



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

August 26, 1983

OFFICE OF
THE ADMINISTRATOR

Honorable William D. Ruckelshaus
Administrator
Environmental Protection Agency
Washington, D.C. 20460

Dear Mr. Ruckelshaus:

The Clean Air Scientific Advisory Committee (CASAC) has completed its second and final review of the revised draft Office of Air Quality Planning and Standards (OAQPS) Staff Paper entitled Review of the National Ambient Air Quality Standards for Sulfur Oxides: Assessment of Scientific and Technical Information.

The document is consistent in all important aspects with the scientific evidence presented and interpreted in the combined criteria document for sulfur oxides and particulate matter. It has organized the data relevant to the establishment of sulfur dioxide primary and secondary ambient air quality standards in a logical and compelling way, and the Committee believes that it provides you with the kind and amount of technical guidance that will be needed to make appropriate decisions about revisions to the standards.

During the course of the Committee's review of the Staff Paper for Sulfur Oxides a number of significant scientific issues related to the establishment of primary and secondary standards were addressed. A review of the existing data base for this pollutant led the Committee to conclude that there are two scientifically supportable options for revising the existing standards. One option for which there is strong but not unanimous support on CASAC includes the following: establishment of a new 1-hour primary standard in the range between .25-.75 parts per million, retention of a 24-hour primary standard, conversion of the current .03 ppm annual primary standard to an annual secondary standard at or below that level, and selection of a revised 3-hour secondary standard between a range of .40-.50 ppm. The other option for which there is some support on the Committee is to retain the existing primary and secondary standards, while providing some additional public health protection by converting the existing 3-hour secondary standard into a primary standard. The choice between these options is a policy decision which is not within the scope of the Committee's mission. CASAC's wishes to inform you that either of these options would be supported by the available scientific evidence.

Other scientific issues and studies of interest to the review and possible revision of the primary and secondary standards are reviewed in the attached report. In addition, I have attached a recent CASAC report on research needs for the gases and particles program within the Agency. It is clear that there are major gaps in our understanding of these pollutants and that the Agency should develop a more balanced and more adequately funded research program.

I hope the CASAC's findings and recommendations prove useful to you as you review and consider revisions to the sulfur dioxide standards. The Committee appreciates the opportunity to advise you on this important issue, and it will provide further review and comment to you during the public comment period that follows the proposal of revised standards in the Federal Register.

Sincerely,



Bernard D. Goldstein, Chairman
Clean Air Scientific Advisory
Committee

Attachment

cc: Alvin Alm
Charles Elkins
Terry F. Yosie

Findings, Recommendations and Comments
of the Clean Air Scientific Advisory Committee on the
OAQPS Revised Draft Staff Paper for Sulfur Oxides

CASAC's evaluation of the scientific basis for a review and possible revision of the ambient air quality standards for sulfur dioxide began with its recommendation in November 1978 that the Agency evaluate the joint interaction of sulfur oxides and particulate matter on human health and the environment by the development of a joint criteria document for these pollutants. Following three public reviews of the criteria document and its subsequent revision by Agency staff, the Committee concluded in a letter to the Administrator dated January 29, 1982 that the Agency's assessment of the existing literature for these pollutants was scientifically adequate. This report addresses the OAQPS staff's interpretation of the criteria document and the scientific rationale that is developed to support their proposals for reviewing and revising the SO₂ standards.

The Scientific Basis for Primary SO₂ Standards

1. A major OAQPS conclusion of the criteria document review process was that sulfur dioxide continued to pose a serious health problem to important subgroups of the population which warranted its continued separate control. Thus, OAQPS does not recommend a joint SO₂/particles primary standard, believing that current information on health effects and U.S. exposures to these two pollutant categories warrants a continuation of separate controls.

CASAC concludes that separate SO₂ and particles standards, each set with appropriate consideration for potential interactions, does appear to protect public health. Furthermore, the complexities of setting and implementing a joint SO₂/particles standards through monitoring and other requirements create numerous uncertainties which the available scientific evidence is ill-equipped to resolve. CASAC concurs with the OAQPS position and its supporting rationale and recommends that you retain the current approach of setting separate primary and secondary standards for sulfur dioxide and particulate matter.

2. The scientific basis for a 24-hour standard stems primarily from epidemiological studies. These studies (Lawther et al. 1970 [analysis of bronchitics]; Martin and Bradley, 1960, Mazumdar et al., 1981, and Ware et al., 1981 [analysis of mortality]) do not show evidence of clear thresholds, but they suggest that risk to public health increases as concentration levels increase. The Air Quality Criteria Document for Sulfur Oxides/Particulate Matter and the SO₂ staff paper interpret these studies as suggesting that increases in excess mortality occurred in the range of 500-1000 ug/m³ British Smoke and .19-.38 ppm SO₂, and that such effects are most likely when both pollutants exceeded 750 ug/m³ (.29 ppm SO₂). Lawther's study of reported symptoms among bronchitics also suggests that this population group experiences significant responses associated with 24-hour averages of .19 ppm SO₂. Based

upon these studies and the need for a margin of safety the staff paper developed a range of interest between .14 to .19 ppm in recommending a revised 24-hour primary SO₂ standard.

