

**Mirant-ATSDR Meeting**  
**June 4, 2008, 11:00-12:30 pm**  
**ATSDR Headquarters**  
**Conference Room 5A, Bldg 106, 4770 Buford Highway, Chamblee, GA**

The meeting came to order at 11:05 am. Dr. Tom Sinks, Deputy Director National Center for Environmental Health (NCEH)/Agency for Toxic Substances and Disease Registry (ATSDR), called the meeting to order and asked participants to introduce themselves. Dr. Sinks distributed a one page document "Meetings with Stakeholders Guidelines" that described ATSDR's general guidelines for meeting with stakeholders (Attachment 1). He then read from the document.

Dr. Sinks then asked Ms. Werner to provide a brief summary of ATSDR's involvement regarding the Mirant Potomac River power plant in Alexandria, Virginia.

**Ms. Werner**

Dr. Charles Konigsberg, Alexandria Health Department requested ATSDR's assistance in January 2006. We began with a review of available air modeling and emissions data. We identified data gaps and concerns about SO<sub>2</sub> in a health consultation letter, which we provided to Dr. Konigsberg in January 2007. We identified areas of concern not currently being monitored, and conducted an Exposure Investigation monitoring event for 6 weeks during the summer of 2007 to address this data gap. After the monitoring event was complete, we held a series of meetings and a public availability session, and we also launched the website. Following the monitoring event, we spent the next approximately six months reviewing the data for quality control, and now we are analyzing the data for the draft health consultation. That draft will be submitted for external scientific peer review, followed by its release as a public comment version, and lastly it will be published as a final document. We are still planning to release the public comment version of the health consultation in 2008. We must address all peer review comments before the public comment version is released. All of the peer review comments (both the peer review comments collected on our Exposure Investigation protocol and on the Health Consultation document) and our responses will be released with the public comment document.

**Mr. Holmstead**

Will there be collaboration with EPA?

**Dr. Sinks**

We collaborate with EPA on site issues as appropriate and necessary. As evidenced by EPA participation in today's meeting, we are working with them at this site.

**Mr. Ginsburg**

Lora Werner has ensured consultation with EPA thus far.

**Ms. Werner**

There will be another series of public meetings when the public comment document comes out.

**Ms. Raggio**

Ms. Raggio noted she has both professional and personal concerns about this site. Alexandria is a very political city. The plant is critical to the region's energy. A crisis is coming—no one wants new plants but they want more energy. In 2005, we received modeling data about SO<sub>2</sub> at levels that led us to shut down the plant. At the time we had to take into account all of Mirant's stakeholders (DOE, the Pentagon, etc.), who objected to the shut down. We still shut down, but told them that if they had to have us run then they would need to find a way. DOE eventually ordered us to run, which was not an ideal situation for the plant because of environmental liability and other factors. When ATSDR got involved and wrote the Health Consultation letter, the City released a news release saying a health hazard had been found. At this time and to this day, Mirant has met all regulatory standards. This was the beginning of the company's issues with ATSDR. We voluntarily use monitors that others do not use because they want to avoid detecting problems. We get good results from the monitors including SO<sub>2</sub> monitoring. We put the monitors where EPA told us to put them; we're not trying to have them in the wrong place. We are trying to work with everyone and their preconceived opinions. Mirant is looking for the facts and will fix problems identified by the facts; we are not looking to shut down the plant. The city has a resolution to shut down the plant and doesn't care if lights go out in the district. I try to show facts to make my arguments and the public may argue with emotions and doesn't listen to data and facts. We are regulated by EPA and believe ourselves to be in good standing if we follow EPA's guidance; our data shows we're ok; we are concerned about a standard other than EPA's. The public sees EPA and ATSDR as one entity (not one regulatory and one health/non-regulatory) and we don't want ATSDR's findings to be taken out of context.

**Dr. Konigsberg**

At some point, may I have time for a statement?

**Dr. Sinks**

We have scheduled time for that in the agenda.

**Ms. Raggio**

I'm talking about perception here; that drives management and decisions, it drives everything.

**Mr. Holmstead**

Dr. Sinks, perhaps Dr. Konigsberg should make his statement now.

