Charge Questions for the Clean Air Scientific Advisory Committee's (CASAC) Ambient Air Monitoring and Methods Subcommittee (Subcommittee) Advisory on Light Extinction Monitoring to Support a Possible Alternative Secondary PM NAAQS February 24th and 25th, 2010

Purpose of the Advisory

If EPA revises the secondary PM NAAQS to be based on a light extinction indicator, EPA will face the following tasks as part of setting the standard and developing monitoring requirements. EPA is seeking CASAC advice in order to better plan its approaches to these tasks.

1. Establish a specific Federal Reference Method (FRM) for measuring light extinction, or establish specifications and procedures for approval of specific methods/instruments to be Federal Reference Methods.

2. Establish specifications and procedures for approval of Federal Equivalent Methods (FEM).

3. Provide network design and probe and siting criteria to State, local, and tribal[1] monitoring agencies.

Charge Questions

Questions regarding a PM Light Extinction Measurement Goal and Method

The accompanying white paper proposes an overall PM light extinction measurement goal. This goal would provide for measuring daylight hourly PM light extinction at a wavelength of 550nm with an aerosol size fractionation of PM_{10} under ambient relative humidity conditions with overall accuracy and precision $\leq$ 10% in a range of condition from 10 Mm^{-1} to 1000 Mm^{-1} for relative humidity conditions $\leq$ 90%. EPA staff believe that such a goal would be reasonable starting point for establishing performance specifications to support light extinction measurements for a PM visibility standard.

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[1] Note: Minimum monitoring requirements do not specifically apply to Tribal monitoring programs; however, when Tribal monitoring programs intend to use data for comparison to the NAAQS, approved methods and other criteria do apply.

1. Does the Subcommittee agree with the goal identified? Please comment on each of the specifications for the goal, the adequacy of each specification, and whether each specification is attainable. If applicable, please explain other useful options for the specifications and a rationale for why a different specification should be considered.

    a. Wavelength of 550 nm

    b. Aerosol size fractionation at PM_{10}

    c. Operation at ambient relative humidity

    d. Overall accuracy and precision $\leq$ 10%

    e. Range of conditions from 10 Mm^{-1} to 1000 Mm^{-1}

    f. Valid measurements (with all other appropriate checks) when sampled at $\leq$ 90% relative humidity

2. Based on the method selected there may be additional specifications that should be considered for a PM light extinction measurement goal. Please comment on inclusion of the following additional performance specifications:

    a. Measurement averaging times

    b. Instrument specific parameters such as angular integration for nephelometers?

    c. Calibration with a gas that has known Rayleigh scattering properties.

    If applicable, please explain the parameter(s), whether the parameter applies to one or more types of instruments, the purpose of the parameter(s) and an appropriate goal to support a PM light extinction measurement.

3. As summarized in the white paper, EPA staff believe that currently available nephelometer light scattering and filter transmission light absorption measurement instruments are suitable to meet the light extinction goals.

    a. To what extent does the Subcommittee support the staff's position that currently available nephelometer light scattering and filter transmission light absorption measurement instruments are suitable to meet the light extinction goals?

    b. What are the Subcommittees thoughts on alternative instrumental approaches that should be considered to meet the light extinction goals?

4. Considering the potential need to deploy nephelometer light scattering and filter transmission light absorption instruments in routine monitoring applications, EPA solicits the Subcommittee's input on:

    a. Suggestions for improvement to the commercial versions of these technologies for optimization in future routine monitoring applications for light extinction. Note: please offer any suggestion for improvement either generically for all types of instruments or for specific makes and models. A good starting point for existing makes and models might include both light scattering nephelometers correlated to PM mass already used in routine monitoring programs as well as filter-based absorption methods used in support of characterizing black carbon PM.

    b. If applicable, what are the Subcommittees suggestions for improvement of alternative instrumental approaches for use in future routine monitoring applications?

Questions Regarding the Establishment of Specifications and Procedures for Approval of Federal Reference Methods (FRM's) and Federal Equivalent Methods (FEM's).

