Summary Minutes of the
U.S. Environmental Protection Agency (EPA)
Clean Air Scientific Advisory Committee (CASAC)
Sulfur Oxides Panel
Public Meeting
March 20-21, 2017

Date and Time: Monday, March 20, 2017, 9:00 AM – 5:00 PM ET;
Tuesday, March 21, 2017, 8:30 AM – 3:30 PM ET

Location: Residence Inn Arlington Capital View, 2850 South Potomac Avenue, Arlington, Virginia 22202

Purpose: The purpose of the meeting was to peer review EPA's *Integrated Science Assessment for Sulfur Oxides - Health Criteria (Second External Review Draft – December 2016)* and provide consultative advice on EPA's *Review of the Primary NAAQS for Sulfur Dioxide: Risk and Exposure Assessment Planning Document (External Review Draft – February 2017).*

Participants: CASAC Sulfur Oxides Panel (for full Panel, see roster[1])
Dr. Ana Diez Roux, Chair
Mr. George A. Allen
Dr. John Balmes (by phone)
Dr. James Boylan
Dr. Judith Chow
Dr. Aaron Cohen (by phone)
Dr. Alison Cullen
Dr. Delbert Eatough
Dr. H. Christopher Frey
Dr. Steven Hanna
Dr. Jack Harkema
Dr. Farla Kaufman (by phone)
Dr. Donna Kenski (by phone)
Dr. David Peden
Dr. Richard Schlesinger (by phone)
Dr. Lianne Sheppard
Dr. Frank Speizer
Dr. James Ultman
Dr. Ronald Wyzga

Mr. Aaron Yeow, Designated Federal Office (DFO)
Mr. Christopher Zarba, EPA SAB Staff Office

Dr. Bruce Rodan, EPA Office of Research and Development
Dr. Tina Bahadori, EPA National Center for Environmental Assessment (NCEA)
Dr. John Vandenberg, EPA NCEA
Dr. Steven Dutton, EPA NCEA
Dr. Tom Long, EPA NCEA

Mr. Robert Hetes, EPA Office of Air Quality and Planning Standards (OAQPS)
Dr. Nicole Hagan, EPA OAQPS
Dr. Stephen Graham, EPA OAQPS
Other Attendees (See Attachment A)

Monday, March 20 2017

Opening Remarks

Mr. Aaron Yeow, DFO, opened the meeting. He noted that as required under the Federal Advisory Committee Act (FACA), the Panel's deliberations are held in public with advanced notice given in the Federal Register,[2] and the meeting minutes will be made publicly available after the meeting. He noted that there were two public comment periods noted on the agenda for members of the public who registered in advance with the SAB Staff Office to make oral comments. He stated that there were also two clarifying comment periods on the agenda where members of the public could request an opportunity to provide short clarifying comments. He noted that the Panel did receive written public comments, which were posted on the meeting webpage. He stated that the SAB Staff Office determined that there were no issues with conflict-of-interest nor any issues with an appearance of a lack of impartiality for any of the Panel members. He then turned the meeting over to Mr. Christopher Zarba, Director of the SAB Staff Office, who welcomed everyone, and then turned it over to Dr. Ana Diez Roux, Chair of the CASAC.

Dr. Diez Roux welcomed everyone and had the Panel members introduce themselves. She then provided an overview of the Agenda[3] and asked the EPA to begin their presentation.

EPA Presentation on ISA

Dr. John Vandenberg, Director, EPA National Center for Environmental Assessment - Research Triangle Park Division, welcomed the panel, thanked them for their public service, and introduced Dr. Bruce Rodan, Acting Deputy Assistant Administrator for Science, EPA Office of Research and Development, and Dr. Tina Bahadori, Director, EPA National Center for Environmental Assessment (NCEA). Dr. Bruce Rodan thanked the members of the panel and emphasized the importance of their peer review of the science. Dr. Tina Bahadori discussed many of the products developed by EPA NCEA and how many of those products are peer reviewed by the NAS and EPA Federal Advisory Committees (FACs) such as the Science Advisory Board (SAB) and CASAC. Dr. Steve Dutton, EPA NCEA, went over the EPA presentation,[4] and focused on the SOx ISA Team, an Overview of the Process for Reviewing the NAAQS. Dr. Tom Long, EPA NCEA, continued the presentation and focused on the Anticipated Timeline for the SOx ISA, the Main Revisions in the 2nd Draft SOx ISA, Sources of SO2, Ambient Concentrations, Exposure, Health Effects of SO2, At-Risk Populations and Lifestages, and Next Steps for the SOx ISA.

