

July 25, 2000

EPA-SAB-CASAC-ADV-00-006

Honorable Carol M. Browner
Administrator
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, NW
Washington, DC 20460

Subject: Clean Air Scientific Advisory Committee (CASAC) Advisory on the PM_{2.5} Monitoring Network

Dear Ms. Browner:

The Clean Air Scientific Advisory Committee (CASAC) of EPA's Science Advisory Board reconstituted its Technical Subcommittee on Fine Particle Monitoring (the "Subcommittee"), at the Agency's request, to provide advice and commentary on the Agency's fine particulate matter (PM_{2.5}) monitoring program. The Subcommittee, chaired by Dr. Phil Hopke of CASAC, met with Agency staff on April 18-19, 2000 for another in a continuing series of discussions as the monitoring program is designed and implemented. The attached Subcommittee report has been reviewed and approved by the full CASAC.

This Subcommittee report conveys CASAC's view that the most appropriate role for the Subcommittee is to respond to questions posed by the Agency and provide additional advice and commentary in a continuing, participatory, and pro-active manner. The working relationship between CASAC and the NAS/NRC Committee on Research Priorities for Airborne Particulate Matter was described in the previous report of the Subcommittee that the CASAC endorsed to you in January 1999 (*CASAC Advisory on the PM_{2.5} Monitoring Program*, EPA-SAB-CASAC-ADV-99-002, January 28, 1999).

The attached report summarizes the Subcommittee's technical advice regarding issues posed by the Agency, and provides additional comments on related issues. Two separate Notifications of a Consultation concerning the Subcommittee's discussions with the Agency on thermal carbon analysis and the sampler intercomparison study have been produced and forwarded to you under separate cover to acknowledge CASAC's ongoing participation in these issues (EPA-SAB-CASAC-CON-00-006 and EPA-SAB-CASAC-CON-00-007, respectively).

The CASAC is pleased to establish an interactive advisory relationship with the Agency through this Subcommittee, and looks forward to assisting the Agency in optimizing the design and implementation of its fine particle monitoring system and the utility of the information that system will provide.

We look forward to your response.

Sincerely,

/s/

Dr. Joe L. Mauderly, Chair
Clean Air Scientific Advisory Committee

Enclosure

**U.S. Environmental Protection Agency
Science Advisory Board
Clean Air Scientific Advisory Committee (CASAC)**

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Report of the
Clean Air Scientific Advisory Committee (CASAC)
Technical Subcommittee on Fine Particle Monitoring

May 8, 2000

Dr. Joe L. Mauderly, Chair
Clean Air Scientific Advisory Committee (CASAC)
USEPA Science Advisory Board
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, NW
Washington, DC 20460

Subject: Advisory on the PM_{2.5} Monitoring Network

Dear Dr. Mauderly:

The Technical Subcommittee on Fine Particle Monitoring of the Clean Air Scientific Advisory Committee (CASAC), met on April 18 and 19, 2000 to conduct an Advisory on the PM 2.5 Monitoring Network, in a public meeting in Research Triangle Park, NC.

There were three issues that were brought to the Subcommittee's attention for our advice and recommendations: a) the deployment and future plans for the PM_{2.5} monitoring network; b) the approach to be used for the analysis of carbon species in samples collected in the chemical speciation monitoring network; and c) the sampling strategy for coarse particles should a coarse particle NAAQS be developed in the 2002 standard setting process.

The PM monitoring network includes the compliance mass monitoring network, the chemical speciation network, and the supersites. Each network is currently in a different stage of deployment. Most of the mass monitors are in place. Initial data capture rates are reasonable for such a rapid implementation process, and it appears that the data completeness is improving as experience is gained in sampler operation. The data quality indicators provided suggest that the precision of the samplers and related mass determinations are very good. This high precision is likely to result from the stringent protocols developed for the Federal Reference Method (FRM) measurements. The use of co-located samplers and the Performance Evaluation Program (PEP) audits appear to contribute to this precision. However, with increased experience, it is clear that the current procedures put a substantial burden on the state and local agency personnel who are responsible for servicing the samplers. Thus, the Subcommittee recommends that the FRM procedures be assessed to determine if some of the rigidity in the sample handling, and accompanying difficulties in implementation, could be reduced with a negligible loss of precision. For example, could the 96 hour waiting period be extended? Is shipment in coolers with "blue ice" necessary? Limited relaxation of the requirements could result in significant cost savings in the labor required to perform the sampling while maintaining adequate precision in the measurements to meet the data quality objectives.

A limited test of the operation of chemical speciation samplers by state and local air quality agency personnel is currently underway following the initial tests in four cities and at the Atlanta

supersite. The remainder of the National Trends Network will be deployed later this year, and the rest of the samplers for the state and local agencies will be acquired and sited next year. The process has been slowed from initial plans based on advice provided by this Subcommittee and other advisory bodies to make more extensive tests of the sampler performance and field operation. These tests have clearly been helpful in identifying and removing problems before extensive deployment occurs, and the start-up of the speciation network appears to be proceeding well. The immediate issue in the network development is the desire to coordinate some of the state and local sites with the activities of the supersites and with sites deployed by other jurisdictions. Efforts have been initiated to facilitate that coordination.