For all established NAAQS, EPA has an FRM and FEM approval process that includes criteria and procedures so that designated methods produce data that are appropriate for comparison to the applicable air standard. This process has a number of advantages such as ensuring methods meet performance criteria and expediting procurements (e.g., during procurement, a monitoring agency can state that a method must be FRM or FEM rather than have to state each of the performance criteria and rely on the vendor to affirm that they meet the criteria), but also some disadvantages such as potentially limiting the entry of new instruments to the market due to the often high cost of field testing.

EPA is interested in exploring how approval of methods as FRM's and FEM's can be optimized. During a review of its Clean Air Research Program[2] the Board of Scientific Counselors recommended "…that ORD revise the procedures for designation of an approved instrument method, which will accommodate and provide incentives for the development and introduction of new measurement technologies for air quality

[2] Review of the Office of Research and Development's Clean Air Research Program at the U.S. Environmental Protection Agency, Final Report, August 28, 2009; Revised, September 23, 2009. http://www.epa.gov/osp/bosc/pdf/air0910rpt.pdf

monitoring" (pages 5, 13, and 17). The timing of this recent BOSC review fits nicely with EPA's need to develop criteria and procedures to approve FRM's and/or FEM's for a potential light extinction measurement; therefore. EPA is seeking advice now as we formulate our plans for how light extinction methods may ultimately be approved by EPA.

If a traditional approach to designation of light extinction measurements is taken, EPA will need to define how FRM's are to be approved so that a reference method is available for approval of potentially subsequent FEM's and/or deployment in routine monitoring networks. Considering the need to establish FRM's and performance criteria for FEM's to meet the light extinction measurement goal and also considering the recommendation above from the BOSC review, please address the following questions:

5. Identify the advantages and disadvantages of the following potential options for approval of a light extinction method as a FRM. Please provide specific advice on how to best address scientific questions on interferences, precision, accuracy, and operability; degree of data needed to support decisions; who could perform the work; what kind of peer review would be appropriate, and whether the approach would potentially lead to more innovation in the measurements system or not. Note: if an option could lead to more or less innovation, depending on other factors, please explain.

    a. Translate the measurement goal to a performance standard(s) plus procedures for demonstrating that the performance standard is met, without specifying any particular measurement principle. What aspects of performance should the standards cover?

    b. Specify the measurement principle(s), calibration procedure(s), and operational performance requirements and demonstration procedures? What aspects of performance should the standards cover?

    c. Specify a particular instrument model or models as the Federal Reference Method, and rely on the equivalent method process to allow for approval of other models. What side-by-side performance testing requirements would be appropriate under this approach?

    d. Provide the specification for the measurement principle(s), calibration procedure(s), and operational performance requirements and demonstration procedures as in b. above; but also specify one or more specific makes and models that would serve as already approved reference methods. Note this would be similar in practice to the Australian/New Zealand Standard™, Methods for sampling and analysis of ambient air, Method 12.1: Determination of light scattering – Integrating

nephelometer method. In that method, a generic approach for the method is provided with an appendix that describes the calibration and response of specific integrating nephelometers.

6. Which aspects of a light extinction measurement could be adequately assessed in a laboratory and which require field studies (perhaps across multiple air sheds). For example, are laboratory challenges for a calibration gas and other similar test sufficient to test an instrument, or are experimental studies needed to ascertain the sensitivity of (or effects of humidity on) the instruments and are field challenges required to evaluate different real world aspects of the performance standard (e.g., aerosols varying geographically and interferences)? If a combination of both, please explain which aspects of an instrument are best suited for laboratory challenges and which in the field.

7. Would some aspects of performance be better addressed through a design standard, e.g., for the flow rate and the geometry of the PM_{10} inlet, rather than a performance specification and demonstration requirement?

8. What data and analysis does the Subcommittee believe EPA staff should have studies or performed in establishing some kind of FRM (5.a-d) for use in regulatory decisions and to help inform the public?

