UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NC 27711

August 19, 2005

MEMORANDUM

SUBJECT: CASAC Review of Particle Methods and Data Quality Objectives

FROM: Phil Lorang /s/ Phil Lorang
Acting Group Leader
Ambient Air Monitoring Group
Office of Air Quality Planning and Standards (D243-02)

TO: Fred Butterfield
Designated Federal Officer
Clean Air Scientific Advisory Committee
EPA Science Advisory Board Staff Office (1400F)

Attached are materials for information and review by the Clean Air Scientific Advisory Committee's (CASAC) Ambient Air Monitoring and Methods (AAMM) Subcommittee. These materials will be the subject of a peer review and consultation by the AAMM Subcommittee, scheduled for a public meeting to be held in Durham, NC on September 21-22, 2005. The peer review will focus on a $PM_{10-2.5}$ federal reference method (FRM), while the consultation will cover field evaluation of $PM_{10-2.5}$ methods, optimization of the $PM_{2.5}$ FRM, equivalency criteria for $PM_{2.5}$ continuous methods, monitoring data quality objectives for $PM_{10-2.5}$, and equivalency criteria for $PM_{10-2.5}$ continuous methods. I am requesting that you forward these materials to the AAMM Subcommittee to prepare for the consultation.

This project, entitled *Particle Methods and Data Quality Objectives*, has been requested by EPA's Office of Air Quality Planning and Standards (OAQPS), within EPA's Office of Air and Radiation, in anticipation of potential revisions to the particulate matter (PM) National Ambient Air Quality Standards (NAAQS). Consistent with the approach described in the PM Staff Paper, the measurement of coarse particles is intended to focus on those particles in the ambient air with a nominal diameter in the range of 2.5 to 10 micrometers (*i.e.*, $PM_{10-2.5}$, or the thoracic coarse particle fraction of PM_{10}).

The peer review of a $PM_{10-2.5}$ FRM will provide scientific advice for the EPA prior to proposing a monitoring method for a potential $PM_{10-2.5}$ standard. Charge questions associated with this peer review are provided below.

The consultation on the field evaluation of $PM_{10-2.5}$ methods will solicit Subcommittee comment on field studies associated with the testing and development of $PM_{10-2.5}$ monitoring

technologies. The consultation on the optimization of the $PM_{2.5}$ FRM will assist EPA in considering whether to propose improvements to this method that would reduce the burden on State, local, and Tribal monitoring agencies in operating the $PM_{2.5}$ monitoring network while maintaining designed data quality. The consultation on the equivalency criteria for $PM_{2.5}$ continuous methods will provide the first CASAC review of a new approach being considered for defining the metrics and tolerances for approval of candidate equivalent $PM_{2.5}$ continuous methods and approved regional methods. The consultation on the $PM_{10-2.5}$ monitoring data quality objectives (DQOs) includes an update on additional analysis performed on the advice of the CASAC AAMM Subcommittee provided during OAQPS's July 2004 consultation with the Subcommittee. The consultation on the equivalency criteria for $PM_{10-2.5}$ will focus on our initial thoughts on how these criteria can be developed, building on the new $PM_{2.5}$ equivalency criteria and the $PM_{10-2.5}$ monitoring DQOs. Charge questions associated with each part of the consultation are provided below.

The upcoming peer review and consultation will support the EPA by providing scientific advice as the EPA Administrator considers potential revisions to the PM NAAQS; a notice of proposed rulemaking is to be signed by December 20, 2005. To meet this date, which is governed by a consent decree, we are requesting that CASAC expedite its peer review of the $PM_{10-2.5}$ FRM. Although the consultation part of this review does not call for a consensus statement, we are requesting each of the members to provide his or her individual written comments as soon on an expedited schedule as well.

Following peer review and consultation, the Agency will issue a proposed rulemaking with regard to our review of the PM NAAQS, together with a proposed rulemaking on an FRM for $PM_{10-2.5}$, should the EPA Administrator propose new coarse particle standards. Further review of $PM_{10-2.5}$ measurement methods and associated monitoring activities by the AAMM Subcommittee may be appropriate for future consideration, taking into account the outcome of the upcoming peer review and consultation and decisions by the EPA Administrator to propose new or revised PM standards.