One of the difficulties in the implementation of the chemical analysis plans that have been made for the samples from the Chemical Speciation Network is the determination of carbon species. These species classifications are commonly designated as Organic Carbon (OC) and Elemental Carbon (EC) are operationally defined, and there are currently two widely used methods. These methods are known as the IMPROVE and National Institute of Occupational Safety and Health [NIOSH] protocols. Although these protocols use different techniques to correct for pyrolysis of the organic carbon during the initial part of the analysis cycle, the primary difference is in the temperature cycles applied to the samples. In particular, in the NIOSH method, the sample is heated to 850°C in helium (He) while the IMPROVE protocol does not include a high temperature step in the OC determination. Recent results suggest that the reason that the IMPROVE procedure assigns more mass to elemental carbon relative to the NIOSH method is that the material evolved under these 850°C/He conditions evolves only at the high temperatures that are applied by IMPROVE protocol in the Elemental Carbon (EC) portion of the procedure. Thus, the two methods, as commonly applied, produce significantly different values for the OC and EC fractions. EPA has proposed to separately report the lower temperature He atmosphere results as OC, the 850°C/He material as a separate entity, and the EC as the high temperature helium-oxygen atmosphere material. Thus, in order to compare with earlier IMPROVE results, this 850°C/He peak can be added to the EC. The Subcommittee concurs with this proposal. However, further study on the issue is highly recommended. Thus, there is the problem of potentially overestimating the OC because of the high temperature step in the NIOSH method. It has been observed in some cases particularly for rural samples that the reflectivity or transmissivity of the filter returns to the initial value before initiating the step with oxygen in the support gas. Anecdotal evidence suggests a difference between rural and urban samples. There can also be absorption of gaseous compounds onto the quartz filter. These effects may result in an overestimation of the OC. This "positive artifact" problem of OC on quartz fiber filters should be examined, with respect to differences, if any, that are observed between the two OC/EC methodologies.

In addition, the Subcommittee recommends the study of the comparability of light absorption methods with OC/EC measurements. As part of these studies, the comparability of continuous light absorbing monitors with integrated measurements should be made, as well as the consistency of the total carbon measurements made with continuous monitors. The aim of these studies would be the assessment of the difference between total carbon and light-absorbing carbon as a measure of organic carbon. The goal would be to move toward continuous monitors that provide more complete data with lower operational costs if acceptable comparability can be demonstrated.

With respect to OC/EC determinations, the Subcommittee recommends that calibration standards rather than reference materials be developed for the calibration of these methods. A reference material would be samples of material comparable to ambient samples containing known concentrations of organic

and elemental carbon. Because of the extreme difficulties in sampling and preserving ambient fine particles that are truly representative of the materials that would be encountered in the atmosphere, the effort to develop ambient aerosol reference materials is probably misguided. The development of reproducible calibration standards would be more useful at this time. In addition, standards for calibration of continuous total carbon analysis systems are also badly needed.

The cooperative agreements to establish and operate the seven Phase II supersites have been awarded, and the investigators are in the process of organizing their individual operations. There are concerns with respect to having a sufficient core of common measurements at all of the sites to provide a strong data base for some uses such as air quality model evaluation. The Office of Air Quality Planning and Standards (OAQPS) is making an effort to develop a more consistent set of core measurements. At this point, a specific set of measurements has not been developed, and thus the Subcommittee cannot comment on the appropriateness of the measurements included or excluded. Should the Agency develop such a list, the Subcommittee could be asked to provide more specific advice with respect to its adequacy. The Agency has made a good effort to develop voluntary collaborations among the supersites and, to the extent possible, between supersites and other components of the PM monitoring and research programs, such as the PM Health Effects Research Centers. Follow-up of these initial efforts will be needed to develop and maintain the links that have been initiated, and the Subcommittee is heartened to see that there seems to be a strong commitment to make this effort.

Continuous monitoring efforts are currently being deployed primarily for providing the data for determining the Air Quality Index (Federal Register (FR), *Air Quality Index Reporting; Final Rule*, Vol. 64, No. 149, Wednesday, August 4, 1999, pp. 42530-42549). However, there is not currently a strong effort to develop the Quality Assurance/Quality Control (QA/QC) and calibration methods to move them toward an eventual replacement for the current FRM measurements. Substantial gains in data completeness would be obtained by having an equivalent continuous mass monitoring method. Such data would be highly useful both in assessing health effects and atmospheric processes. It would also lead to lower costs of network operation, and more complete data for decision-making purposes. The Subcommittee suggests that the current criteria for equivalency of continuous mass (particularly Class III Equivalency) methods may be too rigid and difficult to attain relative to the significant gains in data completeness and operational costs that would derive from the use of such samplers. Thus, the Subcommittee strongly recommends that we discuss this matter at a meeting called for that purpose in the near future.