The upper end of the recommended range of .14 to .19 ppm represents a level at which effects are identified in the criteria document and for which there is little or no margin of safety for exposed sensitive individuals. You should be aware that the ranges of interest developed in the staff paper for the 24-hour standard were based on epidemiological studies which provided quantitative concentration/response data of the populations studied. A final decision on whether or not to revise the 24-hour standard should also incorporate information generated through controlled human, animal toxicology and the less quantitative epidemiology studies discussed in the criteria document and staff paper. In view of all of the above, CASAC recommends that you consider selecting a value at the lower end of the range for the 24-hour standard, taking into account whether a separate 1-hour primary standard is also established.

3. CASAC's review of the scientific evidence related to the annual primary standard presents a dilemma because the Committee could find no real quantitative basis for retaining this standard. This is a troublesome issue because there is the possibility that repeated SO₂ peaks of 1-hour and 24-hour exposures might lead to effects on human respiratory systems

over the long-term. Second, an annual primary standard affords protection against health effects that can't be measured well in short-term controlled human studies. Third, air quality analysis conducted by OAQPS staff suggests that 1-hour and 24-hour primary standards in the range stated in the staff paper would not prevent SO₂ concentrations from exceeding the current annual primary standard in some heavily populated areas of the country. Fourth, as pointed out in the discussion of secondary standards, there is a scientific basis for a secondary standard at the level of the annual current primary standard. Following extended discussion the Committee concluded that some protection against chronic SO₂ exposures is needed, but that the most persuasive scientific basis for an annual standard is found in the effects on welfare.

4. The scientific basis for the development of a 1-hour primary standard rests largely on several major controlled human clinical studies conducted by three separate laboratories that were published in the peer reviewed literature in 1981 and 1982. These studies documented measurable changes in respiratory function of exercising asthmatics exposed for short periods at or below concentration levels of .50 parts per million (ppm). The studies (Kirkpatrick et al. 1982; Koenig et al. 1982; Linn et al. 1982; and Sheppard et al. 1981) raise

the issue of how adequately the existing primary standards are protecting public health and provide a scientific basis for a 1-hour primary standard that provides additional protection against such reported short-term effects.

The OAQPS staff, after reviewing this data, proposed consideration of a 1-hour primary standard in the range between .50 to .75 ppm. The staff noted that the lower end of the range represented the lowest level where potentially significant responses in asthmatics have been observed with oronasal breathing, and that the upper bound of the range represented levels at which the risk of significant functional and symptomatic responses in exposed asthmatics and other sensitive groups appeared high.

CASAC has evaluated the OAQPS staff position that resulted in the establishment of the range of interest at .50-.75 ppm. The staff suggest that there may be little or no margin of safety at the upper bound of the range. Air quality analyses conducted by OAQPS also indicate that a 1-hour standard selected from within the range would still permit exposures in excess of one to two ppm during the peak five or ten minute intervals. A related point is that establishment of a 24-hour standard in the range of .14-.19 ppm would not necessarily protect against shorter term peaks above the proposed 1-hour range of .50-.75 ppm. This information suggests that a 1-hour primary standard selected between .50-.75 ppm range might

not adequately protect sensitive populations with an adequate margin of safety from the effects acknowledged in the staff paper that would occur as a result of brief peak exposures to concentrations greater than the .50-.75 ppm hourly average that a 1-hour standard would permit. Because five to ten minute peaks can reach levels as much as two or more times the 1-hour average, CASAC recommends that the range be modified to state the lower bound at .25 ppm.

In reviewing the issue of whether to establish a 1-hour primary standard between .25-.75 ppm several additional factors should be considered. These include 1) it is not clear that the reported effects experienced at or below .50 ppm are significant. The functional changes and symptoms reported in the .50-.75 ppm range appear to be reversible. You will need to determine which effects you consider to be adverse; 2) it is probable that some asthmatics are more sensitive than those who took part in the studies; 3) given current air quality conditions there is a low probability of exposure to exercising asthmatics at peak concentration levels; and 4) as the staff paper suggests, other stimuli interacting with SO₂, such as temperature and humidity, may increase the risk of an attack to exercising asthmatics more than either of these factors acting alone.

The Scientific Basis for Secondary SO₂ Standards

The kinds of effects reviewed by CASAC in relation to the establishment of secondary ambient air quality standards include those on vegetation, materials, and acidic deposition.

1. Current scientific information documents effects on vegetation resulting from both short-term and long-term exposures to SO₂ and/or SO₂ in combination with other pollutants. One should keep in mind that there is no single concentration at which all species of plants are injured, just as there is not single point or threshold at which all humans suffer significant effects from SO₂. What is at issue in the development of secondary standards is the need to protect sensitive vegetative species from effects such as physiological and biochemical changes, foliar injury, and reduced growth and yield. The available studies of SO₂ effects on vegetation represent approximately one percent of total plant species, but they include such important species as soybeans, barley, and white pine, to name a few.

