



August 5, 2009

MEMORANDUM

SUBJECT: CASAC Review of Integrated Science Assessment for Particulate Matter: Second External Review Draft

FROM: John Vandenberg, Ph.D.
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TO: Holly Stallworth, Ph.D.
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The *Integrated Science Assessment for Particulate Matter: Second External Review Draft* (ISA) prepared by the Environmental Protection Agency's (EPA) National Center for Environmental Assessment – Research Triangle Park Division (NCEA –RTP) as part of EPA's ongoing review of the National Ambient Air Quality Standards (NAAQS) for particulate matter (PM) was released on July 31, 2009. This second external draft ISA will be reviewed by the Clean Air Scientific Advisory Committee (CASAC) PM NAAQS Review Panel (the CASAC PM Panel) at a public meeting to be held in Chapel Hill, NC on October 5–7, 2009. The purpose of the ISA is to identify, evaluate, and summarize scientific information on the health and welfare effects associated with PM. The ISA is designed to “accurately reflect the latest scientific knowledge useful in indicating the kind and extent of identifiable effects on public health which may be expected from the presence of [a] pollutant in ambient air” (Clean Air Act, Section 108; 42 U.S.C. 7408). I am requesting that you forward the second external draft ISA to the CASAC PM Panel to prepare for that review.

This second external review draft ISA includes revisions based on the comments and advice provided by the CASAC PM Panel and the public on the first external review draft ISA. In addition, we have incorporated information on policy-relevant studies published since the release of the first external review draft ISA (December 2008) through May 15, 2009. Changes to the content and structure of the draft are described on a broad scale in the list below together with the new charge questions for this CASAC PM Panel review. Specific revisions to the second draft PM ISA are described in more detail in EPA's recent response to the CASAC letter regarding the first draft PM ISA. We have carefully considered all of the comments provided by the CASAC PM Panel members and the public in creating this second draft ISA. The comments received on the first draft PM ISA, as well as recent CASAC comments on a first external review draft Carbon Monoxide ISA (March 2009), have been extremely useful as we continue to refine the development of the ISAs under EPA's revised process for review of the NAAQS.

This second external review draft ISA integrates the scientific evidence for review of the primary (health-based) and secondary (welfare-based) NAAQS for PM and provides findings, conclusions and judgments on the strength, coherence and plausibility of the evidence. The draft ISA is supported by six Annexes that provide more comprehensive and detailed information on the relevant evidence available from the disciplines of atmospheric sciences and human exposure (Annex A), dosimetry (Annex B), clinical studies (Annex C), toxicology (Annex D), epidemiology (Annex E) and source apportionment health studies (Annex F). These Annexes are provided with the ISA for the Panel's information. The CASAC PM Panel is being asked to review the draft ISA. NCEA-RTP will also address comments received on supporting material in the Annexes to the extent that Panel members wish to review and provide comments on the Annexes.

Following the review of the second external review draft ISA, NCEA-RTP staff will produce a final PM ISA for release in December 2009 that addresses comments received from the CASAC PM Panel and the public. Additional steps in the NAAQS review process include the development of a draft risk and exposure assessment (REA) and a policy assessment document. EPA's Office of Air Quality Planning and Standards (OAQPS) will submit drafts of these documents for the CASAC PM Panel review and public comment.

Charge to the CASAC PM Panel

We are specifically asking that the CASAC PM Panel comment on the following topic areas that focus on more substantive chapter revisions, but would also appreciate any other feedback in their review of the second draft ISA:

- 1) Evaluation of the health evidence in Chapters 6 and 7:
 - a) In response to the CASAC PM Panel comments about the determinations of causality for PM₁₀, we have refocused the evaluation of health effects resulting from exposure to PM₁₀. PM₁₀ studies are now included where they provide insights into general relationships between PM and its effects, such as concentration-response relationships. Separate causality determinations are no longer presented for PM₁₀; however, PM₁₀ study results are considered in causality determinations for PM_{2.5} and PM_{10-2.5} where appropriate. Please comment on this approach to evaluation of evidence from studies of PM₁₀.
 - b) In the first draft ISA, causal judgments were made for cardiovascular morbidity, respiratory morbidity, and all-cause mortality. In the second draft PM ISA, causal judgments were made for cardiovascular effects, and respiratory effects, using evidence from both morbidity and mortality. New sections were included within cardiovascular and respiratory effects for cause-specific mortality in Chapters 6 (Sections 6.2.11 and 6.3.9, respectively) and 7 (Sections 7.2.10 and 7.3.8, respectively) that draw upon the more complete discussions of this evidence in the later mortality sections (Sections 6.5 and 7.6). These latter sections continue to present evidence of cause-specific mortality, as it informs the discussions and causality determinations for all-cause mortality. Furthermore, important results of analyses that examined potential effect modifiers,

potential confounding by copollutants, PM-mortality concentration-response relationships, and the influence of different modeling approaches on the PM-mortality relationship remain in Chapter 6, Section 6.5. Considering both mortality and morbidity as part of a suite of effects, in addition to the other considerations underlying causality judgments, resulted in a change to the causal conclusion for long-term exposure to PM_{2.5} and cardiovascular effects from “likely causal” to “causal.” The conclusion for cardiovascular effects with short-term exposure to PM_{2.5} remained “causal.” The conclusions for respiratory effects, for both short- and long-term exposure to PM_{2.5}, remained “likely causal.” Please comment on the inclusion of cause-specific mortality, as part of a suite of cardiovascular and respiratory effects, in the development of causality judgments.

