientific research and that $PM_{2.5}$ mass is a likely contributor to adverse health effects. Although they are among the more precise $PM_{2.5}$ monitoring devices available, in some instances mass-only monitors underestimate the fine particle mass because they lose unstable components of the $PM_{2.5}$ mixture as the temperature rises during the day. Also, as shown in table 1, the capital costs for mass-only monitors vary significantly. This cost difference depends mostly on whether the monitor's filter must be manually changed after a single 24-hour sampling period or whether the monitor can electronically change filters for multiple sampling periods. A schematic of a typical mass-only monitor is shown in figure 1. These monitors, which are generally about 2 to 2.5 meters high, must have unobstructed air flow for a minimum of 2 meters in all directions, with the air inlet located from 2 to 15 meters above ground level.[3]

[3]These monitors must meet EPA-specified design, performance, and operational requirements as provided in 40 CFR, Part 50, App. L (July 18, 1997 Federal Register).

Figure 1: Schematic of a Typical Pm 2.5 Mass-Only Monitor



[a]Air temperature is recorded electronically by the monitor's computer.

[b]The filter exchange mechanism for sequential monitors uses either a rotating filter cassette or a pneumatic tube exchange system.

Source: GAO Illustration based on EPA-supplied information.

Mass-only monitors are not the only monitors with limitations. The speciation and IMPROVE monitors also lose unstable, volatile components of the $PM_{2.5}$ mixture as the temperature rises during the day. Continuous

monitors are needed to obtain the more frequent readings that portray human exposures, but these monitors also have limitations. EPA officials said that continuous monitors are an acceptable indicator tool when used in combination with other monitors, but they produce inaccurate readings in some circumstances, especially in humid conditions. For example, continuous monitors do not provide data on the variety of chemicals that make up the $PM_{2.5}$ mixture, and some also lose volatile components of the mixture to a greater degree than do other monitors.

Because all of the currently available monitors have limitations, EPA officials have developed another monitoring approach—known as supersite—that describes the agency's most intensive efforts to understand the complex $PM_{2.5}$ mixture in various regions of the nation. As explained in table 1, supersites use prototype and research-grade monitors, along with one or more of the other monitors, to conduct intensive fine particle analyses of the complex $PM_{2.5}$ mixture, population exposure patterns, and emissions source characterization and identification. Because of the high cost of supersites—from $1.0 to $3.5 million per site—fewer than 10 supersites will be established nationwide. Supersites may operate from less than 1 to more than 5 years. According to agency officials, the supersites part of the $PM_{2.5}$ monitoring program is still in the developmental phase.

While fiscal year 1999 funding for the $PM_{2.5}$ monitoring program was $65.7 million (including $50.7 million for state and local grants, plus an additional $15.0 million for the supersites program), EPA estimates that—after establishment—ongoing expenses for the $PM_{2.5}$ monitoring program will be about $42.5 million annually. Although the overall network is designed, overseen, and currently fully funded by EPA, state and local air quality agencies are responsible for establishing and operating the monitoring sites, including taking periodic samples, handling and transporting the samples, conducting laboratory analyses, ensuring data quality, and reporting the data to EPA and the states. Equally important, state and local agencies are responsible for developing strategies to achieve and maintain the $PM_{2.5}$ standards, including identifying and controlling $PM_{2.5}$ emissions sources. According to EPA, the agency will assume full funding for the $PM_{2.5}$ network until such time as the Congress determines that states should contribute to the operation and maintenance of the network. At that point, states will be expected to provide approximately 40 percent of the total funding needed to operate the program, assuming a traditional grant funding approach. Under traditional grant funding, EPA covers about 60 percent of program expenses, and state

and local agencies provide matching funds sufficient to cover 40 percent of program costs. Such a funding arrangement is generally known as a 60/40 match. While the $PM_{2.5}$ monitoring program is the most expensive EPA has ever asked state and local agencies to implement, the decisions to be made based on the $PM_{2.5}$ data are also envisioned to be very expensive. For example, EPA estimates that industry will spend about $8.6 billion annually to control $PM_{2.5}$ emissions beginning in 2008. Full compliance with the $PM_{2.5}$ standards is expected no later than 2012. EPA's next review of the $PM_{2.5}$ standards is scheduled for 2002. According to agency officials, subsequent reviews should occur at intervals no longer than 5 years thereafter.

EPA Has Taken Actions to Address the Academy's Concerns

EPA made numerous changes in its $PM_{2.5}$ monitoring program to address the concerns raised in the Academy's March 1998 report. For example, in response to the Academy's concern that EPA's planned program was too heavily oriented toward mass-only monitors, EPA reduced the number of planned mass-only monitoring sites from 1,392 to 1,094 sites, about a 21-percent reduction. This change allowed EPA to increase the number and frequency of analyses at the more expensive speciation monitoring sites and to more than double the number of continuous monitoring sites planned—actions that should help the agency better address the health, exposure, and atmospheric uncertainties of $PM_{2.5}$. After these changes, EPA's revised plans called for 57 percent of the $PM_{2.5}$ monitoring budget to be devoted to monitoring efforts designed to better understand $PM_{2.5}$ scientific uncertainties. EPA's responsiveness to the Academy's earlier concerns was commended by several members of the Academy and the Clean Air Science Advisory Committee (CASAC)[4] in a public session in November 1998. Table 2 summarizes eight key concerns in the Academy's 1998 report and the actions EPA has taken to address them.

[4]CASAC is a permanent subcommittee of the Science Advisory Board established by the Clean Air Act Amendments of 1977.

Table 2: Summary of EPA's Actions to Address the Academy's Key Concerns

Description of key concern	Summary of EPA's actions	Concern addressed
1. EPA is moving forward rapidly with too narrow a focus on mass-only monitoring.	EPA reduced the number of mass-only monitors planned from 1,392 to 1,094; increased the number and frequency of analyses at 54 speciation sites; increased the number of continuous monitors from 62 to 137; added plans for up to 9 supersites (an increase of $15 million in EPA's monitoring budget); however, EPA continued with rapid deployment of 823 mass-only monitors by Dec. 31,1998.	Partially
2. Planned network may not adequately support research on health effects, exposure assessment, and atmospheric modeling.	Changes in planned network allowed EPA to increase fiscal year 1999 monitoring funds for health effects, exposure, and atmospheric modeling research by $21.5 million (a 42-percent increase); revised plan now allocates 57 percent of $65.7 million in fiscal year 1999 monitoring funds to monitoring efforts to help address these research issues.	Yes
3. Plans to collect speciation samples once every 6 days will not provide useful data for improving health risk assessments.	EPA used $3.1 million of funds planned for the mass-only monitoring program to increase the frequency of speciation sampling from one sample every 6 days to daily sampling at 10 major urban sites, and from one sample every 6 days to one sample every 3 days at 44 other sites; efforts to increase sampling frequency at another 40 speciation sites is under review; regarding remaining 208 sites, EPA officials recognize that having more frequent data is better, but said all data, including samples collected once every 6 days, will be useful to scientific community.	Mostly
4. EPA should make greater use of continuous monitors to help determine human exposures and facilitate time-series epidemiological studies.	EPA used $3.4 million of funds planned for the mass-only monitoring program to increase the number of continuous monitoring sites from 62 to 137, a 121-percent increase in continuous monitoring sites nationwide.	Yes
5. Mass-only monitors will likely not measure some important components of the $PM_{2.5}$ mixture, such as nitrates and organic compounds.	EPA's revised plans call for speciation sites to use three types of filters (teflon, nylon, and quartz) to measure components of the $PM_{2.5}$ mixture, such as nitrates, organic compounds, sulfates, metals, and other components of the $PM_{2.5}$ mixture; also, 108 IMPROVE sites in national park and wilderness areas will use these three filters.	Yes
6. Future research results may indicate mass-only monitors are not measuring the most biologically important aspects of particulate matter.	EPA's revised plans provide a better relative mix of monitoring sites to help the agency both implement the 1997 standards for particle mass and investigate the health, exposure, and atmospheric uncertainties associated with the $PM_{2.5}$ mixture.	Yes
7. Specific objectives, operating conditions, number, and location of monitors should be independently peer-reviewed prior to implementation.	Objectives, conditions, number, and siting criteria for the mass-only monitoring network were peer reviewed in August 1996; first 54 speciation sites, 108 IMPROVE sites, and 2 initial supersites were peer-reviewed in November 1998; EPA has announced plans to have the remaining 248 speciation sites peer-reviewed.	Yes
8. Interface between monitoring and research on particulate matter still largely uncoordinated and fragmented.	EPA established steering committee to coordinate its $PM_{2.5}$ monitoring activities with others involved in similar activities (federal, state, local, and multinational associations; academia, nonprofit advisory bodies, others); efforts to establish procedures ensuring optimization of $PM_{2.5}$ data collection activities continue.	Mostly

