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

October 9, 1979

OFFICE OF THE ADMINISTRATOR

SUBJECT: Findings, Recommendations, and Comments of the Subcommittee on Carbon Monoxide of the Clean Air Scientific Advisory Committee (CASAC) Concerning the Revised Criteria Document for Carbon Monoxide

FROM: Harry H. Hovey, Jr.
Chairman, Subcommittee on Carbon Monoxide

THRU: Sheldon K. Friedlander
Chairman, Clean Air Scientific Advisory Committee

TO: The Administrator

Introduction

The Clean Air Act Amendments of 1977 directed the Agency to establish an independent scientific review committee to complete a review of the criteria published under Section 108 and the national primary and secondary ambient air quality standards promulgated under Section 109. Pursuant to this requirement, the Agency chartered the Clean Air Scientific Advisory Committee of the Science Advisory Board (SAB).

On June 14-15, 1979, a subcommittee of CASAC completed its review of two documents that address the major scientific issues associated with exposure to CO. These documents were: 1) the Air Quality Criteria Document for Carbon Monoxide, and 2) a Preliminary Assessment of Adverse Health Effects from Carbon Monoxide and Implications for Possible Modifications of the Standard (referred to henceforth as Adverse Health Effects memorandum). The purpose of this memorandum is to summarize the major findings, recommendations, and comments provided by the subcommittee to assist you in reviewing the data necessary for proposing an ambient air quality standard for carbon monoxide as required by law.

Major Issues Pertaining to the Criteria Document

Five major issues pertaining to the CO criteria document were discussed by subcommittee members. These issues include:

1. Does the criteria document adequately identify, discuss, and evaluate the critical health studies for CO?

2. Does the document address and assess in sufficient detail the methodologies for measuring CO?

3. Does the document adequately identify exposure conditions for the population as can best be ascertained from presently available information?

4. Does the criteria document adequately address and evaluate the global cycle of carbon monoxide?

5. Does the criteria document fulfull the requirements of law set forth in Section 108 of the Clean Air Act Amendments of 1977?

ISSUE #1: Identification, Discussion, and Evaluation of Critical Health Studies for CO.

In general, the subcommittee concluded that the criteria document represents a comprehensive and balanced presentation and interpretation of the information contained within the literature of critical health studies for carbon monoxide. Specific comments were made in relation to the role and importance the Agency should attribute to particular studies and to related health issues. Those studies and issues of a major concern to the subcommittee included:

- the role of the 1978 Aronow study on passive smoking

Evaluation of the Aronow study was discussed within the context of relating critical levels of blood carboxyhemoglobin (COHb) to adverse health effects. Specifically, the subcommittee was requested to advise whether Aronow's conclusion that a concentration of 1.8% COHb produced aggravation of angina pectoris should be relied upon by the Agency in determining the threshold level for adverse health effects. In addressing this question, subcommittee members commented upon the methodology of the Aronow study. In measuring COHb levels in patients seated in an enclosed room, Aronow did not account for individuals who were smoking; consequently, he did not measure and did not account for other components of cigarette smoke in the air. The health effects of CO exposure alone upon COHb levels of the patients, therefore, is in doubt. The conditions of this study, as well as Aronow's 1972 freeway study, raise but do not resolve the issue of whether there are interactions or synergisms between CO and other pollutants. The subcommittee recommended, however, that the Agency retain the use of the 1978 Aronow study in considering adverse effects.

o populations at risk

The subcommittee concluded that the criteria document adequately identifies the sensitive population groups at risk from ambient CO concentrations. The subcommittee recommended that members of the smoking population not be listed as a sensitive group which a proposed standard would be specially designed to protect.

ISSUE #2: Methodologies for Measuring CO

The subcommittee concurred that the criteria document adequately addresses and evaluates in sufficient detail the models for measurement of carbon monoxide in the air and in the blood. Individual members did suggest, however, that some minor editorial or clarifying statements be incorporated that pertain to measurement procedures and detectable levels of CO.