**Dr. Konigsberg**

I am speaking on behalf of the Alexandria Health Department and Virginia Department of Health; these are not my personal comments. The original request for

ATSDR consultation came from me on behalf of the Alexandria Health Department; I consulted the Commonwealth of Virginia's Department of Health Commissioner and State Epidemiologist who concurred with the petition/request to ATSDR and asked me to handle the petition/request. When statements are made about "public health problems," I take interest and want to know the facts, data and science to back that up. We didn't have the resources to investigate this situation and that's why we requested ATSDR's involvement. I've worked with ATSDR through this process and coordinated public meetings. It's been 2.5 years since the original request and I would like to see resolution to this, keeping in mind it's not an easy request.

**Ms. Raggio**

My comments are as a company representative but are shaded by my personal experience.

**Mr. Holmstead**

This situation is unlike any I've seen, despite my tenure with EPA prior to this position. Any evidence will be used by plant opponents to try to shut down the plant (see court cases, mayor's speeches, city resolution). I felt your original letter was correct about what the concerns are and what they are not. We forwarded you the city's press release which takes your statements out of context to declare you found a serious health hazard. There are many examples of how this plant has been treated differently than any other plant (legislation, permits, etc). Decisions about this plant are fundamentally more political. We are eager to talk to you about our legitimate concern that anything you find can and will be misused. The city has rejected all of our proposed ways to improve air quality because the plant would still operate. Our specific concerns include how you characterize and what you say about the short-term health effects of SO<sub>2</sub> exposure. There is an extraordinary scientific process to create the EPA air quality criteria documents and they are going through this process for SO<sub>2</sub> again (last time in 1996/1997). It's a comprehensive review and reflects the best, most robust, science. These documents result in the national ambient air quality standards. EPA looked at the effects on asthmatics and people exercising in the 1990s and decided not to set short term national standards because the effects were transient and reversible. Shortly after that ATSDR published a Toxicological Profile for SO<sub>2</sub>, the reason why is unclear to us legally, because SO<sub>2</sub> isn't a priority chemical. In that Toxicological Profile, ATSDR suggested a lower health effects level than EPA's standards as well as a safe level.

**Dr. Sinks**

It's not a standard; it is a conservative "screening" level.

**Mr. Holmstead**

EPA voiced concerns that these levels were inappropriate and ATSDR did not respond to EPA. We can provide this correspondence to ATSDR in this meeting.

**Dr. Sinks**

We do have the discretion to go outside the priority chemicals list for our Toxicological Profiles as provided by law. If there are chemicals that people have health concerns about, we do have a role to play in evaluating the public's exposures to these chemicals. I wasn't with ATSDR when this Toxicological Profile was done so I don't know the specifics of choosing to do SO<sub>2</sub>.

**Mr. Holmstead**

We don't understand why ATSDR chose to do this when EPA had just done their process.

**Dr. Sinks**

EPA collaborates with us and will be involved in the review. We will take their suggestions seriously.

**Mr. Holmstead**

It will be important how the data are presented. EPA may be moving the level lower (to 500 ppb from 600ppb), but it will still be very different from 10 ppb (ATSDR's safe level). There is, to my knowledge, no other plant in the world that has done this level of monitoring of air quality.

**Ms. Raggio**

This monitoring was what we did for EPA to be comfortable with us running. We collaborated with EPA on this and put the monitors where EPA told us to. There aren't many plants as high profile as this one. The monitoring is showing no problems.

**Mr. Holmstead**

We are still seeing about six percent of our readings [for SO<sub>2</sub>] that are over 10 ppb, but below 600 ppb. The highest we've seen in places people could breath the air is about 400 ppb.

**Ms. Raggio**

We've addressed the problems with SO<sub>2</sub>. Another issue you raise is PM<sub>2.5</sub>, but our research shows that's not a problem. You also raise questions about metals.

**Mr. Holmstead**

We are concerned you are doing things that are not in your protocol, like modeling.

**Ms. Raggio**

What are you modeling?

**Mr. Holmstead**

Why are you modeling when the models don't work well here and we have monitoring data? It looks like you're trying to show that there is a problem.

**Dr. Fowler**

We intended to use modeling if we had hits at a station. We would use the meteorology to determine the whole area affected, not just at the station. We are not necessarily going to do modeling, but we might if called for.

**Dr. Sinks**

It would be in the report if it happened and peer reviewed and available for public comment. It would be supplemental information to assist us.

**Ms. Raggio**

We are concerned about meteorological modeling after the disconnect with the earlier modeling and our monitoring findings in this locale.