Document Associated with Subcommittee's Peer Review of a $PM_{10-2.5}$ FRM:

- **Attachment 1** – *Summary and Rationale for $PM_{10-2.5}$ FRM*

Background and Summary: At multiple locations covering a variety of aerosols and climates EPA researchers have conducted field studies of commercially available $PM_{10-2.5}$ methods. These field studies have demonstrated the utility of various $PM_{10-2.5}$ methods to support multiple monitoring objectives for a potential $PM_{10-2.5}$ standard. Although there are many monitoring objectives to consider, one or more $PM_{10-2.5}$ methods must be capable of supporting three overall objectives: (1) being used as the basis of comparison for all $PM_{10-2.5}$ methods approved in the network — typically defined as the FRM; (2) characterizing chemical composition of $PM_{10-2.5}$; and (3) providing highly time-resolved $PM_{10-2.5}$ data necessary to support a $PM_{10-2.5}$ standard that may only include a daily component and for use in characterizing short-term episodes of PM. The field studies conducted have demonstrated that the filter-based difference method (operation of separate low-volume FRMs for PM_{10} and $PM_{2.5}$ and calculating $PM_{10-2.5}$ by difference)

has better data quality compared to other commercially available methods. Considering that this method utilizes well-established reference method samplers, whose designs accurately provide upper and lower size fractionation curves, using the numerical difference between PM_{10} concentrations and $PM_{2.5}$ measured by collocated concurrent reference method samplers, the difference method is a fundamentally sound method for measuring 24-hour $PM_{10-2.5}$ concentrations. The filter-based difference method is also capable of supporting chemical characterization of collected samples. Despite these advantages, the Agency does not envision widely deploying the difference method since continuous $PM_{10-2.5}$ methods are expected to be the most useful monitoring technologies in support of a potential daily $PM_{10-2.5}$ standard. The difference method is expected to be useful in approving those continuous $PM_{10-2.5}$ methods and in on-going quality assurance of continuous methods.

Documents Associated with Subcommittee's Consultation:

- **Attachment 2** – *Multi-Site Evaluations of Candidate Methodologies for Determining Coarse Particulate Matter ($PM_{10-2.5}$) Concentrations: August 2005 Updated Report Regarding Second-Generation and New $PM_{10-2.5}$ Samplers*

Background and Summary: Since the AAMM Subcommittee last consulted with EPA on $PM_{10-2.5}$ methods in July of 2004, modifications have been made to a few of the methods tested and new monitors have been added to EPA's PM methods development testing. Since the modifications to the methods took several months to complete, only one additional 30-day field study has been completed. This study was performed in April and May of 2005 at the same Phoenix site as previous field studies with the $PM_{10-2.5}$ methods. This study included an evaluation of several methods for the mass measurement of $PM_{10-2.5}$ in the ambient air, including filter-based and continuous monitoring technologies. As the primary basis of comparison, a discrete difference method was used (operation of separate low-volume FRMs for PM_{10} and $PM_{2.5}$ and calculating $PM_{10-2.5}$ by difference). A second filter-based, time-integrated method was tested that involved the use of a sequential dichotomous sampler. Five continuous $PM_{10-2.5}$ monitoring methods with a time resolution of one hour or less were also tested. Three of these technologies have been tested in previous EPA-ORD study's on $PM_{10-2.5}$ methods: a commercially available system based on beta attenuation; a sampler using tapered element oscillating microbalance (TEOM) technology; and an aerodynamic particle sizer (APS). Two new continuous technologies were tested in this study: a sampler employing the Filter Dynamic Measurement System (FDMS) technology with use of a virtual impactor for the concurrent measurement of $PM_{2.5}$ and $PM_{10-2.5}$ and a Grimm optical aerosol spectrometer. In addition, a limited set of $PM_{10-2.5}$ speciation samples were collected for diagnostic purposes using PM_{10} FRMs, $PM_{2.5}$ FRMs, and dichotomous samplers. The report provides an examination of these methods under one general set of conditions and should therefore be carefully interpreted. However, the results of this study combined with notes on how samplers were modified and the data from earlier studies can lead to broader

interpretation of the applicability of these methods to support a potential $PM_{10-2.5}$ monitoring network.

