U.S. Environmental Protection Agency
EPA Science Advisory Board (SAB) Staff Office
Clean Air Scientific Advisory Committee (CASAC)
CASAC Ozone Review Panel

Summary Meeting Minutes of the CASAC's Public Advisory Meeting

Wednesday, May 4, 2005 – 9:00 a.m. to 5:30 p.m. Eastern Time
Thursday, May 5, 2005 – 8:30 a.m. to 5:00 p.m. Eastern Time

Hilton Raleigh-Durham Airport at Research Triangle Park (RTP)
4801 Page Road, Research Triangle Park, NC 27709

Meeting to Conduct a: (1) Peer-Review of EPA's 1st External Review Draft Air Quality Criteria Document (AQCD) for Ozone and Related Photochemical Oxidants; and (2) Consultation on EPA's Draft Ozone Health Assessment Plan: Scope and Methods for Exposure Analysis and Risk Assessment

Panel Members: See CASAC Ozone Review Panel Roster – Appendix A

Agenda: See Meeting Agenda – Appendix B

Purpose: The purpose of this meeting was for EPA's Clean Air Scientific Advisory Committee (CASAC) to conduct a peer review of the Agency's *1st External Review Draft Air Quality Criteria Document (AQCD) for Ozone and Related Photochemical Oxidants*; and to conduct a consultation on EPA's Draft *Ozone Health Assessment Plan: Scope and Methods for Exposure Analysis and Risk Assessment*.

Attendees:

Chair:	Dr. Rogene Henderson
CASAC Members:	Dr. Ellis Cowling Dr. Frederick Miller Mr. Richard Poirot Dr. Frank Speizer
Panel Members:	Dr. John Balmes Dr. William (Jim) Gauderman Dr. Henry Gong Dr. Paul Hanson Dr. Jack Harkema Dr. Philip Hopke Dr. Michael Kleinman Dr. Allan Legge Dr. Morton Lippmann Dr. Maria Morandi Dr. Charles Plopper

Panel Members: (cont.)	Dr. Armistead (Ted) Russell Dr. Elizabeth (Lianne) Sheppard Dr. James Ultman Dr. Sverre Vedal Dr. James Zidek
EPA SAB Staff:	Mr. Fred Butterfield, CASAC Designated Federal Officer (DFO) Dr. Tony Maciorowski, SAB Staff Office Associate Director for Science Dr. Heidi Bethel, Intern
Other EPA Staff:	Dr. James Brown, ORD, NCEA-RTP Dr. Lester Grant, ORD, NCEA-RTP Dr. Brooke Hemming, ORD, NCEA-RTP Dr. William Hogsett, ORD-NHEERL Dr. Jee Young Kim, ORD, NCEA-RTP Dr. Dennis Kotchmar, ORD, NCEA-RTP Dr. John Langstaff, OAR, OAQPS Dr. Karen Martin, OAR, OAQPS Dr. David McKee, OAR, OAQPS Dr. Joe Pinto, ORD, NCEA-RTP Mr. Harvey Richmond, OAR, OAQPS Dr. David Svendsgaard, ORD, NCEA-RTP Ms. Lydia Wegman, OAR, OAQPS Dr. Lori White, ORD, NCEA-RTP Dr. John Vandenberg, ORD, NCEA

(1) Peer-Review of EPA's 1st External Review Draft Air Quality Criteria Document (AQCD) for Ozone and Related Photochemical Oxidants

Meeting Summary

The discussion followed the issues and general timing as presented in the meeting agenda (Appendix B).

WEDNESDAY, MAY 4, 2005

Convene Meeting, Call Attendance, Introduction and Administration

Mr. Fred Butterfield, Designated Federal Officer (DFO) for the CASAC, opened the meeting, called attendance, and welcomed all attendees. He noted that the CASAC is a Federal advisory committee chartered under the Federal Advisory Committee Act (FACA) to provide advice and recommendations to the EPA administrator. Consistent with FACA regulations, its deliberations

are held as public meetings and teleconferences for which advance notice is given in the *Federal Register*. The DFO is present at all such meetings to assure compliance with FACA requirements. Meeting minutes were taken for this meeting. The minutes will be certified by the Clean Air Scientific Advisory Committee (and Ozone Review Panel) Chair and made available on the SAB Web site (www.epa.gov/sab). In addition, a full transcription of this meeting is being taken at the request of the EPA program office to capture the discussions at the meeting; however, the DFO noted that the Science Advisory Board (SAB) Staff Office does not certify the accuracy of transcripts of its meetings. All Panelists have earlier submitted documentation with respect to possible financial conflicts-of-interest, which was reviewed by a SAB staff member prior to the meeting and found to be satisfactory.

Dr. Tony Maciorowski, SAB Associate Director for Science, thanked the Chair and members of the CASAC Ozone Review Panel for taking part in this review. He also mentioned that Steve Johnson, EPA Administrator, was recently confirmed as the first EPA Administrator with a scientific background and that comments from the CASAC Ozone Review panel will be going to Mr. Johnson.

Purpose of the Meeting

Dr. Rogene Henderson, CASAC and Ozone Review Panel Chair, briefly stated the purpose of the meeting, the peer review of EPA's 1st External Review Draft Air Quality Criteria Document (AQCD) for Ozone and Related Photochemical Oxidants.

Overview of Presentation on EPA's 1st Draft Ozone Air Quality Criteria Document

Dr. John Vandenberg, Acting Associate Director for Health, National Center for Environmental Assessment (NCEA), gave brief welcoming remarks, in which he thanked both the Panel members and acknowledged his staff for their efforts in reviewing and producing the document.

He was immediately followed by Dr. Les Grant, Director of NCEA in Research Triangle Park, NC (NCEA-RTP), who thanked the members of the panel for reviewing the criteria document and acknowledged the technical and support staff involved in the writing of the AQCD. He stated that the purpose of the document was to give a scientific overview of current air quality and health data with respect to ozone and other photochemical oxidants and gave a brief presentation on the overview of the document and the first chapter. Dr. Grant also remarked that the document will be used to support the revisions of the National Ambient Air Quality Standard (NAAQS) for ozone. Under the provisions of the Clean Air Act, this standard must be reviewed every five years.

Dr. Grant was immediately followed by various NCEA-RTP staff, who presented reviews of the chapters in the 1st Draft Ozone AQCD. Agency speakers included: Dr. Joe Pinto, Dr. James Brown, Dr. Lori White, Dr. Dennis Kotchmar, Dr. Jee Young Kim, Dr. David Svendsgaard, Dr. William Hogsett, and Dr. Brooke Hemming. (A hard-copy of NCEA-RTP's presentations is located in FACA file for this meeting.)