As shown in table 2, EPA continued with the rapid deployment of over 800 mass-only monitors by December 31, 1998. Although the Academy was concerned that the agency was moving forward too rapidly with too

narrow a focus on mass-only monitors, EPA officials explained that they continued with the rapid deployment of these monitors for several reasons. First, they explained that the agency needed 3 years of data to make reliable determinations of those areas that exceed the new standards and that the agency received extensive public comments regarding the estimated 15,000 premature deaths annually from fine particles. They also said that EPA deployed these monitors in response to a July 1997 presidential directive to expedite the deployment of the network and a provision in the Transportation Equity Act for the 21st Century requiring compliance monitors be installed by December 31, 1999. Additionally, they said that the agency deployed these monitors only after both the monitors and the network design were peer-reviewed, and that the number of mass-only monitoring sites is comparable to other ambient air monitoring programs.

EPA officials pointed out that the agency had planned to deploy 1,500 monitoring sites over a 3-year period (beginning in fiscal year 1999), with about 20 percent deployed the first year, 40 percent the second year, and the remaining 40 percent the third year. However, in July 1997, EPA condensed its deployment schedule from 3 to 2 years, with over half of the 1,500 monitoring sites to be deployed by December 31, 1998. As will be discussed in the next section, some state and local agencies' experiences indicate that the rapid deployment of these monitors has not been without problems. Nonetheless, even with the early problems encountered, EPA officials believe the $PM_{2.5}$ mass-only monitoring network will be producing quality data earlier than had EPA used its originally planned 3-year deployment schedule. (Additional information on the status of EPA's actions to address the Academy's concerns is provided in app. I.)

State and Local Agencies Face Implementation Challenges

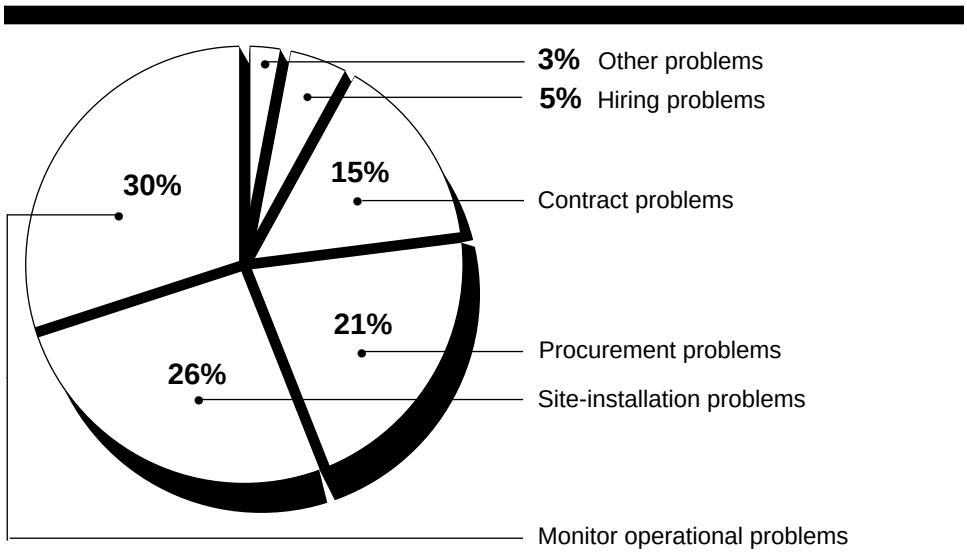
State and local agencies face both near-term and long-range challenges in establishing and operating the $PM_{2.5}$ monitoring program. These challenges include correcting various operational problems with mass-only monitors, resolving data gaps caused by a lack of spare monitors, ensuring the full testing of future monitors before deployment, and obtaining sufficient state and local resources to pay for their share of the program. EPA has actions under way or planned to mitigate these challenges. Among other things, EPA is working with state and local agencies and affected manufacturers to remedy the remaining operational problems with monitors, providing funding for spare monitors, and developing a deployment schedule that will provide additional time for field testing of the more complex speciation monitors yet to be deployed. As of May 1999,

the network was 91-percent complete, which EPA officials told us represents a significant amount of success, considering the enormousness of the task and their historical experiences with implementing a major new monitoring program of this magnitude. However, about 9 percent of the network that was supposed to be operational by December 31, 1998, was still not operating after more than 4 months.

Monitor Operational Problems Have Affected Data Quality

While funding for the $PM_{2.5}$ monitoring program is a long-term concern of state and local agencies, their most immediate challenge has been correcting the operational problems they have experienced with the mass-only monitors that were to be deployed by December 31, 1998. According to a May 1999 EPA survey, state and local agencies nationwide have had operational problems with about 30 percent of the monitors deployed to date. For those monitors that have experienced problems, figure 2 shows the types of obstacles that state and local agencies have experienced.