An issue of increasing concern in the protection of vegetation is that SO₂ is not present alone in the ambient air except at a few isolated point sources. It almost invariably occurs in the presence of other pollutants, primarily nitrogen oxides and ozone. The scientific evidence is conclusive that the combination of such pollutants is more damaging to vegetation than the presence of SO₂ alone.

The staff paper recommends consideration of a 3-hour standard at or below the current secondary standard level of .50 ppm to protect vegetation. Although there are reports in the literature concerning plant injury at .10 to .20 ppm averaged over several hours, there are great uncertainties associated with the effects of the exposures at these lower levels. The existing data on the acute effects of SO₂ on vegetation suggest to CASAC that a concentration limit selected within a range of .40 to .50 ppm for a 3-hour period would provide adequate protection to sensitive vegetative species.

The review of longer term effects on plants was hampered by a very limited data base, thus making it difficult to distinguish whether such effects resulted from chronic lower-level exposures or a series of shorter-term peak exposures. Available data do suggest, however, that changes in species diversity and reduced growth in vascular plants are effects that may occur over the long term. In addition, non-vascular plants, particularly lichens and mosses, are affected by SO₂ during prolonged periods of exposure. On the basis of scientific work conducted to date, CASAC concurs with the OAQPS staff recommendation that an annual secondary standard at or below .03 ppm (a level equivalent to the existing annual primary SO₂ standard) would afford adequate protection to vascular plant vegetation. The basis for concern over effects

in non-vascular plants at lower levels needs to be strengthened. CASAC also agrees with the staff proposal to address this issue in the context of later action on fine particles and acidic deposition.

2. The action of SO₂ alone or in combination with other pollutants has been associated with a number of damages to building materials, corrosion of ferrous and non-ferrous structures, and impairment of other goods and materials.

OAQPS staff have reviewed the evidence documenting materials damage from SO₂. These effects are responsible for economically significant losses which have been adequately summarized in both the criteria document and the staff paper. Analyses of existing air quality data by OAQPS indicate that continued protection against SO₂-induced materials damage is needed, and toward that end, the staff paper recommends consideration of a long-term SO₂ standard at or below the level of the existing annual primary standard (.03 ppm). CASAC concurs with the staff recommendation.

3. Throughout its review of both the Air Quality Criteria Document for Sulfur Oxides/Particulate Matter and the Staff Paper for Sulfur Oxides, CASAC has recognized the complexity of the acidic deposition problem. Since SO₂ is only one of the

precursor pollutants that lead to the formation of acidic deposition, CASAC recommended in August 1980 that EPA prepare a separate Critical Assessment Document that recognizes and incorporates information on causes, effects and data bases for all of the various pollutants relevant to acidic deposition. This CASAC recommendation was accepted by two previous Administrators, Douglas Costle and Anne Burford, and the assessment document should be available for CASAC review in the near future. At that time the Committee will be in a position to provide a more comprehensive and critical assessment of the acidic deposition problem.

Re-affirmation of the Existing Primary and Secondary Standards

Throughout its review of the staff paper, CASAC recognizes that large uncertainties exist in the data that support development of the options for setting the standards discussed in the previous pages. Given these uncertainties CASAC discussed the extent to which the existing standards provide adequate protection to the public health. The Committee recognizes the substantial improvements in air quality that have occurred since the 1971 promulgation of the primary SO₂ standards. In addition, more information on the effects of the short-term SO₂ exposures should become available in the peer reviewed literature in the next few years. Air quality modeling analyses also suggest that attainment of the proposed 24-hour and annual standards would not ensure complete

attainment of the proposed 1-hour primary standard at all sites within the ranges of interest stated. The reverse also appears to be true.

CASAC's evaluation of the scientific evidence associated with existing averaging times in the staff paper leads the Committee to conclude that continuation of the existing primary and secondary standards also provides protection against the effects identified in the criteria document and staff paper from SO₂ at ground level. If you choose to follow this option some CASAC members suggest that additional health protection can be obtained by converting the existing 3-hour secondary standard into a primary standard. A principal argument supporting the latter is that since the states are already implementing a 3-hour secondary standard, conversion to a 3-hour primary standard would not be impractical. In summary, in view of the many uncertainties that pertain to the review of the SO₂ standards, retention of the existing set of primary and secondary SO₂ standards is an option that you ought to seriously consider at the present time.

Conclusion

CASAC recognizes that your statutory responsibility to set standards requires public health policy judgments in addition to determinations of a strictly scientific nature. The submission of this closure letter completes the Committee's

scientific assessment of this pollutant and we see no need to provide any additional formal comments on the standards prior to their proposal in the Federal Register. The public comment period will then provide sufficient opportunity for the Committee to provide any additional comment or review that may be necessary.