Public Comment Period

Mr. Fred Butterfield kicked off the public comment period by reminding speakers to limit their oral statements to no more than five minutes. (See Appendix C for a summary listing of all public speakers.)

Dr. Allen Lefohn, A.S.L. & Associates

Dr. Lefohn presented integrated comments from himself and Professor Paul Switzer from the Department of Statistics, Stanford University. Dr. Lefohn made several short points in his presentation. He commented that there are inconsistencies in chapter 8 regarding evidence for thresholds in ozone-related health effects. Key assumptions in chapters 7 and 8 of the AQCD regarding the spatial homogeneity of ozone monitors within an area may be invalid. Dr. Lefohn stated that flux models to estimate effects of ozone on plants do not take into account immune responses of the plant to ozone; therefore, the document overestimates vegetation effects. Finally, he commented that the criteria document underestimates the importance of stratospheric ozone in contributing to surface ozone concentrations which leads to the underestimation of policy relevant background ozone and inflated human health risks and estimates.

Ms. Deborah Shprentz, Consultant, American Lung Association (ALA)

Ms. Shprentz complemented EPA on a very through document that is inclusive of almost all of the major new studies of interest. The ALA agrees with the fundamental conclusion of the document, that short term exposures to ozone are causally related to respiratory mortality and morbidity. However, there were several studies, cited in her written comments, which had been omitted from the document or had been published after the draft document was completed. ALA believes there is rather cautious interpretation of the literature which underestimates the significance of evidence of health effects occurring at levels below the current standards. A review by the American Academy of Pediatrics (AAP) found that the current ozone standards may not protect infants and children. The ALA would also like to see quantitative estimates of various subpopulations at risk to ozone exposure. She urged the document writers not to dismiss studies done on rhesus monkeys that were done at high ozone concentrations. Ms. Shprentz also stated that significant new research on long-term effects of ozone exposure suggest that EPA should consider whether the short term ozone standards are adequately protective of long term exposures. She urged EPA to use its meta-analysis study in analysis of ozone effects on short term mortality in the AQCD and for the risk assessment in the staff paper.

Dr. Will Ollison, American Petroleum Institute (API)

Dr. Ollison stressed that the single type of monitor in the current ozone compliance monitoring network, the UV Absorption Monitor with a manganese dioxide room temperature scrubber, is subject to measurement interference from ozone precursor compounds, photo degraded products and mercury from incinerators which leads to inaccurately high ozone measurements. He encouraged EPA to review a number of recent articles since 1996 in the Air Quality Criteria Document including an article just accepted for publication in the *Journal of the Air and Waste Management Association* (A&WMA) indicating that there are interference problems with the monitor and how the interferences affect the bias in the ozone measurements. In conclusion, Dr. Ollison

stated that there are heated metal scrubbers that can correct the ozone measurement problems and EPA should support the states using those scrubbers.

Dr. Ron Wyzga, Electric Power Research Institute (EPRI)

Dr. Wyzga stated that the AQCD did a good job in summarizing a lot of the evidence to date, but that the literature search was incomplete. Many recent epidemiology studies were not included in the document and he has sent this list on to EPA. He then updated EPA on some of his current data on the ARIES air pollution epidemiology study being, a time-series study which looked at several health events simultaneously lined up with detailed characterization of air quality. These results are unpublished but he suggested that EPA may want to consider these studies in their future research. These results of the ARIES study suggest that EPA may want to give more consideration to other photochemical oxidants besides ozone in the future. Dr. Wyzga felt that the Veteran's study of 90,000 U.S. veterans and associations with ozone exposures was not accurately described in the 1st Draft Ozone AQCD and he provided some clarification. The studies used annual measurements of ozone as a basis for health effects and EPRI feels that this approach measures health effects of climatology rather than ozone exposure effects. Also, the results of the studies are to some extent probably a function of the areas where cohorts existed, showing higher mortality in Los Angeles and Houston than other cities.

Dr. Adam Wanner, University of Miami [FL] School of Medicine speaking on behalf of the American Thoracic Society (ATS)

(Note: The speaker was on the teleconference line and the call was inaudible in many places due to technical difficulties.)

Dr. Wanner complemented the authors of the document in their collection, collation, and summaries of the health effects of exposure to ozone. He encouraged the authors to look at the recent comments of the American Lung Association regarding additional studies that could be included in the AQCD.

Mr. Jon Heuss, Air Improvement Resource, Inc. (AIR)

(Note: The speaker was on the teleconference line and the call was inaudible in many places due to technical difficulties.)

First, Mr. Heuss stated that the definition of Policy Relevant Background in the 1st Draft Ozone AQCD is too narrow and does not take into account emissions of ozone from agriculture and emissions from Mexico and Canada. He stated that the Agency should not fully rely on the 2003 Fiori study to estimate Policy Relevant Background. Mr. Heuss also stressed that there were wide inconsistencies in the conclusions from the epidemiology literature which need to be resolved. He also remarked stated that the document does not take into account that personal exposures to ozone are typically only a fraction of the actual ambient concentrations and questioned if these concentrations could contribute to causes of mortality.

Dr. Michael Halpern (M.D., Ph.D.), Exponent, speaking on behalf of the Utility Air Regulatory Group (UARG)

Dr. Halpern's comments focused on Chapter 7 of the 1st Draft Ozone AQCD. Dr. Halpern stated that the evaluation of the association between ozone and mortality was incomplete and at times, misleading. First, the chapter states that there is a "robust association" between various measures of daily ozone concentration and increased risk of mortality which is not supported by multiple studies presented within Chapter 7. Second, there are a number of studies that are not supportive of an association between ozone exposure and mortality which are included in tables in the chapter or in the appendix but are not discussed in the text. Finally, there are inconsistent statements in Chapter 7 regarding the role of co-pollutants on the health effects of ozone. Initial statements found in Chapter 7 indicate the importance of ozone as a component of a complex mixture of air pollutants. However, at the conclusion of the chapter, the associations between cardiopulmonary disease and other pollutants, besides ozone, are dismissed. The AQCD must give an accurate and unbiased review of all the relevant literature, particularly the literature regarding ozone exposure mortality. Additionally, Chapter 7 must provide consistent information regarding the compounding effects of co-pollutants on ozone mortality.

