United States
Environmental Protection
Agency

Office of the Administrator
Science Advisory Board
Washington, DC 20460

EPA-SAB-CASAC-89-018
April 1989

Report of the Clean Air Scientific Advisory Committee (CASAC)

Review of the Lead NAAQS Exposure Analysis Methodology and Validation

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D C 20460

April 27, 1989

OFFICE OF
THE ADMINISTRATOR

The Honorable William Reilly
Administrator
U.S. Environmental Protection Agency
401 M Street, SW
Washington, DC 20460

Dear Mr. Reilly:

We are pleased to transmit via this letter the advice of the Clean Air Scientific Advisory Committee (CASAC) concerning its review of the EPA document "Review of the National Ambient Air Quality Standards for Lead: Exposure Analysis Methodology and Validation" (August 1988).

This document was reviewed by the Lead Exposure Subcommittee of CASAC on October 25, 1988. It was the unanimous consensus of the Subcommittee that the document is scientifically adequate for use in the standard setting process for lead as an ambient air pollutant. The CASAC hereby endorses the report of its Subcommittee. A detailed presentation of our views are contained in the attached report.

We appreciate the opportunity to provide advice on this important issue. Further advice concerning the lead national ambient air quality standards will be contained in our closure letter on the Lead Staff Paper.

Sincerely,

Timothy Larson

Timothy Larson
Chairman, Lead Exposure
Subcommittee

Roger O. McClellan

Roger O. McClellan
Chairman, Clean Air Scientific
Advisory Committee

ABSTRACT

This report presents the views of the EPA's Clean Air Scientific Advisory Committee on its review of the Agency's document entitled: "Review of the National Ambient Air Quality Standards for Lead: Exposure Analysis Methodology and Validation". The Committee concurred with the general modeling framework presented in the report and endorsed the use of the biokinetic model in children under six years of age, and the use of the disaggregate approach in adults. The Committee cautioned that these modeling predictions were not valid for pregnant women and their fetuses due to a lack of information on this subpopulation. The use of the biokinetic model for metals other than lead was not recommended.

NOTICE

This report has been written as part of the activities of the Science Advisory Board, a public advisory group providing extramural scientific information and advice to the Administrator and other officials of the Environmental Protection Agency. The Board is structured to provide a balanced expert assessment of scientific matters related to problems facing the Agency. This report has not been reviewed for approval by the Agency; and, hence, the contents of this report do not necessarily represent the views and policies of the Environmental Protection Agency or other agencies in the Federal Government. Mention of trade names or commercial products does not constitute a recommendation for use.

U. S. Environmental Protection Agency
Science Advisory Board
Clean Air Scientific Advisory Committee

LEAD EXPOSURE SUBCOMMITTEE

Chairman

Dr. Timothy Larson, Environmental Engineering and Science Program, Department of Civil Engineering, University of Washington, Seattle, Washington

Members

Dr. J. Julian Chisolm, Jr., Associate Professor, Johns Hopkins School of Medicine, Francis Scott Key Medical Center, Baltimore, Maryland

Dr. Scott Clark, Professor of Environmental Health, Department of Environmental Health, University of Cincinnati Medical Center, Cincinnati, Ohio

Dr. Ian von Lindern, President, Terragraphics Environmental Engineering, Moscow, Idaho

Dr. Kathryn R. Mahaffey, Science Advisor, Office of the Director, NIEHS, University of Cincinnati Medical Center, Cincinnati, Ohio

Dr. M. Granger Morgan, Head, Department of Engineering and Public Policy, Carnegie Mellon University, Pittsburgh, Pennsylvania

Dr. Paul Mushak, Consultant and Adjunct Professor, University of North Carolina, Durham, North Carolina

Dr. Michael B. Rabinowitz, Investigator, Marine Biological Laboratory, Woods Hole, Massachusetts

Dr. Robert D. Rowe, Senior Vice President, RCG/Hagler, Bailly Inc., Boulder, Colorado

Executive Secretary

Mr. A. Robert Flaak, Environmental Scientist, Science Advisory Board (A-101F), U.S. Environmental Protection Agency, 401 M Street, SW, Washington, DC 20460

U.S. ENVIRONMENTAL PROTECTION AGENCY
SCIENCE ADVISORY BOARD

CLEAN AIR SCIENTIFIC ADVISORY COMMITTEE

Chairman

Dr. Roger O. McClellan, President, Chemical Industry Institute of Toxicology, Research Triangle Park, North Carolina

Members

Dr. Timothy Larson, Environmental Engineering and Science Program, Department of Civil Engineering, University of Washington, Seattle, Washington

Dr. Gilbert S. Omenn, Professor of Medicine and of Environmental Health, Dean, School of Public Health and Community Medicine, University of Washington, Seattle, Washington