- **Attachment 3 –** *Memo to PM NAAQS Review Docket (OAR-2001-0017) – Potential changes being evaluated for the $PM_{2.5}$ Federal Reference Method*

Background and Summary: Since the deployment of the $PM_{2.5}$ monitoring network EPA has been working with State and local agencies on issues regarding implementation of the FRM method. While much of the $PM_{2.5}$ FRM is working well, some aspects of the method may need to be updated to reflect what the EPA and State and local agencies have learned since its implementation. With the PM standards being reviewed, it is appropriate to consider modifications to the $PM_{2.5}$ FRM that would be neutral with respect to bias, but improve the operation and maintenance aspects of on-going operation. The EPA staff identified four potential changes to the FRM for consideration. These include: (1) adopting the Very Sharp Cut Cyclone (VSCC) as an approved second-stage impactor, given that the VSCC is already approved as an *equivalent* method second-stage impactor; (2) utilizing an alternative oil identified as dioctyl sebacate (DOS) for use in the Well Impactor Ninety-Six (WINS), should this impactor be retained as a part of the FRM; (3) extending the maximum allowed time to recover filters from samplers; and (4) modifying the filter transport temperature and post-sampling time requirements for final laboratory analysis.

- **Attachment 4 –** *Criteria for Designation of Equivalence Methods for Continuous Surveillance of $PM_{2.5}$ Ambient Air Quality*

Background and Summary: As a follow-up to previous interactions with the CASAC's subcommittee on particle monitoring (EPA-SAB-CASAC-LTR-02-01, March 1, 2002), the Subcommittee recommended "…EPA undertake a thorough DQO process to determine the needs for monitors so that FEM requirements can be defined based on a clearly defined set of data quality needs." EPA staff has been working on this over the last few years and has developed new draft criteria that could be used to approve candidate federal equivalent $PM_{2.5}$ continuous methods. These criteria have been developed following a DQO process that ties potential new criteria with existing DQO's for the $PM_{2.5}$ monitoring network. Initial work on this project is described in the document *Data Quality Objectives for PM Continuous Methods*, TR-4423-03-08, June 2003. Additional work on this project is described in the document *Data Quality Objectives for PM Continuous Methods II*, TR-CAN-04-02, June 2004. Both of these documents were used in the development of attachment 4 - *Criteria for Designation of Equivalence Methods for Continuous Surveillance of $PM_{2.5}$ Ambient Air Quality*, September 2004. All of these documents are available on EPA's web site at: http://www.epa.gov/ttn/amtic/casacinf.html.

- **Attachment 5** - *Sensitivity of the $PM_{10-2.5}$ Data Quality Objectives to Spatially Related Uncertainties*

Background and Summary: At the CASAC AAMM Subcommittee's July 22, 2004, consultative meeting, the use of a DQO approach was presented as it related to developing the appropriate measurement quality objectives for $PM_{10-2.5}$. DQOs are qualitative and quantitative statements that help define the appropriate type of data, and specify the tolerable levels of data uncertainty. In general, EPA received positive feedback on the DQO approach. Some specific comments were implemented; others required a more detailed assessment. In addition to the submissions from a number of Subcommittee members, it was also suggested at the meeting to look at the effects of spatial variability and multi-modal distributions. This report presents the techniques that were used to address these two issues, how they were incorporated into the DQO tool, and how these components of variability might affect the performance curves. Preliminary performance curves were assessed for their sensitivity to the input parameters. The assessment found that for a daily standard the performance curves were most sensitive to sampling frequency, followed by the completeness, the population coefficient of variation (CV) of the coarse fraction of particulate matter, and the ratio of the mean concentrations between the coarse and fine fractions of particulate matter. The effect of multi-modal distributions was very small. The effect of spatial variability is small compared to the parameters mentioned above, but EPA suggests including this parameter in the DQO evaluation. Appendix A to the attachment provides more detail on the models used.

- **Attachment 6 –** *$PM_{10-2.5}$ Method Equivalency Development*

Background and Summary: This document ties the work performed in developing equivalency criteria for $PM_{2.5}$ continuous methods together with the network DQOs being developed for $PM_{10-2.5}$. This work presents a first look at potential $PM_{10-2.5}$ equivalency criteria. The document does not attempt to repeat all the information presented in the development of the $PM_{2.5}$ equivalency criteria. The results demonstrate that reasonable criteria for approval of candidate continuous methods can be developed to support a daily standard for $PM_{10-2.5}$. Although these criteria provide an option for equivalency criteria that could meet potential DQOs, EPA expects to further refine the equivalency criteria based upon final decisions on a $PM_{10-2.5}$ standard, including: level and form; final decisions on the $PM_{10-2.5}$ DQOs; and the capabilities of commercially-available monitoring technologies for $PM_{10-2.5}$.

