Summary Minutes of the
U.S. Environmental Protection Agency (EPA)
Science Advisory Board (SAB) Staff Office
Clean Air Scientific Advisory Committee (CASAC)
Sulfur Oxides Primary National Ambient Air Quality Standard (NAAQS) Review Panel
Public Meeting
April 16-17, 2009

Committee Members: (See Roster – Attachment A)

Scheduled Date and Time: From 8:30 a.m. to 5:30 p.m. (Eastern Time) on April 16, 2009; and from 9:00 a.m. to 2:00 p.m. (Eastern Time) on April 17, 2009. (See Federal Register Notice, Attachment B)

Location: Sheraton Chapel Hill Hotel, One Europa Drive, Chapel Hill, NC 27517

Purpose: To conduct a peer review of EPA's *Risk and Exposure Assessment (REA) to Support the Review of the SO_2 Primary National Ambient Air Quality Standard: Second Draft*

Attendees:

Panel Members:
Dr. Jonathan Samet
Dr. Ed Avol
Dr. John R. Balmes
Dr. Ellis B. Cowling (April 16, 2009 only)
Dr. James Crapo (April 16, 2009 only)
Dr. Douglas Crawford-Brown (by phone)
Dr. Terry Gordon
Dr. Dale Hattis (by phone)
Dr. Rogene Henderson
Dr. Donna Kenski
Dr. Patrick Kinney (by phone)
Dr. Steven Kleeberger (April 16, 2009 only)
Dr. Timothy Larson
Dr. Kent Pinkerton (by phone)
Dr. Armistead (Ted) Russell
Dr. Richard Schlesinger (by phone, April 16, 2009 only)
Dr. Elizabeth A. (Lianne) Sheppard (in person, April 16, 2009; by phone, April 17, 2009)
Dr. Frank Speizer (by phone)
Dr. George Thurston
Dr. James Ultman,
Dr. Ronald Wyzga

SAB Staff Office:
Dr. Angela Nugent, EPA SAB Staff Office, Designated Federal Officer (DFO)

Dr. Anthony Maciorowski, Deputy Director of the EPA SAB Staff Office

EPA Participants Listed on the Agenda

Ms. Lydia Wegman, (EPA OAR)
Dr. Stephen Graham (EPA OAR)
Mr. Harvey Richmond (EPA OAR)
Dr. Michael Stewart (EPA OAR)

Meeting Summary – April 16, 2009

The discussion addressed the topics included in the Proposed Meeting Agenda (See Meeting Agenda - Attachment C) and roughly followed the sequence summarized below.

Opening of Public Meeting

Dr. Angela Nugent, Designated Federal Officer (DFO) for the CASAC Oxides of Nitrogen Primary NAAQS Review Panel, opened the public meeting at 8:30 a.m. Dr. Nugent noted that five individuals had requested opportunities for public comment and three sets of written public comments had been submitted and provided to panel members.

Dr. Anthony Maciorowski welcomed CASAC panel members and thanked them for their work. Dr. Jonathan Samet thanked members for the pre-meeting comments and reviewed the agenda.

Introduction to Second Draft SO_2 Risk and Exposure Assessment for Sulfur Oxides –

Ms. Lydia Wegman expressed appreciation for the panel's work and presented the schedule (below) for EPA's completion of the NAAQS review for nitrogen oxides and sulfur oxides.

Schedules for the SO_2 and NO_2 Primary NAAQS Reviews

Stage of Review	Major Milestone	SO_2 Primary	NO_2 Primary
Risk and Exposure Assessment	CASAC/public review of 2nd draft REA	Apr. 16-17, 2009	
	Final REA	June 2009	
Policy Assessment/ Rulemaking	Proposed rulemaking	Nov. 16, 2009	June 26, 2009
	Final rulemaking	June 2, 2010	Jan. 22, 2010

Dr. Michael Stewart, Dr. Stephen Graham, and Mr. Harvey Richmond provided an overview of key changes and additions in second draft SO_2 REA analysis and provided a slide presentation overview of the draft REA (see Attachment D).

Panel members followed the presentation with clarifying questions. Agency representatives clarified that analysis of data on asthmatics drew from available data on mild to moderate asthmatics. Panel members noted that all asthmatic individuals do not fall into this category. Agency representatives acknowledged that the draft REA did not include a full analysis of 24-hour or annual standards. Panel members discussed the desirability of including a table or chart showing implications of choosing different short-term standards on longer-term exposures and on options for the 24-hour and annual standards.

First Public Comment Period

Dr. Angela Nugent introduced five members of the public who requested the opportunity to provide public comment.

Ms. Deborah Shprentz provided oral comments on behalf of the American Lung Association (Attachment E). Dr. Julie Goodman provided oral comments on behalf of the American Petroleum Institute (Attachment F). Dr. Jay Turim provided comment on behalf of the American Chemistry Council (Attachment G). Dr. Anne Smith provided comment on behalf of the Utility Air Regulatory Group (Attachment H). Mr. David W. Heinold provided comment on behalf of the National Association of Manufacturers (Attachment I).

Discussion and response to Agency charge questions relating to characterization of air quality (chapters 2, 5, 6, and 7)

Charge Question: Does the Panel find the results of the air quality analyses to be technically sound, clearly communicated, and appropriately characterized?

Drs. Lianne Sheppard and Douglas Crawford-Brown were the lead discussants. Dr. Sheppard commended EPA for a good air quality modeling effort. They noted that exposures to SO_2 were highly influenced by local sources and that the air quality analysis assumed the universe of modeling data represents reasonable sample of analysis. They provided suggestions for improving the air quality modeling analysis, which included adding a description of monitoring network design in chapter 2 and providing further information on the geographic distribution of monitors. They suggested that EPA also discuss more prominently in chapter 6 that only one five-minute exceedance per day was counted in the air quality analysis. Dr. Crawford Brown noted that the REA material in air quality section was consistent with information in the Integrated Science Assessment (ISA). He recommended that EPA more clearly explain how monitoring results related to estimates of exposures and more clearly describe uncertainties related to air quality monitoring. He found the semi-quantitative/qualitative uncertainty analysis adequate,

Several members noted that EPA had adapted the World Health Organization (WHO) guidance on uncertainty in the REA. One member noted that EPA should strengthen the REA by explaining its rationale for choosing one of many tiered approaches for characterizing uncertainty discussed in the WHO guidance. Members noted that the REA should explain the headings in Table 7-14 more clearly and discuss the implications of the information presented in the table in more detail. Panel members also discussed the importance of including older

publications on susceptibility to SO_2. They noted that most clinical studies were conducted with mild to moderate asthmatics, because researchers feared exposing severe asthmatics to SO_2.

Charge question 2: In order to simulate just meeting potential alternative 1-hour daily maximum standards, we have adjusted SO2 air quality levels using the same approach that was used in the first draft to simulate just meeting the current standards. What are the Panel's views on this approach? To what extent does this approach characterize the public health implications of the current standards? Does the Panel have technical concerns with this approach?

Dr. Armistead Russell, the lead discussant, provided initial comment. He noted improvements in the second draft REA's overall characterization of air quality. He advised EPA to discuss more fully the extremes of distribution, especially in the high end, and to use a probability-based scale in the graphical representation of air quality distributions

He endorsed EPA's relatively simple linear approach to quantifying current concentrations. He noted that this approach was the best available and that there were "many benefits to a simple transparent approach." In his view, the draft REA adequately communicated the limitations and implications of this approach.

Panel members then discussed other points related to the charge question. Several members voiced concern that measuring exceedances in terms of only one five-minute maximum exeedance in 24 hours might understate exposures if multiple high exceedances occur in a single 24-hour period. Multiple exceedances are highly correlated and it may make better sense from a public health perspective to examine the temporal profiles of exceedances and when they occur in time. An EPA representative responded that the REA distinguishes between counting how many times people exceed benchmark exposure level and impacts on public health. Panel members noted that this approach may present problems in communicating effectively with decision makers and the public.

Charge question 3: In this second draft document, the locations selected for detailed analyses were expanded from twenty to forty counties, using ambient SO2 monitoring data for years 2001-2006. What are the views of the Panel regarding the appropriateness of these locations and time period of analysis? To what extent is the rationale for selection of these locations and time periods clear and sufficient to justify their use in detailed air quality and exposure analyses?

Dr. Timothy Larson served as lead discussant for this charge question and noted that EPA should revise the REA to include the table provided in EPA's overview presentation that presented St. Louis and Green counties in the context of the 40 counties studied in the air quality analysis. He advised EPA to provide a discussion of whether the two counties selected for detailed analysis represent the represent the general case and whether they capture both the peaks and the lower exposures to large populations. He found that EPA's criteria for using 24-hour annual average, relative to just meeting criteria, are reasonable.

Other members then provided their views. One member noted concern about the representativeness of the air quality network. An EPA representative noted that the EPA could revise the document to include more discussion of the geographic features of the network. Such

information appears in the appendix; a summary of that information could be inserted to provide a fuller characterization in the main document.

Discussion and response to Agency charge questions relating to characterization of health effects evidence and selection of potential alternative standards for analysis (chapters 3, 4, 5)

Charge question 1: The presentation of the SO2 health effects evidence is based on the information contained in the final ISA for Sulfur Oxides. Does the draft REA accurately reflect the overall characterization of the health evidence for SO2 contained in the final ISA? Does the Panel find the presentation to be clear and appropriately balanced?

Dr. John Balmes, the lead discussant, provided initial comment that the second draft REA was fair and appropriately balanced. He advised EPA to revise the document to provide a more integrated approach to summarizing the science. He found that the clinical studies were supported by epidemiology studies and that chapter 3 provided adequate discussion of susceptibility of asthmatics. He found that the REA appropriately characterized the uncertainty associated with health effects for severe asthmatics. In the discussion that followed, panel members agreed that EPA should revise the REA to provide a clearer synthesis of the health literature.

Members also recommended that the discussion of susceptibility and variability in the REA could be improved by following the model provided by ISA and REA for particulate matter, which was better developed and more informative. One member advised EPA to revise Table 3.1 on variability to address factors such as exercise, work, ventilation, differential pathways (i.e., nose vs. mouth) more adequately. Several members agreed that the table needs additional detail and clarification of the factors included. Several members noted the particular importance of the susceptibility of mouth breathers.

Members then discussed several other issues. One member noted inconsistent usage of the terms exposure and dose (e.g., the REA refers to increased exercise as increased exposure, rather than dose). Another member called for an expanded discussion of adversity on page 24-25 because controlled human exposure studies addressing lung function primarily identify transitory effects and because health effects for SO_x are different from other chemicals. He also called for a discussion of diurnal variability in pollution levels and the effect of that variability on diurnal change in lung function for asthmatics. He noted that the document deviates from the American Thoracic Society guidelines for characterizing SO_x effects and that the document would be enhanced by a fuller discussion of the rationale for characterizing effects. Another member noted that effects of children's exposures in the morning are apparent in the afternoon. Yet another member noted that the REA would be strengthened if EPA better explained the impact of transient lung function effects on asthmatic individuals. He observed that "physicians get concerned if they see a 10% decline in forced expiratory volume in one second (FEV1) in an asthmatic individual, even without symptoms." Individuals typically under-report symptoms, because they want to "keep up their daily routines" and resist more medication. A panel member noted that asthma is measured by other indicators than FEV 1, which is easy to measure. Those other indicators may reflect other events that are of concern. A fellow panel member noted that epidemiology studies find increased hospital emissions at levels ten times lower than responses shown in controlled human exposure studies. Members noted that the REA could describe these

findings in more detail and acknowledge discrepancies between the epidemiological and clinical data.

Charge question 2: The specific potential alternative standards that have been selected for analysis are based on both controlled human exposure and epidemiological studies. To what extent is the rationale for selection of these potential alternative standards clear and sufficient to justify their use in the air quality, exposure and risk analyses? What are the views of the Panel regarding the appropriateness of these potential alternative standards for use in conducting the air quality, exposure, and risk assessments?

Professor Edward Avol and Dr. Frank Speizer were the lead discussants. Dr. Avol noted there was appropriate continuity between the ISA and REA. Dr. Speizer commented that the REA's discussion of the form of the standard was not adequately clear. Agency representatives noted that they would clarify in the document that the form of the standard consistently referred to the 98th or 99th percentile of the daily maximum exposure per hour in a year in each of three years and that the percentile value would be averaged.