**Dr. Sinks**

We are probably more in agreement with you than you think. We are doing the exposure investigation because of concerns about monitoring sites not picking up everything. We saw a data gap and we're trying to plug it.

**Ms. Raggio**

We wanted the meeting because we don't know what you are doing. People are always confronting us that "ATSDR is coming out with data that will show health problems." Where is this coming from?

**Dr. Sinks**

It is possible our findings will be used to reinforce existing beliefs, whether we find something or not. Our results will be based on the science, not politics or expectations. We will work with our collaborators to get the science right and possibly learn to do this better. We are a small agency with a tight budget but we are doing extensive work here and trying to do our best and be objective and transparent.

**Dr. Konigsberg**

That is the reason I turned to ATSDR for assistance—they're objective, they're not paid for their perceptions. I turned to them not because I knew the answer but because I wanted to find out the answer. Part of my job is to separate the personal from the science, no matter what spin people put on it. I want the best science available, free from political influences.

**Ms. Raggio**

That's difficult when Congressman Moran calls you out about shutting down the plant in your appropriations hearing.

**Mr. Holmstead**

There was the appearance of a rush to get the protocol out to find high values and in that rush there were scientific concerns that weren't resolved. I've never seen a protocol that didn't identify the monitors' locations.

**Dr. Sinks**

They were withheld for privacy reasons.

**Mr. Holmstead**

But we're concerned they could be in the homes of people with agendas or in places with other air quality issues. We understand that Mirant is the most significant source of SO<sub>2</sub> concentrations in the area, but our position is that Mirant is not the primary source for the other things you're looking at (PM<sub>2.5</sub>, etc). The real issue is the secondary formation of other chemicals for the region. We know from our research that there is no possible way that the plant is a significant contributor to the metals. We're concerned how you will present the non SO<sub>2</sub> findings.

**Dr. Sinks**

You want us to be cautious about interpreting SO<sub>2</sub> levels, but even more cautious about the levels of the other chemicals because there are multiple sources for those chemicals.

**Ms. Raggio**

We are optimistic about merging our stacks internally this fall.

**Mr. Holmstead**

We need to provide some background about the stacks merger. Whenever you build an industrial source you need to worry about dispersal. About 20 years ago, there was concern about how tall stacks should be. Some facilities just built tall stacks as a solution. When this plant was built the airport led to low stacks. We tried to get a permit to build higher but the city said no. Now we're trying to make the stacks virtually higher through the stacks merger.

**Dr. Sinks**

When were the power plant and the high-rise next door built?

**Ms. Raggio**

The plant was built in the 1940s. The high-rise was built in the 1970s. Our levels are in compliance with our permits. Merging the stacks will significantly improve the ambient air quality making all of our past monitoring moot, as well as your monitoring.

**Dr. Sinks**

We've discussed how your changes will affect our data and we are open to additional sampling depending on our analysis of these data. If you make changes that improve the situation we will look to document that. We want to move this forward in a timely way but also make sure we are doing the best possible job and being transparent, which will delay the process.

**Ms. Raggio**

Again, we're looking for the facts and I think we're aligned on that.

**Mr. Ginsburg**

To summarize what I'm hearing: there's a confusing history and jumble of facts on this concern. I think that we're not in a position to say whether we agree or disagree with the study criteria. We provide feedback but we have different missions and mandates. There's been debate about potential health effects at levels lower than EPA's standards. In the absence of conclusions from the study, there are concerns about what people are doing with their uncertainty. Mirant is first and foremost subject to Virginia regulations. A large concern is how people are using information and the lack of information to inflame emotions. We want to pay attention to how we communicate about this study to address these concerns.

**Mr. Holmstead**

We welcome a good study because from our research we think we know what it will find. We are concerned about characterizing low levels of SO<sub>2</sub> as having a health effect. We support you in doing good science, but please be sensitive to how the information can be misused. We know more about how EPA works and their criteria and methods when it comes to respiration and want to be sure you are aware of some of these factors.

**Dr. Sinks**

Are their final comments from those around the table and on the phone?

*[None.]*

**Dr. Sinks**

Thank you for coming. This was a useful conversation. We will do the best job we can on the science and be very open to comments and criticisms about the science. All the issues you brought up, we are aware of already. If we don't get it right our reviewers will let us know. We are concerned about how information is used. We will be cognizant of that. We will call it as we see it.