Figure 2: Obstacles to Pm 2.5 Monitor Operations for the First Quarter, 1999

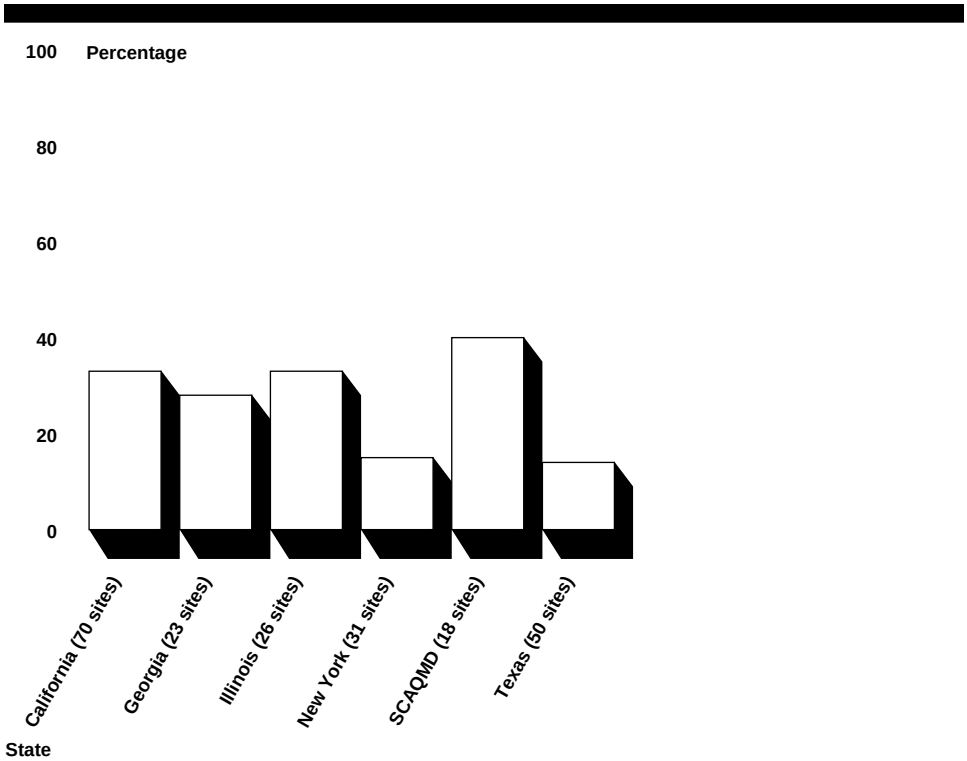


Source: EPA's Office of Air Quality Planning and Standards.

As shown in figure 2, while monitor malfunctions have been the single largest challenge for state and local agencies, other challenges have

included site installation problems (such as obtaining leases to use property), state procurement delays, and state hiring limitations. Because data quality reports for first quarter monitoring activities are not due until July 1, 1999, it is too early to tell the nationwide impact of these problems. However, we contacted six state and local agencies that, collectively, operate 218 of the 823 monitoring sites deployed, or about one-fourth of the sites that were to be established by December 31, 1998, to discuss their monitoring experiences and the impact of monitor problems on data quality. As shown in figure 3, each of the six state and local agencies that we contacted have experienced significant operational problems with one or more of their mass-only monitors since January 1, 1999—problems they believe have impacted their ability to meet EPA's $PM_{2.5}$ data quality requirements for the first quarter of 1999.

Figure 3: Percentage of Monitors With Operational Problems Potentially Impacting Data Quality During the First Quarter, 1999



*South Coast Air Quality Management District (California).

Source: GAO illustration based on estimates supplied by officials of six state and local agencies.

Among the more significant problems state and local agencies have encountered are the following:

- Filter cassettes jammed in very cold weather, resulting in lost data and causing state and local agencies to operate their monitors in manual mode, which increases labor costs.
- Monitor access doors were improperly sealed, allowing dust into the monitor, contaminating the filter, and resulting in voided and incorrect filter readings.
- Monitor cooling fans pulled in dust containing coarse mode (greater than 2.5 microns) and other unwanted particles, potentially resulting in incorrect readings.
- Software for the automated multiday samplers had problems, resulting in lost data because the most recent readings overwrote previous readings.
- Troubleshooting instructions provided to state and local agencies were insufficient, which precludes technicians from making simple repairs on-site and requires monitors to be shipped back to the manufacturer, thus causing more data to be lost in the interim.

Some officials in the six state and local agencies we contacted said that the rapid deployment and the number of monitors needed exceeded manufacturers' short-term production capacity. For example, in addition to being nearly 2 months later than expected, officials of the California Air Resources Board's (CARB) Monitoring and Laboratory Division[5] told us that 5 of the 120 monitors they received arrived at their offices already in need of repair. In conducting initial acceptance testing on these monitors, the CARB staff found that some monitors had wiring problems, and, in some cases, parts within the sampling tube had not been anodized, a process that coats the interior wall of the sampling tube so that particles pass through freely and do not adhere to the walls of the tube. Georgia, Illinois, and the South Coast Air Quality Management District (a local program in California) also had monitors delivered later than EPA had planned. According to EPA, the late deliveries were due to the length of time EPA needed to get final versions of the monitors and full documentation from the manufacturers, thus delaying testing and approval for use in the $PM_{2.5}$ monitoring program. Although New York's monitors were received on time, two monitors failed initial acceptance testing and had to be sent back to the manufacturer for repairs; according to New York officials, data were lost in the meantime.

[5]CARB's Monitoring and Laboratory Division performed initial acceptance testing for Arizona, Hawaii, and district offices in California.

While getting monitors installed and operating is a major step, it does not ensure data quality. For example, a monitoring expert with California's South Coast Air Quality Management District—who is also a member of CASAC and Chair of the Association of Local Air Pollution Control Officials (ALAPCO)[6] Monitoring Committee—told us he is concerned about the quality of data being recorded by these first monitors. In March 1999, according to this member, the District found that over 40 percent of the field blanks—filters used to identify contamination inside the monitoring device in the actual field environment—had shown excessive accumulations of dust. Officials from Illinois and New York also told us they are concerned they will not meet the data quality requirements for several monitoring stations for the first quarter of 1999, and some expressed concern about the second quarter of 1999 as well. Additionally, an unknown factor, they said, is how well these monitors will perform in hot, humid, or dusty summertime conditions. EPA officials said that, if such additional problems occur, they will work with the state and local agencies and the manufacturers to resolve any problems as expeditiously as possible. Additionally, EPA officials pointed out that it is primarily due to the agency's extensive $PM_{2.5}$ quality assurance program—instituted before the mass-only monitors were deployed—that state and local agencies have been able to identify some of the operational problems in the deployment of the monitoring network.

State and local agency officials said that manufacturers have been repairing monitors under their warranty provisions. While some said the problems experienced are not unusual for a major new monitoring program of this magnitude, others believed differently. For example, Illinois officials said the equipment malfunctions were severe, and the decision to rapidly deploy the majority of the nationwide network in the first year now meant "massive equipment redesigns and retrofits." While EPA officials agreed that some monitor repairs have been necessary, they disagreed with Illinois' characterization of these problems as massive. The officials noted that both EPA headquarters and regional offices have been assisting the affected state and local agencies in resolving these early program problems. For example, because of the magnitude of the problems encountered, in April 1999 EPA's contracting officer sent letters to the mass-only monitor manufacturers requesting full warranty coverage for an additional 3 months to ensure that the manufacturers' repairs have been successful. EPA officials said the problems encountered did not surface in the agency's initial testing and that the manufacturers have cooperated in repairing monitors under their 1-year warranty provisions.

[6]ALAPCO is a trade association for local air pollution programs.

EPA has also provided state and local agencies with new options for meeting their data quality requirements in the interim while manufacturers work to correct equipment problems, and the agency has increased its funding estimates for monitor operation and maintenance activities, including labor costs.

Some Data Lost Because Spare Monitors Were Not Available

An additional concern relates to the lack of spare monitors. According to state and local agency officials, EPA did not initially provide funding for spare monitors. Therefore, as monitor operational problems have occurred, data have been lost while monitors are shipped back to the manufacturers for repairs. According to CARB officials, provisions should have been made for about 10 percent more monitors to be used as spares, given the agency's plans for widespread deployment in the first year. Similarly, New York air quality officials said that, without spare monitors, they found it necessary to cannibalize two monitors in order to obtain spare parts in an attempt to increase the number of valid samples.