ISSUE #3: Identification of the Exposure Conditions for the Population Based upon Existing Information

The subcommittee concluded that, based upon existing information, the criteria document contains the most practicable analyses in identifying and assessing population exposure conditions from CO, but it observed that the paucity of such information limits a more precise understanding of health effects that occur at ambient levels of CO. Pursuant to addressing this problem of insufficient data, the subcommittee made the following comments: (1) an apparent contradiction exists between measured CO levels in cities and overall emission levels. In urban areas, where monitoring stations are located, measured levels of ambient CO has shown a decreasing trend. On a nationwide scale, however, CO emissions continue to increase due to the greater number of aggregrate vehicle miles traveled. The criteria document should address this issue. (2) CO concentrations represent a health concern chiefly to population groups residing in cities. Most available data utilized by the Agency, however, project nationwide CO concentrations. Consequently, there is a need to obtain a better profile within specific urban areas, at the neighborhood or street level, to assess the health effects of CO exposures at such "hotspots." The subcommittee recommended that the Agency devote increased resources in the future to attain such profile improvements in order to obtain a more realistic scientific appraisal of urban CO exposures. (3) the criteria document should place a greater emphasis upon the problem identified in item 2 above, and (4) a section on exposure concentrations resulting from cigarette smoking should be included within the criteria document.

ISSUE #4: Global Cycle of Carbon Monoxide

The subcommittee concluded with a unanimous consensus that the criteria document adequately addresses, presents, and interprets information concerning the various sources and sinks of CO in the global atmosphere.

ISSUE #5: Fulfilling the Requirements of Section 108 of the Clean Air Act Amendments of 1977

Section 108 of the Clean Air Act Amendments requires the Agency to establish national primary and secondary ambient air quality standards for air pollutants based upon air quality criteria that "shall 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 such pollutant in the ambient air, in varying quantities. The criteria for an air pollutant, to the extent practicable, shall include information on:

(A) those variable factors (including atmospheric conditions) which of themselves or in combination with other factors may alter the effects on public health or welfare of such air pollutant;

(B) the types of air pollutants which, when present in the atmosphere, may interact with such pollutant to produce an adverse effect on public health or welfare; and

(C) any known or anticipated adverse effects on welfare."

The subcommittee, after reviewing the scientific information as identified, discussed, and evaluated in the criteria document for carbon monoxide, and after receiving a reading of Section 108 of the Clean Air Act Amendments, reached a consensus that the criteria document adequately fulfills the requirements of law.

Major Issues Pertaining to the Adverse Health Effects Memorandum

The subcommittee addressed a number of issues that will influence a proposed ambient air quality standard for carbon monoxide. The issues addressed and the recommendations include the following:

- the role of the 1978 Aronow study in standard setting. The subcommittee recommended that the Agency should continue to rely upon the Aronow study in developing an ambient CO standard but, given the uncertainties stemming from the methodological approach, it should utilize the

study for margin of safety considerations rather than using it for the determination of a threshold value.

- the subcommittee discussed a range of COHb concentration levels addressed in the criteria document. A majority consensus was reached that: 1) aggravation of angina pectoris represents an adverse health effect, and 2) the critical COHb level at which adverse health effects do occur falls within a range of 2.7% - 3.0% COHb. One member of the subcommittee dissented from this finding and advised that the critical level was reached at approximately 4.0% COHb.

- the available health effects evidence indicates that the population groups at greatest risk to low level CO exposures include coronary artery and peripheral vascular disease individuals.

- the principal mechanism of toxicity for standard setting purposes at this time is hypoxemia.

- the Coburn model provides the best availabe tool for predicting COHb levels resulting from CO exposures.

- the findings of animal studies suggest that CO produces detrimental effects on human fetal development. This evidence relates primarily to animal studies showing that the developing fetus is exposed to COHb concentrations considerably higher than the pregnant mother for long-term CO exposures. However, such findings cannot be extrapolated directly to identify specific human effects levels.