**Dr. Bashor**

We are having our board of scientific counselors review our peer review process to evaluate and improve that process.

**Meeting Adjourned**

**Attachments**

1. Proposed Agenda
2. List of Attendees
3. Meetings with Stakeholders Guidelines
4. Letter from Lester Grant, EPA (provided by Mr. Holmstead)

Attachment 1: Proposed Agenda

**Mirant-ATSDR Meeting**  
**June 4, 2008, 11:00-12:30 pm**  
**ATSDR Headquarters**  
**Conference Room 5A, Bldg 106, 4770 Buford Highway, Chamblee, GA**

**AGENDA**

1. Introductions (Dr. Sinks)
2. Brief summary of ATSDR work at Mirant site, and future plans
3. Mirant Concerns:
  - a. Short -term Exposures to SO<sub>2</sub> -- Characterizing Effect Levels, Coordination with EPA
  - b. Other Pollutants -- Background vs. Po River Contribution
  - c. Process Concerns
    - i. Scope of Study
    - ii. Technical Issues
4. Around the Table
5. Closing Comments (Dr. Sinks)

## Attachment 2: List of Attendees

### **Mirant**

Debra L. Raggio, Vice President and Assistant General Counsel, Mirant Corporation  
Jeff Holmstead, Bracewell & Giuliani LLP (Mirant consultant)

### **NCEH/ATSDR**

#### **Office of the Director**

Dr. Tom Sinks, Deputy Director, NCEH/ATSDR  
Dr. Mark Bashor, Associate Director for Science  
Mike Groutt, Health Analyst, Office of Policy, Planning and Evaluation  
Dagny Olivares, Health Communication Specialist, Office of Communication

#### **Division of Health Assessment and Consultation (DHAC)**

Dr. William Cibulas, Director, DHAC  
Dr. David Fowler, Toxicologist  
Dr. Daphne Moffett, Associate Director for Science  
Susan Moore, Chief, Exposure Investigations & Site Assessment Branch

#### **Division of Regional Operations (DRO)**

Dr. Tina Forrester, Director, DRO  
Lora Siegmann Werner, Senior Regional Representative, ATSDR R3

### **CDC Office of General Counsel**

Mark Kashdan, CDC Office of General Counsel

### **EPA**

#### **Office of Air Quality Planning and Standards**

Eric Ginsburg, Senior Program Advisor, Sector Policies and Programs Division  
\*Dr. Michael Stewart, Environmental Protection Specialist, Office of Air Quality Planning and Standards, EPA  
\*Susan Stone, Environmental Health Scientist, Office of Air Quality Planning and Standards, EPA

#### **EPA Region 3**

\*Todd Ellsworth, Environmental Scientist, Air Quality Analysis Branch, Air Protection Division, EPA Region 3  
\*Denis Lohman, Meteorologist, retired, formerly EPA Region 3 Air Protection Division

### **Alexandria Health Department**

Dr. Charles Konigsberg, Health Director, Alexandria Health Department

*\* Attended by telephone*

## Attachment 3: Meetings with Stakeholders Guidelines

## Meetings with Stakeholders

- NCEH/ATSDR will accommodate meeting requests with stakeholders upon request but is not obligated to do so.
- The purpose is to listen, provide publicly available information without negotiating activities or engaging in scientific debate.
- Meetings may be held exclusively with the requesting party or others may be included as mutually agreed upon.
- NCEH/ATSDR cannot require a stakeholder to meet with another stakeholder present.
- Meetings are not confidential. Information shared by the outside party is subject to FOIA. Notes will be taken.



Attachment 4: Letter from Lester Grant, EPA (provided by Mr. Holmstead)

Set 11 ED Murray

# 84



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY  
NATIONAL CENTER FOR ENVIRONMENTAL ASSESSMENT  
RESEARCH TRIANGLE PARK, NC 27711

March 23, 1998

#84

OFFICE OF  
RESEARCH AND DEVELOPMENT

Dr. Selene Chou  
Division of Toxicology  
Agency for Toxic Substances and Disease Registry  
1600 Clifton Road, Mailstop E29  
Atlanta, GA 30333

Dear Dr. Chou:

We have enclosed comments on ATSDR's Toxicological Profile for Sulfur Dioxide. As discussed in a previous letter to you, we did not have time to provide comments to you prior to the stated deadline but have now completed our comments. Our main concern is with the calculation of the MRL and the selection of the LOAEL. As you can see from the attached comments, we do not think that the responses observed at the purported LOAEL actually constitute adverse health effects nor do we think that the use of uncertainty factors is appropriate for use with the extensive data on inhalation exposure to SO<sub>2</sub> in asthmatic subjects. We are also concerned with the inconsistencies between the Appendix worksheet and the main text of the document.

