

**Summary Minutes of the United States Environmental Protection Agency (U.S. EPA)
Clean Air Scientific Advisory Committee (CASAC) Oxides of Nitrogen (NO_x) and Sulfur
Oxides (SO_x) Secondary Review Panel Meeting**

October 6-7, 2010

Oxides of Nitrogen (NO_x) and Sulfur Oxides (SO_x) Secondary Review Panel¹

Date and Time: October 6, 2010, 8:30 p.m. to 5:00 p.m.; October 7, 2010, 8:30 a.m. - 1:00 p.m.
Eastern Time

Location: Marriott at Research Triangle Park, 4700 Guardian Drive, Durham, NC, 2880

Purpose: to peer review EPA's *Policy Assessment for the Review of the Secondary National Ambient Air Quality Standards (NAAQS) for NO_x and SO_x: Second External Review Draft* (September 2010).

CASAC Panel:

Dr. Armistead (Ted) Russell, Chair
Dr. Praveen Amar
Dr. Andrzej Bytnerowicz
Ms. Lauraine Chestnut
Dr. Ellis B. Cowling
Dr. Charles T. Driscoll, Jr.
Dr. H. Christopher Frey
Dr. Rudolf Husar
Dr Dale Johnson
Dr. Naresh Kumar,
Dr. Myron Mitchell
Mr. Richard L. Poirot
Dr. Kathleen Weathers

EPA presenters and representatives

Ms. Lydia Wegman, EPA Office of Air Quality Planning and Standards (OAQPS)
Dr. Bryan Hubbell, EPA OAQPS
Dr. Richard Scheffe, EPA OAQPS
Dr. Tara Greaver, EPA Office of Research and Development

SAB Staff Office Participants

Dr. Angela Nugent, Designated Federal Officer (DFO)
Dr. Anthony Maciorowski, Deputy Director

Meeting Summary - October 6, 2010:

The meeting was announced in the Federal Register² and discussion at the meeting generally followed the issues and timing as presented in the agenda³.

Convene the meeting

Dr. Angela Nugent, SAB DFO, convened the advisory meeting and welcomed the group. She noted that there had been four requests for oral public comment and that written comments had been provided to the panel and posted on the SAB Web site. Dr. Anthony Maciorowski, SAB Staff Office Deputy Director, expressed appreciation for members' preparations for the meeting.

Purpose of meeting and review of the agenda

Dr. Armistead Russell, the Panel chair, spoke of the importance of EPA's *Policy Assessment for the Review of the Secondary National Ambient Air Quality Standards (NAAQS) for NO_x and SO_x* and of the need for the Panel to develop recommendations regarding the elements of the NAAQS. He thanked panel members for providing their preliminary written comments.⁴ He spoke of the novelty and importance of the *Policy Assessment*, which addressed multiple pollutants in a single document and advanced the first separate assessment for secondary effects of NAAQS chemicals.

Background and schedule for NO_x/SO_x Secondary NAAQS Review and Introduction to the second draft Policy Assessment

OAQPS provided a slide presentation on the background and schedule for NO_x/SO_x Secondary NAAQS Review and introduction to the second draft *Policy Assessment*.⁵ In her remarks, Ms. Lydia Wegman noted that EPA was seeking recommendations from the Panel for reasonable ranges of the secondary standards and options for forms of the standards. OAQPS speakers noted that they planned to request a meeting with the CASAC Ambient Air Quality Monitoring and Methods Subcommittee (AAMMS) regarding the Federal Reference Method that would be part of a proposed rule on the secondary standards.

CASAC panel members asked how OAQPS staff envisioned attainment/nonattainment decisions working with the type of secondary standard envisioned by the *Policy Assessment*. Staff responded that state officials would use the Atmosphere Acidification Potential Index (AAPI) equation, "plug in NO_y and NO₄" for a water body, and compare the result against the level of standard AAPI that was chosen as the standard. The degree of nonattainment would be the exceedances over the AAPI standard. Dr. Bryan Hubbell noted that OAQPS sought CASAC advice on the percentage of lakes to protect from acidification because that percentage helps to determine the percentage of NO_x and SO_x to control. He noted *Policy Assessment* described a NO_x / SO_x tradeoff curve that could be used to determine attainment. States would determine nonattainment areas as they developed State Implementation Plans.