EPA officials agree that initial grants (fiscal year 1998) for the purchase of $PM_{2.5}$ monitors did not include funds to purchase spare monitors. In their opinion, it was more important initially to get the compliance monitors set up and operational at as many sites as possible in the first year, and then later to buy any spare monitors that might be needed. The officials pointed out that, in designing the program, they believed that spare monitors would more likely be needed after the first year when, due to wear and tear, monitors may need major repairs. However, after the early experiences, they said EPA took steps to rectify the problem by approving funds for the purchase of spare monitors in state and local agency grants (fiscal year 1999) for the next round of purchases. EPA has also provided state and local agencies with options for meeting data quality requirements, such as allowing less frequent sampling at problem sites in the interim and using valid results from similar time periods next year to fill current data gaps.

Full Testing of Monitors Not Completed Before Widespread Deployment

Most of the state and local air quality monitoring officials we contacted believe EPA's deployment of the mass-only monitors was too optimistic and that a slower schedule would have been better. In their opinion, slower deployment would have allowed the identification of monitor problems before the bulk of the monitors were operating in the field. They attribute many monitor difficulties to EPA's expedited deployment of mass-only monitors without adequate operational testing performed under actual

field conditions for a full annual cycle before their widespread deployment. Some of the officials said that they informed EPA before deployment that the agency was moving too quickly to authorize the $PM_{2.5}$ mass-only monitors and that they disliked having to purchase the monitors based on prototype design and manufacturer specifications without seeing a production model in operation.

Based on the $PM_{2.5}$ monitoring program's level of complexity and the sensitivity of the measurements, the state and local agencies said they wanted sufficient time to evaluate a few monitors over different seasons and in actual field conditions before making large-scale purchases. For example, CARB officials noted that their agency commented early on that they were concerned about the adequacy of the mass-only monitors and the lack of full field testing.[7] Similarly, New York officials said that the majority of the problems related to the deployment of the monitoring portion of the $PM_{2.5}$ program have resulted from the compressed time frame for implementation. The officials believe that in addition to extensive design development, laboratory testing, and preliminary all-season field testing, the program should have been phased in gradually. Georgia, Illinois, and Texas officials also expressed concern that the deployment schedule was too ambitious, especially considering the sensitivity of the new $PM_{2.5}$ monitoring system and past problems experienced with deploying new monitoring systems for other air pollutants. Most suggested that an alternative "go slow" approach would have saved time and money by eliminating the need for state employees to ship defective monitors back to the manufacturer or to remove and ship defective parts back to the manufacturer. EPA officials acknowledged that this slower approach was preferred by the monitoring community but said other factors—namely public health concerns—were considered in their decision to expeditiously deploy the mass-only monitors. According to EPA, the agency recognized state and local agencies' concerns about the deployment schedule, but EPA relied on testing under the monitor approval process rather than delay the deployment in order to test monitors over a full annual cycle of conditions.

More importantly, some state and local agency officials are concerned that deployment of the more complex and costly speciation monitors without adequate field testing would present even greater challenges than they have faced to date. To help preclude similar problems with future monitors, the officials suggested that EPA take a slower approach to

[7]Full field testing is an evaluation of the monitor under actual field conditions where temperature, humidity, and other factors, such as season of the year, are not simulated.

approving the remaining monitors to ensure that they operate properly under all conditions and all seasons before their widespread use is undertaken. According to EPA officials, the agency recently reevaluated its $PM_{2.5}$ monitoring plans and has extended deployment of the more complex and costly speciation and other monitors an additional year—to December 2000—to allow more time for field testing by state and local agencies, as well as completion of additional work sponsored by EPA in fiscal year 1999.

State and Local Agencies Face Future Resource Challenges

State and local agency officials are generally pleased that EPA has been fully funding the program so far; however, they are concerned about their ability to match the federal grant in future years. With ongoing program costs expected to exceed $42 million annually, the $PM_{2.5}$ monitoring program is the most expensive air monitoring program for a single pollutant in EPA's history, according to agency officials. Once the monitoring program is established and operational, state and local agencies must provide matching funds to operate the $PM_{2.5}$ monitoring program—a requirement that presents significant challenges to them in the future, they said, given the other air quality programs for which they already must provide matching funds.

Some state and local agencies we contacted are uncertain about the amount of matching funds they will have for $PM_{2.5}$ activities in future years. Resource challenges, they believe, could cause them to have to reduce the number of $PM_{2.5}$ monitoring sites they will be able to operate when they have to pay for 40 percent of the program costs. The agencies believe that a technological breakthrough in monitor design is needed to reduce their operating costs. Such a breakthrough occurred in the PM_{10} program[8] when a continuous PM_{10} monitor was developed. EPA officials are aware that this is an expensive program and have said the agency is relying on the current appropriations authority that provides for full federal funding of the $PM_{2.5}$ program through its demonstration phase. The extension of this authority for full funding will mitigate the near-term impact on state and local agencies, they said, and provide an opportunity for advances in monitor design in the intervening years, which could reduce the resource burden state and local agencies will face. The development of a continuous mass monitoring system is a high priority for EPA's Office of Research and Development (ORD), which has a goal of an improved monitor by the end of 2001. EPA allocated about $200,000 to such efforts in fiscal year 1999,

[8]The PM_{10} monitoring program was established in 1987 to monitor for coarse particles 10 microns and smaller.

with increases in funding anticipated for 2000 and 2001. According to ORD officials, this is an appropriate level of federal funding because, due to market incentives, private industry manufacturers are already heavily involved in their own research and development of continuous $PM_{2.5}$ monitors. EPA also noted that an important part of future budget planning will be a review of the availability of new monitoring methods and other scientific advancements, as well as an examination of actual costs for program elements not yet fully implemented.

Conclusions

EPA made numerous changes in its $PM_{2.5}$ monitoring program to respond to the concerns raised by the National Academy of Sciences; however, the agency continued with the rapid deployment of over 800 mass-only monitors without full field testing. This decision led to numerous operational problems discovered only after the monitors were deployed, resulting in some lost and questionable data and unanticipated operational and maintenance expenses. While steps are under way to address current problems, future problems with the other more complex and expensive monitors—if they occurred—would impact data quality, increase labor costs, delay needed health protections, and eventually erode public confidence in the network. To help prevent similar problems from occurring in the future, EPA is delaying its planned deployment of speciation monitors for 1 year to allow more time for field testing. While the additional field testing may identify problems before the monitors are deployed, we believe that EPA should not place an arbitrary time limit on its field tests and should take whatever time is necessary to ensure that future monitors successfully pass full field testing before large-scale deployment is permitted.

Recommendation

We recommend that the Administrator, Environmental Protection Agency, ensure that all remaining monitors planned for the $PM_{2.5}$ network undergo and successfully pass full laboratory and full field testing and evaluation under actual operating conditions to ensure that the monitors meet data quality objectives before large-scale deployment of these monitors is authorized.