To support our comments, we have also enclosed copies of the two EPA documents which provide extensive discussion of the effects of SO<sub>2</sub> exposure in asthmatics. As you know, SO<sub>2</sub> is a "criteria" air pollutant and we at EPA have an important mandate to protect public health through the establish of air quality standards that have a strong scientific basis. However, we do not believe that the public interest is served by the calculation of a Minimal Risk Level, well below the ambient air quality standard, that ignores much of the scientific guidance provided to EPA. We hope that you will reconsider the calculation in light of these comments and the attached documentation.

2.14 Relevance to Public Health  
General Comment

Sincerely,

*L. D. Grant*

Lester D. Grant, Ph.D.  
Director  
National Center for Environmental  
Assessment - RTP (MD-52)

4 pgs +  
- 10 comments

Enclosure

U.S. EPA (NCEA/RTP) Comments on External Review Draft of ATSDR  
Toxicological Profile for Sulfur Dioxide

**Major Concern:** There is inappropriate use of uncertainty factors in the derivation of the Minimal Risk Level (MRL) and there are internal inconsistencies (within the draft document) in the manner in which this MRL is derived. The purpose of uncertainty factors is to provide a means of estimating a safe level when the data base is insufficient. Thus there are uncertainty factors for animal to human extrapolation, human variability and so on. In the study which was selected for the MRL estimation on Page 47 of the draft document, there are a number of important factors to consider. First, the study was conducted on asthmatics, who have been well established to be the most sensitive members (by a factor of 10) of the human population to SO<sub>2</sub>. There is an extensive data base for this information which is reviewed in EPA's Air Quality Criteria Document (AQCD) for Particulate Matter and Sulfur Oxides (1982) and its addenda and supplements (USEPA, 1986, 1994). Some of these references are also include in the present Toxicological Profile draft.

The following issues should be considered in relation to the MRL derivation:

1. Adversity of health effect: Is a small increase in airway resistance an adverse health effect? Increases of airway resistance of less than 4-5 cmH<sub>2</sub>O/l/s are trivial, probably imperceptible to the typical individual with asthma, and would not require any treatment. At a higher concentration of 0.25 ppm, also tested in the study cited as the basis for the MRL calculations (Sheppard et al., 1981), none of the seven subjects had any respiratory symptoms. To consider these small changes in response to exposure to 0.10 ppm (about 2.5 cm H<sub>2</sub>O / l / s estimated by graphic interpolation) as adverse is inappropriate. These changes are well within the range of changes in SR<sub>aw</sub> that asthmatics routinely experience on an everyday basis. These effects only occurred in the two most sensitive individuals selected from an already known sensitive population. The validity of the statistical technique for determining statistical significance for individuals is also open to question. Although 0.1 ppm may be the lowest detectable trivial health response, it should not be considered the LOAEL because it is not "adverse" and it does not deal with a group statistical effect such as Horstman et al (1988) where a more appropriate LOAEL for a group of asthmatics might be determined (the most sensitive subject responded at an estimated concentration of 0.28 ppm). EPA's Clean Air Scientific Advisory Committee, in a review of the 1994 supplement to the EPA PM/SO<sub>2</sub> Air Quality Criteria Document (AQCD), concluded that the small physiological changes observed in Sheppard's 1981 study and several other studies with similar physiological findings at higher concentrations did not constitute adverse health effects.

2.4 Reference to PH

Another important factor should be considered in the determination of adversity. Each subject in the Sheppard et al. (1980, 1981, 1983, 1984, etc.) studies breathed through a mouthpiece. This unnatural mode of breathing enhances the effect of SO<sub>2</sub> above and beyond that which occurs during normal oronasal breathing and artificially lowers the concentration at which responses are first measurable.