CASAC panel members asked OAQPS to comment on the relationship between the Clean Air Act Title 4 Acid Rain Program and the NAAQS program. Ms. Wegman noted that the two provisions of the Clean Air Act are independent of each other. Title 4 establishes caps on emissions, allocations, and reporting and monitoring requirements. The NAAQS, in contrast, sets benchmarks for environmental effects. The Clean Air Act has provisions both for primary and secondary NAAQS to be set, without regard to costs, although states can consider costs in developing implementation plans for both.

A CASAC member asked whether measured Acid Neutralizing Capacity (ANC) could be used to validate modeled ANC used as an input for calculating AAPI. OAQPS staff responded that such measurements might be used in the future, as the secondary NAAQS was re-evaluated, but that lags in ecosystem response to nitrogen confound use of monitoring data. Current ANC levels might reflect historical nitrogen deposition, not just from air sources, but also from other environmental sources. EPA's goal is to provide requisite protection against adverse effects to public welfare from NO_x and SO_x.

Public comments

Four members of the public provided oral comments. Dr. Eladio Knipping from the Electric Power Research Institute (EPRI) provided a slide presentation⁶ and read from a short version of his prepared comments.⁷ He also provided panel members with an extended version of his written comments.⁸ In response to questions, he noted that 1) his detailed comments described the inputs for the uncertainty analyses conducted by EPRI and that 2) high quality research requires examination of the variability in air quality models, ecosystem impacts, lag time, and cation exchange. In his view, EPA's assessment did not adequately cover those topics.

Mr. Aaron Flynn of Statement of Hunton & Williams LLP presented a statement on behalf of the Utility Air Regulatory Group.⁹ He voiced concerns that the public did not have adequate time to review the technical material presented in the *Policy Assessment*.

Mr. John J. Jansen presented comments on behalf of the Southern Company.¹⁰ He noted that that the approach suggested NO_x and SO_x secondary standard may not be consistent with the Clean Air Act intent for the NAAQS. He asked whether a secondary standard was needed in light of acid rain protections under Title 4.

Mr. John Heuss participated by telephone and provided comments he had developed with Dr. George T. Wolff of Air Improvement Resource, Inc. on behalf of the Alliance of Automobile Manufacturers.¹¹ He made comments on the appropriateness of developing a secondary standard to address acid deposition effects, the formulation of EPA's approach, and implementation issues.

Discussion of Chapter 3: Considerations of Adversity to Public Welfare

The committee proceeded to discuss the charge questions provided by EPA.¹²

Charge question 1. The Lead Discussant, Ms. Lauraine Chestnut summarized the major points of her written comments regarding adversity to public welfare. Panel members made the following additional points and raised the following questions:

- It would be helpful to provide maps illustrating nitrogen deposition in the East and West. Two maps would more effectively show where the highest levels are
- Title 4 provides an indicator of national and social preferences for controlling acidification of water bodies. EPA might cite the dollar investment in the acid rain program
- EPA might include mention of the Department of Energy Environmental Air Pollution Program
- It is important to ensure that the tone of this chapter does not communicate that nitrogen lacks positive impacts on the environment, such as carbon sequestration.
- Correct Figure 3.2 to indicate that European data relate to the effects of acidification.

Discussion of Chapter 4: Adequacy of the Current Standards

Charge questions 2. The Lead Discussant, Dr. Ellis Cowling, supported the major finding in chapter 4 that there is significant risk to acid sensitive aquatic ecosystems at atmospheric concentrations of NO_x and SO_x at or below the current standards. He noted the appropriateness of the evidence provided and arguments made.

Charge question 3. Dr. Cowling noted the appropriateness of EPA's evaluation of present standards. One member noted the importance of ensuring the discussion acknowledges the positive impacts of nitrogen in the environment.

Charge question 4. The Lead Discussant, Dr. Dale Johnson, summarized his written comments and expressed concern that the document should be more balanced in its discussion of the positive impacts of nitrogen in the environment, especially as a counter balance to carbon in the environment. He also expressed concern that policy considerations appear too prominently in the document. Other panel members made the following points.

- The second draft *Policy Assessment* has been revised to acknowledge different positive contributions of nitrogen in the environment.
- The N_{eco} could be better explained as including the potential of nitrogen to stimulate growth.
- The purpose of the *Policy Assessment* is different from the *Integrated Science Assessment*, which evaluated available science to inform development of policy options. The *Policy Assessment* is intended to “bridge the gap” between scientific information and the judgments required of the Administrator in determining whether it is appropriate to retain or revise the standards. Policy issues must be included and addressed by definition.

