



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
NATIONAL CENTER FOR ENVIRONMENTAL ASSESSMENT

OFFICE OF
RESEARCH AND DEVELOPMENT

January 10, 2017

MEMORANDUM

SUBJECT: CASAC Review of the Second External Review Draft Integrated Science Assessment for Sulfur Oxides – Health Criteria

FROM: John Vandenberg, Ph.D.
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TO: Aaron Yeow, M.P.H.
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The Second External Review Draft *Integrated Science Assessment for Sulfur Oxides – Health Criteria* (second draft SO_x ISA) prepared by the U.S. Environmental Protection Agency's (U.S. EPA) National Center for Environmental Assessment – Research Triangle Park Division (NCEA-RTP) as part of EPA's ongoing review of the primary (health-based) National Ambient Air Quality Standard for sulfur dioxide (SO₂) was released on December 9, 2016. Electronic copies are available for download at <http://www.epa.gov/isa>. The second draft SO_x ISA will be reviewed by the Clean Air Scientific Advisory Committee (CASAC) Sulfur Oxides Panel at a public meeting anticipated to be held March 20-21, 2017. I am requesting that you forward our charge to the CASAC Sulfur Oxides Panel.

The ISA is intended to “accurately reflect the latest scientific knowledge useful in indicating the kind and extent of all identifiable effects on public health or welfare, which may be expected from the presence of [a] pollutant in the ambient air” [Clean Air Act, Section 108; 42 U.S.C. 7408(b)]. This second external review draft SO_x ISA integrates the scientific evidence for review of the primary (health-based) NAAQS for SO₂ and provides draft findings, conclusions, and judgments on the strength, coherence, and plausibility of the evidence.

Following the review of the second draft ISA, NCEA-RTP staff will produce a final ISA, projected for release by December 2017, which will address comments received from the CASAC Sulfur Oxides Panel and the public. The final SO_x ISA, in conjunction with additional technical assessments, will provide the scientific basis for the U.S. EPA's decision regarding the adequacy of the current primary standard for SO₂ to protect human health.

Charge to the CASAC Sulfur Oxides Panel

The second draft ISA includes revisions developed in response to the comments and advice provided by the CASAC Sulfur Oxides Panel and comments received from the public on the first external review draft SO_x ISA. Specific revisions were described in EPA's response (August 2016) to the CASAC Sulfur Oxides Panel's review letter on the first draft ISA (April 2016).¹ We have carefully considered all of the comments provided by the CASAC Sulfur Oxides Panel and the public in creating this second draft ISA. In addition, we have incorporated information from relevant studies published since the release of the first external review draft ISA, through August 2016. The revisions reflected in the second draft SO_x ISA focus on several overarching concerns raised by the CASAC Panel:

- Revising the language in the Executive Summary to make it more accessible for a nontechnical audience.
- Clarifying definitions for sulfur oxide sources and updating the air quality analyses to incorporate more recent data.
- Reorganizing and clarifying the discussion of human exposure to ambient sulfur oxides to distinguish between issues relevant to all criteria air pollutants and those that are specific to SO₂.
- Revisiting causal determinations for short-term SO₂ exposure and cardiovascular effects as well as for long-term SO₂ exposure and total mortality, reproductive/developmental effects, and cancer.
- Clarifying the discussion of potentially at-risk populations.

Charge questions for this review by the CASAC Sulfur Oxides Panel are provided below. These charge questions are not intended to limit the scope of the Panel's review but rather are intended to assist the Panel by highlighting specific areas where the Agency has responded to prior comments of the Panel or where the Agency raises issues to be addressed by the Panel.

Charge #1 – Executive Summary and Chapter 1

The Executive Summary and Chapter 1 provide overviews of the ISA. The Executive Summary is intended to be a concise synopsis of key findings targeted to the broadest audience, whereas Chapter 1 is a more detailed synthesis of the ISA's most policy-relevant findings.

Please comment on the extent to which revisions to the Executive Summary and Chapter 1 have reduced redundancy and made the Executive Summary more accessible to a nontechnical audience.