<u>Discussion and response to Agency charge questions relating to characterization of health risks (chapters 7, 8, 9):</u>

Charge Question 1: Based on conclusions in the ISA regarding decrements in lung function in exercising asthmatics following 5-10 minute SO2 exposures, we have adjusted our range of 5-minute potential health effect benchmark values to 100 – 400 ppb. To what extent does this range of benchmark values appropriately reflect the health effects evidence related to 5-10 minute SO2 exposures evaluated in the ISA?

Professor Edward Avol and Dr. Kent Pinkerton were the lead discussants. They agreed that the REA made appropriate use of the ISA range. Other members commented favorably on EPA's method for using benchmark numbers. Several members advised EPA to clarify the difference between the use of the term "benchmark" (i.e., "potential health effect benchmark level" based on the evaluation of controlled human exposure levels) and threshold levels.

Charge question 2: Does the Panel view the results of the risk characterization in Chapters 7 and 8 and the lung function quantitative risk assessment in Chapter 9 to be technically sound, clearly communicated, and appropriately characterized?

Dr. James Ultman, the first lead discussant, responded that overall, the answer is yes. The methodology is clearly explained and well done. He asked EPA to more fully discuss the ventilation rate assumed, the derivation for the value assumed, and the implications of this assumption for both nose and mouth breathers. Dr. Ronald Wyzga, the second lead discussant, observed that the REA methodology was complex and comprehensive and noted that he would voice concerns about uncertainty assessment related to the analysis later in the meeting.

Charge Question 3: A quantitative risk assessment has been conducted with respect to two indicators of lung function response in exercising asthmatics in St. Louis and Greene County, MO. What are the views of the Panel on the approach taken and on the interpretation of the results of this analysis?

Dr. George Thurston, the lead reviewer, observed that the risk assessment did not include epidemiology results. He suggested that an analysis using Benmap for all 40 cities could give additional perspective on broad public health implication, information not provided by a detailed analysis of only two counties. He recommended that every NAAQS assessment include a risk analysis based on epidemiology data.

The panel noted that EPA did not have the data available for a risk assessment based on epidemiology data for SO_2, but members generally agreed that EPA should conduct a risk assessment using epidemiology data, where data exist.

Charge Question 4: What are the views of the Panel regarding the adequacy of the discussion of uncertainty and variability? To what extent have sources of uncertainty been identified and the implications for the risk characterization been addressed? To what extent has variability adequately been taken into account?

Dr. Christopher Frey, the lead discussant, noted that this question had broad implications for uncertainty assessment throughout the document. He advised EPA to list the objectives of its uncertainty analysis more clearly, and in every discussion of uncertainty to describe the objectives, methodology, results, and implications of these uncertainties more fully than presented in the second draft REA. He noted that Chapter 9 contained a more complete and useful discussion of uncertainties.

Other panel members agreed that such a standard approach would improve the document's clarity. Some panel members strongly advocated quantifying the most important types of uncertainty, such as use of Probit vs. Logistic model. Members agreed that EPA should distinguish systematic error (which may lead to bias) vs. imprecision (random error). Members noted that the Administrator has the discretion to make judgments in case of uncertainty and that the REA should identify statements can be made with confidence (while acknowledging uncertainties) as well as clearly identify the directionality of uncertainty.

<u>Discussion and response to Agency charge questions relating to characterization of exposure (Chapters 6 and 8):</u>

Charge Question 1: Does the Panel view the results of the exposure analyses to be technically sound, clearly communicated, and appropriately characterized?
Charge Question 4: What are the views of the Panel regarding the adequacy of the assessment of uncertainty and variability? To what extent have sources of uncertainty been identified and the implications for the risk characterization been addressed? To what extent has variability adequately been taken into account?

Drs. Armistead Russell and Ellis Cowling served as lead discussants. Dr. Russell noted that the second draft REA used appropriate tools but could be improved. He advised EPA to clarify how peak concentrations were determined in the AERMOD analysis and how AERMOD was used for APEX analysis. He called on EPA to include an explicit acknowledgement that

there has been no evaluation of APEX for the REA SO_2 analysis. He advised EPA to clarify the contributions of APEX modeling for the upper tails of the distribution.

Dr. Cowling noted that Chapters 6 and 8 do include summary statements and that such summaries of key findings are critical to inform decision makers about the science supporting the NAAQS decisions.

Charge Question 2: The second draft REA evaluates exposures in St Louis and Greene County, MO. What are the views of the Panel on the approach taken? To what extent does this approach help to characterize the public health implications of the current standards? Does the Panel have technical concerns with this approach?

Dr. Timothy Larson, the lead discussant, once again noted that EPA should revise the REA to include the table provided in EPA's overview presentation that presented St. Louis and Green counties in the context of the 40 counties studied in the air quality analysis.

Charge Question 3: What are the views of the Panel regarding the approaches taken to model SO2 emission sources? Does the Panel have comments on the comparison of the model predictions to ambient monitoring data?
Charge Question 5: What are the views of the Panel regarding the staff's characterization of the representativeness of the St. Louis and Greene County, MO exposure and risk estimates?

Dr. Lianne Sheppard, the lead discussant, noted that the EPA's characterization may contain an underprediction, because the uncertainty analysis addresses the number of persons exposed in terms of a single peak per hour. She also suggested that the REA address the prevalence of air conditioner use, and the representativeness of this factor compared to other spatial locations. She suggested that the document compare the port of St. Louis to exposures in other ports.

EPA representatives responded that even though continuous monitoring may seem to provide an abundance of data, there are significant data gaps. Many monitors only have a single site-year of data. EPA elected to use the worst case, which serves as an upper bound.

<u>Policy Assessment (Chapter 10):</u>

Charge Question 1: The policy chapter has integrated health evidence from the final ISA and risk and exposure information in this second draft REA as it relates to the adequacy of the current and potential alternative standards. Does the Panel view this integration to be technically sound, clearly communicated, and appropriately characterized?

Dr. Steven Kleeberger summarized his own lead discussant comments and those provided by lead discussant, Dr. Christopher Frey. Both discussants agreed chapter 10 was a useful, well documented, well-written chapter. They advised EPA to strengthen the document by clarifying the science rationale for choosing a one-hour annual standard.

Charge Question 2: What are the views of the Panel regarding the staff's discussion of considerations related to the adequacy of the current standards? To what extent does the draft policy chapter adequately characterize the public health implications of the current standards?

Dr. Terry Gordon, as lead discussant, commented that the REA should provide a more extended, separate rationale for considering the adequacy of the 24-hour standard. Dr. Donna Kenski, the second lead discussant, commented that there was adequate justification for revoking 24-hour standard, but less justification in the REA regarding the annual standard.

Panel member discussed the need for the document to explain more clearly why a five-minute standard was not desirable and the importance of stability in considering possible standards.

Charge question 3: To what extent does the draft policy chapter adequately characterize the public health implications of the potential alternative 1-hour daily maximum SO2 standards?

Dr. Joseph Brain, as lead discussant, advised EPA, once again, to state more clearly the implications of choosing a one-hour standard on choosing an annual standard. He noted that chapter 10 would be enhanced by addition of a one-page summary of key conclusions.

Other members noted that chapter 10 was well written and noted additional text that might strengthen it. Several members suggested that the REA provide additional explanation for choosing 98^{th} vs. 99^{th} percentile as the form of the standard.

A member noted that the REA did not consider sulfates, because SO_2 was identified as an indicator for SO_x. An Agency representative responded that the particulate matter review will address sulfate as a particulate species within the particulate matter mixture.

Charge question 4: Staff believes that the evidence presented in the final ISA and the exposure and risk information presented in this second draft REA supports a potential alternative 1-hour daily maximum standard within a range of 50- 150 ppb. To what extent does the draft policy chapter provide sufficient rationale to justify this range of levels?

Drs. Richard Schlesinger and James Crapo provided comments as lead discussants. Dr. Schlesinger agreed that the REA range was appropriate for the one-hour standard. In his view, the REA provides sufficient rationale for beginning the range at 50 and asked whether the upper limit of 150 was sufficiently protective. He expressed concern over peak excursions and suggested that the range be 50-100 ppb. Dr. Crapo commended EPA for chapter 10's summary and discussion of the analysis. In his view, the range 50 to 150 was well considered. For him, the convincing data for setting the short term standard came from human clinical studies that demonstrated effects down to 200 ppb. As dose declines, the intensity of response drops, but still produces measurable, reproducible responses. Although there are a number of occurrences that reach from 100-200 range, morbidity at lower mean levels reflects excursions at 100 ppb. Based on this information, he noted that a short term standard in the range of 50- 150 ppb should be adequate. He noted that no data indicate cumulative dose effects. In regard to the lower range, he noted mixed data. He recognized a number of excursions at high levels driving the

data. In his view, however, there are probably multi-pollutant complex effect happening. The data, in his view did not dictate a lower range.

Dr. Crapo noted that, over his experience reviewing NAAQS for criteria pollutants, the science indicates more and more sensitive indices and expressed concern that CASAC could find itself in the difficult position of advising EPA that exposures be reduced to zero. He expressed the view that Congress might usefully consider this issue. EPA staff responded that legal interpretations of the Clean Air Act did not require that "protecting public health with an adequate margin of safety" drive standards to zero.

One member responded to Dr. Crapo's comment by calling for more analysis of the interactions between gases and particles. Particles can be activated by gases and made more bio-available and particles can serve as vectors for gases, making them reach more deeply.

Discussion of process for Agency response to comments from CASAC

Dr. Samet initiated a discussion about an improved process for Agency response to CASAC advice. He reminded the Agency of a December 16, 2008 letter, where he, as CASAC chairs, called for EPA staff to "adopt a practice of responding more specifically to CASAC's major concerns summarized in our letters to the EPA Administrator." He noted that EPA had not provided a "response to comment document" summarizing major changes related in the second draft SO_2 REA. He and other panel members noted that providing such a document will allow reviewers to be more efficient in reviewing long documents and increase the clarity and transparency of the process of peer review.

Agency representatives acknowledged the December 2008 advice and made a commitment to provide a separate "response to comments" document in the future responding to CASAC advice. They committed to provide a separate "response to comment" document for the next draft of the ISA for particulate matter.

Dr. Samet then enquired whether EPA had any suggestions to make CASAC advisory letters more useful to them. Agency representatives responded that when CASAC identifies an over-arching issue, it is most useful to have the CASAC's views on that issue clearly identified and the underlying rationale. If there are different rationales supporting a view, it is helpful for those different rationales to be articulated.

Remarks and presentation on European science on air pollutants.

At the request of CASAC member, Dr. Ellis Cowling, Dr. Samet introduced Dr. Peringe Greenfelt, Science Director, Swedish Environmental Research Institute, for a brief discussion of European science and management of air pollutants. Panel members voiced interest in efforts to regulate multiple pollutants. In response to a question, Dr. Greenfelt noted that the European Union had not yet addressed hazardous air pollutants.

Conclusion of Discussion on April 16, 2009

The chair asked lead discussants to provide draft text by 10 p.m. to the DFO, who would integrate their responses so that panel members could discuss the draft report early on April 17th. At the chair's request, the Designated Federal Officer adjourned the meeting at 5:15 p.m.

Meeting Summary – April 17, 2009

The DFO opened the meeting at 8:30. Panel members discussed a draft of the panel report. Panel members discussed the draft letter and attachment, which contained the consensus panel responses to charge questions. The chair asked if any member of the public wished to comment. There were no public comments on the committee's draft letter and attachment. The panel agreed with the substantive points in the draft letter and attachment.

Summary of Next Steps Related to the Review of the draft Risk and Exposure Assessment

The chair informed the panel that he would work with the DFO to revise the draft letter and attachment to make editorial changes within the next ten days. The draft would then be circulated to the panel for concurrence.

At the chair's request, the Designated Federal Officer adjourned the meeting at 11:30 a.m.