Dr. Herman Gibb, Sciences International, Inc. speaking on behalf of Alliance of Automobile Manufacturers (AAM)

Dr. Herman Gibb first stated that the 1st Draft Ozone AQCD was generally a through document; however, limitations of many of the studies were not noted. The document states that there is a "robust association" between ozone exposures and health effects, but this association is not adequately supported by all of the literature. Additionally, the content of the time series studies should be evaluated more thoroughly. For example temporal trends such as changes in population, viral infections, the effects of climate and weather should be addressed in the evaluation of the data. Several of the controlled human exposure studies do not present independent results because they use the same or very similar populations. The AQCD does not demonstrate a link between many of the animal ozone toxicology studies and humans. Finally, Dr. Gibb stated that the AQCD is not critical enough in its review of the epidemiology data with regard to controlled studies and some of the individual data should be made available for additional analyses.

Summary of CASAC Ozone Review Panel Discussion and Deliberations re: AQCD for Ozone

Overall Format of the Document

Upon the advice of CASAC, the January 2005 1st Draft Ozone AQCD followed a streamlined format. Emphasis was placed on interpretative evaluation and integration of evidence in the main body of the document, with more detailed descriptions of individual studies being presented in a series of accompanying annexes. Key information from historical ozone-related literature was summarized in the opening paragraphs of each section or subsection, to provide a very brief overview of previous work. The revised format was intended to make the document easier to review by the members of the CASAC Ozone Review Panel members and the public. In general, panel members liked the new format of the document and thought that it improved the effectiveness of the document. However, several suggestions were made by individual panel

members for improvements. Several panelists stated that the chapter annexes were somewhat duplicative of the main chapters and that the main chapters need to focus on the main points rather than details. Using bullet points to highlight main issues was mentioned as a style which may be considered for simplification of some of the chapters. However, one panel member stated that rather than using bullet points exclusively, the chapters should focus on the relative importance of the various studies in the chapters.

Review of Chapter 9 Characterization of Ozone-Related Welfare Effects

One panel member thanked the SAB Staff for placing the welfare effects chapter ahead of the health effects chapters in this document. He explained some of the historical aspects of the implementation of ozone standards in Europe to protect plants and living things. His main point was that a secondary standard for ozone needs to be developed, different from the primary standard because plants are more sensitive to ozone than people. He stated that we need to adopt a more seasonal aspect to ozone concentrations and standard development and that a seasonal aspect has merit with regard to health effects also.

Overall, panel members thought that this chapter was a good start, but a lot of rearranging and reorganization needs to be done for consistency. One panel member complemented the authors on their discussion of the study methodologies and the transition to new types of study designs for vegetation effects. This panel member also stated that the effects of ozone on vegetation need to be discussed in relationship to the current ozone standard. A panelist thought the summary of research needs on ecosystems was good, but needs to be expanded upon.

Many problems in the organization of the chapter were mentioned by the panel. The text needs to be streamlined in order to remove repetitive information. Disparate views within in the text need to be reconciled. There are references missing from the reference list and in the text. Verb tense in the chapter needs to be consistent. All acronyms need to be clearly defined in the text. The information in Sections 9-5 and 9-6 is inconsistent with information presented in other parts of the document. There is some confusion between exposure response and dose response which needs to be reconciled. Discussion of a potential secondary standard in the document is inappropriate and the development of this standard is something that should be left up to the Office of Air Quality Planning and Standards (OAQPS). References to the existence of a threshold are inconsistent in the document and needs to be clarified throughout the document. Also, an explanation of the derivation of the "policy-relevant background" level of ozone concentrations needs to be included. The text also mixes up Latin names with common names; one name should be used consistently for clarity. Overall, the text is overly optimistic about what has been accomplished with regard to ozone effects research since 1996.

One panel member questioned the adequacy of the ozone monitoring network in supporting a lower ozone standard for the protection of vegetation which prompted a discussion by the panel members. In general, the panel members felt that the ozone monitoring network would need to be extended in order to support the implementation of a secondary ozone NAAQS.

Chapter 10 UV-B Flux and Climate Change

Chapter 10 addresses the potential effects to tropospheric ozone or changes in tropospheric ozone on UV-B flux and climate-change processes. Several panel members expressed the opinion that the background materials and introductory sections of this chapter are well qualified and meaningful. One panel member stated that our ability to make a true quantitative assessment of the influence that small changes in tropospheric ozone may have on UV-B flux and climate change is not available at this time. Therefore, the briefness of this chapter is appropriate and adequate at this point in time. One suggestion from this panel member was to consider not only ozone's effect on UV-B flux and climate change, but also to consider the opposite question. That is to say, the chapter may want to consider the effect of the change in UV-B flux and climate change on the production of tropospheric ozone. The panel member stated that the references to international documents in the climate process sections was great, but the absence of U.S. and EPA references puts the Agency in a difficult spot and the EPA needs to take a more reactive role in the area of climate change research. One panel member commented that the summary section should state in clear terms whether or not we have sufficient information to judge the importance of ozone's role in UV-B flux at the Earth's surface. If sufficient information is not available, the chapter should state this in clear terms.

Chapter 11 Effects of Ozone on Manmade Materials

This short chapter discusses the effects of ozone on manmade materials for which there is a limited amount of data. Overall, panel members thought this chapter presents a lot of good data, but needs to be organized in such a way as to make it more useful and evaluative of the effects of ozone exposure on manmade materials. One suggestion that panel members had in order to reorganize this chapter was to explain in the chapter the importance of the materials that are being damaged by ozone. This may be accomplished by presenting the data in a table showing the relative importance of the various materials. With such a diversity of materials presented in the chapter, it is difficult to evaluate the overall effects of ozone exposure on the materials. There is also no mention of the economic impacts of the ozone degradation of the various types of materials. Also, panel members felt that the effect of other photochemical oxidants on these manmade materials should be considered in this chapter.

Chapter 2 Characterization of Physics and Chemistry of O_3

Overall, the panel members thought that Chapter 2 provided a very comprehensive picture of what we know about the chemistry and physics of ozone. One of the overarching issues of concern for the panelists in Chapter 2 was the significance of other photochemical oxidants in relation to ozone. In this document and in many of the studies that have been done, ozone is used as a surrogate for a mixture of photochemical oxidants because it is easy to measure. The Ozone AQCD needs to evaluate the use of ozone as a surrogate for other photochemical oxidants and state what is known about other photochemical oxidants. The appendices of chapter 2 and 3 need more information on the other types of oxidants that are found in the air and more information on the carbon mass balance of photochemical reactions. Chapter two also needs to emphasize advances in modeling tools and source apportionment of intercontinental transport of ozone.