¹The CASAC Sulfur Oxides Panel's review letter is available at:

[https://yosemite.epa.gov/sab/sabproduct.nsf/4620a620d0120f93852572410080d786/8DEC36A7E2A54BA485257F9600667D81/\\$File/EPA-CASAC+2016-002+Unsigned.pdf](https://yosemite.epa.gov/sab/sabproduct.nsf/4620a620d0120f93852572410080d786/8DEC36A7E2A54BA485257F9600667D81/$File/EPA-CASAC+2016-002+Unsigned.pdf).

EPA's response to the CASAC Sulfur Oxides Panel's review letter is available at:

[https://yosemite.epa.gov/sab/sabproduct.nsf/4620a620d0120f93852572410080d786/8DEC36A7E2A54BA485257F9600667D81/\\$File/EPA-CASAC-16-002_Response-08-31-16.pdf](https://yosemite.epa.gov/sab/sabproduct.nsf/4620a620d0120f93852572410080d786/8DEC36A7E2A54BA485257F9600667D81/$File/EPA-CASAC-16-002_Response-08-31-16.pdf).

Charge #2 – Atmospheric Chemistry and Ambient Concentrations of Sulfur Dioxide and other Sulfur Oxides

Revisions to Chapter 2 include those to more clearly define sources and source categories of sulfur oxides, to clarify and expand the discussion of chemical processes involving sulfur oxides, and to update the air quality analyses to incorporate the most recent data available (2013-2015). We have also revised the material on measurement methods and air quality modeling.

Please comment on the extent to which these revisions improve the characterization of sources, chemistry, and concentrations of ambient sulfur oxides and hence provide a scientific foundation for subsequent technical and policy analyses during the review of the SO₂ NAAQS.

Charge # 3 – Exposure to Ambient Sulfur Dioxide

As suggested by the CASAC Sulfur Oxides Panel, Chapter 3 has been reorganized to eliminate redundancy with Chapter 2 and ensure that each key topic is covered coherently in one place to improve the clarity and flow of the document. For example, copollutant correlation data were consolidated into Chapter 3 from both the ambient monitoring network and epidemiologic studies. Additionally, edits were made to more clearly distinguish exposure issues that apply to all criteria air pollutants from those that apply more specifically to SO₂.

Please comment on these revisions insofar as the chapter supports the evaluation of the strength of inference and potential for copollutant confounding in epidemiologic studies in Chapter 5.

Charge # 4 – Health Effects of Short-Term and Long-Term SO₂ Exposure

The CASAC Panel recommended re-evaluating the evidence for effects of SO₂ outside the respiratory system and revisiting the causal determinations for short-term SO₂ exposure and cardiovascular effects, as well as for long-term SO₂ exposure and total mortality, reproductive/developmental effects, and cancer. Upon further evaluation we agree with the CASAC Panel's recommendation that for these outcomes at these exposure durations a causal determination of "inadequate" is consistent with the evidence, and we have revised the text accordingly.

Please comment on the extent to which our characterization of the evidence and rationale for these causal determinations is consistent with the EPA's causal framework.

We have also revised the discussion of the evidence for respiratory effects of SO₂ to provide more information on the structure and function of the respiratory tract and factors influencing breathing rate and habit, including age, sex, and body mass index.

Please comment on the adequacy of the characterization of respiratory effects observed in controlled human exposure and epidemiologic studies, particularly in different populations and lifestages.

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

Chapter 6 has been revised in two important ways. First, the introductory material has been expanded and clarified to provide more information on relationships between the various types of factors that may contribute to increased risk in a population or lifestage. Second, evaluation of the evidence for potential at-risk factors is now focused on respiratory effects, since that is the only outcome category for which the ISA concluded that a “causal” or “likely causal” relationship exists.

Please comment on the adequacy of these revisions to clarify the characterization of the evidence for increased risk of SO₂-induced health effects in different populations and lifestages.

We look forward to the CASAC Sulfur Oxides Panel review of the second draft ISA at the upcoming meeting. Should you have any questions regarding the second draft SO_x ISA, please feel free to contact m (919-541-4527, Vandenberg.john@epa.gov), Dr. Steven Dutton (919-541-5035, dutton.steven@epa.gov) or Dr. Tom Long (919-541-1880, long.tom@epa.gov).

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