Discussion of Chapter 5: Conceptual Design of an Ecologically Relevant Multi-Pollutant Standard

Charge question 5. The Lead Discussant, Dr. Praveen Amar, summarized his written comments commending EPA for its development of an effective conceptual design. Other panel members made the following points:

- There is need for additional analysis and verification of the CMAQ model, given its importance for the approach described in the *Policy Assessment*. It may be useful to examine the use of CMAQ for both dry and wet deposition. (OAQPS staff responded that EPA is transitioning to use CMAQ more for wet deposition and will need to examine evaluation of the model for this purpose)
- The *Policy Document* should be corrected so it does not convey that nitrate is solely released from snowpack.
- Although the framework "looks fine" from a theoretical standpoint, effective implementation requires a fuller evaluation of robustness. There are concerns about key models and data limitations.

Charge question 6. The Lead Discussant, Dr. Praveen Amar, briefly summarized his written comments. Although he acknowledged EPA's need for a balance between simplicity and complexity in choosing an approach to evaluate water bodies to identify an appropriate population of lakes to consider when determining a standard, he noted that the draft *Policy Assessment* did not adequately describe the rationale for choosing the ecoregions approach and the significance of the Omernik option. Other members added the following points:

- EPA should revise the chapter to include a more extended description of each option, distinguish more clearly between the options described, and describe the "pros and cons" of each more clearly.
- In evaluating options, EPA should consider data availability, and combinations of atmospheric concentrations and ecological characteristics that identify appropriate groupings.
- The U.S. Forest Service is considering a critical loads approach for nitrogen, using a cluster approach. It would be good to use a similar approach for acidification and nutrient/nitrogen evaluation.
- For Table 5-5, EPA should include medians and well as means to provide a sense of the distribution.
- EPA should include maps to complement Tables 5-5 and 5-6 to allow a comparison of deposition and sensitivity.
- EPA should include a key that explains Omernik's subcategories.

Charge question 7. The lead discussant, Dr. Andrzej Bytnerowicz summarized his comments and noted that the critical loads approach was logical and appropriate for developing secondary standards and for examining NO_x and SO_x interactions and reduced forms of nitrogen. He found EPA's proposal to use filtering criteria to remove lakes and streams that are naturally acidic or not sensitive to atmospheric deposition approach to be inadequately explained. Other panel members made the following points:

- The filtering approach lacks transparency. EPA should leave the lakes of concern in the analysis and adjust the percentage of lakes to be protected or use criteria to remove them after the analysis is complete.

- Although Florida lakes are naturally acidified and would need to be screened out post analysis, New York State will be concerned if Adirondack lakes of concern were not protected and were filtered out from the start

Charge question 8. The lead discussant, Dr. Bytnerowicz noted that the proposed method of establishing NO_x/SO_x tradeoff curves makes sense but would benefit from a clearer description. Other panel members made the following point:

- EPA should seek better spatial information on NO_x and SO_x deposition, preferably at the ecoregions scale.

Charge question 9. The Lead Discussant, Dr. Naresh Kumar, noted that EPA had not introduced many changes related to deposition transfer ratios since the first draft *Policy Assessment*. He suggested that EPA consider the variability of CMAQ, compared to models used by other agencies, to consider inter-annual variability, variability in emissions related to wet and dry deposition, and different chemical mechanisms. It would be helpful to compare the Comprehensive Air Quality Model with extensions (CAMx) and CMAQ to see if there are any significant differences. Other panel members made the following points:

- It is appropriate to use CMAQ to estimate deposition, but there may be a concern that SO₂ estimates of dry deposition may be over predicted; the mass balance will need to be adjusted and assessed.
- EPA should compare CMAQ and deposition monitoring data from the CASTNET system with special attention to nitrate.

Charge question 10. The Lead Discussant, Dr. Naresh Kumar, noted that an averaging time of three to five years is appropriate. No other panel views were expressed on this question.

Charge questions 11. The Lead Discussant, Dr. Charles Driscoll, noted that the range of target ANC values discussed in the *Policy Assessment* was appropriate. He noted that the rationale for the range and literature supporting the range supported the Agency's choice. Other panel members made the following points.