Agency Comments

We provided a draft of this report to the Environmental Protection Agency for its review and comment. The agency generally agreed with the overall message of the report, noting that it provides a fair and balanced depiction of EPA's efforts to implement the $PM_{2.5}$ monitoring program. Specifically, EPA

agreed with our conclusion that no arbitrary time limit should be imposed on testing the remaining monitors planned for the $PM_{2.5}$ monitoring network; however, EPA did not comment on our recommendation. EPA also suggested several changes to clarify information in the report, and we incorporated these comments where appropriate. Appendix III contains the full text of the agency's written comments and our responses.

We conducted our review from October 1998 through June 1999 in accordance with generally accepted government auditing standards.

As arranged with your office, unless you publicly announce its contents earlier, we plan no further distribution of this report until 15 days after the date of this report. At that time, we will send copies of this report to the Honorable Carol M. Browner, Administrator, Environmental Protection Agency, and other interested parties. We will also make copies available to others upon request.

If you have any questions regarding this letter, please contact me or David G. Wood at (202) 512-6111. Key contributors to this report were William F. McGee, James R. Beusse, Philip L. Bartholomew, and Richard A. Frankel.

Sincerely yours,

Peter F. Guerrero
Director, Environmental
Protection Issues

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Abbreviations

ALAPCO	Association of Local Air Pollution Control Officials
CARB	California Air Resources Board
CASAC	Clean Air Science Advisory Committee
CENR	Committee on Environment and Natural Resources
EPA	Environmental Protection Agency
FRM	federal reference method
HUD	Department of Housing and Urban Development
IMPROVE	Interagency Monitoring of Protected Visual Environments
NARSTO	North American Research Strategy for Tropospheric Ozone (and Aerosols).
NAS	National Academy of Sciences
NRC	National Research Council
O&M	operation and maintenance
ORD	Office of Research and Development
PM_{10}	coarse particles 10 microns and smaller
$PM_{2.5}$	fine particulate matter smaller than 2.5 microns in diameter
SAB	Science Advisory Board
STAPPA	State and Territorial Air Pollution Program Administrators
VA	Department of Veterans Affairs

EPA's Actions to Address Concerns With the PM 2.5 Monitoring Program

In its March 1998 report,[1] the National Academy of Sciences (Academy) raised eight key concerns about the ambient air monitoring part of the Environmental Protection Agency's (EPA) $PM_{2.5}$ program. Academy representatives said that EPA has made significant changes to the $PM_{2.5}$ program to address many of the key concerns presented in its report. Information on EPA's actions to address these concerns is discussed in this appendix.

1. EPA appeared to be moving forward rapidly with too narrow a focus on $PM_{2.5}$ Federal Reference Method mass-only monitoring

EPA has made significant efforts to broaden its monitoring program focus by involving the scientific community in the speciation and supersite network planning. For example, since the Academy's 1998 report, EPA has sought expert external scientific advice on the siting, sampling, and measurements needed to address health, exposure, and atmospheric research questions and jointly sponsored a workshop with over 200 individuals to further involve the scientific community in EPA's planning for the speciation and supersite monitoring networks. As a result, the agency reevaluated its monitoring plans and decided to slow down the rollout of the speciation monitors and supersites pending greater input from the scientific community. EPA also reduced the number of mass-only monitors planned from 1,392 to 1,094 and increased the number and frequency of analyses at 54 speciation sites. EPA also more than doubled the number of continuous monitoring sites, from 62 to 137, and added plans for up to 9 supersites—an increase of $15 million in EPA's $PM_{2.5}$ monitoring budget. Additionally, EPA tripled the types of analyses to be performed at 108 Interagency Monitoring of Protected Visual Environments (IMPROVE)[2] sites located in national parks and wilderness areas, requiring these monitors to use three different filters instead of the previous single-filter approach. After these changes, EPA's revised plans allocated 57 percent of $65.7 million in fiscal year 1999 $PM_{2.5}$ monitoring funds to efforts designed to better understand $PM_{2.5}$ scientific uncertainties.

EPA continued to move forward rapidly with the $PM_{2.5}$ mass-only monitoring network, largely because of extensive public comments regarding the estimated 15,000 premature deaths annually from fine particles, a

[1]Research Priorities for Airborne Particulate Matter: Immediate Priorities and a Long-Range Research Portfolio, Committee on Research Priorities for Airborne Particulate Matter, National Research Council, National Academy of Sciences (Mar. 1998).

[2]IMPROVE is a joint effort with the Department of the Interior, Federal Land Managers, and state and local agencies.

July 1997 presidential directive to expedite the network, and a provision in the Transportation Equity Act for the 21st Century calling for completion of the compliance portion of the network by December 31, 1999. EPA officials pointed out that, prior to these inducements, the agency had planned for the 1,500 monitors to be deployed over a 3-year period, with about 20 percent deployed the first year, 40 percent the second year, and the remaining 40 percent the third year. However, in July 1997, EPA condensed its original deployment schedule from 3 to 2 years, with over half of the 1,500 monitors to be deployed by December 31, 1998. EPA officials said they were required by regulation to establish a minimum of about 850 federal reference method (FRM) mass-only sites for a complete nationwide network. About 823 FRM mass-only monitors were supposed to be fully operational by December 31, 1998, with the remainder to be installed by December 1999.

2. The relative mix of planned monitoring sites may not adequately support health effects, exposure, and atmospheric modeling research efforts

Since the Academy's report, EPA has reduced the number of planned FRM mass-only sites from 1,392 to 1,094. EPA's revised allocation of fiscal year 1999 $PM_{2.5}$ monitoring funds allocates about $28.5 million to FRM mass-only monitoring; $17.2 million for speciation monitoring; $5.1 million for continuous monitoring; and $15.0 million for supersite monitoring. EPA has delayed the deployment of these supersites in order to more fully integrate supersite planning with its research needs for health risk, exposure assessment, and monitoring advances. Intensive supersite monitoring efforts may run from less than 1 to more than 5 years and are estimated to cost from $1.0 to $3.5 million per site. EPA officials believe this allocation of funds strikes an appropriate balance between regulatory and research needs, taking into consideration that this is the first time that EPA's regulatory program has ever designed an ambient air monitoring program both to determine compliance and to address scientific uncertainties about a pollutant.

The $15.0 million in science and technology funds EPA received in fiscal year 1999 to conduct intensive research monitoring efforts at four to nine supersites was to be used for scientific purposes, but EPA had tremendous discretion in how the $50.7 million in state and local agency grant funds was allocated. By reducing the number of FRM mass-only sites from 1,392 to 1,094, EPA was able to shift about $6.5 million to other efforts. About half, or $3.1 million, of these funds will be used to increase the number

and frequency of analyses performed at speciation sites from sampling once every 6 days to sampling no less often than once every 3 days at 54 speciation sites. Similarly, about $3.4 million of these funds will be used to increase the number of continuous monitoring sites from the 62 originally planned to 137 sites. In addition to helping satisfy regulatory program needs, such as identifying likely $PM_{2.5}$ sources and assessing control strategy effectiveness, the more frequent speciation analyses and additional continuous monitors will help support health effects, exposure, and atmospheric modeling research efforts, according to EPA officials.