In general, the panel members thought that the long annex, in relation to the main chapter, was needed to support the document for readers that are not familiar with the background material.

Dr. Arlene Fiore of NOAA gave a brief, five-minute presentation on the procedure for calculating Policy Relevant Background Ozone using the GEOS-CHEM model. (Her presentation can be found in the FACA file for this meeting.)

Chapter 3 Environmental Concentrations, Patterns, and Exposure Estimates of O_3

Panel members complemented the authors on their compilation of a significant amount of material; however, one member stated that the chapter needs to be more coherent and structured. Again, overarching themes of needed improvements to Chapter 3 of the 1st Draft Ozone AQCD include more information on other photochemical oxidants besides ozone in order to set the stage for the toxicology, epidemiology and welfare effects chapters. A case needs to be made that ozone is an appropriate surrogate to gage the health effects of a range of photochemical oxidants. This opinion was again expressed by several panel members. Also, several panel members spoke about the adequacy of the ozone monitoring network and thought that an analysis of the network needs to be completed. One panel member made suggestions for improvement in the accuracy of the policy-relevant background calculations. Another panel member commented that the actual ozone exposures of the public are going to be lower than the concentrations obtained at stationary modeling sites. Measurements from stationary modeling sites are only serving as surrogate measures for aggregate exposures.

Chapter 4 Interspecies Extrapolations

Several committee members stated that chapter 4 was a well written initial draft that was presented in an easily readable format. Panel members stated that more information should be included concerning the aspects of species homology between primates and humans. Panel members thought that EPA's document which describes the calculation of reference concentrations and provides a framework for equivalent exposures between animals and humans should be included in the Ozone AQCD.

Additionally, more figures could be included in the chapter in order to illustrate principles including a graph of dead space air volume countered with inter-subject variability based on modeling work that has been done. Clarification needs to be made in the chapter that oral vs. nasal breathing makes a big difference in terms of ozone dosimetry. More information regarding chronic ozone exposures needs to be included in the chapter. One member stated that the chapter should include more details regarding the organization of the lung and comparison of the lung between species — noting that the work of panel member Dr. Charles Plopper of University of California at Davis on monkeys should also be more fully-included in the chapter, and that there should be also a discussion of the entire conducting airway system rather than just the pulmonary alveolar or proximal alveolar regions. Dr. Plopper stated that people with compromised airways will have different lung geometry than people with healthy airways, so the ozone dose distribution can be completely different for these different groups of people. Another suggestion by the panel members was that the risk for young children with growing lungs should be discussed in

the chapter. There needs to be a bridge between chapters 4 and 5 and cross references between the two chapters.

Chapter 5 Characterization of Short-Term Exposure Effects in Experimental Studies

Panelists stated that chapter 5 of the 1st Draft Ozone AQCD was well-written, and that it thoroughly and comprehensively reviewed the new literature since 1996. A panel member commended the authors for their work. The framework of the chapter was well-designed and provided the reader with a brief introduction, historical background, detailed descriptions of the new studies, and a brief summary and conclusion. The sections on pulmonary function were excellent. The tables were excellent and more of them should be included in the body of the text.

Many suggestions for structural improvements to this chapter were emphasized. In various sections of the chapter, the introductions were too brief and did not contain enough historical background data. Because there are limited studies since 1996 on ozone toxicology, some of the older, but key toxicology studies should be emphasized throughout the introduction and subsections of the chapter. In various locations throughout the text, clarification is needed as to which animal species are being discussed. The chapter annex is a duplication of effort and some structural reorganization of what is included in the chapter vs. the annex needs to be done. Section summaries need to present a synthesized critique of the material being reviewed and the appropriateness of the various studies to the task at hand.

Technical improvements to the chapter were suggested by panel members. Descriptions of some of the exposure regimes were inadequate throughout the chapter and it was necessary to return to the annex for explanations. There needs to be more consistency throughout the chapter in the reporting of concentration and duration of exposure. In various sections of the chapter, studies are compared which use wide ranges of ozone exposures. Several panel members expressed the opinion that some of the studies done at very high ozone concentrations (>1 ppm) need to be removed from the chapter discussions because mechanisms of ozone damage are very different for low and high ozone concentrations. There needs to be more reporting of the differences between cumulative vs. episodic ozone exposures studies and acute, sub-chronic and chronic studies. Additionally, one panel member pointed out that the structural lung changes reported in the intermittent vs. continuous exposure studies give some support for a seasonal standard for ozone and this section needs to be expanded upon. The genetic susceptibility of various mouse model strains to ozone needs to be mentioned in the chapter. A description of the adequacy of specific models that were used in the chapter and how they compared to humans would be useful. In the biochemistry section of the chapter, the bioavailability of the molecules that ozone will react with needs to be discussed.

For this chapter, as with others, the discussion of the inclusion of the effects of other photochemical oxidants, besides ozone, resurfaced. The general consensus of the panel was that there is not a lot of data for other photochemical oxidants and this may be an area to place more research emphasis in the future. One panel member suggested that it may be useful to give an estimate of the amounts of some of the other photochemical oxidants in relationship to ozone to show that the dominant health effects are probably going to be from ozone.

Finally, panel members had a brief discussion on whether or not to have a separate chapter or document specifically focusing on research needs. Panel members differed on their views and Dr. Grant of NCEA-RTP stated that he would consider consolidating research needs in a separate chapter or a separate document.

Chapter 6 Acute Pulmonary Function/Respiratory Symptom Effects

The panel congratulated the staff on writing a comprehensive, balanced chapter. The chapter had a logical progression and captured "about 98-99 percent" of all the clinical studies.

Panel members suggested multiple improvements to the organization of the chapter. Panelists felt that the main chapter needs to be reorganized to focus on the issue of whether the studies done since 1996 support the implementation of a new ozone standard. One panel member suggested that the pre-1996 studies be separated from the post-1996 studies in order to focus on what we have learned since that time. There is too much duplication between the between the annex and the main chapter and this needs to be reorganized. A summary at the end of the chapter that organizes the studies by level of ozone exposure would be useful. Some of the sections discussed throughout the chapter did not make it into the summary, i.e. information on inflammation and pulmonary effects. References to acute biological responses to ozone exposure occur throughout the chapter and these need to be focused in one area of the chapter.