Charge to the AAMM Subcommittee

The purpose of the upcoming CASAC AAMM Subcommittee meeting is to provide a peer review of the filter-based difference method for the $PM_{10-2.5}$ FRM and consultation on several aspects of the PM methods that will help inform the Agency's selection of PM measurement methods as part of its ongoing review of the PM NAAQS. Accordingly, the Agency requests that the Subcommittee focus on the following questions in its review:

Peer Review Questions:

Questions associated with Attachment 1 – Selection and technical summary of $PM_{10-2.5}$ FRM:

1. What are the scientific and operational strengths and weaknesses of the $PM_{10-2.5}$ difference method relative to other options for a proposed FRM, especially when used as the basis for approval of other methods?

2. Based on the field study report as well as any other available data, *e.g.*, data from State and local agencies, how does the demonstrated data quality of the $PM_{10-2.5}$ difference method support or detract from it being proposed as a FRM?

Consultation Questions:

Question associated with Attachment 2 – EPA's Multi-Site Evaluations of Candidate Methodologies for Determining Coarse Particulate Matter ($PM_{10-2.5}$) Concentrations: August 2005 Updated Report Regarding Second-Generation and New $PM_{10-2.5}$ Samplers:

1. Based upon the latest available field study data, which $PM_{10-2.5}$ methods have both sufficient utility to meet one or more important monitoring objectives and appropriate data quality to be considered for deployment as Federal Equivalent Methods (FEMs) or speciation samplers in a potential $PM_{10-2.5}$ monitoring network?

Questions associated with Attachment 3 – Memo to PM NAAQS Review Docket (OAR-2001-0017) – Potential changes being evaluated for the $PM_{2.5}$ Federal Reference Method

2. What are the Subcommittee's views on the Very Sharp Cut Cyclone (VSCC) being approved as an alternative second-stage impactor to the Well Impactor Ninety-Six (WINS) for use on a $PM_{2.5}$ FRM?

3. To what extent are the stated advantages of relaxing existing requirements identified for the $PM_{2.5}$ FRM supported by the information cited in Attachment 3, available literature, or good field and laboratory practices? Does the Subcommittee have additional recommendations for the $PM_{2.5}$ FRM that would be neutral with respect to bias, but would improve the performance and minimize the burden on agencies conducting the sampling?

Questions associated with Attachment 4 – Criteria for Designation of Equivalence Methods for Continuous Surveillance of $PM_{2.5}$ Ambient Air Quality

4. Considering the statistical measures of precision, correlation, multiplicative bias, and additive bias identified for approval of $PM_{2.5}$ continuous methods, what are the Subcommittee's views on the usefulness of each measure to ensure that approved or equivalent methods meet the monitoring network data quality objectives?

5. What are the advantages and disadvantages of using sampler precision and sample population to help determine the minimum correlation requirement for the approval of $PM_{2.5}$ continuous methods?

6. What are the Subcommittee's views on using a $PM_{2.5}$ continuous monitor approved as a FEM, being applicable for use as part of a potential $PM_{2.5}$ secondary standard for visibility?

Question associated with Attachment 5 – Sensitivity of the $PM_{10\text{-}2.5}$ Data Quality Objectives to Spatially Related Uncertainties

7. To what extent have the assessments of spatial variability and the sensitivity of the DQO process to a variety of population distributions been appropriately addressed?

Question associated with Attachment 6 – $PM_{10\text{-}2.5}$ Method Equivalency Development

8. What are the Subcommittee's views on the approach identified for the development of criteria to approve continuous $PM_{10\text{-}2.5}$ equivalent methods?

We appreciate the efforts of you and the Subcommittee to prepare for the upcoming meeting and look forward to discussing this project in detail on September 21-22. General questions regarding the enclosed materials should be directed to Mr. Tim Hanley, EPA-OAQPS (phone: 919-541-4417; e-mail: hanley.tim@epa.gov); specific questions regarding the $PM_{10\text{-}2.5}$ measurement methods evaluation study should be directed to Dr. Robert Vanderpool, National Exposure Research Laboratory (NERL), within EPA's Office of Research and Development (ORD) (phone: 919-541-7877; e-mail: vanderpool.robert@epa.gov).

Attachments

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