Respectfully Submitted:

/Signed/

Angela Nugent
Designated Federal Officer

Certified as True:

/Signed/

Jonathan Samet
Chair

NOTE AND DISCLAIMER: The minutes of this public meeting reflect diverse ideas and suggestions offered by committee members during the course of deliberations within the meeting. Such ideas, suggestions, and deliberations do not necessarily reflect definitive consensus advice from the panel members. The reader is cautioned to not rely on the minutes to represent final, approved, consensus advice and recommendations offered to the Agency. Such advice and recommendations may be found in the final advisories, letters, or reports prepared and transmitted to the EPA Administrator following the public meetings.

Attachments

Attachment A	Roster
Attachment B	Federal Register Notice
Attachment C	Meeting Agenda
Attachment D	Overview of Key Changes and Additions in the Second Draft Risk and Exposure Assessment for the SO2 Primary NAAQS Review
Attachment E	Public comments of Ms. Deborah Shprentz, Consultant to the American Lung Association
Attachment F	Presentation by Dr. Julie Goodman on behalf of the American Petrolum Institute
Attachment G	Presentation by Dr. Jay Turim on behalf of the American Chemistry Council
Attachment H	Presentation by Dr. Anne Smith on behalf of the Utility Air Regulatory Group
Attachment I	Presentation by Mr. David W. Heinold on behalf of the National Association of Manufacturers

Attachment A: Roster

U.S. Environmental Protection Agency
Clean Air Scientific Advisory Committee (CASAC)
Sulfur Oxides Primary NAAQS Review Panel

CHAIR

Dr. Jonathan M. Samet, Professor and Chair of the Department of Epidemiology, Bloomberg School of Public Health, Johns Hopkins University, Baltimore, MD

CASAC MEMBERS

Dr. Joseph Brain, Philip Drinker Professor of Environmental Physiology, Department of Environmental Health, Harvard School of Public Health, Harvard University, Boston, MA

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

Dr. James Crapo, Professor of Medicine, Department of Medicine, National Jewish Medical and Research Center, Denver, CO

Dr. H. Christopher Frey, Professor, Department of Civil, Construction and Environmental Engineering, College of Engineering, North Carolina State University, Raleigh, NC, USA

Dr. Donna Kenski, Data Analyst, Lake Michigan Air Directors Consortium, Des Plaines, IL

Dr. Armistead (Ted) Russell, Professor, Department of Civil and Environmental Engineering, Georgia Institute of Technology, Atlanta, GA

CONSULTANTS

Professor Ed Avol, Professor, Preventive Medicine, Keck School of Medicine, University of Southern California, Los Angeles, CA

Dr. John R. Balmes, Professor, Department of Medicine, Division of Occupational and Environmental Medicine, University of California, San Francisco, CA

Dr. Douglas Crawford-Brown, Professor and Director, Department of Environmental Sciences and Engineering, Carolina Environmental Program, University of North Carolina at Chapel Hill, Chapel Hill, NC

Dr. Terry Gordon, Professor, Environmental Medicine, NYU School of Medicine, Tuxedo, NY

Dr. Dale Hattis, Research Professor, Center for Technology, Environment, and Development, George Perkins Marsh Institute, Clark University, Worcester, MA

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

Dr. Patrick Kinney, Associate Professor, Department of Environmental Health Sciences, Mailman School of Public Health , Columbia University, New York, NY

Dr. Steven Kleeberger, Professor, Lab Chief, Laboratory of Respiratory Biology, National Institute of Environmental Health Sciences, National Institutes of Health, Research Triangle Park, NC

Dr. Timothy V. Larson, Professor, Department of Civil and Environmental Engineering, University of Washington, Seattle, WA, USA

Dr. Kent Pinkerton, Professor, Regents of the University of California, Center for Health and the Environment, University of California, Davis, CA

Dr. Edward Postlethwait, Professor and Chair, Department of Environmental Health Sciences, School of Public Health, University of Alabama at Birmingham, Birmingham, AL

Dr. Richard Schlesinger, Associate Dean, Department of Biology, Dyson College, Pace University, New York, NY

Dr. Christian Seigneur, Director, Atmospheric Environment Center, Université Paris-Est, Champs-sur-Marne, France

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

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

Dr. George Thurston, Professor, Environmental Medicine, NYU School of Medicine, New York University, Tuxedo, NY

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

Dr. Ronald Wyzga, Technical Executive, Air Quality Health and Risk, Electric Power Research Institute, Palo Alto, CA

SCIENCE ADVISORY BOARD STAFF

Dr. Angela Nugent, Designated Federal Officer, 1200 Pennsylvania Avenue, NW 1400F, Washington, DC, Phone: 202-343-9981, Fax: 202-233-0643, (nugent.angela@epa.gov)

Attachment B:Federal Register Notice

Science Advisory Board Staff Office; Notification of a Public Advisory Committee Meeting of the Clean Air Scientific Advisory Committee (CASAC); Sulfur Oxides Primary NAAQS Review Panel

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Science Advisory Board Staff Office; Notification of a Public Advisory Committee Meeting of the Clean Air Scientific Advisory Committee (CASAC); Sulfur Oxides Primary NAAQS Review Panel

[Federal Register: March 18, 2009 (Volume 74, Number 51)]
[Notices]
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From the Federal Register Online via GPO Access [wais.access.gpo.gov]
[DOCID:fr18mr09-54]

ENVIRONMENTAL PROTECTION AGENCY
[FRL-8782-9]

Science Advisory Board Staff Office; Notification of a Public Advisory Committee Meeting of the Clean Air Scientific Advisory Committee (CASAC); Sulfur Oxides Primary NAAQS Review Panel

AGENCY: Environmental Protection Agency (EPA).
ACTION: Notice.

SUMMARY: The Environmental Protection Agency (EPA) Science Advisory Board (SAB) Staff Office announces a public meeting of the Clean Air Scientific Advisory Committee's (CASAC) Sulfur Oxides Primary NAAQS Review Panel (Panel) to conduct a peer review of the EPA's Risk and Exposure Assessment to Support the Review of the SO2 Primary National Ambient Air Quality Standards: Second Draft.

DATES: The meeting will be held from 8:30 a.m. (Eastern daylight time) on Thursday, April 16, 2009 through 1 p.m. (Eastern daylight time) on

Friday, April 17, 2009.

ADDRESSES: The April 16-17, 2009 meeting will take place at the Sheraton Chapel Hill Hotel, One Europa Drive, Chapel Hill, NC 27517.

FOR FURTHER INFORMATION CONTACT: Any member of the public who wishes to submit a written or brief oral statement (five minutes or less) or wants further information concerning this meeting must contact Dr. Angela Nugent, Designated Federal Officer (DFO), EPA Science Advisory Board (1400F), U.S. Environmental Protection Agency, 1200 Pennsylvania Avenue, NW., Washington, DC 20460; via telephone/voice mail (202) 343-9981; fax (202) 233-0643; or e-mail at nugent.angela@epa.gov. General information concerning the CASAC and the CASAC documents cited below can be found on the EPA Web site at http://www.epa.gov/casac.

SUPPLEMENTARY INFORMATION: Background: The Clean Air Scientific Advisory Committee (CASAC) was established under section 109(d)(2) of the Clean Air Act (CAA or Act) (42 U.S.C. 7409) as an independent scientific advisory committee. CASAC provides advice, information and recommendations on the scientific and technical aspects of air quality criteria and national ambient air quality standards (NAAQS) under sections 108 and 109 of the Act. The CASAC is a Federal advisory committee chartered under the Federal Advisory Committee Act (FACA), as amended, 5 U.S.C., App. The Panel will comply with the provisions of FACA and all appropriate SAB Staff Office procedural policies.

Section 109(d)(1) of the CAA requires that the Agency periodically review and revise, as appropriate, the air quality criteria and the NAAQS for the six ``criteria'' air pollutants, including sulfur oxides (SOX). EPA is in the process of reviewing the primary NAAQS for sulfur dioxide (SO2), an indicator for SOX.
Primary standards set limits to protect public health, including the health of ``sensitive'' populations such as asthmatics, children, and the elderly.

CASAC has previously provided consultative advice on EPA's Integrated Plans for Review of the Primary NAAQS for NO2 and SO2 and conducted peer review of the first and second drafts of EPA's Integrated Science Assessment for Sulfur Oxides--Health Criteria. CASAC also provided consultative advice on EPA's Sulfur Dioxide Health Assessment Plan: Scope and Methods for Exposure and Risk Assessment and conducted peer review of EPA's Risk and Exposure Assessment to Support the Review of the SO2 Primary National Ambient Air Quality Standards: First Draft. The CASAC advisory reports are available on the EPA Web site at http://www.epa.gov/casac. The purpose of this meeting is for CASAC to conduct a peer review of the Risk and Exposure Assessment to Support the Review of the SO2 Primary National Ambient Air Quality Standards: Second Draft.

Technical Contact: Any questions concerning EPA's Risk and Exposure

[[Page 11550]]

Assessment to Support the Review of the SO2 Primary National Ambient Air Quality Standards: Second Draft should be directed to Dr. Michael Stewart, OAR by telephone (919) 541-7524, or e-mail stewart.michael@epa.gov.

Availability of Meeting Materials: EPA-OAR's Risk and Exposure Assessment to Support the Review of the SO2 Primary National Ambient Air Quality Standards: Second Draft will be accessible via the Agency's Office of Air Quality Planning and Standards Web site at http://www.epa.gov/ttn/naaqs/standards/so2/s_so2_cr_rea.html on or about March 19, 2009. Agendas and materials supporting the meeting will be placed on the EPA Web site at http://www.epa.gov/casac before the meeting.

Procedures for Providing Public Input: Interested members of the public may submit relevant written or oral information for the CASAC Panel to consider during the advisory process. Oral Statements: In general, individuals or groups requesting an oral presentation at a public meeting will be limited to five minutes per speaker, with no more than a total of one hour for all speakers. Interested parties should contact Dr. Angela Nugent, DFO, in writing (preferably via e-mail) by April 10, 2009 at the contact information noted above to be placed on the public speaker list for this meeting. Written Statements: Written statements for the public meeting should be received by Dr. Angela Nugent at the contact information above by April 10, 2009, so that the information may be made available to the Panel for their consideration prior to this meeting. Written statements should be supplied to the DFO in the following formats: one hard copy with original signature (optional), and one electronic copy via e-mail (acceptable file format: Adobe Acrobat PDF, MS Word, MS PowerPoint, or Rich Text files in IBM-PC/Windows 98/2000/XP format).

Accessibility: For information on access or services for individuals with disabilities, please contact Dr. Nugent at the phone number or e-mail address noted above, preferably at least ten days prior to the meeting, to give EPA as much time as possible to process your request.

Dated: March 11, 2009.
Anthony F. Maciorows,
Deputy Director, EPA Science Advisory Board Staff Office.
[FR Doc. E9-5870 Filed 3-17-09; 8:45 am]
BILLING CODE 6560-50-P

Attachment C: Meeting Agenda

U.S. Environmental Protection Agency – Science Advisory Board (SAB) Staff Office
Clean Air Scientific Advisory Committee (CASAC)
Sulfur Oxides (SO_x) Primary National Ambient Air Quality Standards (NAAQS) Review Panel
Public Meeting
April 16-17, 2009
Sheraton Chapel Hill Hotel, One Europa Drive, Chapel Hill, NC 27517

Meeting Agenda

Purpose: to conduct a peer review of the EPA's Risk and Exposure Assessment (REA) to Support the Review of the SO_2 Primary National Ambient Air Quality Standards: Second Draft.