Panel members had multiple suggestions for improvements to the technical content of the chapter. One panel member stated that there should be more interpretation in the main chapter of the data presented in the annex. Definitive conclusions were not included throughout the chapter or in the chapter summary. The chapter focused on group means of responses to ozone exposure rather than an evaluation of the ranges or the variability of responses. It is important to understand what the variability of responses is, especially when considering the severity of responses of particular susceptible groups, *e.g.*, asthmatics. In the chapter summary, there is a statement that the responses of asthmatics to ozone exposures increase with their disease severity which does not have support in the chapter or the references. The section on pulmonary inflammation and lung defenses could be rewritten for clarity. Great effort was made to include all of the new studies that have been conducted since 1996; however, some editorial judgment needs to be used as to the relative importance of certain studies, including those that were reviewed in the previous Ozone AQCD. One important pre-1996 study which considered NO_2, H_2SO_4 and ammonium sulfate among other compounds was not included in the summary of literature.

There is some confusion in the chapter regarding acute responses to ozone and their effect on lung function changes and airway inflammatory responses. It needs to be emphasized that these responses to ozone exposures are probably separate genetically controlled responses and do not occur together. The section of the chapter on genetic susceptibility to ozone needs to be developed better. One panel member suggested including a table that summarizes the genetic findings, the polymorphism studied, the population exposed and the outcome. A summary of research needs should be included at the end of the chapter.

Panel members had an extended discussion about the inclusion of papers past the cut-off deadline of December 2004. Panelists were in agreement that any papers accepted or published past

the deadline that would make a difference in the understanding of the science should be included in the document. Dr. Grant stated that his group would do their best to include papers beyond December 2004 that were recommended by the panelists and presented significant new and useful data.

Chapter 7 Observational Studies of Short and Long-Term O_3 Effects

Panel members felt that in general, chapter 7 was a well-written first draft. The chapter provided a comprehensive review of the past literature and the more recent literature. The chapter was written in well-organized prose and had competent individual section summaries.

Panel members suggested several improvements to the organization of the chapter. More summary information was needed of the studies in the appendix. Also, references to the appendix need specific page information. The chapter introduction was repeated in section 7-6.

Panel members had multiple suggestions for improvements to the technical content of the chapter including a long list of minor changes that need to be made to the document. Several more recent papers were mentioned for possible inclusion in this chapter of the Ozone AQCD. The document needs to emphasize the relative importance of the studies presented. The chapter has not addressed the issues of mortality at low ambient concentrations in the time series studies. Clarification needs to be made about the change in respiratory function responses with age. The exposure assessment section should be presented in a way that is relevant to epidemiology and make an effort to state in the document that there are differences in studies with different designs, *i.e.*, acute vs. chronic studies. The California study which presents ozone exposures as a cause of asthma needs to be balanced against more poorly designed studies which do not show asthma as a symptom of ozone exposures. Changes in FEV need to be qualified as changes in children or adults. Authors may want to present changes in FEV as percentages rather than absolute volumes. Changes in FEV should also be qualified for sensitive groups such as asthmatics. The summary section of the chapter should be a straight presentation of the data without interpretation by the authors, followed by a separate section with research needs. An attempt needs to be made by the authors to follow other areas of research which may point to cardiovascular effects of ozone exposure. Several panelists debated the utility of including more ecological effects in this chapter.

Multiple suggestions were made to improve the interpretations of studies, their statistical significance and measurement errors. One panel member stated that there was too much emphasis on the significance of statistics. The document should address the problem of multiple testing by putting forth a hypothesis and then discussing each of the studies in reference to that hypothesis. There is confusion about how the density plots were generated. A description of their derivation in the appendix would be helpful. Each study reported should include the effect estimate of ozone exposure and the confidence interval. It is not clear in the document which studies are discussing cumulative risk estimates and single day estimates. These studies have different study parameters and measurement errors. There was an extensive discussion by the panel members about the interpretation of long term effects of episodic ozone exposures. Panel members did not feel that past issues surrounding GAM-related statistical studies were significant and that studies using GAM statistical analyses should be included in the document. A definition of “transfer

effects" should be included. Transfer effects occur because various pollutants are measured at different rates of precision which may cause an insignificant pollutant with regard to health effects appear to be an important factor in that particular health outcome. The implication of measurement errors on the outcomes of various studies should also be explained.

EPA staff responded to comments of the panel. They thanked the members of the panel for their very detailed list of improvements to the chapter. Agency staff asked the panelists to respond specifically to the charge questions that were presented to them as well as providing comments on other improvements to the chapter. They requested that the panel provide any additional literature that may support the implementation of some of their requested improvements.

Chapter 8 Integrative Synthesis of Exposure, Dosimetry, and Health Effects Information

One panel member stated that chapter 8 was a good first effort by the authors. Suggestions for improvements were mainly general in nature. Panelists requested that authors synthesize data that is coherent and state specifically the data that presents conflicting results. The various time series studies need to be described better in this chapter. Include a discussion of the combined health effects of particulate matter and ozone. The range of responses of individuals to ozone exposures needs to be discussed in the chapter rather than just the mean responses. Several panel members expressed that the chapter should address the issue of measurement error in the concentration response factors to ozone exposure. School absences in the children's health studies were not mentioned as a societal effect to ozone exposure and should be mentioned in the summary. The summary section of the chapter needs to do a better job of wrapping up the entire document.

Once again, panel members and EPA staff had an extensive conversation about the health effects of other photochemical oxidants for which there is currently only limited data. Multiple discussions about this topic throughout the two day meeting attest to its importance in the view of panelists. One panel member stated that the Ozone AQCD should explain the relationship between ozone and other photochemical oxidants. Panel members and Agency staff agreed that potential health effects of other photochemical oxidants need to be examined in the future and that EPA should potentially put more effort into supporting more research in this area.

Closing Remarks

Dr. Rogene Henderson and Mr. Butterfield wrapped-up the meeting. They requested that Panelists submit any additional comments about the 1st Draft Ozone AQCD to each of them for incorporation into the CASAC's letter to the Administrator.

Mr. Butterfield, the DFO, adjourned the meeting at approximately 2:45 p.m. on May 5, 2005.

(2) Consultation on EPA's Draft Ozone Health Assessment Plan: Scope and Methods for Exposure Analysis and Risk Assessment

Meeting Summary

The discussion followed the issues and general timing as presented in the meeting agenda.