The final issue was how to develop a coarse particle FRM sampler. Because of the U.S. Court of Appeals for the District of Columbia Circuit's May 14, 1999 decision to vacate the revised coarse particle (PM₁₀) standard and EPA's subsequent decision not to contest the ruling, some measure of coarse particles will have to be the indicator rather than PM₁₀. There is, therefore, a need to have a measurement method that will be used to ascertain compliance with any new coarse particle standard to be promulgated in the future. In the presentation made to the Subcommittee, the Agency presented a number of options. Most of these options were not practical to pursue given the target date of 2002 for promulgation of revised PM NAAQS for fine and coarse particles. The options that could lead to a coarse particle sampling system were based on modification of the existing PM_{2.5} FRM sampler. This PM_{2.5} sampler configuration already incorporates many of the key features that are needed in a FRM sampling system, such as volumetric flow control, and would not require as extensive laboratory and field testing as would be required for any other new sampler. One option is to replace the WINS impactor

with a straight tube so that the sampler collects PM_{10} instead of $PM_{2.5}$. This option would require two samplers ($PM_{2.5}$ and PM_{10}) to run side-by-side and the coarse particle fraction would be calculated by difference. The Subcommittee agrees that the precision of the originally designated PM_{10} samplers is insufficient to permit a difference measurement that would provide a meaningful indicator of coarse particles. However, concern was raised with the problem of mixing coarse and fine in the PM_{10} sample. There are cases where the acidic fine particles will chemically react with materials in the coarse particles, resulting in the volatilization of some of the collected particulate matter.

Another option was to utilize a polyurethane foam (PUF) plug in the WINS impactor as a collection surface instead of oil. The weight gain in the PUF plug can provide the coarse particle mass measurement. This approach also provides separate samples of the coarse and fine particles, eliminating any chemical reaction problems. However, it might adsorb gaseous components of the atmosphere. Also it is not clear that the PUF placement can be automated, and thus it might represent significantly more effort in the field for the technicians servicing the instruments. It will also require more extensive testing to determine the effect of the change in the coarse particle collection surface on the characteristics of the PM_{2.5} samples. However, it appears to be an alternative worthy of careful exploration.

In any case, the Subcommittee wants to express its strong support for a change in the basic approach to monitoring particles in both the coarse or fine size fractions in that the emphasis should be on development of continuous monitoring methods over integrated filter methods. It is clear that there have been substantial technological developments in continuous mass monitoring approaches, and the Agency needs to move as rapidly as practical toward implementation of continuous monitoring methods of particulate matter as is now used for most of the other criteria pollutants. Such continuous methods provide a wealth of additional data that are not available with the current limited frequency integrated mass measurements by FRM samplers. It also provides a significant cost savings in network operations for the state and local agencies that are required to operate and maintain these networks. As an initial step in this direction, the Subcommittee reiterates its desire to meet with the Agency soon to discuss the problems associated with the current criteria for equivalency of continuous monitors for PM_{2.5} to the FRM monitor.

Sincerely,

/s/

Dr. Philip Hopke, Chair
Technical Subcommittee on Fine Particle Monitoring
Clean Air Scientific Advisory Committee

**U.S. Environmental Protection Agency
Science Advisory Board
Clean Air Scientific Advisory Committee
CASAC Technical Subcommittee for Fine Particle Monitoring
April 18-19, 2000 Meeting**

Chair

Dr. Phil Hopke, Clarkson University, Potsdam, NY (Member of CASAC)

Members of CASAC

Dr. John Elston, State of New Jersey, Dept. of Environmental Protection & Energy, Trenton, NJ

Dr. Warren White, Washington University, St. Louis, MO

Members of Other SAB Committees

Dr. JoAnn Lighty, University of Utah, College of Engineering, Salt Lake City, UT (Member and Liaison from SAB Environmental Engineering Committee)

Dr. Morton Lippmann, Nelson Institute of Environmental Medicine, New York University, Tuxedo, NY

Consultants to CASAC

Dr. Petros Koutrakis, Harvard University, Boston, MA

Dr. Debra Laskin, Environmental & Occupational Health Sciences Institute, Rutgers University, Piscataway, NJ (Did not attend meeting)

Dr. Peter H. McMurry, University of Minnesota, Department of Mechanical Engineering, Minneapolis, MN

Dr. Kimberly A. Prather, Department of Chemistry, University of California-Riverside, Riverside, CA

Dr. Carl M. Shy, Department of Epidemiology, University of North Carolina at Chapel Hill, School of Public Health, Chapel Hill, NC

Dr. George T. Wolff, General Motors, Corporate Affairs, Detroit, MI (Did not attend meeting)

Mr. Mel Zeldin, Monitoring and Analysis Division, South Coast Air Quality Management District (SCAQMD), Diamond Bar, CA

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