April 16, 2009

8:30 a.m.	Welcome	Dr. Angela Nugent, EPA SAB Staff Office, Designated Federal Officer Dr. Anthony Maciorowski, EPA, SAB Staff Office
8:40 a.m.	Review of agenda and purpose of meeting	Dr. Jonathan Samet, Chair
8:50 a.m.	Introduction to second draft REA	Ms. Lydia Wegman, EPA, Office of Air and Radiation (OAR) Dr. Michael Stewart, EPA OAR Dr. Stephen Graham, EPA OAR Mr. Harvey Richmond, EPA OAR
9:20 a.m.	Public Comments	To be announced
	Members' Discussion and Deliberations	
9:45 a.m.	Charge questions relating to characterization of air quality	Lead Discussants
	Charge questions 1 and 4	Dr. Ronald Wyzga Dr. Douglas Crawford-Brown (by phone)
	Charge question 2	Dr. Armistead Russell
	Charge question 3	Dr. Timothy Larson
10:30 a.m.	Break	

10:45 a.m.	Charge questions relating to characterization of health effects evidence and selection of potential alternative standards for analysis	Lead Discussants
	Charge question 1	Dr. John Balmes Dr. Edward Postlethewaite (by phone)
	Charge question 2	Dr. Edward Avol Dr. Frank Speizer (by phone)
12:00 p.m.	Lunch	
1:15 p.m.	Charge questions relating to characterization of exposure	Lead Discussants
	Charge questions 1 and 4	Dr. Armistead Russell Dr. Ellis Cowling
	Charge question 2	Dr. Timothy Larson Dr. Patrick Kinney (by phone)
	Charge question 3	Dr. Dale Hattis (by phone)
	Charge question 5	Dr. Lianne Sheppard
2:15 p.m.	Charge questions relating to characterization of health risks	Lead Discussants:
	Charge question 1	Dr. Edward Avol Dr. Kent Pinkerton (by phone)
	Charge question 2	Dr. James Ultman
	Charge question 3	Dr. George Thurston
	Charge question 4	Dr. Christopher Frey
3:30 p.m.	Break	
3:45 p.m.	Charge questions relating to policy assessment	Lead Discussants
	Charge question 1	Dr. Steven Kleeberger Dr. Christopher Frey
	Charge question 2	Dr. Terry Gordon Dr. Donna Kenski
	Charge question 3	Dr. Joseph Brain Dr. Rogene Henderson

	Charge question 4	Dr. Richard Schlesinger (by phone) Dr. James Crapo
5:00 p.m.	Summary and next steps	Dr. Jonathan Samet
5:15 p.m.	Recess for day	

April 17, 2009

8:30 a.m.	Reconvene the panel meeting	Dr. Angela Nugent
9:10 a.m.	Discussion of draft responses	Panel members
10:30 a.m.	Break	
10:45 a.m.	Second public comment period	To be announced
11:00 a.m.	Continued discussion of draft text and approval of major points Identification of next steps	Panel members Dr. Jonathan Samet
12:30 p.m.	Adjourn the meeting	

Attachment D

Presentation: Overview of the Second Draft Risk and Exposure Assessment to Support the NO_2 Primary NAAQS

Attachment D
Overview of Key Changes and Additions in the Second Draft Risk and Exposure Assessment for the SO2 Primary NAAQS Review

Overview of Key Changes and Additions in the Second Draft Risk and Exposure Assessment for the SO_2 Primary NAAQS Review

Presentation to the Clean Air Scientific Advisory Committee

Office of Air Quality Planning and Standards
Environmental Protection Agency

April 16-17, 2009

1

Overview

- REA Development
- Key changes and additions with respect to the first draft Risk and Exposure Assessment (REA)
  - Health benchmark levels
  - Air quality characterization
  - Exposure assessment
  - Quantitative lung function risk assessment
  - Policy assessment

2

REA Development

- **First Draft REA:**
  - Assessed exposures and characterized risks considering current air quality and air quality simulated to just meet the current standards
  - Informed by health information and conclusions in 1st and 2nd drafts of the ISA
- **Second Draft REA:**
  - Revised and expanded air quality, exposure, and risk analyses to include potential alternative standards in St. Louis and Greene County, MO
  - Includes quantitative risk assessment for lung function responses for asthmatics associated with 5-minute exposures while engaged in moderate or greater exertion
  - Includes a policy assessment considering evidence based and air quality, exposure, and risk based considerations
- **Final REA:**
  - Will be informed by comments from CASAC and the public on the second draft of the document
  - Considered in conjunction with the health information evaluated in the final ISA to inform the rulemaking process

3

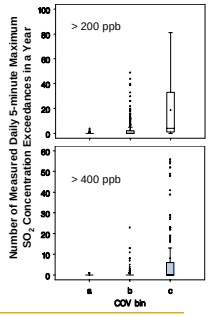
Key change: Lowering of potential health effect benchmark levels

- Potential health effect benchmark values derived from 5-10 minute exposures of exercising asthmatics lowered from 400 – 600 ppb to 100 -400 ppb
  - Considers that the lowest observed effect level in 5-10 minute free-breathing chamber studies follows a 200 ppb exposure, but that participants in those studies do not represent the most sensitive asthmatics (i.e. severe asthmatics)
  - Considers that 400 ppb is the lowest exposure level in 5-10 minute free-breathing chamber studies at which moderate or greater lung function decrements are frequently accompanied with respiratory symptoms

4

Key changes: Air quality characterization

- Reorganized chapter and improved clarity
- Added ambient monitor characterization
  - Siting characteristics, proximity to emission sources, population density, concentration variability
- Evaluation of current and potential alternative standards
  - Elaborated discussion on concentration adjustment procedure
  - Expanded counties selected to 40
- PMR statistical model
  - Expanded bins from 3 x 5 to 3 x 7
  - Cross-validation of predicted/observed
    - Two bin types evaluated (COV, GSD)
- Expanded uncertainty analysis



5

Key changes: Exposure assessment

- Reorganized chapter and improved clarity
- Focused analysis on Greene County (1st draft) and St. Louis
- Expanded modeled-to-monitored air quality concentration evaluation
- Enhanced indoor SO_2 removal rate distributions
- Results now include microenvironmental contribution to exposures
- Added section on representativeness of St. Louis and Greene County to other U.S. areas
- Expanded uncertainty analysis including
  - Dispersion and exposure modeling uncertainties
  - Impact of multiple peaks within an hour

6

Additional representativeness evaluation of St. Louis and Greene County air quality

- St. Louis was not one of the 40 selected counties for the air quality characterization
  - Mean daily 5-minute maximum SO_2 concentrations were modeled in St. Louis as was done with the other 40 counties using the hourly monitoring data (2001-2006)
  - The estimated annual benchmark exceedances, average total emissions (within 20 km of monitors), and average population (within 5km) were ranked in ascending order within the 40 county data set results

7

Additional representativeness evaluation of St. Louis and Greene County air quality (cont.)

Location	Air Quality Scenario	Benchmark Exceedance Rank (out of 41)			
		100 ppb	200 ppb	300 ppb	400 ppb
Greene County, MO Population – 19th Emissions – 37th	AS IS	31	23	22	21
	Current Standard	40	33	27	23
	99-50	8	4	4	22.5
	99-100	13	6	5	4
	99-150	27	9	7	5
	99-200	32	14	8	8
	99-250	34	22	9	7
	98-200	36	21	9	8
St. Louis, MO Population – 9th Emissions – 26th	AS IS	38	37	39	38.5
	Current Standard	2	3	8	14
	99-50	30	22.5	27	22.5
	99-100	20	30	25	24
	99-150	13	27	30	28.5
	99-200	9	21	29	30
	99-250	8	15	27	28
	98-200	8	16	24	26

8

Key change: Added quantitative lung function risk assessment

- Combined outputs from the exposure analysis for asthmatics (all) and asthmatic (children) with estimated exposure-response functions to estimate:
  - Percentage and number of asthmatics likely to experience two specified levels of response in lung function
  - Total number of occurrences per year of two specified levels of response in lung function
- Exposure–response functions were based on controlled human exposure studies
- Used sRaw $\geq$100% and $\geq$200% and decrement in FEV_1 $\geq$15% and $\geq$20%.
- Considered current air quality, and air quality adjusted to simulate just meeting the current, and potential alternative 99th percentile 1-hour alternative standards
- Results presented for St. Louis and Greene County

9

Table 9-4. Number of Asthmatics Engaged in Moderate or Greater Exertion Estimated to Experience At Least One Lung Function Response Associated with Exposure to SO_2 Under Alternative Air Quality Scenarios*

Location	"As is" SO_2 Concentrations**	SO_2 Concentrations that Just Meet the Current Standards***	SO_2 Concentrations that Just Meet Alternative nth Percentile 1-Hr Daily Maximum Standards, with Levels (in ppb) of m (Standard Denoted n/m):					
			99/50	99/100	99/150	99/200	99/250	98/200
Response = Increase in sRaw >= 100%								
Greene County, MO	90 (20 - 390)	210 (80 - 620)	80 (20 - 380)	90 (20 - 390)	100 (20 - 420)	120 (30 - 460)	160 (50 - 520)	140 (40 - 500)
St. Louis, MO	1010 (340 - 3010)	13460 (9740 - 18510)	730 (220 - 2490)	1990 (860 - 4690)	3650 (1900 - 7100)	5520 (3230 - 9490)	7500 (4770 - 11850)	7050 (4410 - 11320)
Response = Increase in sRaw >= 200%								
Greene County, MO	30 (0 - 210)	70 (20 - 310)	30 (0 - 210)	30 (0 - 210)	30 (0 - 220)	40 (10 - 240)	50 (10 - 270)	50 (10 - 260)
St. Louis, MO	330 (70 - 1520)	5520 (3400 - 8960)	230 (40 - 1290)	670 (210 - 2270)	1280 (510 - 3360)	2010 (940 - 4470)	2830 (1470 - 5590)	2640 (1340 - 5330)

*Numbers are median (50th percentile) numbers of asthmatics. Numbers in parentheses below the median are 95% credible intervals based on statistical uncertainty surrounding the SO_2 coefficient in the 2-parameter logistic exposure-response function. Numbers are rounded to the nearest ten.

**The "as is" exposure scenario was based on monitoring and modeling using 2002 air quality information.

***The current primary SO_2 standards include a 24-hour standard set at 0.14 parts per million (ppm), not to be exceeded more than once per year, and an annual standard set at 0.03 ppm, calculated as the arithmetic mean of hourly averages.

10

Table 9-6. Number of Occurrences (In Hundreds) of a Lung Function Response Among Asthmatics Engaged in Moderate or Greater Exertion Associated with Exposure to SO_2 Concentratrons Under Alternative Air Quality Scenarios*

Location	"As is" SO_2 Concentration s**	SO_2 Concentration s that Just Meet the Current Standards***	SO_2 Concentrations that Just Meet Alternative nth Percentile 1-Hr Daily Maximum Standards, with Levels (in ppb) of m (Standard Denoted n/m):					
			99/50	99/100	99/150	99/200	99/250	98/200
Response = Increase in sRaw >= 100%								
Greene County, MO	125 (24 - 572)	127 (25 - 577)	125 (24 - 572)	125 (24 - 572)	125 (24 - 573)	126 (24 - 573)	126 (24 - 575)	126 (24 - 574)
St. Louis, MO	657 (128 - 2985)	1672 (663 - 4740)	652 (125 - 2975)	686 (141 - 3041)	762 (176 - 3184)	880 (234 - 3398)	1036 (315 - 3673)	997 (295 - 3604)
Response = Increase in sRaw >= 200%								
Greene County, MO	38 (4 - 310)	39 (4 - 312)	38 (4 - 310)	38 (4 - 310)	38 (4 - 310)	38 (4 - 310)	39 (4 - 311)	39 (4 - 311)
St. Louis, MO	201 (21 - 1614)	560 (165 - 2407)	199 (20 - 1609)	211 (24 - 1639)	237 (32 - 1703)	278 (47 - 1799)	332 (68 - 1923)	319 (63 - 1892)

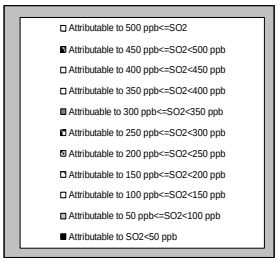
*Numbers are median (50th percentile) numbers of occurrences. Numbers in parentheses below the median are 95% credible intervals based on statistical uncertainty surrounding the SO_2 coefficient in the 2-parameter logistic exposure-response function. Numbers are rounded to the nearest whole number.

**The "as is" exposure scenario was based on monitoring and modeling using 2002 air quality information.

***The current primary SO_2 standards include a 24-hour standard set at 0.14 parts per million (ppm), not to be exceeded more than once per year, and an annual standard set at 0.03 ppm, calculated as the arithmetic mean of hourly averages.