- c) We reexamined the controlled human exposure and toxicological studies of fresh diesel and gasoline exhaust and determined that while these exposure atmospheres contain relatively high mass concentrations of PM_{2.5}, the particle number count distribution was predominantly in the ultrafine size range. Therefore, for the second draft ISA, we considered the diesel and gasoline exhaust studies, in addition to the other considerations underlying causality judgments, when making our causal determinations for ultrafine PM exposure and cardiovascular and respiratory effects, resulting in a change from “inadequate” to “suggestive” for both categories. Diesel and gasoline exhaust studies also continued to be considered as part of the evidence for PM_{2.5} health effects, as was done for the first draft ISA. With consideration of this rationale, please comment on the scope of evidence considered in the causal determinations for ultrafine PM.
 - d) The CASAC PM Panel recommended that we further consider the evidence related to PM exposure and cancer. Section 7.5 (Cancer) was revised to include evaluation of epidemiologic studies of both mortality and incidence of cancer with exposure to PM, as well as a brief overview of the toxicological evidence conducted using intratracheal instillation or dermal routes of exposure to better characterize the role of PM in mutagenicity, genotoxicity, and carcinogenicity. As a result of revisions to this section, the causal determination for PM_{2.5} and cancer was changed from “inadequate” to “suggestive”; the causal determination for PM_{10-2.5} remained unchanged. Please comment on the expansion of this evaluation to include a summary of toxicological studies using routes of exposure other than inhalation, as well as consideration of both mortality and incidence studies.
- 2) Revisions to Chapters 1 (Introduction), 4 (Dosimetry), and 5 (Mode of Action): Changes to these chapters included expansion or clarification in a number of areas, as presented in more detail in the recent letter from EPA’s Administrator. These included expansion or addition of sections on the history of the previous PM NAAQS review in Chapter 1; deposition and clearance of particles in Chapter 4; and epigenetics, lung development, atherosclerosis and consideration of acute and chronic responses in Chapter 5. Please comment on the revisions to these chapters.
 - 3) Evaluation of susceptible population groups in Chapter 8: In response to the CASAC PM Panel comments, we have now focused specifically on susceptible subpopulations (defined

for this ISA as those subpopulations that have a greater likelihood of experiencing health effects related to PM exposure) in Chapter 8. The introduction of this chapter was revised to include this new definition of susceptible subpopulations, recognizing that the terms susceptible and vulnerable have sometimes been used interchangeably in the literature, and in other cases have been used to represent two different categories (i.e., biological factors [e.g., age gender, etc.] vs. non-biological factors [e.g., SES, differential exposure, etc.]), resulting in the lack of a clear and consistent definition. The discussion was reorganized to improve the characterization of factors that may contribute to increased susceptibility to PM-induced health effects. Each section was also revised to include the different exposure durations (short- and long-term) and PM size fractions examined in the studies discussed within each subsection of the chapter. Please comment on the organization and presentation in Chapter 8 of evidence regarding susceptible subpopulations.

- 4) Revisions to Chapter 3 on Source to Exposure: Consistent with revisions made to the health effects chapters, Chapter 3 was revised to clarify that PM₁₀ incorporates both PM_{2.5} and PM_{10-2.5} and reorganized to begin with PM_{2.5} and PM_{10-2.5}, followed by PM₁₀, where applicable. The discussion of measurement techniques and chemistry of PM_{10-2.5} has been expanded in Sections 3.4 and 3.5, in response to CASAC comments. In addition, Section 3.8 on human exposure to PM has been reorganized and expanded to better characterize the evidence and provide useful information for interpretation of epidemiologic studies. We would appreciate comments from the CASAC PM Panel on these revisions.
- 5) Integrative Synthesis in Chapter 2: The CASAC PM Panel recommended expanding Chapter 2 to include all important findings of the PM ISA. The integration of health evidence in Chapter 2 was reorganized to focus on effects of PM_{2.5}, PM_{10-2.5}, and ultrafine particles, and was expanded to include discussions of effects for which a "suggestive" causality determination was drawn. New integration sections were added that combine the evidence for health effects of PM_{2.5}, PM_{10-2.5}, and ultrafine PM across exposure durations. In addition, these integration discussions incorporated evidence related to mode of action, dosimetry, atmospheric chemistry, and exposure assessment to the extent possible. When appropriate, figures were added that summarize the overall U.S. and Canadian epidemiologic evidence for specific size fractions and exposure durations, along with the concentrations reported in the studies or provided by study authors. A new section was also added to Chapter 2 that contains policy-relevant considerations, including summaries for the evidence for susceptible subpopulations, lag structure of associations in epidemiologic studies, and the PM concentration-response relationship. Please comment on these revisions and additions to the integration of health effects evidence in Chapter 2.
- 6) Welfare effects evaluation in Chapter 9: Several revisions were made to the evaluation of the welfare effects evidence in Chapter 9, in response to the CASAC PM Panel comment, to focus further on effects on climate and ecosystems and include further evaluation of urban visibility evidence, where possible. In addition, as recommended by the CASAC PM Panel, key findings and conclusions from this chapter were incorporated in Chapter 2. The discussion of PM effects on climate was increased with substantially more detail from recent publications, including discussion of specific climate forcing effects from individual PM components and size fractions. The discussion of ecological effects was also reorganized to

focus on the types of effects and effects of individual components. For the effects of PM on visibility, new material was added including sections on direct optical measurements and the value of good visual air quality. Please comment on the effectiveness of the reorganization and revisions regarding welfare effects.

We look forward to discussing these issues with the CASAC PM Panel at our upcoming meeting. Should you have any questions regarding the second draft PM ISA, please feel free to contact Dr. Mary Ross (919-541-5170, ross.mary@epa.gov) or Dr. Lindsay Wichers Stanek (919-541-7792, stanek.lindsay@epa.gov).

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