- The range is consistent with the approach taken in Europe.
- EPA should strengthen its discussion of the impact of the choice of target values on terrestrial ecosystems in specific ecoregions. Chapter 6 has a helpful graph, but more text is needed discussing linkages between aquatic and terrestrial systems.
- EPA should examine the last bullet in the Executive Summary to see if it contradicts Table 2-1. If there are sensitive species that won't return unless the ANC value is above 50, then the potential benefit of targets over 50 are not well described.

Charge question 12. The Lead Discussant, Dr. Driscoll, noted that EPA's proposed approaches for considering alternative target percentages of water bodies are appropriate. One panel member made the following additional point:

- EPA should expand the discussion to evaluate impacts on biodiversity in some fashion, whether qualitative or quantitative.

Discussion of Chapter 6: Co-protection

Charge question 13. The Lead Discussant, Ms. Lauraine Chestnut, summarized her written comments. She encouraged EPA to expand its discussion of co-benefits for terrestrial systems and note that protection of aquatic resources will not necessarily protect against terrestrial effects. She asked EPA to provide more discussion of the share of sensitive ecosystems likely to be protected. She called for a table of co-benefits, such as visibility. Panel members provided no additional comments.

Discussion of Chapter 7, Uncertainty and Variability

Charge question 14. The Lead Discussant, Dr. Rudolf Husar, noted that the new chapter 7 provides a useful consolidation of discussions of uncertainty, variability, and sensitivity in EPA's analysis. He suggested that EPA should also include discussion of uncertainties not easy to quantify or explain, such as overestimates of sulfur dioxide. He suggested that EPA should identify the significance of uncertainties discussed in terms of their impact and the direction of possible bias on EPA's overall analysis. Other panel members made the following points:

- The analysis should include a quantitative assessment of uncertainties, as the CASAC had recommended in its June 22, 2010 advisory letter.
- EPA should add a discussion of impacts on terrestrial systems and include them in its uncertainty tables.
- EPA should examine the impacts of uncertainties of components of the AAPI on that index, as well as how uncertainties impact the allowable depositional loads and associated ambient concentrations.
- A quantitative evaluation of analyses related to aquatic systems is needed.

Charge question 15. The Lead Discussant, Dr. Husar, summarized his written comments. Other panel members made the following point:

- The EPRI analysis discussed by the public commenter, Dr. Elladio Knipping, illustrated that EPA could conduct a quantitative analysis of key uncertainties.

Charge question 16. The Lead Discussant, Dr. Charles Driscoll, summarized his written comments. Other panel members made the following points:

- EPA should discuss variability and uncertainty related to geographic and temporal averaging in Chapter 7 to support discussion of policy options in Chapter 9.
- Chapter 7 should provide a framework for considering all the uncertainties discussed and their significance for key aspects of EPA's analysis. The chapter could use a tiered approach to uncertainty that would include significant quantitative evaluation and some qualitative discussion.

Charge question 17. The Lead Discussant, Dr. Driscoll, again summarized his written comments related to EPA's discussion of future research and data collection. Other panel members made the following points:

- Members commended EPA for including a section on research needs; such a section should be a part of future Policy Assessments for other chemicals.

- Discussion of needs for monitoring data would benefit from a more extended and clearer introduction.
- Research needs should include terrestrial acidification and nutrient enrichment, CMAQ's treatment of reduced nitrogen compounds, examination of local variations of ammonia.

Discussion of Chapter 8, Monitoring

Charge questions 18, 19, and 20. The Lead Discussant, Mr. Richard Poirot, expressed appreciation for the introduction to this chapter, which noted that monitoring has multiple purposes. Monitoring is useful for compliance and can fill a research need. He noted the possibility that EPA might calculate NO_y from CASTNET information. Panel members made the following points:

- EPA should identify uncertainties and data needs and examine priorities for monitoring sites or investments in improved monitoring networks.
- EPA is collaborating with the governments of Canada and the Netherlands on innovative monitoring methods.
- New methods for monitoring for secondary NO_x and SO_x will have benefits in terms of monitoring for other pollutants.