3. The current plans for the speciation of particulate matter once every 6 days will not provide useful data for improving risk assessments

A reduction in the number of planned FRM mass-only sites allowed EPA to improve other aspects of the $PM_{2.5}$ monitoring program. For example, EPA will use about $3.1 million of mass-only funds to increase the frequency of speciation sampling from 1 sample every 6 days to daily sampling at 10 major urban area sites, and from 1 sample every 6 days to 1 sample every 3 days at 44 other speciation sites. Additionally, agency officials are considering ways to increase the sampling frequency at another 40 speciation sites located near supersites, with a goal of sampling at least once every 3 days. With respect to the remaining 208 speciation sites where samples will be collected once every 6 days, EPA officials recognize that more frequent data is better, but said that all speciation data—including samples collected once every 6 days—will still be useful to the scientific community.

4. EPA should make greater use of continuous monitors to help determine human exposures and facilitate time-series epidemiological studies

EPA plans to use about $3.4 million of mass-only monitoring funds to increase the number of continuous monitoring sites from 62 to 137—a 121-percent increase in the number of continuous monitoring sites planned. According to agency officials, these additional continuous monitors should help determine human exposures and facilitate time-series epidemiological studies.

5. FRM mass-only samplers will likely not measure some important parameters (nitrates and organic compounds)

EPA officials said the FRM mass-only monitor's limitations were recognized early, but no single sampling device is currently able to accurately measure airborne fine particulate matter. They noted that many factors influenced the decision to use the FRM sampler, including the need to balance sampler cost, ease of use, and ability to produce reproducible measures that can be quality assured. The FRM mass-only sampler also produces data most comparable to the historical epidemiological data base on which the $PM_{2.5}$ standards are based, and loses fewer constituents than most other monitors, according to EPA officials. They also noted that the speciation monitors should measure nitrates and organics, and that the choice of the FRM mass-only monitor was peer-reviewed and approved by the Clean Air Science Advisory Committee (CASAC)[3] Technical Subcommittee for Fine Particle Monitoring in August 1996. The agency's revised plans call for speciation sites to use three types of filters (teflon, nylon, and quartz) to speciate nitrates, organic compounds, sulfates, metals, and other components of the $PM_{2.5}$ mixture. Additionally, the 108 IMPROVE sites in national park and wilderness areas will use these three filters.

6. Future research results may indicate that the monitors are not measuring the most biologically important aspects of particulate matter

EPA officials said that they recognize that future research results may show that the $PM_{2.5}$ monitors are not measuring the most biologically important aspects of particulate matter. However, they believe this determination is years away, and—as noted previously—their assessment of their 1997 regulation is that $PM_{2.5}$ mass should be monitored at a minimum of about 850 sites. Additionally, they pointed out that $PM_{2.5}$ may be a confounding co-contributor to adverse health effects, and measuring $PM_{2.5}$ mass may be the most cost-effective, long-term surrogate measure for a nationwide network. To help address this Academy concern, as noted previously, EPA significantly revised the relative mix of sites to better support health, exposure, and atmospheric modeling research.

[3]CASAC is a permanent subcommittee of the Science Advisory Board established by the Clean Air Act Amendments of 1977.

7. Specific objectives, operating conditions, number, type, and location of monitors should be thoroughly and independently peer-reviewed prior to implementation

EPA officials said they planned to have these aspects of the $PM_{2.5}$ monitoring program independently peer-reviewed prior to implementation. For example, the basic FRM mass-only monitoring network composed of about 1,094 sites was peer reviewed and approved by the CASAC Technical Subcommittee for Fine Particle Monitoring in August 1996. More recently, this subcommittee also peer-reviewed and approved 54 speciation network trends sites, 108 IMPROVE sites, and 2 test supersites in November 1998. EPA plans for the remaining 248 sites to be peer-reviewed before implementation.

8. Interface between monitoring and research on particulate matter is still largely uncoordinated and fragmented

According to EPA officials, the agency coordinates its $PM_{2.5}$ monitoring program internally through a steering committee jointly headed by representatives of the agency's program and research offices. Externally, EPA coordinates its $PM_{2.5}$ monitoring program with key federal programs and activities involved in similar work. These include the North American Research Strategy for Tropospheric Ozone organization, composed of EPA, National Oceanic and Atmospheric Administration, the Department of Energy, and over 50 other public and private institutions; the Health Effects Institute; as well as the IMPROVE steering committee, comprised of EPA, National Park Service, Forest Service, Fish and Wildlife Service, Bureau of Land Management, the Western States Air Resources cooperative, and Northeast States for Coordinated Air Use Management. EPA also coordinates with the State and Territorial Air Pollution Program Administrators/Association of Local Air Pollution Control Officials (STAPPA/ALAPCO) $PM_{2.5}$ committee, the National Academy of Sciences/National Research Council's Committee on Research Priorities for Airborne Particulate Matter, and the Science Advisory Board's CASAC Technical Subcommittee on Fine Particle Monitoring. According to agency officials, they recognize that coordination with some other federal and nonfederal agencies and organizations could be improved and have recently established a formal cross-federal coordination group under the Committee on Environment and Natural Resources to coordinate EPA's $PM_{2.5}$ monitoring and research activities with the National Institute of Environmental Health Sciences; the National Institute of Occupational Safety and Health; the departments of Energy, Defense, Agriculture, and Health and Human Services; the National Oceanic and Atmospheric

Administration; the National Aeronautics and Space Administration; and others. EPA is still developing procedures to ensure optimization of $PM_{2.5}$ data collection activities.

Objectives, Scope, and Methodology

The Chairman, Subcommittee on VA, HUD, and Independent Agencies, House Committee on Appropriations, asked us to describe (1) EPA's actions in response to the National Academy of Sciences' concerns with EPA's planned $PM_{2.5}$ monitoring program and (2) the challenges that state and local agencies face in establishing and operating the $PM_{2.5}$ monitoring program, as well as EPA's response to these challenges.

To describe the actions EPA has taken in response to key concerns identified in the Academy's March 1998 report, we obtained and reviewed EPA's, states', and local agencies' reports, guidance documents, memorandums, and financial data showing the changes that were made. We also interviewed officials from the Academy; the Science Advisory Board's Clean Air Science Advisory Committee; EPA's Office of Air Quality Planning and Standards; EPA's Office of Research and Development; and 5 of EPA's 10 regional offices; six state and local agencies; and the State and Territorial Air Pollution Program Administrators/Association of Local Air Pollution Control Officials (STAPPA/ALAPCO) to gain a better understanding of the actions the agency has taken.

To understand the challenges that state and local air monitoring agencies face in establishing and operating the $PM_{2.5}$ program, we interviewed officials from five states and the nation's largest local program, as well as their respective EPA regional offices. These state and local programs were selected to provide a nationwide representation of the environmental conditions under which the $PM_{2.5}$ monitors would be expected to operate. The selected states were California, Georgia, Illinois, New York, and Texas, and the local program was California's South Coast Air Quality Management District. The selection of these six state and local programs was coordinated with EPA and STAPPA/ALAPCO, both of which agreed before we contacted these agencies that they represented a good cross section of $PM_{2.5}$ monitoring program experiences. Collectively, these six state and local agencies operate 218 of the 823 monitoring sites that were to be deployed by December 31, 1998, or about one-fourth of the sites. We asked representatives from these programs about their experiences with the monitors, including sampling, sample handling and transport, laboratory analysis, and data reporting. We also asked if they had any recommendations they believe would improve the program. We also interviewed officials from the national organization that represents state and local air monitoring programs to gain nationwide perspective on the experience that their other members have had with the $PM_{2.5}$ monitoring program. Additionally, we obtained information from several regional organizations that represent state and local air monitoring agencies to gain

a regional perspective on $PM_{2.5}$ air monitoring experiences and issues. We also interviewed EPA headquarters and regional officials to identify any ongoing or planned mitigating actions to help state and local agencies address the challenges they face in establishing and operating their $PM_{2.5}$ networks.