9. As detailed in the white paper, there are a number of instrumental approaches that could be used for making these measurements, including single instruments that measure total light extinction or instrument combinations that measure light scattering and light absorption separately. Some of the methods have inherent limitations that require data adjustments for known biases. While we have already solicited advice on a method to meet the light extinction measurement goal, we would like to explore this topic further as it relates to options for FRM's and FEM's and their eventual deployment in routine monitoring networks.

    a. Of the available or soon to be available approaches, are any sufficiently limited so that EPA should not further consider them as FRM candidates, need not ensure that the FEM provisions provide a path to their approval as FEMs, and should not consider them when offering advice to or procuring equipment for state, local, and tribal agencies?

    b. Are any of the methods clearly superior in operation and also meet the measurement goal, such that they should be adopted as the FRM and thus serve as the "gold standard" for approval of FEMs (under one of the three FRM approaches listed in question 5(c or d)), and/or for possible widespread deployment?

c. What does EPA staff need to know about the biases of various instruments and should the FRM and FEM require methods to adjust for these biases to ensure data of known quality?

d. What weight should EPA give to other factors in establishing a reference method for routine PM light extinction monitoring? Please comment on each of the following:

   i. resources needed to acquire and fully support routine operation;

   ii. current availability;

   iii. record of successful field experience; and

   iv. ability to generate supplemental information (e.g. multiwavelength scattering/absorption, albedo, forward/backscattering, scattering polarization, etc.)?

Questions Regarding Network Design and Probe and Siting Criteria

EPA anticipates that a network design strategy would focus on sites that are well suited to characterize visibility impairment on an area-wide basis such as neighborhood and larger scales that have the highest levels of PM. Probe and siting criteria should include specifications that minimize ground effects and other positive and negative interferences (e.g., an HVAC vent), and are consistent with the intent of the NAAQS.

10. To what extent does the Subcommittee concur that it would be appropriate to focus a network design strategy on sites that can characterize the maximum visibility impairment across an urban area? What other considerations should EPA include in setting a network design strategy?

11. EPA and the State monitoring programs have an extensive historical dataset of $PM_{2.5}$ mass and speciation measurements. In the Visibility Assessment Document,[3] EPA used existing PM speciation and mass data to evaluate visibility impairment at a single site in each of 15 cities. However, the selection of sites used in this evaluation was severely constrained by the availability of sites with the necessary types of collocated measurement, and in several cases the site used was not the site with the highest concentrations of PM in the respective city. EPA expects that a review of available data within each city combined with

[3] Available at http://www.epa.gov/ttn/naaqs/standards/pm/data/20100121UFVAforCASAC.pdf

information from networks assessments[4] would be appropriate to identify likely candidate locations for light extinction measurements. Such measurements are likely to be in the area of expected maximum PM concentration that are also at neighborhood or urban scale and would complement and be complemented by PM mass and speciation measurements.

a. To what extent does the Subcommittee support collocation of PM mass and light extinction measurements to complement each of the measurements systems while also achieving the purpose of both the primary NAAQS and potential secondary NAAQS? Please offer specifics as to the advantages and disadvantages of collocating both types of measurements systems in an area-wide location of expected maximum concentration.

b. Considering the intra-urban variability of PM in any city, what additional factors (e.g., population, expected poor visibility, scenic views, etc.) should be considered to prescribe monitoring locations? Under what circumstances would multiple sites be appropriate to characterize the maximum area-wide visibility impairment across an urban area?

12. What aspects of probe and siting criteria should be emphasized to ensure that the placement of a PM light extinction instrument is not in a local “heat island” which could also be a “dry spot” with respect to relative humidity?

13. In an urban area the average height of the typical sight path is likely well above the inlet height of most current air quality monitoring; however, the mixing of aerosols impacting light extinction occurs throughout the boundary layer. Considering site path, aerosol mixing, the goal of PM light extinction measurements, site logistics, and the location of other air monitoring equipment inlets[5], what should be the acceptable range for probe height?

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[4] Network Assessments are required of each State or delegated monitoring agency every five years with the next assessment due to EPA Regional Offices by July 1, 2010.

[5] The appropriate range for PM inlets at neighborhood and larger scales is 2 – 15 meters. See: Table E-4 to Part 58.