2. Use of uncertainty factors: In the description of the MRL within the body of the document (page 47), it is stated: "*The available data indicate that 0.1 ppm sulfur dioxide may be close to the threshold for bronchoconstriction and can be considered a minimal LOAEL. This concentration was divided by an uncertainty factor of 10 (3 for the use of a minimal LOAEL and 3 for human variability) to yield a calculated MRL of 0.01 ppm. The uncertainty factor of 3 for human variability was used since severe asthmatics are not examined in typical controlled human studies ... Severe asthmatics may be more responsive ...*" However, in the MRL worksheet (Appendix A), a minimal LOAEL of 0.25 ppm was selected and an uncertainty factor (UF) of 10 for human variability was applied, using the same rationale as above for the UF of 3. The review group chose to ignore several studies of asthmatics exposed to SO<sub>2</sub>, without mouthpiece breathing, that showed no effect of SO<sub>2</sub>, at 0.2 to 0.3 ppm. The apparent rationale was that in these studies, "subjects may have been preselected for sensitivity to sulfur dioxide." This, of course, would lower the LOEL rather than increase it and thus is an inappropriate basis to ignore these studies.

214  
In the selected study, subjects were drawn from a highly sensitive population. Asthmatics constitute approximately 5% of the population of the U.S. The MRL focuses on 2 of 7 individuals who were the most sensitive of this sensitive group. Thus the study is already dealing with the most sensitive members of the population and no further use of uncertainty factors is necessary. Additional research (Linn et al., 1990) which is cited in the Draft document bibliography but not in the text, and is discussed at length in EPA's 1994 Criteria Document Supplement indicates that severity of asthma is not a major uncertainty factor. Asthmatics with more severe disease have similar responses to SO<sub>2</sub> as do mild asthmatics. Thus it is our contention that no uncertainty factor should be applied for human variability. The statement that "0.1 ppm sulfur dioxide may be close to the threshold for bronchoconstriction" implies that there is some uncertainty that there may actually be effects at lower levels. There are several studies showing a NOEL with concentrations of 0.25 ppm and higher (Linn et al., 1983, 1984; Schachter et al., 1984; Roger et al., 1985; Sheppard et al., 1984). Thus to infer that a further uncertainty factor needs to be applied to this questionable "LOAEL" is wholly inappropriate.

In appendix A, Page A-5, the final paragraph concludes, "available data on asthmatics indicate that 0.25 ppm sulfur dioxide may be close to the threshold for changes in lung function in sensitive asthmatics. Therefore, 0.25 ppm can be considered a minimal LOAEL." Why, if this is the conclusion reached by the workgroup, was 0.1 ppm selected in the body of the document? The inconsistency of these two calculations and the questionable approach by which uncertainty factors are applied suggests that, in the main text of the document, the outcome of the workgroup deliberations is not accurately reflected. The recommendation of the workgroup for a minimal LOAEL of 0.25 ppm, although still not meeting criteria for adversity, is somewhat more reasonable.

2.4  
3. Significance of health effect

The responses observed by Sheppard et al. 1981 at 0.10 ppm, using (artificial) mouthpiece breathing are trivial. The changes in resistance are physiologically insignificant, are statistically insignificant for the group of subjects, and involve no symptoms (and are thus imperceptible to the individual). Thus they represent a measurable but trivial effect which is most certainly not adverse by any reasonable definition of the term.

Other Comments

\*\*\*Page 106: Table 7-1 indicates that the State of Florida has an 8-h standard for SO<sub>2</sub> of 50 µg/m<sup>3</sup>. This is in error. There is no 8-h standard. The 3-h standard in Florida (as per 62-204.240 Ambient Air Quality Standards, FL Dept. of Environ. Protection) is 1300 µg/m<sup>3</sup> or 0.5 ppm. The 24-h standard is 260 µg/m<sup>3</sup> or 0.10 ppm.

References

1. Second addendum to air quality criteria for particulate matter and sulfur oxides (1982): assessment of newly available health effects information. Research Triangle Park, NC: Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office; EPA report no. EPA-600/8-86-020F, 1986.
2. Supplement to the Second Addendum (1986) to air quality criteria for particulate matter and sulfur oxides (1982); assessment of new findings on sulfur dioxide acute exposure health effects in asthmatic individuals. Research Triangle Park, NC: National Center for Environmental Assessment; EPA report no. EPA-600/FP-93/002, 1994.