Public Comments on the ISA

There were no public comments on the ISA.

Discussion of the ISA Charge Questions and Response to ISA Charge Questions

Charge #2 - Chapter 2 – Atmospheric Chemistry and Ambient Concentrations of Sulfur Dioxides and other Sulfur Oxides

The panel generally thought that the revisions to Chapter 2 were good and addressed most of the previous panel comments. They noted that SO2 emissions are a rapidly moving target, especially for electric generating units, and the final draft needs to be updated with the most recently available data. One member pointed out two items that were not addressed: identifying emissions from smelters and integrated iron and steel mills; and identifying non-sulfate S(IV) and S(VI) formation in the atmosphere. There was discussion about clarifying peak-to-mean ratios (PMRs) and AERMOD not being locked into a 1-hour averaging time. There was also discussion about a justification needed for excluding negative values, which may introduce bias.

Charge #3 - Chapter 3 – Exposure to Ambient Sulfur Dioxide

Overall the panel found the chapter to be much improved from the First Draft ISA. However, it could still use improvement in supporting the evaluation of the strength of inference in epidemiologic studies in Chapter 5. Clarification of terms, such as surrogate, is needed. Exposure information from the more recent NAAQS reviews should be incorporated in this ISA. The summary of the various modeling methods would be improved with a table that compares the modeling approaches.

Charge #4 - Chapter 4 – Dosimetry and Modes of Action and Chapter 5 – Integrated Health Effects of Exposure to Sulfur Oxides

The panel found that overall Chapters 4 and 5 appropriately characterize the evidence and rationale for the causal determinations and are consistent with the causality framework. The additions and revisions to Chapter 4 have improved the chapter. The panel found the new section on the structure and function of the airway side of the respiratory system and new material on breathing rates, effect of breathing through the nose vs. mouth, possible effects of obesity to be useful. They did note that the SO2 mass transfer rates neglects SO2 concentrations and that a more complete description of diffusion and reaction processes that contribute to absorption is needed. The panel agreed with the causal determinations and found the discussion of the evidence and rationale to be improved from the First Draft ISA.

Charge #5 – Chapter 6 – Populations and Lifestages Potentially at Increased Risk for Health Effects Related to Sulfur Dioxide

The panel found that the chapter needs to more clearly describe what it is trying to accomplish how the information in the chapter will be used. Much of the health effect evidence in Chapter 5 is on effect modification already because it is in asthmatics, making it redundant in Chapter 6. The panel noted that the discussion on obesity was missing and the discussion on children was downplayed, yet both of these are discussed in the REA PD. There needs to be a consistent discussion and similar weight of importance between the two documents.

Charge #1 - Executive Summary and Chapter 1

The panel found that the revised ES and Chapter 1 adequately addressed the CASAC's previous comments and suggestions on the First Draft ISA. The ES is now reasonably free from technical jargon.

The EPA is still encouraged to further refine this important section of the ISA so that it is can be more understandable (readable) for a wider sector of the public.

Public Clarifying Comments

There were no public clarifying comments.

As the panel was ahead of schedule, Dr. Diez Roux decided to use the remainder of the day for the Writing Session by Subgroups on ISA and Summary of Major Findings and Recommendations on ISA, which were originally scheduled for March 21, 2017.

Writing Session by Subgroups on ISA

The panel broke into subgroups for a writing session to develop major findings and recommendations for the ISA charge questions.

Summary of Major Findings and Recommendations on ISA

The panel reconvened and the lead authors summarized the key findings and recommendations for each of their charge questions.

For Charge #2, the key findings and recommendations include: 1) to revise emission trends in Figure 2-5 and Table 2-1, to include 2011-2016 emission estimates, specify emission source subtypes such as metal processing, especially integrated iron and steel mills and copper smelting, and to acknowledge the low contribution of low vehicle engine exhaust to the national SO2 emission inventory; 2) address the atmospheric chemistry of SO2, including non-sulfate compounds such as inorganic S(IV) species, organic S(IV) species, and organic S(VI) species due to potential confounding of SO2 health effects where copper smelters or integrated iron and steel mill emissions are present; 3) discuss the PMR peak 5-minute peak to hourly mean calculated by AERMOD clarify how the ratio; 4) acknowledge the algorithms in Gaussian models can apply to all averaging times; 5) clarify the treatment of negative values versus lower detection limits.