We conducted our review from October 1998 through June 1999 in accordance with generally accepted government auditing standards.

Comments From the Environmental Protection Agency

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NC 27711

JUL 8 1999

OFFICE OF
AIR QUALITY PLANNING
AND STANDARDS

Mr. Peter F. Guerrero
Director, Environmental Protection Issues
United States General Accounting Office
Washington, DC 20548

Dear Mr. Guerrero:

Thank you for the opportunity to review your draft report entitled "EPA's Actions to Resolve Concerns with the Fine Particulate Monitoring Program." We appreciate the difficulty that assimilating and interpreting such technically-detailed information on an extremely complex subject must have presented. Your report provides a fair and balanced depiction of the Agency's efforts, with the assistance of our State and local partners, to implement a national monitoring program for particulate matter (PM).

As the report correctly acknowledges, following promulgation of the new ambient air quality standards for PM, the Environmental Protection Agency (EPA) placed a premium on rapid deployment of monitoring network given the significant health effects associated with the pollutant and the presidential and congressional directives to expedite implementation of the monitoring program. While additional field testing of available monitoring technology is always desirable, timely deployment of the monitors as our first step to protect public health was of utmost importance. In addition, the speed and accuracy with which EPA 'debugged' and marshaled field acceptance of the PM network compares favorably to other new broad-based technologies deployed nationally. For example, the deployment of the $PM_{2.5}$ monitoring program occurred much more quickly, with many fewer problems, and a much lower relative cost of correction than did the national PM_{10} or the Photochemical Assessment Monitoring Stations (PAMS) network when they were put in place.

In summary, EPA feels that the deployment of the $PM_{2.5}$ ambient monitoring network has been a very successful undertaking to date. A few highlights include:

- In less than a year, the EPA mobilized State and local agencies and the vendor community to certify, manufacture, and deploy nearly 1000 monitors that will establish baseline information on the extent of the $PM_{2.5}$ problem throughout the United States. Despite difficult start up problems, over 90% of these instruments are operational with improvements continuing.

- EPA responded to the research community by implementing midstream adjustments in the $PM_{2.5}$ monitoring program, including a reduction in the number of Federal Reference method (FRM) sites, increased chemical speciation sampling, and active engagement of scientific experts in developing guidance to the monitoring program.

- The Quality Assurance system developed by EPA and implemented jointly by EPA and State and local agencies has successfully identified and led to correction of some initial start-up problems with FRMs, and promises to ensure that data quality objectives are met.

- Based on experiences gained from deploying the FRMs, EPA is working closely with State and local agencies and the research community to deploy a carefully planned, fully tested, and phased-in chemical speciation network.

- EPA is facilitating an unprecedented level of partnerships across regulatory agencies, universities, and industry in developing and deploying the Supersites program which should provide valuable information into understanding the $PM_{2.5}$ phenomenon.

We have a number of specific comments and clarifications for your attention which I have listed and explained below.

See comment 1.

(1) In the first paragraph of the letter to The Honorable James T. Walsh, the sixth sentence reads (italics added): "Such 'mass-only' monitors, while *useful* for determining areas that exceed the $PM_{2.5}$ standard, provide limited data to address the scientific uncertainties about the health effects and health risks of the components comprising the $PM_{2.5}$ mixture."

The 'mass-only' monitors referred to in this sentence are the only measurement method that is currently acceptable for determining compliance with the National Ambient Air Quality Standard for $PM_{2.5}$. We recommend replacing 'useful' with 'essential' to clarify that these 'mass-only' monitors are not really choices among several alternatives for this purpose. None of the available alternatives (speciation, continuous, etc.) for monitoring would be "useful" for this purpose and, therefore, these mass-only monitors are "essential."

See comment 2.

(2) We recommend rewriting the next to the last sentence in the first paragraph of the second page of the report which begins: "Although one of the Academy's concerns was that the agency was moving forward rapidly with too narrow a focus on mass-only monitors, EPA continued its rapid deployment ... ". We understand this line is intended to convey EPA's arguments for timely adoption, and we offer the following edit, which we feel more accurately portrays our views:

"Although one of the Academy's concerns was that the Agency was moving forward rapidly with too narrow a focus on mass-only monitors, EPA continued its rapid deployment for a core network of over 800 mass-only monitors by December 31, 1998 on the basis that 3 years of data from this network were needed for a credible national determination of attainment status with the

new $PM_{2.5}$ standards. EPA officials noted that timely action on network deployment was important given the significant health effects associated with PM (including thousands of premature deaths and serious illnesses), as well as because of presidential and congressional directives to expedite the monitoring network."

See comment 3.

(3) We suggest adding the term 'speciation' to both the fifth and sixth sentences of the second paragraph on page 2 as shown below to make clear to the reader exactly what monitors are being discussed:

"However, state and local agencies remain concerned that the future deployment of the more complex and costly *speciation* monitors without field testing would present even greater challenges. As a result, EPA has re-evaluated its monitoring plans and delayed deployment of the more complex and costly *speciation* monitors an additional year -- to December 2000 -- to allow more time for field testing".

See comment 4.

(4) EPA has established eight national ambient air quality standards for particulate matter and, therefore, we suggest editing the report so that every reference to the particulate matter standards is plural except when you wish to indicate a specific standard (e.g., the annual primary $PM_{2.5}$ standard). For example, the fourth sentence of the first paragraph of the Background section beginning on page 3 should read:

"As a result, EPA is faced with the dual tasks of both implementing the 1997 standard*s* (emphasis added) for particle mass and simultaneously ..."

See comment 5.

(5) We recommend rewriting the second and third sentences of footnote 2 on page 3 to more accurately reflect recent events:

"After further briefing, on June 18, 1999, the Court announced that it was not persuaded that the $PM_{2.5}$ standards should be vacated. On June 28, 1999, EPA appealed the remand decision and hopes to sustain the standards that were remanded. As of the date of issuance of this report, EPA's $PM_{2.5}$ standards are still in place and EPA is continuing with the deployment and operation of the $PM_{2.5}$ fine particle monitoring program".

Now on p. 7.
See comment 6.

(6) We recommend adding the italized parenthetical passage to the first sentence of the last paragraph on page 6 as follows:

"While Fiscal Year 1999 funding for the $PM_{2.5}$ monitoring program was $65.7 million *(including $50.7 million for state and local grants plus an additional $15 million for the Supersites program)*, EPA ..."

Now on p. 7.
See comment 7.

(7) On page 6, the last two full sentences in the last paragraph read: "Additionally, once the program is fully operational, EPA plans to reduce the amount of program costs it covers to about 60 percent of program expenses, and state and local agencies are then to provide matching funds

sufficient to cover 40 percent of program costs. Such a funding arrangement is generally known as a 60/40 match." We recommend replacing the above sentences with the following.