WEDNESDAY, MAY 5, 2005

Convene Meeting, Call Attendance, Introduction and Administration

Mr. Fred Butterfield, CASAC DFO, opened the meeting, called attendance, and welcomed all attendees. He stated that this meeting would be conducted in accordance with FACA regulations.

Mr. Butterfield stated that the purpose of the meeting was a consultation on EPA's Draft *Ozone Health Assessment Plan: Scope and Methods for Exposure Analysis and Risk Assessment* prepared by OAQPS, within EPA's Office of Air and Radiation (OAR). He stated that the SAB Staff Office has developed the consultation as a mechanism to provide early input and advice to EPA on technical issues that should be considered in the development of regulations, guidelines, or technical guidance before the Agency has taken a position. Minutes are taken and posted on the SAB web-site (www.epa.gov/sab) once they are certified by the CASAC Chair. However, no formal report will be written. Members of the panel may submit individual comments, but they are not required to do so. After the meeting, there will be a formal letter to the Administrator indicating that the consultation has taken place.

Opening Statement

Dr. Rogene Henderson, CASAC Chair, briefly restated the purpose of the meeting, which is to conduct a consultation on EPA's Draft Ozone Health Assessment Plan, and opened the floor for the speakers.

Overview of Presentation of EPA's Draft Ozone Health Assessment Plan

Dr. Karen Martin of OAQPS introduced Mr. Harvey Richmond and Dr. John Langstaff of the OAQPS staff. Mr. Richmond presented an overview of the Draft Ozone Health Assessment Plan. (A hard-copy of OAQPS' presentations is located in FACA file for this meeting.) He indicated that the planners of exposure analysis and risk assessment were seeking advice on the scope and approaches to estimating exposure and health risks posed by current ozone levels and the current ozone standard and alternative standards that the committee may recommend.

Panel Questions and Suggestions

After the overview presentation, panel members asked for clarification on many aspects of the Draft Ozone Health Risk Assessment Plan, including information on ozone exposure estimates.

Mr. Richmond stated that the exposure estimates take into account age, sex, body weight distribution and activity data to calculate ventilation rate. Asthmatic children are also assumed to have the same activity levels as non-asthmatic and healthy children. These individuals are matched to similar measurements in the controlled studies. The exposure scenarios evaluated are eight hour ozone exposures at moderate exertion levels. These are the same exposure metrics that were used in the last review that was completed by EPA. The study design will present one year of exposure risk results, for 2004. The data for 2004 will be characterized by the variability during the 2002–2004 time period rather than generating exposure risk results for all three years in order to reduce the amount of data. Panel members and Agency staff had a discussion about the calculation of ozone concentrations and the temporal and spatial variations of ozone concentrations. EPA stated that they calculate the ozone concentrations for a particular area using the data from the model to interpolate two census tracks of ozone data. Several panel members also discussed the fact that specific activities happen at different times of the year in different parts of the country. For example, some students may start school at different times in one part of the country than in other parts. If this is not taken into account in the exposure analyses, there will be some biases in the data generated. Panel members discussed emergency room visit data and its utility in EPA's analyses. One panel member stated that there are many nuances in emergency room visits which cause their utility as an endpoint to be diminished.

Members of the CASAC Ozone Review Panel asked for clarification on the different types of data that could be generated from the exposure analyses and endpoints that would be examined. EPA staff stated that from the model, data for individual groups of people could be separated out of the full analyses. For example, selected groups (*e.g.*, different age groups, or people with asthma) could be removed from the main group in order to evaluate individual group effects. Staff also indicated that it would be possible to distinguish between one occurrence of a particular health outcome for a single person versus multiple occurrences for a single person. Panelists and EPA staff indicated that multiple day studies which show distributive lag effects due to ozone exposures over the course of several days are not available and more research needs to be focused in this area. Agency staff stated that if distributive lag effects due to ozone exposure data are not available for a particular observed endpoint, the epidemiology studies in the AQCD would be used to determine if there is a conclusion for a particular effect, *i.e.*, cardiovascular mortality, and correlation with a particular lag time. Panel members and EPA staff had a discussion about the use of 15 % FEV decrement as a measurement of significance for the in the exposure estimates instead of 10 % decrement. EPA staff emphasized that when using 15% FEV decrement as an endpoint, they would be looking at individual responses, not group mean responses. Panel members did not seem to have a strong opinion on whether a 10 % or 15 % decrement in FEV was used as an endpoint.

There was a brief discussion about single pollutant models versus multi-pollutant models. One panelist questioned how the data from these two different models would be integrated and interpreted. Another panel member suggested that EPA analyze correlation levels of multi-pollutant exposures and health endpoints that are significant before completing multiple multi-pollutant analyses. Agency staff stated that the data for single and multi-pollutant studies would not be integrated. Each set of data would stand on its own for qualitative assessment.

Panel members offered several suggestions for comparing model results with actual published results from scientific literature. Panelists identified a newly published paper on personal monitoring of air exposures of children in Los Angeles. The panel suggested including this document in the Ozone AQCD and discussing this document in terms of the exposure study design. Panel members thought it would be useful to compare the results of this study to model predictions.

There were several discussions regarding the number of cities examined for each health endpoint. For example, the Agency is only analyzing school absences in one city, Los Angeles. Panel members suggested that at least three different cities should be considered in examining each endpoint. The panel mentioned several additional studies and study locations that EPA may want to consider in its evaluation. Agency staff stated that they focused on cities and areas that were in non-attainment of ozone standards in order to conserve resources. Several panel members urged EPA to focus on some areas that are in attainment right now in the event that the ozone standard is lowered.

One discussion of overarching importance for the committee members involved simplification of the study design. Panelists urged EPA to simplify their risk assessment analyses by estimating the exposure data and comparing that to the probabilistic risk distribution. Complete analyses of the estimated data would need to be done at the out start in order to justify its use in the model. After the model has been run on the estimated data, a back check should be done of the detailed assumptions made. Panel members emphasized that a tremendous amount of data would be generated in this study and every effort needs to be made for simplification.

Public Comment Period

Mr. Fred Butterfield kicked off the public comment period by reminding speakers to limit their oral statements to no more than five minutes. (See Appendix C for a summary listing of all public speakers.)