- the one hour and the eight hour averaging times in the current ambient standard for CO should be retained because they provide an appropriate time frame from which to evaluate health effects from both short-term and continuous exposures, respectively. In particular, the one and eight hour standards provide reasonable protection against the bolus effect (high spikes of short duration) in the urban ambient environment.

- the reduced O_2 pressure at higher altitudes can result in hypoxemia that may interact with the effect of CO exposures upon persons with impaired cardiovascular systems. The key issue of concern is adaptability. While a healthy young person might adapt to hypoxic stress, for example, an elderly person with coronary disease might be adversely affected. The possible

adverse effects on non-adaptable population groups should be considered in selecting an adequate margin of safety for the proposed CO standard.

Minority Report

As part of the working procedures adopted by the Clean Air Scientific Advisory Committee, individual members may submit a minority report to address those major issues or problems which they believe remain unanswered or unresolved within the criteria document.

The subcommittee on Carbon Monoxide achieved consensus on each of the five major issues listed above, but such consensus was not always unanimous. Dr. Domingo Aviado has participated in both reviews of the criteria document and believes that major scientific problems remain to be resolved before it can be used as a scientific basis for proposing an ambient air quality standard for carbon monoxide. His report is appended to the report of the subcommittee.

Minority Report by Domingo M. Aviado

This member of CASAC would like to file an objection to the final subcommittee report because the Criteria Document on Carbon Monoxide has failed to place in proper perspective the observations on exercising subjects. Results from only a few subjects, suggesting that exposure to carboxyhemoglobin levels as low as 1.8 to 3.0% for less than one hour can influence the heart, cannot be used to determine the threshold for adverse effects. Animal studies of daily exposure to carbon monoxide for several hours or even up to 24 hours daily for weeks or months indicate that there are no adverse cardiovascular effects with 5.0% carboxyhemoglobin saturation.

Almost all of my written suggestions (7 pages and 13 pages) have been rejected by the staff responsible for the Criteria Document. I am not contesting this because our group is entirely advisory in nature. However, the Criteria Document of Staff Paper might include a quotation from the National Academy of Sciences Report on Carbon Monoxide on the significance of the exercise studies:

"If the results of the clinical studies are applicable to this large population at risk, then a major public health problem exists. Taking the current results at face value suggests only that, when patients with angina are exposed to low carbon monoxide concentrations for short periods, they cannot exercise as long on a bicycle or treadmill before developing chest pain as those breathing compressed air. There is no evidence from these results that the exposure to carbon monoxide increases the frequency and severity of chest pain or the development of other complications or that it shortens life expectancy among patients with angina pectoris or other clinical manifestations of heart disease. We can only infer the existence of such a relationship."

There are other portions of the National Academy of Science Report which would be helpful in the preparation of the Staff Paper, particularly the determination that 4.0 or 5.0% carboxyhemoglobin is the threshold for adverse effect on human health.

DMA, 8/6/79

Additional Information on Exercise Testing

The subcommittee on Carbon Monoxide has not been able to discuss the merits and limitations of exercise testing. It should be noted that exercise testing has never been applied to determine exaggeration of a disease process, other than by two groups of investigators working on carbon monoxide. The article by Weiner et al and accompanying Editorial in the August 2, 1979, issue of The New England Journal of Medicine are noteworthy because they discuss the limitations of exercise testing. Please note that the concluding paragraph by Epstein of the National Heart, Lung, and Blood Institute does not mention any application of exercise testing in evaluation of increasing severity of angina:

"Finally, although the results of the Coronary Artery Surgery Study and related studies focus on the limitations of exercise testing as a diagnostic tool in the detection of coronary-artery disease, they do not obviate the important use of stress testing in many other contexts. Exercise testing can elicit arrhythmias that may help to explain unusual exercise-related symptoms and thereby influence the choice of therapy. Observation of the patient during exercise can often elucidate otherwise ambiguous symptoms, as well as