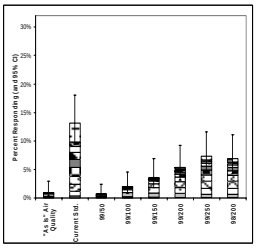
11

Key for contribution of risk figures

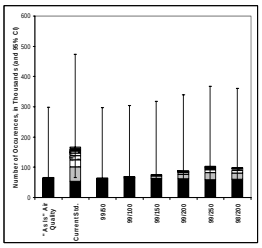


12

Lung Function Responses (defined as ≥ 100% increase in sRaw) for Asthmatics- Total and Contribution of 5-Minute SO2 Exposure Ranges



Estimated Percent of Asthmatics Experiencing One or More Lung Function Responses



Estimated Annual Number of Occurrences

13

Key addition: Policy assessment

- Considers the scientific evidence from the ISA and the exposure and risk information in the REA as it relates to the:
  - Adequacy of the current standards
    - 24-hour average of 0.14 ppm, not to be exceeded more than once per year
    - Annual average of 0.03 ppm
  - Consideration of potential alternative standards
    - 99th percentile 1-hour daily maximum levels of 50, 100, 150, 200, and 250 ppb
    - 98th percentile 1-hour daily maximum level at 200 ppb
- Key conclusions
  - The scientific evidence and exposure and risk information call into question the adequacy of the current standards to protect public health with an adequate margin of safety from the respiratory effects associated with SO_2 exposure.
  - Staff provisionally concludes that the scientific evidence and exposure and risk information reasonably support a 99th percentile 1-hour daily maximum standard at levels ranging from 50 -150 ppb
  - Staff recognizes that the particular standard level selected will have implications for retaining or revoking the current 24-hour and/or annual standard

14

Attachment E: Comments of the American Lung Association on EPA's Risk and Exposure Assessment to Support the Review of the SO_2 Primary National Ambient Air Quality Standards: Second Draft EPA-452/P-09-003 March 2009

Prepared by Deborah Shprentz
Consultant to the American Lung Association
April 14, 2009

Docket ID #: EPA-HQ-OAR-2007-0352

The current National Ambient Air Quality Standards (NAAQS) for sulfur dioxide (SO_2) were set in 1971. These standards are an annual average standard of 30 ppb and a 24-hour average standard of 140 ppb, not to be exceeded more than once per year. The American Lung Association concurs with EPA's assessment in the second draft Risk and Exposure Assessment (REA) that the current standards are inadequate to protect public health.

Heath Studies Provide Clear Evidence of Effects Below the Current Standards

- Clinical studies provide clear evidence for harm to people with asthma who breathed high levels of SO_2 while they were exercising. These studies generally found that these individuals suffered a decline in lung function and an increase in respiratory symptoms, even after only a 15-minute exposure of 200 ppb and greater.[1] People with asthma suffered increased airway resistance after several minutes of breathing SO_2 at concentrations of 100 ppb under conditions of exercise, when exposed to SO_2 via a facemask.[2]

- Animal toxicology studies have demonstrated lung inflammation, airway hyperreactivity, and exaggerated allergic responses after repeated exposures of 100 ppb and greater.[3]

[1] U.S. EPA. Integrated Science Assessment for Sulfur Oxides - Health Criteria. ISA: EPA/600/R-08/047F, September 2008, p. 3-4.
[2] Sheppard D, Saisho A, Nadel JA, Boushey HA.. Exercise increases sulfur dioxide-induced bronchoconstriction in asthmatic subjects. *Am Rev Respir Dis* 1981; 123: 486-491.
[3] U.S. EPA. Integrated Science Assessment for Sulfur Oxides - Health Criteria. ISA: EPA/600/R-08/047F, September 2008, pp. 3-19 - 3-20, 3-31.

- Epidemiological studies find effects at far lower concentrations than the clinical chamber studies. The community health studies provide convincing evidence of increased respiratory symptoms in children at current ambient concentrations, well below the level of the current 24-hour current NAAQS of 140 ppb. A large multi-city study linked previous day SO_2 concentrations with morning respiratory symptoms in 8 urban areas where median 3-hour average SO_2 levels ranged from 17 ppb to 37 ppb.[4] Inner city children with asthma suffer from declines in lung function following exposure to higher daily concentrations of sulfur dioxide.[5] Present day concentrations of SO_2 are also implicated in increased emergency department visits and hospitalizations for respiratory causes among children and older adults.[6]

- A study in Bronx, New York found that asthma hospitalizations in children climbed as hourly sulfur dioxide concentrations increased. Hospitalizations began to rise at hourly concentrations greater than 9 ppb, with a sharp increase an concentrations greater than 40 ppb.[7]

- Reducing SO_2 levels results in an immediate gain in life expectancy, according to evidence from intervention studies that examine health effects after reduction in sulfur dioxide exposures.[8]

- According to the EPA Integrated Science Assessment: "The evidence is suggestive of a causal relationship between short-term exposure to SO_2 and mortality."[9]

Court Remands Standards to EPA

EPA last considered revisions to the SO_2 standards in 1996. At that time, there was considerable new evidence that short exposures to peak levels of SO_2 in the air can make it difficult for people with asthma to breathe when they are active outdoors.

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[4] Mortimer KM, Neas LM, Dockery DW, Redline S, Tager IB. The effect of air pollution on inner-city children with asthma. *Eur Respir J* 2002; 19: 699-705; Schwartz J, Dockery DW, Neas LM, Wypij D, Ware JH, Spengler JD, Koutrakis P, Speizer FE, Ferris BG Jr. Acute effects of summer air pollution on respiratory symptom reporting in children. *Am J Respir Crit Care Med* 1994; 150: 1234-1242.

[5] O'Connor GT, Neas L, Vaughn B, Katttan M, Mitchell H, Crain EF, Evans III R, Gruchalla R, Morgan W, Stout J, Adams GK, Lippmann M. Acute respiratory health effects of air pollution on children with asthma in US inner cities. *J Allergy Clin Immunol* 2008; Article in press doi: 10.1016/j.jaci.2008.02.020.

[6] U.S. EPA Draft ISA. Table 5-5. Effects of short-term SO_2 exposure on emergency department visits and hospital admissions for respiratory outcomes. May 2008.

[7] Lin S, Hwang SA, Pantea C, Kielb C, Fitzgerald E. Childhood asthma hospitalizations and ambient air sulfur dioxide concentrations in Bronx County, New York. *Arch Environ Health* 2004; 59: 266-275.

[8] Hedley AJ, Wong CM, Thach TQ, Ma S, Lam TH, Anderson HR. Cardiorespiratory and all-cause mortality after restrictions on sulphur content of fuel in Hong Kong: an intervention study. *Lancet* 2002; 360: 1646-1652.

[9] U.S. EPA. Integrated Science Assessment for Sulfur Oxides - Health Criteria. ISA: EPA/600/R-08/047F, September 2008, p. 5-10.

However, in 1996, EPA declined to set a short-term standard for SO_2, reasoning that too few people were likely to be exposed to high concentrations. The American Lung Association challenged the final decision not to set a 5-minute standard in court. On January 30, 1998, the Court of Appeals for the District of Columbia found that EPA had failed to adequately explain its decision not to set a 5-minute standard and remanded the matter back to EPA.

In response to the remand, EPA embarked on a voluntary program with the states to collect and analyze additional air quality data focused on 5-minute concentrations of SO_2.

However, the results of the data collection effort focusing on short-term concentrations are quite limited and disappointing. Not a lot of additional data was generated, and where five-minute data was provided, monitors may not have been optimized for short-term data collection.

Now, over a decade later, we are pleased that EPA is considering revisions to the NAAQS for SO_2. Unfortunately, the limitations on the data leave us urging that EPA be more conservative in the ranges under review. For many reasons listed below, the need to protect public health calls for recognition that the risks are to more widespread populations and that the effects are larger than previously assumed.

Evidence Does Not Support Relying on a 1-hour Standard to Control 5-minute Exposures

Simply put, there is too little data to assume that 1-hour standard will be protective of 5-minute peak exposures. Given the very limited data on 5-minute exposures, we do not have confidence in the peak-to-mean ratios generated to scale up to a 1-hour average standard.

The peak-to-mean ratios based on the limited data are highly variable and uncertain. Table 10-1 indicates that the 5-minute max: 1 hour daily max ratio ranges from 1.2 to 4.6, difference of nearly a factor of four.

It is inaccurate and an oversimplification to assume a 2:1 peak to mean ratio. There are a range of emissions scenarios and atmospheric conditions that drive peak concentrations, including start up, shutdown, upsets, malfunctions, downwash, and inversions. Further, the peak to mean ratio may not relevant for non-utility sources such as ports.

In fact, an independent analysis of short-term monitoring data performed by A.S. L. & Associates concluded that "No relationship could be found between the hourly maximum 5-minute and hourly maximum SO_2 values."[10]

[10] LeFohn, Allen S. A.S.L. & Associates. Assessing the Potential for the Occurrence of Hourly Maximum 5-Minute Concentrations $\geq$ 0.5 ppm at SO_2 Emission Sources in the United States. Prepared for Clean Air Task Force. March 22, 1999.

Even for a One-hour Standard, the Upper End of the Range Must Be Lower

If EPA pursues a 1-hour standard, several factors suggest that 150 ppb is too high an upper end of the range for a maximum daily one-hour concentration form. EPA should limit the upper end of range to no higher than 100 ppb.

First of all, the benchmark concentrations for assessing the impacts of the 5-minute exposures in the chamber studies range from 100 to 400 ppm. This range needs to be adjusted when considering a 1-hour average standard.

Evidence exists of changes in airway resistance at 5-minute concentrations as low as 100 ppb when combined with exercise for a period of several minutes. The REA fails to mention a controlled human exposure study that examined changes in specific airway resistance in seven exercising subjects with mild asthma. Investigators reported that 2 of the 7 subjects experienced increased airway resistance after inhalation of 100 ppb.[11] SO_2 in this study was administered by mouthpiece. A subsequent study reported that both oral and oronasal breathing of low concentrations of SO_2 during exercise can cause significant bronchoconstriction in people with asthma.[12] The mouthpiece studies are relevant because a substantial percent of the population are mouth breathers whether by preference, habit, or obligation. Mouth breathing may also occur when people are breathing hard due to exercise, or when their nasal passages are blocked by a respiratory infection. These conditions are known risk factors for asthma exacerbations. Regardless of the cause, inhaling air contaminated with sulfur dioxide that bypasses the nasal defense mechanisms initiates reactions at lower concentrations.

Several additional aspects of the chamber studies underline the need for conservative ranges and standards:

- As noted by the REA, severe asthmatics and children were not studied.
- In evaluating the controlled human exposure studies, it is important to consider the responses by individual subjects as well as the group mean responses.
- Due to the small number of subjects included in any one study, the most sensitive people may not have been included.
- In the real world, people breathe sulfur dioxide under different atmospheric conditions than in the laboratory. For instance, chamber studies are usually

[11] Sheppard D, Saisho A, Nadel JA, Boushey HA.. Exercise increases sulfur dioxide-induced bronchoconstriction in asthmatic subjects. *Am Rev Respir Dis* 1981; 123: 486-491.
[12] Kirkpatrick MB, Sheppard D, Nadel JA, Boushey HA. Effect of the oronasal breathing route on sulfur dioxide-induced bronchoconstriction in exercising asthmatic subjects. *Am Rev Respir Dis* 1982; 125: 627-631.

conduced at room temperature; some asthmatics experience increased response when sulfur dioxide is administered in cold dry air.[13]

- Exposures in the laboratory are to sulfur dioxide alone, not in combination with sulfates and other fine particles as people breathe in real world atmospheres.

The Lower End of the Proposed Range for the One-Hour Standard is Too High

Just as the upper end of the proposed range is too high, the lower end is not low enough. As discussed above, there is a range of conversion factors for the 5-minute to one-hour extrapolation, and ratios larger than 2 applied to the chamber study results would lead to a lower bottom end of the range.

In addition, epidemiology studies find effects at concentrations below 50 ppb, the lower end of the proposed range.