Ms. Deborah Shprentz, American Lung Association (ALA)

Ms. Shprentz expressed several concerns about the EPA's study design for the Draft Ozone Health Assessment. She urged EPA to broaden the scope of the analyses in terms of the populations that are being evaluated, the geographic areas and the health endpoints. ALA believes that important populations of children and adults are not being evaluated. These groups include preschool children, infants, outdoor workers and senior citizens. Uncertainties in the exposure analyses may also cause an underestimation of exposure and risk. The geographic scope of the cities being reviewed needs to be expanded. For example, school absences are only being looked at in Los Angeles and hospital admissions will only be examined for New York, Los Angeles and Cleveland. ALA believes that results cannot necessarily be extrapolated from one city to another. ALA suggests that a broader approach in preparing the regulatory impact analyses might improve decision making. The risk functions for the three meta-analyses that EPA commissioned should be examined rather than just the sensitivity analyses. ALA is also concerned about the suggestion of exploring the effects of hypothetical thresholds without a theoretical base. The 1st Draft Ozone AQCD reports that thresholds are likely to exist on an individual level. The variability in individuals makes it impossible to determine the thresholds.

Dr. Will Ollison, American Petroleum Institute (API)

Dr. Ollison expressed several concerns in his presentation. His first concern was about spatial interpretations of ozone concentrations and the impact area of the ozone monitors. He asked that EPA clarify whether they treat the ozone concentrations as a single ozone distribution or if the population exposed is considered to be a stable, non-moving population. Dr. Ollison also stated that there is additional data on breathing rates that is not being considered by EPA and that this information can be found in API's written comments. API also believes that road construction workers may have the highest ozone exposures rather than children. EPA should reconsider focusing their health assessment on road workers rather than children.

Closing

Dr. Henderson, CASAC Chair, thanked the panel members and the EPA participants, and Mr. Butterfield, CASAC DFO, adjourned the meeting at approximately 5:00 p.m. on May 5, 2005.

Respectfully Submitted:

/s/

Fred A. Butterfield, III

Fred A. Butterfield, III
CASAC DFO

Certified as True:

/s/

Rogene F. Henderson, Ph.D.

Rogene F. Henderson, Ph.D.
CASAC Chair

Appendices

Appendix A – Roster of the CASAC Ozone Review Panel

U.S. Environmental Protection Agency
Science Advisory Board (SAB) Staff Office
Clean Air Scientific Advisory Committee (CASAC)
CASAC Ozone Review Panel

CHAIR

Dr. Rogene Henderson*, Scientist Emeritus, Lovelace Respiratory Research Institute, Albuquerque, NM

MEMBERS

Dr. John Balmes, Professor, Department of Medicine, University of California San Francisco, University of California – San Francisco, San Francisco, California

Dr. Ellis Cowling*, University Distinguished Professor-at-Large, North Carolina State University, Colleges of Natural Resources and Agriculture and Life Sciences, North Carolina State University, Raleigh, NC

Dr. James D. Crapo*, Professor, Department of Medicine, Biomedical Research and Patient Care, National Jewish Medical and Research Center, Denver, CO

Dr. William (Jim) Gauderman, Associate Professor, Preventive Medicine, Medicine, University of Southern California, Los Angeles, CA

Dr. Henry Gong, Professor of Medicine and Preventive Medicine, Medicine and Preventive Medicine, Keck School of Medicine, University of Southern California, Downey, CA

Dr. Paul J. Hanson, Senior Research and Development Scientist, Environmental Sciences Division, Oak Ridge National Laboratory (ORNL), Oak Ridge, TN

Dr. Jack Harkema, Professor, Department of Pathobiology, College of Veterinary Medicine, Michigan State University, East Lansing, MI

Dr. Philip Hopke**, Bayard D. Clarkson Distinguished Professor, Department of Chemical Engineering, Clarkson University, Potsdam, NY

Dr. Michael T. Kleinman, Professor, Department of Community & Environmental Medicine, University of California – Irvine, Irvine, CA

Dr. Allan Legge, President, Biosphere Solutions, Calgary, Alberta, Canada

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

Dr. Frederick J. Miller*, Consultant, Cary, NC

Dr. Maria Morandi, Assistant Professor of Environmental Science & Occupational Health, Department of Environmental Sciences, School of Public Health, University of Texas – Houston Health Science Center, Houston, TX

Dr. Charles Plopper, Professor, Department of Anatomy, Physiology and Cell Biology, School of Veterinary Medicine, University of California – Davis, Davis, California

Mr. Richard L. Poirot*, Environmental Analyst, Air Pollution Control Division, Department of Environmental Conservation, Vermont Agency of Natural Resources, Waterbury, VT

Dr. Armistead (Ted) Russell, Georgia Power Distinguished Professor of Environmental Engineering, Environmental Engineering Group, School of Civil and Environmental Engineering, Georgia Institute of Technology, Atlanta, GA

Dr. Elizabeth A. (Lianne) Sheppard, Research Associate Professor, Biostatistics and Environmental & Occupational Health Sciences, Public Health and Community Medicine, University of Washington, Seattle, WA

Dr. Frank Speizer*, Edward Kass Professor of Medicine, Channing Laboratory, Harvard Medical School, Boston, MA

Dr. James Ultman, Professor, Chemical Engineering, Bioengineering Program, Pennsylvania State University, University Park, PA

Dr. Sverre Vedal, Professor of Medicine, Department of Environmental and Occupational Health Sciences, School of Public Health and Community Medicine, University of Washington, Seattle, WA

Dr. James (Jim) Zidek, Professor, Statistics, Science, University of British Columbia, Vancouver, BC, Canada

Dr. Barbara Zielinska*, Research Professor, Division of Atmospheric Science, Desert Research Institute, Reno, NV

SCIENCE ADVISORY BOARD STAFF

Mr. Fred Butterfield, CASAC Designated Federal Officer, 1200 Pennsylvania Avenue, N.W., Washington, DC, 20460, Phone: 202-343-9994, Fax: 202-233-0643 (butterfield.fred@epa.gov) (Physical/Courier/FedEx Address: Fred A. Butterfield, III, EPA Science Advisory Board Staff Office (Mail Code 1400F), Woodies Building, 1025 F Street, N.W., Room 3604, Washington, DC 20004, Telephone: 202-343-9994)

* Members of the statutory Clean Air Scientific Advisory Committee (CASAC) appointed by the EPA Administrator

**Immediate past CASAC Chair

Appendix B – Meeting Agenda

U.S. Environmental Protection Agency
EPA Science Advisory Board (SAB) Staff Office
Clean Air Scientific Advisory Committee (CASAC)
CASAC Ozone Review Panel