Discussion of Chapter 9: Conclusions

Charge questions 21 and 22. The Lead Discussant, Dr. Christopher Frey, noted that the *Policy Assessment* makes a strong case that the current standards for NO_x and SO_x are not adequately protective of aquatic acidification and its effects. The document provides a good description of ANC and AAPI, with its tradeoffs between NO_x and SO_x. Although there are uncertainties, the approach described is reasonable. Chapter 9 could be strengthened by additional discussion of the possible level of the standard, with special emphasis on the uncertainties that would lead to biases in deriving the AAPI. Other panel members made the following points:

- Does EPA have high confidence that if levels of NO_x and SO_x are reduced, there will be reductions in ANC? Does the MAGIC model show that? An examination of those uncertainties is needed.
- EPA should draw on available data for acid-sensitive regions that show how sulfate and nitrate have decreased and the response of ANC. Available data are fairly consistent with model projections and can bolster the uncertainty analysis
- EPA cites the appropriate available literature on mortality of aquatic organisms.
- EPA should more fully describe the limits of available data on biodiversity, which focuses on spatial patterns related to nitrate and sulfate, which were transferred to temporal patterns.
- The *Policy Assessment* does a "good job of explaining that while ANC is not perfect, it is the most robust metric available."
- The analysis in Chapter 9 should address the question, "given what we know about the uncertainty discussed in Chapter 7, how would those uncertainties affect how we set the AAPI,"
- Chapter 9 should note the strong correlation between ANC and biotic mercury.

- Chapter 9 should note possible impacts of a change in standard on carbon dioxide sequestration and climate change.

Charge question 23. The Lead Discussant, Dr. Kathleen Weathers, clarified EPA's intent with charge question 23 and noted that EPA should retain its existing secondary standards for NO_x and SO_x to protect against direct adverse effects to vegetation due to gas phase exposures. Other panel members made the following point:

- The existing standard protects against phytotoxicity, while a possible new standard supported by the *Policy Assessment* focuses on acidification of aquatic resources.

Charge question 24. The Lead Discussant, Dr. Weathers, summarized her written comments. She noted that the document demonstrates ecosystem impacts of NO_x and SO_x at different levels of deposition. The ANC is a reasonable indicator of aquatic deposition. She noted that EPA should strengthen its explanation of spatial aggregation options and provide more analysis and uncertainty characterization to strengthen confidence in AAPI. Other panel members made the following points:

- EPA should more clearly communicate the implications of different options for selecting different percentages of lakes to protect.
- The *Policy Assessment* should include an Agency recommendation, supported by analysis of pros and cons, for CASAC to review. Decision makers will want to know the "avoided adverse effects" likely at different levels.
- Could CASTNET data be used to supplement modeling analyses used to generate AAPI?
- EPA's analysis of ecosystem services affected by NO_x and SO_x should include non-use concepts, detailing how public welfare is affected by protection of these resources in their natural state even without direct use. EPA can expand its discussion of categories of ecosystem services, even if those affected services cannot be monetized or even measured in biophysical terms.
- EPA should provide better explanation of the benefits of going beyond an ANC level of 50, perhaps drawing on data on an area like the Adirondacks as an example. EPA should describe more fully the numbers of waterbodies that might be protected at different levels and the number of sensitive lakes protected
- EPA should make more explicit its approach to "protecting sensitive populations but not every individual" in an ecosystem context.
- Since AAPI, not ANC, has been described as the possible form of the standard, EPA must increase confidence in AAPI as a measurement.
- EPA should include levels of 20 and/or 25 as possible ANC levels.
- EPA should include analysis of impacts of reduced NO_x and SO_x on carbon dioxide in evaluating a possible standard.
- EPA should adapt Figure 5.23 on page 571 to communicate the benefits of different options. EPA should indicate ecosystem and biological effects at different levels, relate those effects to ANC and AAPI
- It may be useful to break out sensitivity and deposition, two components of the AAPI

The panel then discussed the implications of this discussion for CASAC's letter to the Administrator. The panel chair noted that the key question was: "How ready is this document to inform administrator to make a choice about the secondary standard." Linked to that question is

whether CASAC should advise EPA to proceed with this type of standard at all, given its complexity and the novelty. Members responded with a range of views. One member noted that the document was not ready to support decision on a NAAQS. Another member noted that he was confident enough to support the approach, given the overall analysis in the *Policy Assessment*. Other members noted that the "concept is good," but that they were not ready to support its use because of the level of uncertainty associated with the AAPI. In one member's view, EPA needs to communicate more clearly the step-by-step analysis from deposition to derivation of metric that causes adverse impacts on target types and percentages ecosystem resources. Another member noted that this standard is a "a great opportunity to put together a complex multi-pollutant standard" that would address significant environmental effects of acidification of waters and soils. He noted that the *Policy Assessment* should address the important limitations noted.