For Charge #3, the key findings and recommendations include: 1) revised chapter is much stronger and reorganization is an improvement, but still needs revisions to improve clarity; 2) encourage EPA to leverage previous work from previous ISAs for other criteria pollutants; 3) there is lack of clarity and definition and usage of several terms; 4) the modeling section needs to answer what are the different approaches to exposure modeling and how does the selection and application of an exposure modeling approach affect the conclusions to be drawn from an epidemiologic study; 5) the new Table 3-1 was good and there were suggestions for additional refinement, a new table for consolidate modeling approaches and their features; 6) suggest that the EPA continue to focus on and make improvements to exposure modeling and the impact of exposure estimates on the conclusions of epidemiologic studies; 7) there should be cross-referencing of other chapters.

For Charge #4, the key findings and recommendations include: consistent language should be used to describe uncertainty throughout the document; confidence intervals should not be used as tests of significance; error in exposure estimates should be clearly acknowledged; exercise as an aspect of a study as well as a risk factor should be clearly discussed; asthmatics are a key risk group, however most of the studies are in children with asthma with allergic asthma, which is different from severely affected

asthmatics or persons with different phenotypes of asthma; certain segments of the population are at increased risk of asthma; and the chapter can be made more succinct.

For Charge #5, the key findings and recommendations are: the introduction of Chapter 6 needs to provide an expanded and more articulate discussion of its objectives and how its content will be used; and the chapter needs to more clearly articulate the factors that are associated with increased risk.

For Charge #1, the key findings and recommendations are: the ES and Chapter 1 are much improved and addresses the panel's advice and recommendations on the First Draft ISA; the ES is now reasonable free from technical jargon; the material and format appropriately highlights and summarizes the important information contained in the subsequent chapters.

The meeting was recessed for the day at 5:00 pm.

Tuesday, March 21, 2017

The Panel was reconvened at 8:30 am.

EPA Presentation on the REA Planning Document

The EPA made a presentation on the REA Planning Document.[5] Mr. Robert Hetes, EPA OAQPS, presented the NAAQS Review Process. Dr. Stephen Graham, EPA OAQPS, continued the presentation and covered the following slides: Key Health Effects Evidence, Overview of REA Planned for this Review, Newly Available Information to Support REA development for this Review, Summary Plans for REA, Study Area Selection & Modeling Domain, Temporal/Spatial Representation of Air Quality Surface, Modeling Exposed Individuals at Elevated Exertion Levels, Exposure Benchmark Levels, and Lung Function Risk Assessment. Dr. Nicole Hagan, EPA OAQPS, concluded the presentation with Next Steps in the Review Process.

Public Comments on the REA Planning Document

Julie Goodman, Gradient, presented comments[6] on behalf of the American Petroleum Institute. She stated that the evidence indicates that respiratory effects are not likely to occur below 200 ppb, and therefore the REA should only use health benchmarks above 200 ppb. She also stated that the REA should evaluate a broad set of options for the averaging time, level, and form of the primary SO2 standard.

Lindsey Jones, Texas Commission on Environmental Quality, made an oral statement[7] that focused on the discussion of the exposure-response function in the REA PD. She stated that there is evidence for a threshold and that the panel should recommend to the EPA to incorporate a threshold into the main exposure-response model, not just in the uncertainty analysis. She also urged the panel to recommend the inclusion of uncertainty bounds in the REA and underlying analyses due to uncertainty in exposure-response data below 200 ppb.

Discussion of the REA Planning Document Charge Questions and Response to Charge Questions

Analytic Approach and Study Area Selection

The members generally found the overall analytic approach to be sound and reasonable. The choice to use modeled ambient SO2 concentrations instead of observed concentrations provides more detailed local scale spatial patterns. The panel members did not think that much effort should be expended in addressing indoor microenvironments as exposures from them would be small. For the study area selection, discussion of the representativeness of the 4 sites compared to the rest of the nation and discussion of extrapolation of results from the 4 sites to the national scale is needed. There needs to be better explanation of how the 4 sites were selected and why the other sites considered were not selected.

Ambient Air Concentrations

The panel members generally found the model-based approach to predict hourly concentrations to be appropriate and will better quantify the spatial variation in concentrations compared to using observations alone. AERMOD is an appropriate model for predicting SO2 concentrations in ambient air if it is performing well, but model performance needs to be performed. Sensitivity analyses should also be conducted with the new options for adjustments.

Exposure Analysis

The panel members found that the general approach was reasonable, but that many of the decisions made needed better explanation of the rationale behind those decisions (e.g. population cut point, equations used to estimate missing 5-minute concentrations, selection of the 4 study areas, use of a liner ramp). The members recognized that selected study areas are dictated by available data, but more discussion of how representative the selected study areas were to the rest of the country was needed.