For instance, as mentioned earlier, multi-city studies have linked previous day SO_2 concentrations with morning respiratory symptoms in 8 urban areas where median 3-hour average SO_2 levels ranged from 17 ppb to 37 ppb.[14]

The previously referenced study in Bronx, New York found that asthma hospitalizations in children climbed as hourly sulfur dioxide concentrations increased. Hospitalizations began to rise at hourly concentrations greater than 9 ppb, with a sharp increase an concentrations greater than 40 ppb.[15]

A Short-Term Standard, Preferably a 5-minute Standard, is Needed for Practical Reasons

We need a 5-minute SO_2 standard to protect against peak exposures that can result from start-up, shutdown, upset, malfunction, downwash, complex terrain, and atmospheric inversion conditions.

SO_2 control programs such as the acid rain program is a trading programs that allow some utility sources to forgo controls by buying credits from other, so-called "over controlled" sources. Such trading programs fail to protect the local population nearest to the source, who face the greatest, continuing exposure. Thus, in the absence of a short-term standard for SO_2, there is no way to ensure that people are protected from breathing

[13] Sheppard D et al. Magnitude of the interaction between the bronchomotor effects of sulfur dioxide and those of dry (cold) air. *Am Rev Resp Dis* 1984; 130: 52-55.
[14] Mortimer KM, Neas LM, Dockery DW, Redline S, Tager IB. The effect of air pollution on inner-city children with asthma. *Eur Respir J* 2002; 19: 699-705; Schwartz J, Dockery DW, Neas LM, Wypij D, Ware JH, Spengler JD, Koutrakis P, Speizer FE, Ferris BG Jr. Acute effects of summer air pollution on respiratory symptom reporting in children. *Am J Respir Crit Care Med* 1994; 150: 1234-1242.
[15] Lin S, Hwang SA, Pantea C, Kielb C, Fitzgerald E. Childhood asthma hospitalizations and ambient air sulfur dioxide concentrations in Bronx County, New York. *Arch Environ Health* 2004; 59: 266-275.

short term spikes that can be harmful. We need the backstop measure of a short-term standard to accompany further trading programs.

Attachment F
Presentation by Dr. Julie Goodman on behalf of the American Petroleum Institute

Julie E. Goodman, Ph.D., DABT
Gradient Corporation, Cambridge, MA

regarding

Risk and Exposure Assessment to Support the Review of the SO_2 Primary National Ambient Air Quality Standards: Second Draft

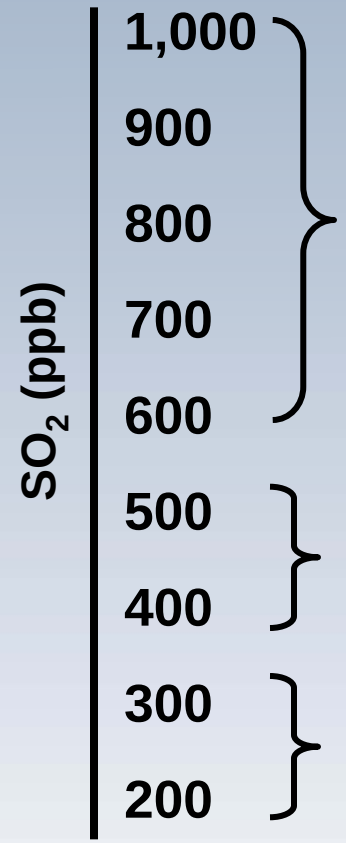
appearing on behalf of the
American Petroleum Institute

April 16, 2009

There is No Basis for the Suggested 1-hr Daily Max SO_2 NAAQS

- Human clinical studies of exercising mild-to-moderate asthmatics show no statistically significant increase of respiratory symptoms at SO_2 peak exposures < 400 ppb.
- Epidemiological studies do not support the suggested 1-hr daily max SO_2 NAAQS.

Health Effects of Short-Term Exposure to SO_2 in Clinical Studies*



ISA, Table 5-1: "Clear and consistent SO_2-induced increases in respiratory symptoms observed…."

"Respiratory effects attributed to SO_2 among asthmatics during exercise may be diminished after cessation of exercise, even with continued SO_2 exposure."

ISA, Table 5-1: "Moderate or greater decrements in lung function clearly demonstrated in asthmatics during exercise, with significant interindividual variability in response…. Respiratory symptoms … observed at concentrations as low as 0.4 ppm."

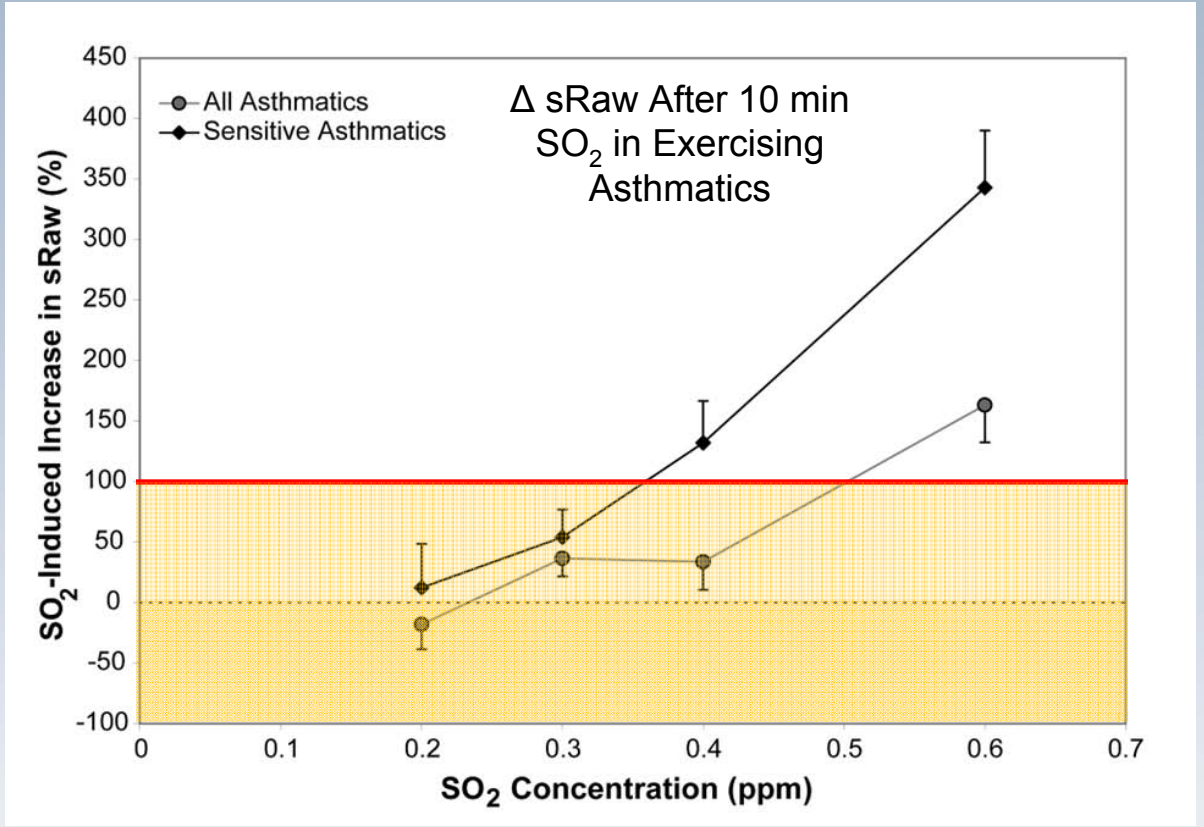
ISA, p. 3-33: No evidence for statistically significant SO_2-induced respiratory effects.

***Subjects are asthmatics during exercise**

Interpretation of Effects in Clinical Studies

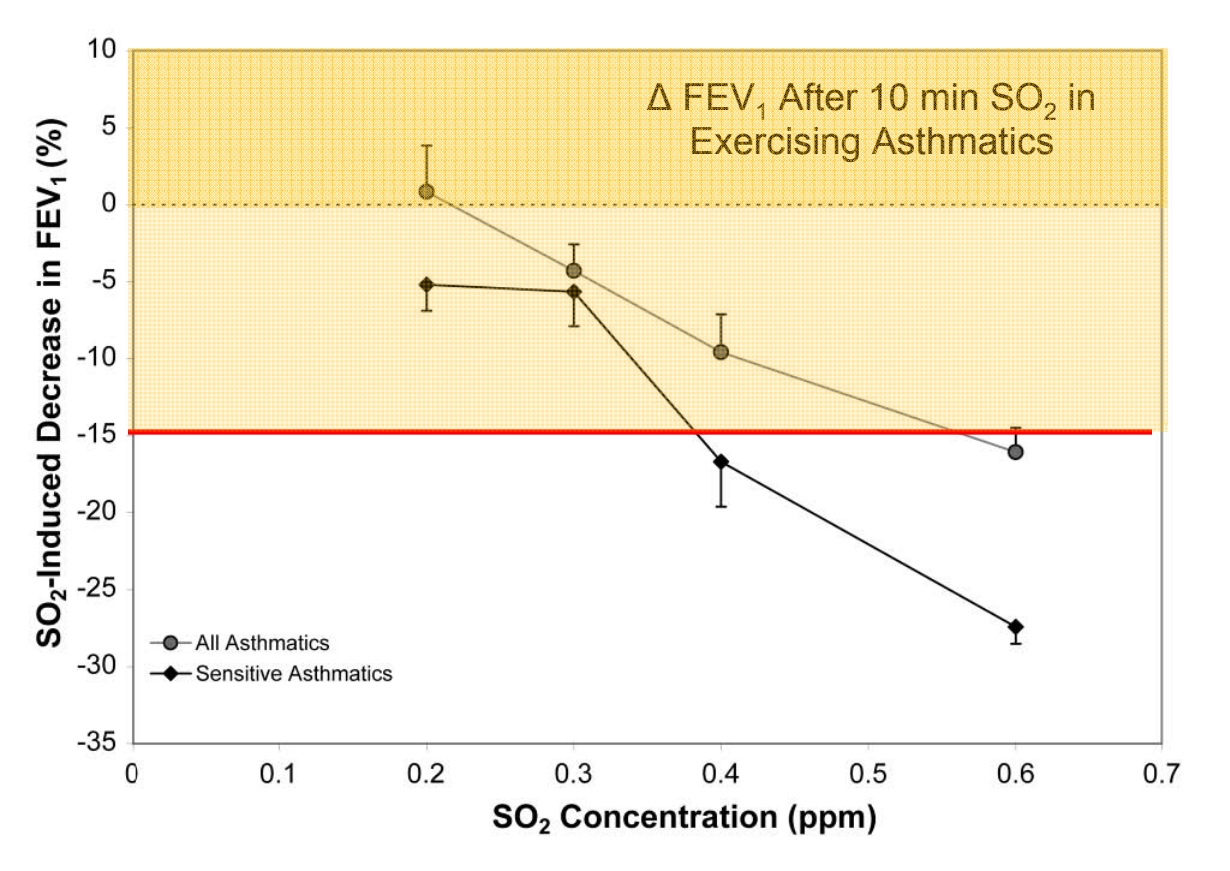
- NAAQS should protect against *adverse* effects.
- A transient decrement in lung function should not automatically be considered an adverse effect.
- Minor transient lung function changes are observed in exercising controls and can be induced by other stimuli such as cold, dry air, stress, and fatigue.

REA defines a "moderate or greater lung function decrement" as ≥ 100% increase in sRaw or ≥ 15% decrease in FEV_1.



Final ISA Figure 4-2

REA defines a "moderate or greater lung function decrement" as ≥ 100% increase in sRaw or ≥ 15% decrease in FEV_1.



Final ISA Figure 4-3

Lower Benchmarks for Short-term SO_2 Suggested in REA are NOT Appropriate

- Effects observed below 400 ppb SO_2 CANNOT be considered adverse by the REA definition (≥ 100% increase in sRaw or ≥ 15% decrease in FEV_1).
- No effects observed below 400 ppb SO_2 are statistically significant.
- The lowest exposures at which *statistically significant adverse* effects occur are ≥ 400 ppb.
- It is highly unlikely that asthmatics would experience *adverse* effects, according to the REA definition, at exposures ≤ 200 ppb.