Members noted that one compelling need was to strengthen confidence in the AAPI and agreed to develop a list of high priority steps EPA should take to build confidence in the index. The Panel chair asked members to identify their priority list of needs to strengthen the AAPI analyses and the PA. Members identified the following items:

- Better explanation of the AAPI and how it would work
- Improving the uncertainty analysis related to the use of AAPI
 - "Hindcasting" with CMAQ and other models used in the AAPI
 - Complete quantitative analysis of sensitivity and uncertainty

The panel chair asked members to provide him by email with additional high priority items to strengthen the analysis of the AAPI.

Members also discussed the possibility of setting a target limit that reflected their current comfort level with the AAPI approach and leaving open the option of EPA's setting a different limit in the future as more data were collected.

Summary of major review comments

The chair asked panel members to conclude the session by briefly summarizing verbally the major points of the discussion of each charge question. He asked them to send a brief written summary of those points to him and the DFO by the end of the day.

The panel recessed at 5:30 for the day.

Meeting Summary - October 7, 2010

Discussion of draft panel response to charge questions

The panel convened at 8:30 and discussed the "Draft response to charge questions for deliberation at 10/7/10 meeting"¹³ developed by panel members over night. Members suggested modifications and additions to responses to charge questions 1-13 and briefly discussed charge question 24. The panel chair also noted that he had developed a draft cover letter to the

Administrator.¹⁴ The panel did not have an opportunity to engage in discussion on the draft letter

Summary and next steps

The panel decided that it could not reach full resolution on its response to charge questions at the meeting or to review the draft letter to the Administrator. The chair noted that he would ask panel members to work in the work groups assigned on the agenda to particular charge questions and would provide a schedule for panel members to provide revised or addition language that would reflect the overall response of the panel to each question. He noted that he would work with the DFO to set up a public teleconference for further discussion of EPA's second draft *Policy Assessment* and that full CASAC review and discussion of the panel's draft report would not happen at the November 8, 2010 teleconference as originally planned. The chartered CASAC would review and discuss the panel's draft report at a date to be scheduled, likely in late November or December.

The Designated Federal Officer adjourned the meeting at 12:15 p.m.

Respectfully Submitted:

Certified as True:

/Signed/

/Signed/

Dr. Angela Nugent
SAB DFO

Dr. Armistead Russell
SAB 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 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 Web site,
<http://www.epa.gov/casac>, at [the page for the October 5-6, 2010 CASAC Panel meeting](http://www.epa.gov/casac):
<http://yosemite.epa.gov/sab/sabproduct.nsf/bf498bd32a1c7fdf85257242006dd6cb/a2a6de5f6c7b3a758525775e006050e3!OpenDocument&Date=2010-10-07>

¹ Roster, Chartered SAB Members and Liaisons, October 6-7, 2010

² Federal Register Notice Announcing the Meeting

³ Agenda

⁴ Panel Members' Pre-meeting Comments

⁵ Overview of the Second Draft Policy Assessment , Presentation by Ms. Lydia Wegman, Dr. Bryan Hubbell, Dr. Tara Greaver, Dr. Rich Scheffe

⁶ Slide Presentation by Dr. Eladio Knipping, Electric Power Research Institute

⁷ Short comments from Dr. Eladio Knipping, Electric Power Research In

⁸ Extended comments from Dr. Eladio Knipping, Electric Power Research Institute

⁹ Statement of Aaron M. Flynn, Hunton & Williams LLP, on behalf of Utility Air Regulatory Group

¹⁰ Statement of John J. Jansen, Principal Scientist, Southern Company .

¹¹ Comments from Jon M. Heuss and George T. Wolff of Air Improvement Resource, Inc., on behalf of the Alliance of Automobile Manufacturers.

¹² Charge to the CASAC NO_x SO_x Secondary NAAQS Review Panel

¹³ Draft response to charge questions for deliberation at 10/7/10 meeting

¹⁴ Draft text for cover letter to be discussed at 10/7/10 meeting