Human Health Risk Assessment

The panel members found that the approach was generally logical and well justified. There was general support for health benchmarks derived from controlled human exposure studies. There needs to be more discussion of the difference between adults and children and how the risk assessment will account for these differences. The members suggested using correction metrics for children for better estimates of biological exposure in children. The database being used to say that 10% of mild asthmatics respond with a doubling of airway resistance is very small and was done in young adults and probably does not apply to children. The choice of using sRaw instead of FEV1 needed more justification and discussion. Members suggested comparisons be made between bronchial constriction and FEV_1 decrement. Members did not find the uncertainty and variability section to be clear and suggested several improvements such as adding a table of sources of variability. There were also suggestions of performing sensitivity analyses on factors that have a large effect on the results.

Public Clarifying Comments on the REA Planning Document

There were no public clarifying comments.

Summary and Action Items

Dr. Ana Diez Roux discussed action items and the remaining schedule for drafting the reports.

The meeting was adjourned by Mr. Yeow at 12:30 pm.

Respectfully Submitted:	Certified as Accurate:
/s/	/s/
Mr. Aaron Yeow	Dr. Ana Diez Roux
Designated Federal Officer	Chair
EPA SAB Staff Office	CASAC Sulfur Oxides Panel

NOTE AND DISCLAIMER: The minutes of this public meeting reflect diverse ideas and suggestions offered by Panel members during the course of deliberations within the meeting. Such ideas, suggestions and deliberations do not necessarily reflect 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, commentaries, letters or reports prepared and transmitted to the EPA Administrator following the public meetings.

Materials Cited

The following meeting materials are available on the CASAC website: http://www.epa.gov/casac, at the March 20-21, 2017 CASAC Sulfur Oxides Panel Meeting page:

[1] CASAC Sulfur Oxides Panel Roster
[2] Federal Register Notice Announcing the Meeting
[3] Agenda
[4] EPA Presentation - Integrated Science Assessment for Sulfur Oxides – Health Criteria Second External Review Draft
[5] EPA Presentation - National Ambient Air Quality Standards (NAAQS): SO2 (Primary) REA Plans
[6] Comments from Julie Goodman, Gradient, on behalf of the American Petroleum Institute
[7] Oral Statement on REA PD from Lindsey Jones, Texas Commission on Environmental Quality

ATTACHMENT A – Other Attendees
CASAC Sulfur Oxides Panel Public Meeting

Name	Affiliation	Mar 20	Mar 21
Armstrong, Annalee*		x	x
Balserak, Paul*	American Iron and Steel Association	x	x
Beardslee, Renee*	USEPA	x	x
Bourne, Troy*	Morningside	x	x
Brown, James*	USEPA	x	x
Buckley, Barbara	USEPA	x	
Carpenter, Tom	USEPA		x
Coffman, Evan*	USEPA	x	x
Deitrich, Casey*	ASC Services	x	x
Economou, Aristole			
Goodman, Julie*	Gradient, on behalf of the American Petroleum Institute	x	x
Hemming, Brooke*	USEPA	x	x
Hines, Erin*	USEPA	x	x
Jones, Lindsey*	Texas Commission on Environmental Quality	x	x
Jones, Samantha	USEPA	x	x
Kalisz, Cathe*		x	x
Kirrane, Ellen	USEPA	x	x
Lackey, Leila	USEPA	x	x
Lamson, Amy	USEPA	x	x
Langworthy, Cindy	Hunton and Williams	x	x
Luben, Tom*	USEPA	x	x
Medeiros, Kevin*	Chevron	x	x
Moore, Brian*	California Air Resources Board	x	x
Murphy, Deirdre	USEPA	x	x
Nichols, Jennifer*	USEPA	x	x
Parker, Stuart*	IWP News	x	x
Patel, Molini*	USEPA	x	x
Pella, Theresa*	Central States Air Resource Agencies Association	x	x
Perry, Steve*		x	x
Price, Doug	Tesoro	x	x
Richmond-Bryant, Jen	USEPA	x	
Reilly, Sean	E&E News		x
Ross, Mary	USEPA	x	x
Steichen, Ted	American Petroleum Institute	x	x
Wesson, Karen	USEPA		x
Williams, Melina	USEPA	x	x
Woods, Clint*	Association of Air Pollution Control Agencies	x	x

*requested call-in information or participated via webcast