Public Advisory Meeting

Wednesday, May 4, 2005 – 9:00 a.m. to 5:30 p.m. Eastern Time
Thursday, May 5, 2005 – 8:30 a.m. to 5:00 p.m. Eastern Time

Hilton Raleigh-Durham Airport at Research Triangle Park (RTP)
4810 Page Road, Research Triangle Park, NC 27709

Meeting to Conduct a: (1) Peer-Review of EPA's 1st External Review Draft Air Quality Criteria Document (AQCD) for Ozone and Related Photochemical Oxidants; and (2) Consultation on EPA's Draft Ozone Health Assessment Plan: Scope and Methods for Exposure Analysis and Risk Assessment

Final Meeting Agenda

Wednesday, May 4, 2005

9:00 a.m.	**Convene Meeting; Call Attendance; Introductions and Administration; and Overview of Meeting Agenda**	Mr. Fred Butterfield, CASAC Designated Federal Officer (DFO)
9:10 a.m.	**Welcome & Opening Remarks**	Dr. Anthony Maciorowski, EPA SAB Staff Office Associate Director for Science
9:15 a.m.	**Purpose of Meeting**	Dr. Rogene Henderson, Chair
9:20 a.m.	**Welcome from EPA's National Center for Environmental Assessment (NCEA)**	Dr. John Vandenberg (tentative), Acting Associate Director for Health, NCEA
9:25 a.m.	**Overview Presentation on EPA's 1st Draft Ozone AQCD**	Dr. Les Grant, Director, NCEA-RTP; and other NCEA-RTP and EPA-ORD staff
10:30 a.m.	**Break***	
10:45 a.m.	**Formal Public Comment Period**	Mr. Butterfield (Facilitator)

*Note: Periodic breaks will be taken as necessary and at the call of the Chair.

Wednesday, May 4, 2005 (continued)

12:00 p.m.	**Lunch (Hotel)**	
1:00 p.m.	**CASAC Ozone Review Panel Discussion and Deliberations: *Environmental or Welfare Effects* (Chapters 9-11)**	Dr. Henderson, Ozone Review Panel Members
2:30 p.m.	**CASAC Ozone Review Panel Discussion and Deliberations: *Atmospheric Physics and Air Quality* (Chapters 2-3)**	Dr. Henderson, Ozone Review Panel Members
4:00 p.m.	**CASAC Ozone Review Panel Discussion and Deliberations: *Human Health Effects* (Chapters 4-8)**	Dr. Henderson, Ozone Review Panel Members
5:20 p.m.	**Summary, Wrap-Up and Next Steps**	Dr. Henderson
5:30 p.m.	**Adjourn Meeting for the Day**	Mr. Butterfield

Thursday, May 5, 2005

8:30 a.m.	**Reconvene Meeting; Call Attendance**	Mr. Butterfield
8:35 a.m.	**Re-cap of Previous Day's Meeting**	Dr. Henderson
8:45 a.m.	**Public Comment Period****	Mr. Butterfield (Facilitator)
9:00 a.m.	**Additional NCEA-RTP Comments**	Dr. Grant
9:05 a.m.	**Continue CASAC Ozone Review Panel Discussion and Deliberations: *Human Health Effects* (Chapters 4-8)**	Dr. Henderson, Ozone Review Panel Members
10:15 a.m.	**Break***	
10:30 a.m.	**Continue CASAC Ozone Review Panel Discussion and Deliberations: *Human Health Effects* (Chapters 4-8)**	Dr. Henderson, Ozone Review Panel Members
12:00 p.m.	**Lunch (Hotel)**	
1:00 p.m.	**Continue CASAC Ozone Review Panel Discussion and Deliberations: *Human Health Effects* (Chapters 4-8)**	Dr. Henderson, Ozone Review Panel Members

Notes:

*Periodic breaks will be taken as necessary and at the call of the Chair.

**The purpose of the public comment period on the second day of the meeting is to permit members of the public who were unable to provide their oral comments on the first day with an opportunity to do so.

Thursday, May 5, 2005 (continued)

2:40 p.m.	**Summary, Wrap-Up, Next Steps and Closing Remarks**	Dr. Henderson
2:45 p.m.	**Adjourn Peer-Review Meeting; Break**	Mr. Butterfield
3:00 p.m.	**Convene Consultative Meeting; Call Attendance; Introductions and Administration**	Mr. Fred Butterfield, CASAC DFO
3:05 p.m.	**Purpose of Meeting**	Dr. Rogene Henderson, CASAC Chair
3:10 p.m.	**Summary Presentation on EPA's Draft Ozone Health Assessment Plan**	Dr. Karen Martin and Mr. Harvey Richmond, EPA's Office of Air Quality Planning and Standards (OAQPS)
3:30 p.m.	**Public Comment Period**	Mr. Butterfield (Facilitator)
3:45 p.m.	**CASAC Ozone Review Panel Discussion and Deliberation**	Dr. Henderson, CASAC Ozone Review Panel Members
4:50 p.m.	**Summary and Next Steps**	Dr. Henderson
5:00 p.m.	**Adjourn Meeting**	Mr. Butterfield

Appendix C –List of Public Speakers

List of Public Speakers

U.S. Environmental Protection Agency
Clean Air Scientific Advisory Committee (CASAC)
CASAC Ozone Review Panel

Peer Review of EPA's 1st External Review Draft Air Quality Criteria Document (AQCD) for Ozone and Related Photochemical Oxidants

Public Meeting ❖ May 4-5, 2005

Hilton Raleigh-Durham Airport at Research Triangle Park,
4810 Page Road, Research Triangle Park, NC 27709

#	Speaker's Name	Organizational Affiliation(s)	Organization(s) Represented (i.e., comments offered on behalf of)
1	Dr. Allen Lefohn	A.S.L. & Associates	same
2	Ms. Deborah Shprentz	Consultant	American Lung Association (ALA)
3	Dr. Will Ollison	American Petroleum Institute (API)	same
4	Dr. Ron Wyzga	Electric Power Research Institute (EPRI)	same
5	Dr. Adam Wanner (M.D.)*	University of Miami [FL] School of Medicine	American Thoracic Society (ATS)
6	Mr. Jon Heuss*	Air Improvement Resource, Inc. (AIR)	same
7	Dr. Michael Halpern (M.D., Ph.D.)	Exponent	Utility Air Regulatory Group (UARG)
8	Dr. Herman Gibb*	Sciences International, Inc.	Alliance of Automobile Manufacturers (AAM)

*Note: Will present oral comments via teleconference (phone) line