"EPA will assume full funding for the $PM_{2.5}$ network until such time as the Congress determines that States should contribute to the operation and maintenance of the $PM_{2.5}$ network. At that point, States will then be expected to provide approximately 40 percent of the total funding needed to operate the program, assuming that the program will convert to the traditional 105 grant funding approach".

Now on p. 9.
See commment 8.

(8) On page 8, the middle column of item number 7 of Table 2 "Summary of EPA Actions to Address the Academy's Key Concerns" contains the following language summarizing EPA actions: "Objectives, conditions, number and siting criteria for *1,094* (emphasis added) mass-only monitoring network were peer reviewed in August 1996; first 54 speciation sites, 108 IMPROVE sites, and 2 initial Supersites were peer reviewed in November 1998; ...". We recommend deleting the number '1,094' since this specific number of monitors was not a part of the August 1996 peer review and evolved later.

Now on pp. 9-10.
See comment 9.

(9) Consistent with comment (2) above, we suggest modifying the second and third sentences on page 8 which start with "Although the Academy was concerned that the Agency was moving..." as follows:

"Although the Academy was concerned that the Agency was moving forward too rapidly with too narrow a focus on mass-only monitors, EPA officials explained that they continued with the rapid deployment of these monitors primarily because 3 years of data from this network were needed for a credible national determination of attainment status with the new $PM_{2.5}$ standards. EPA officials also noted that timely action on network deployment was important given the significant health effects associated with PM (including thousands of premature deaths)".

Now on pp. 11-12.
See comment 10.

(10) We recommend replacing the last sentence on page 10 that begins "As shown in figure 2 ..." with the following:

"It should be noted that the state and local agencies deployed and successfully operated 70% of the monitors without experiencing any major operational problems. Of the 30% for which problems have been encountered, Figure 2 indicates that about two-thirds of these problems were at the state level, such as difficulties with site installation, hiring staff, and purchasing necessary equipment. About 30% of the operational problems experienced have been due to monitor malfunctions and most of these have been addressed".

Now on p. 13.
See comment 11.

(11) In the third sentence in the second paragraph on page 12, we suggest replacing the word 'promised' with 'expected' as follows:

" For example, in addition to being nearly two months later than *expected* [emphasis added], officials of the California Air Resources Board's (CARB) Monitoring and Laboratory Division told us..."

Now on p. 13.
See comment 12.

(12) Also in the second paragraph on page 12, we recommend replacing the fifth sentence which begins "The late deliveries were due to ...." with the following:

"The late deliveries were due to the length of time it took EPA to get final versions of samplers and full documentation from the manufacturers thus delaying testing for designation and approval for use in the $PM_{2.5}$ monitoring program."

Now on p. 16.
See comment 13.

(13) On page 15, we suggest adding the following sentence at the end of the first paragraph:

"EPA recognized the concern about the deployment schedule but relied on testing performed under the monitor designation process rather than delay the deployment to test instruments over a full annual cycle of conditions."

Now on p. 17.
See comment 14.

(14) We recommend deleting the phrase 'and certified as equivalent to the federally approved monitor' from the fifth sentence in the second paragraph on page 16 that begins "Such a breakthrough occurred in the PM_{10} program ...".

Now on p. 17.
See comment 15.

(15) The sixth sentence in the second full paragraph on page 16 in the section entitled, State and Local Agencies Face Future Resource Challenges reads as follows. "The extension of this authority for full funding, if approved, will mitigate the near-term impact on state and local agencies, they said, and provide an opportunity for advances in monitor design in the intervening years, which could reduce the resource burden state and local agencies will face." We suggest deleting ", if approved," from this sentence. The FY 1997 Congressional appropriations language provided the authority to fully fund the $PM_{2.5}$ monitoring network. This authority remains in effect until revised by Congressional appropriations action.

Now on p. 18.
See comment 16.

(16) On page 17, the last sentence in the section entitled "Conclusions" reads: "While the additional field testing may identify problems before the monitors are deployed, we believe that EPA should not place an arbitrary time limit on its field tests and should take whatever time is necessary to ensure that future monitors successfully pass full field testing before large scale deployment is permitted."

We agree with this conclusion and believe that no 'arbitrary' time limit should be imposed. In establishing the current extended schedule for deployment of the speciation monitoring network, EPA has attempted to define a time limit on field tests that balances the need for adequate equipment testing with the need to provide data for use in later State Implementation Plan development activities and in planned health effects research activities. This schedule will allow

EPA to ensure that all remaining monitors planned for the $PM_{2.5}$ network are fully tested and shown to meet Data Collection Objectives before large scale deployment of these monitors is authorized.

Now on p. 26.
See comment 17.

(17) On page 24 under key concern 8. Interface between monitoring and research on particulate matter is still largely uncoordinated and fragmented, we recommend the following revisions as shown below:

(a) Change the second and third sentences to read: "Externally, EPA coordinates their $PM_{2.5}$ monitoring program with key federal programs and organizations involved in similar work. These include the North American Research Strategy for Tropospheric Ozone organization, composed of EPA, the National Oceanic and Atmospheric Administration, the Department of Energy and over 50 other public and private institutions, the Health Effects Institute, as well as the IMPROVE committee..."

(b) Change the fifth sentence to read: "According to agency officials, they recognize that coordination with some other federal and nonfederal agencies and organizations could be improved, and have recently established a formal cross-federal coordination group under the Committee on Environment and Natural Resources to coordinate EPA's $PM_{2.5}$ monitoring and research activities with the National Institute of Environmental Health Sciences, the National Institute of Occupational Safety and Health, the Departments of Energy, Defense, Agriculture and Health and Human Services, NOAA, NASA and many other federal programs."

Again, we appreciate the opportunity to review and comment on your draft report. If you have any questions about these recommendations and/or need to further discuss any matters related to deployment of the $PM_{2.5}$ monitoring network, please do not hesitate to contact me or David Mobley, Acting Director of the Emissions, Monitoring and Analysis Division.

Sincerely,

for John Seitz
Director
Office of Air Quality Planning
and Standards

The following are GAO's comments on EPA's letter dated July 8, 1999. They are numbered in accordance with the numbered comments in EPA's letter.

GAO's Comments

1. This sentence was amended to state that mass-only monitors are required for determining areas that exceed the $PM_{2.5}$ standards, since it is EPA's own regulations that require their use.

2. EPA's views have been added to this section of the report.

3. As suggested, we added the term "speciation" to clarify that the more complex and costly monitors that have yet to be deployed are speciation monitors.

4. We agreed with this comment and have revised the report accordingly.

5. We changed footnote 2 to update the status of court rulings about EPA's particulate standards and the status of EPA's appeals.

6. This sentence was clarified to show that state and local agencies received $50.7 million of the $65.7 million in $PM_{2.5}$ monitoring funds for fiscal year 1999 and that EPA's supersites monitoring effort received $15.0 million of these funds.

7. See comment 4.

8. See comment 4.

9. The statements suggested by EPA have not been included because this section already appropriately addressed these issues.

10. This section was clarified to show that state and local agencies nationwide have had operational problems with about 30 percent of the monitors deployed and, for those monitors that have had problems, the types of obstacles that state and local agencies have experienced.

11. See comment 4.

12. EPA views have been added to this section and attributed to EPA.

13. See comment 12.

14. See comment 4.

15. See comment 4.

16. EPA's agreement with our conclusions has been noted in the agency comments section of the report.

17. See comment 4.

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