Clinical Studies Account for Sensitive Individuals

- Clinical subjects included adolescent and adult asthmatics at exercise.
- Asthmatic adolescents exposed *via* mouthpiece (results in higher SO_2 exposure than real world).
- Linn *et al.* (1987) found responses of moderate/severe asthmatics to increasing SO_2 concentrations were roughly similar to those of minimal/mild asthmatics.
- Responses to SO_2 not strongly dependent on clinical severity of asthma.

Clinical Studies Assess Rare Event in Sensitive Individuals

- Clinical studies do not represent real world scenarios.
- Unmedicated asthmatics engaged in moderate exercise is not a common event.
- Exercise does not generally occur near an SO_2 source that has the potential to produce high ground level SO_2 concentrations.
- If peak short-term SO_2 exposure of 600-1,000 ppb, respiratory effects typically diminish with cessation of exercise, EVEN IF high SO_2 exposures continue.

No Epi Support for 1-hr Daily Max SO_2 NAAQS

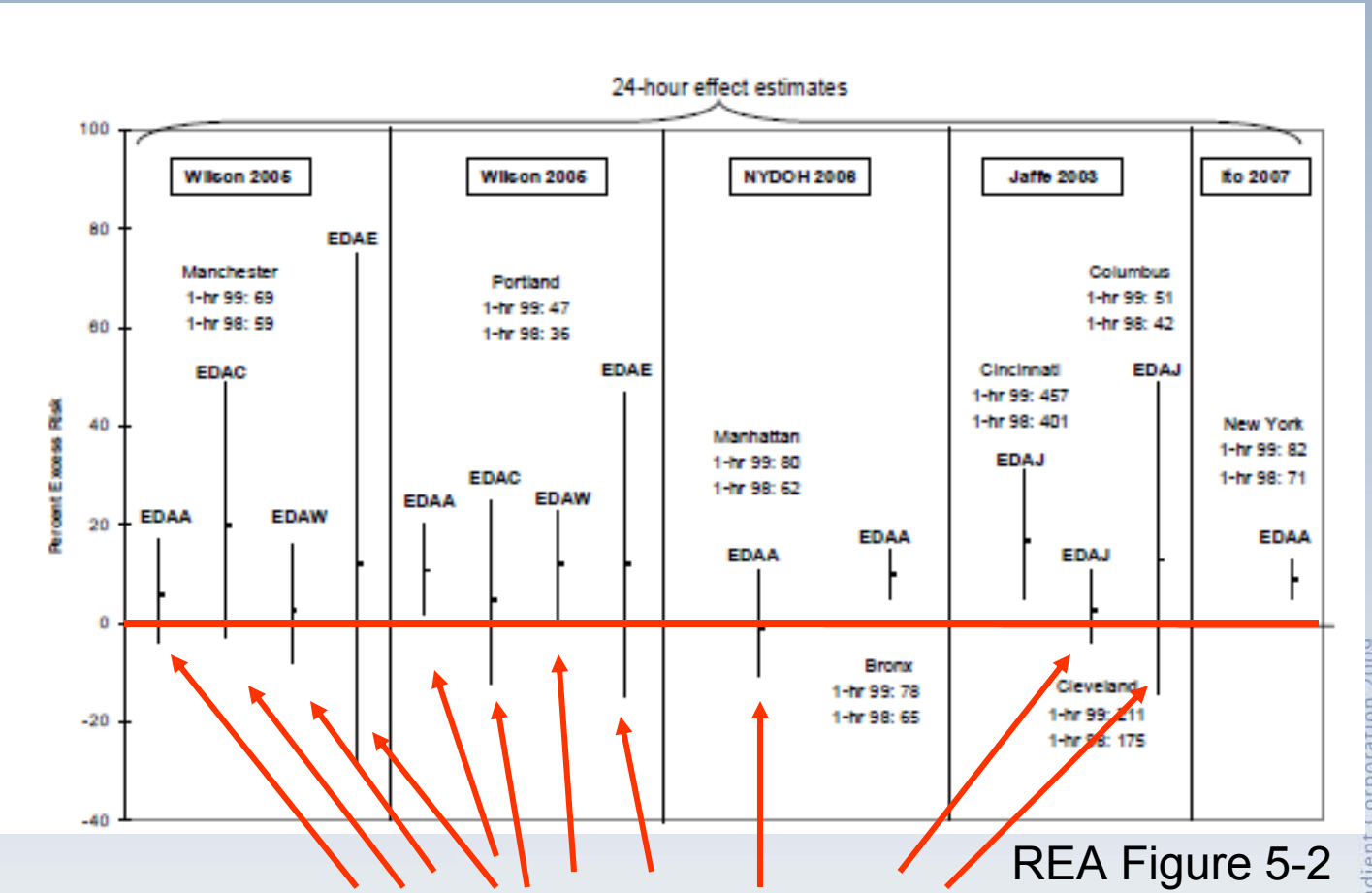
- Majority of studies reported null or weakly positive findings
- Weakly positive findings often became non-significant when adjusted for co-pollutants
- Information on co-pollutants or other exposure-related factors was not included in many studies
- Exposure misclassification could have biased results in either direction
- Measurements from central monitors are not representative of human exposure
  - Spatial and temporal variability
  - Association between ambient concentrations and personal exposures are inadequately characterized.
- Findings inconsistent with better-controlled human clinical studies

Risk Estimates are Very Small

- Many not statistically significant

<u>Additional Bias</u>

- Exposure misclassification
- Known confounders
- Residual confounding
- Unmeasured confounders
- Unknown confounders



REA Figure 5-2

Conclusions

- Clinical data do not support the suggested 1-hr daily max SO_2 NAAQS
  - Includes sensitive individuals (asthmatics, adolescents)
  - Exposure scenario is rare event
  - If symptoms do occur, relief by discontinuing exercise
  - Effects at exposures < 400 ppb do NOT meet REA's definition of adverse
  - Effects at exposures < 400 ppb are NOT statistically significant
  - Use of clinical data incorporates "safety factors"
- Epidemiology studies do not support the suggested 1-hr daily max SO_2

Attachment G
Presentation by Dr. Jay Turim on behalf of the American Chemistry Council

Comments on EPA's 2ND Draft SO_2 REA

Presented to CASAC April 16, 2009
on behalf of the
American Chemistry Council

by Jay Turim, Ph.D.
Exponent, Inc.

SO_2 REA Proposes to:

- Add a new 1-hr standard
- Set lower boundaries for 1-hour standard based on observational epidemiological studies (see REA Tables 5-1 through 5-5)
  - Wilson et al. 2005
  - NYDOH 2006
  - Ito 2006
  - Schwartz 1995.

General Comments

- Four studies all showed low RRs (range of 1.07-1.20); very likely to have publication bias; not known how many other studies showed no association with SO_2
- Any standard setting should be considered within framework of entire SO_2 literature, not selectively chosen few studies at low exposure levels
- Has been suggested (Sarnat 2001, 2005) that ambient SO_2 measurements are better surrogate for $PM_{2.5}$ than personal exposure to SO2; confounding by $PM_{2.5}$ may be real concern in observational studies of SO_2

Wilson et al. 2005

- Hospital ED visits for all respiratory and asthma symptoms
- Important study because it had a 99 percentile exposure of 47 ppb; basis for the proposed lower level of 50 ppb for SO_2 1-hour standard
- Only one of two cities assessed (Portland ME) had statistically significant elevated RR
- Single pollutant models did not control for PM or for NO_2; Portland had generally higher $PM_{2.5}$ levels associated with high SO_2; both co-pollutants important for asthma

Wilson et al. 2005 (continued)

- Authors claim that smaller population of Manchester may account for lack of statistically significant RR disputed by the fact that it had more years of study (21 quarters vs. 13 quarters of data for Portland) and also the CIs for the Manchester study were much tighter than for Portland
- Figure 6 does not suggest that exposure-response relationship is linear; if fact, appears to be a definite turning downwards in response at higher exposure levels
- Authors noted that "the effects seen in this analysis may be due in part or entirely to $PM_{2.5}$"

NYDOH 2006

- ED visits for asthma in two NY locations (the Bronx and Manhattan)
- Statistically significant RR in the Bronx (RR=1.11) but not in Manhattan in single and multi-pollutant models considering O_3, NO_2, and $PM_{2.5}$
- Authors state that high correlations between pollutants make it difficult to confidently identify critical components

Ito et al. 2007

- Paper is not a study of SO_2 but rather is primarily concerned with multi-collinearity among air pollution and weather variables; analysis of SO_2 and other covariates treated as an example to explore this issue
- RR for asthma ED visits in NYC elevated in single pollutant model; loses statistical significance in multi-pollutant model with NO_2

Schwartz 1995

- Hospital admissions for respiratory disease in two cities, New Haven CT and Tacoma WA
- RR statistically significant in single pollutant models in both cities but in both cities loses significance in some multi-pollutant models with PM_{10} and O_3
- Study conducted in 1995 using older methods
  - Used 19 day moving average to control for temporal trends; newer methods use spline smoothing
  - Study completed before problems with GAM S+ convergence issues were recognized

Conclusions

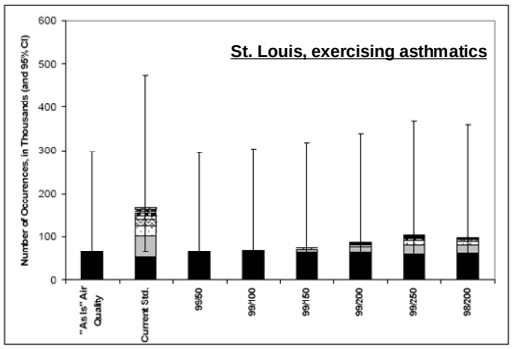
- Four epidemiological studies relied upon by EPA in proposing levels for new 1-hour standard far from persuasive
- Studies marked by inconsistencies, biological implausibility, and omissions
- Full range of information on SO_2 not considered by EPA
- Recommend that EPA reconsider basis for new SO_2 1-hour standard

Attachment H
Comments of Dr. Anne Smith on behalf of the Utility Air Regulatory Group

Dr. Anne E. Smith, Ph.D.
Vice President

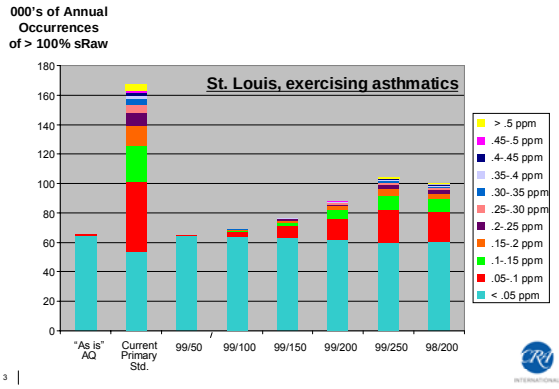
Comments prepared on behalf of UARG

A Key Result Reported in REA: # Occurrences >100% sRaw from 5-Minute Exposures by Exposure Range



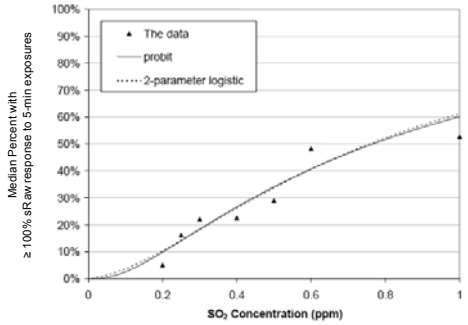
2 | Source: REA Draft 2, Figure 9-7(a), p. 275

Figure 9-7 (a) -- Replicated in Color & Zoomed In



3 |

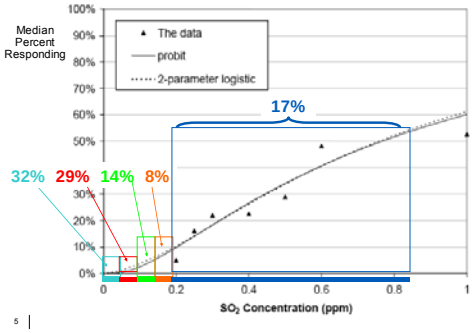
Impacts Estimates Are Based on Logistic Dose-Response Curve that *Assumes* Zero Threshold



4 | Source: REA Draft 2, Figure 9-2, p. 262

Percent of Estimated Impacts (at Current Standard) for Exposures on Different Parts of Dose-Response Curve

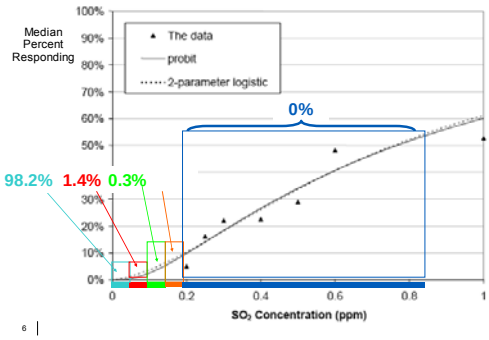
Over 60% of the impacts at the Current Standard are due to 5-minute exposures below 0.1 ppm, which is less than half of the lowest observed response level.



5 |

Percent of Estimated Impacts (under "As Is" AQ) for Exposures on Different Parts of Dose-Response Curve

99.6% of the impacts for "As Is" air quality are due to exposures < 0.1 ppm.

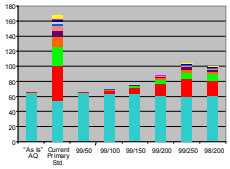


6 |

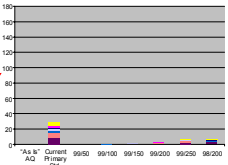
Sensitivity of Impacts to Alternative No-Effects Levels

St. Louis, exercising asthmatics -- 000's of Annual Occurrences of > 100% sRaw

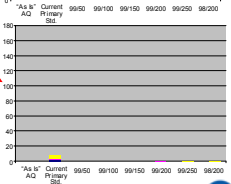
Reproduced REA Figure 9-7(a)



Estimated effects above 0.2 ppm (lowest level of any detected effect):



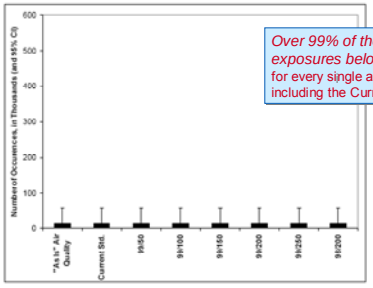
Estimated effects above 0.4 ppm (lowest level of any ATS-defined "adverse" effect 1/):



1/ ATS defines reversible lung function effects as "adverse" if they are statistically significant and accompanied by symptoms. ("What Constitutes an Adverse Health Effect of Air Pollution?" Am J Respir Crit Care Med. Vol. 161, pp. 665-673.)

Comparable Results for Greene Co. Are Buried Deep in Appendix C of the REA

Greene Co., exercising asthmatics



Over 99% of the impacts are due to exposures below 0.1 ppm, for every single alternative standard, including the Current Standard.

 Source: REA Draft 2, Appendix C, Figure 4-5(a), p. 705

The Uncertainty Analysis is Incomplete and Erroneous

Uncertainty	Direction of Bias	Level of of Uncertainty	Comments
AERMOD Inputs and Algorithms	Unknown	Low-Medium	See Table 8-13 and section 8.12.1
Exposure Model (APEX) Inputs and Algorithms	Unknown	Medium	See Table 8-13 and section 8.12.2
Spatial representation	Unknown	Medium - High	See discussion in section 7.4.4
Air quality adjustment	Unknown	Medium	See discussion in section 7.4.5
Causality	~~Unknown~~ Overestimate		SO_2-related lung function responses have been observed in controlled human exposure studies and, thus there is little uncertainty that SO_2 exposures are responsible for the observed lung function responses.
Use of 2-parameter logistic model to estimate probabilistic exposure-response relationships	Overestimate	Low – within range of data Medium – for levels well below 200 ppb	It was necessary to estimate responses at SO_2 levels both within the range of exposure levels tested (i.e., 200 to 1,000 ppb) as well as below the lowest exposure levels used in free-breathing controlled human exposure studies (i.e., below 200 ppb). We have developed probabilistic exposure-response relationships using two different functional forms (i.e., probit and 2-parameter logistic). As shown in Figures 9-2 through 9-5, the two functional forms result in very similar probabilistic exposure-response relationships for the four health response definitions, and therefore, we used only the logistic model to estimate risks. For the risks attributable to exposure levels below 200 ppb, there is greater uncertainty.
Use of 5- and 10-minute lung function response data to estimate 5-minute lung function risk estimates	Overestimate	Low	The 5-minute lung function risk estimates are based on a combined data set from several controlled human exposure studies, most of which evaluated responses associated with 10-minute exposures. However, since some studies which evaluated responses after 5-minute exposures found responses occurring as early as 5-minutes after exposure, we are using all of the 5- and 10-minute exposure data to represent responses associated with 5-minute exposures. We do not believe that this approach appreciably impacts the risk estimates.
Use of exposure-response data from studies of mild/moderate asthmatics to	~~Unknown~~		...in the U.S. population. As indicated in the ISA (p. 3-9), the subjects studied

Unknown – because more severe asthmatics may be more likely to protect themselves with medication before exercising

Missing uncertainty: Effect of medication among mild/moderate asthmatics in daily life
Direction of bias: Overestimate

 Source: REA Draft 2, Table 9-10, p. 279

Attachment I
Presentation by Mr. David Heinold on behalf of the National Association of Manufacturers

AECOM

Public Comments on Risk and Exposure Assessment to Support the Review of the SO_2 Primary NAAQS - Second Draft

Oral Supplement of Written Comments to CASAC: April 16, 2009

David W. Heinold, CCM
AECOM Environment, Westford, Massachusetts
on behalf of the National Association of Manufacturers

Summary of Comments on Second Draft REA for SO_2

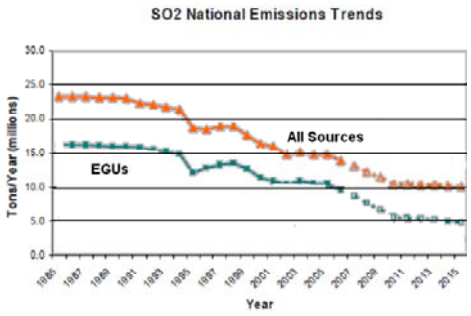
- **Steep downward trends in SO_2 emissions makes the analysis of ambient exposure obsolete.**
- **Inaccurate methods are used to extrapolate historic SO_2 air quality to just attaining current NAAQS level**
- **Exposure assessment applies an incorrect interpretation of diurnal air measurements to specify diurnal emissions profile for area sources.**
- **Probabilistic short-term NAAQS will require probabilistic modeling approaches.**

Issue – Emissions Trends

- **Continuing downward trends of SO_2 emissions will continue to reduce ground-level concentrations**
  - Reincarnation of Clean Air Interstate Rule (CAIR) will reduce utility emissions in East, e.g. the existing rule calls for:
    - 57% reduction by 2010
    - 73% reduction by 2015
  - Ultra Low Sulfur Diesel (ULSD, 15 ppm sulfur) fuel program
    - June 2010: all highway ULSD
    - 2012: locomotive and marine distillate fuel
  - Best Available Retrofit Technology (BART) rule
  - National Petroleum Refinery Priority: reductions > 250,000 tons

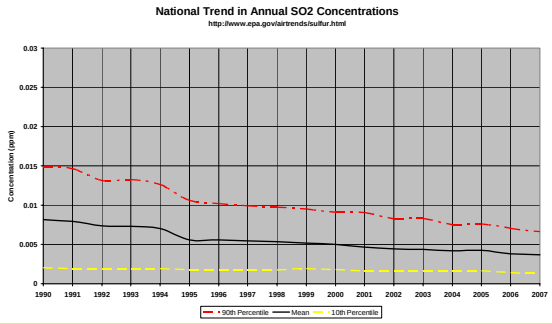
Downward SO_2 Emission Trends

http: acw gov/mon tor ng conference/2008/presentat ons/sess onE E1B_Hameed pdf



Downward Trend in Ambient SO_2

AECOM



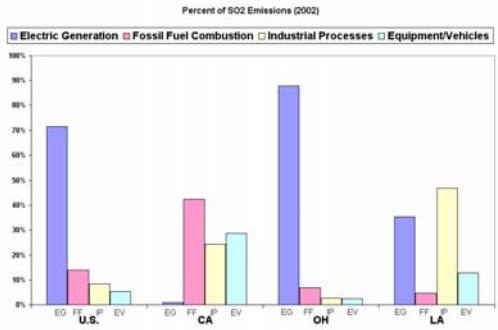
Issue – Just Meeting NAAQS Analysis

AEC

- **Flawed logic used to extrapolate historical SO_2 air quality to ju attaining current NAAQS**
  - Analysis unnecessary since concentrations are well below standards and rapidly decreasing
  - Unrealistically assumes no change in the mix of ambient sources and their temporal emission patterns
- **Improper extrapolation of 24-hour second high concentration**
  - Impact likely due to a single source or a group of sources
  - Likely to be the result of episodic or upset emissions
  - Could be due to unique meteorological conditions that occur only two days out of a year
  - Unreasonably unrealistic and overly conservative to assume that all 1-hour concentrations increase proportionately to meet 24-hour NAAQS
- **Result: Misleading conclusions regarding adequacy of present standards in protecting short-term concentrations.**

National and Regional SO_2 Source Contribution
Percent of Emissions by Region

AECOM



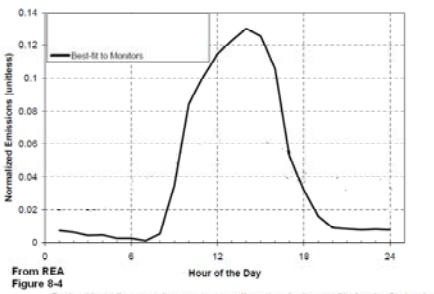
Issue Area Source Emissions in Exposure Assessment

A

- **Exposure assessment incorrectly estimates diurnal patterns area source emissions**
  - Uses a "perfect model assumption" assuming residuals are real
  - Attributes residual between model and monitor results to area sourc emissions alone
  - Ignores the effect of diurnal variations in dispersion
  - Diurnal pattern is well-explained by vertical dispersion of elevated plumes during the day

Derived Diurnal SO_2 Area Source Emissions Pattern Used in REA

AECOM

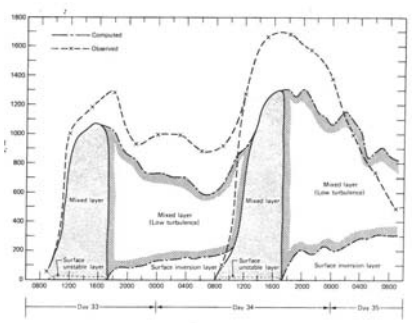


From REA Figure 8-4

Derived best-fit non-point area source diurnal emission profile for the St. Louis domain, compared to other possible profiles.

Diurnal Boundary Layer Variation

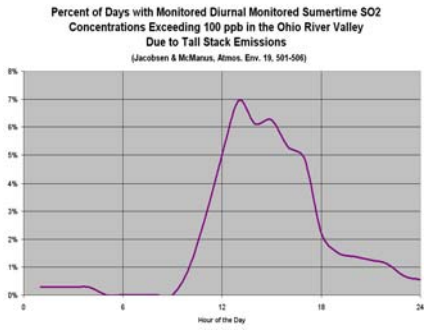
A



Temporal evolution of the atmospheric boundary layer based on output from a model developed by Yamada and Meller (1975)

Monitored Diurnal SO_2 Concentration Near Power Plants

AECOM



Issue – New Compliance Modeling Approaches

- **Probabilistic Short-term NAAQS Will Require Probabilistic Modeling Approaches**
  - Implementation of a 1-hour standard will require that modeling procedures be refined to realistically address frequency of peak sh term impacts.
  - Assuming continuous peak emissions continuous will lead to overestimates of the frequency of peak total impacts.
  - Modeling procedures used in the exposure assessment should consider the use of a frequency distribution of emissions for the sources being considered in order to characterize the probabilistic nature of the intended result more accurately.
  - Procedure should also be adopted for air quality modeling used to demonstrate compliance with revised short term NAAQS.