Dr. Marc B. Schenker, Director, Occupational and Environmental Health Unit, University of California, Davis, California

Dr. Mark J. Utell, Professor of Medicine and Toxicology, Co-Director, Pulmonary Disease Unit, University of Rochester School of Medicine, Rochester, New York

Dr. Jerome J. Wesolowski, Chief, Air and Industrial Hygiene Laboratory, California Department of Health, Berkeley, California

Dr. George T. Wolff, Principal Scientist, General Motors Research Labs, Environmental Science Department, Warren, Michigan

Executive Secretary

Mr. A. Robert Flaak, Environmental Scientist, Science Advisory Board (A-101F), U.S. Environmental Protection Agency, 401 M Street, SW, Washington, D.C. 20460

REPORT OF THE CLEAN AIR SCIENTIFIC ADVISORY COMMITTEE
ON ITS REVIEW OF
"REVIEW OF THE NATIONAL AMBIENT AIR QUALITY STANDARDS FOR LEAD:
EXPOSURE ANALYSIS METHODOLOGY AND VALIDATION"

With the dramatic decline in the emissions of lead from mobile sources, there has been increased interest in airborne lead near stationary sources. Given a proposed change in lead concentrations near stationary sources due to reduced emissions, will there be predictable changes in blood lead levels in the surrounding population? Exposure models are currently the only practical tool that can address this question within the framework of the national ambient air quality standard (NAAQS) setting process. The scientific framework for such modeling is the basis of the document reviewed by the Clean Air Scientific Advisory Committee's (CASAC) Lead Exposure Subcommittee. In addition to discussing various modeling approaches, the document also presents several validation studies in order to compare these modeling approaches with actual observations of blood lead levels near several point sources of lead. It was the unanimous consensus of this Subcommittee that the document is scientifically adequate and that the EPA staff's proposed changes to the document discussed at the meeting appropriately address the written comments of the Subcommittee members. The Clean Air Scientific Advisory Committee (CASAC) hereby endorses this report of its Lead Exposure Subcommittee.

The validation studies presented convincing evidence for a decrease in blood lead levels with increasing distance (out to several kilometers) from a point source. The Subcommittee agreed with the conclusion that any attempt to predict blood lead levels must include all the important exposure pathways and that the direct inhalation route of airborne lead is a relatively minor pathway in children. The validation studies also provided additional information on the lead levels of other important exposure media, including soil, house dust, food and water. Therefore, these studies provide a unique opportunity to test the ability of various exposure/uptake models to predict mean values of blood lead from various routes of exposure. Blood lead levels were predicted using both a disaggregate approach as well as a biokinetic approach. The Subcommittee recognized that several of the inputs to the exposure models are uncertain, but felt that this uncertainty was adequately recognized in the document. More important, the Subcommittee concurred with the general modeling framework and endorsed the use of the biokinetic model in children under six years of age and the use of the disaggregate approach in adults. The Subcommittee also strongly emphasized that these modeling predictions were not valid for pregnant women and their fetuses due to a lack of information on this potentially important subpopulation. The Subcommittee also recommended that the exposure model outputs include not only the predicted mean blood lead levels as a function of downwind distance but also the

corresponding lead levels in all exposure media including air, soil, dust, food and water. These outputs would provide an additional basis for evaluating model performance.

Given a predicted mean blood lead level, another important component of the exposure model is the prediction of maximum blood lead levels in exposed individuals. EPA's approach is to use empirical estimates of the variance of blood lead levels in the general population, as well as those in populations living near lead point sources, as a predictor of peak to mean values. The document correctly recognized that the population variance estimates depend on many different factors (e.g., biological, climatic, behavioral) that exposure modeling cannot fully capture at this time. Given the uncertainties, the Subcommittee agreed that the only reasonable assumption is to use the range of variance estimates from the empirical data. However, because this is a sensitive parameter, we felt the additional concern that as blood lead levels continue to decrease in the future, the assumption of a constant proportional variance (log-normality assumption) may be compromised by analytical uncertainties in the measurement of blood lead, but the Subcommittee felt that this issue was adequately addressed in the document.

The Subcommittee felt very strongly that the results of this modeling exercise not be taken out of context. For example, because the available data on lead in drinking water for the validation studies was limited, the biokinetic model in this application was used to calculate average drinking water exposures over time. However, the biokinetic model is sensitive to total intake from this route and can account for variations in water lead exposure where appropriate data are available. While the model can be used now to evaluate relative changes in blood lead levels from changes in water lead levels, it has not been calibrated for absolute assessments of risk from drinking water in the same way as done for other routes of exposure. Use of the model for other metals was also not recommended at this time. In addition, although the Subcommittee agreed that an appropriate application of this approach might be for prediction of offsite lead exposures from fugitive dust emissions, there was concern that until non-linearities in the relationship between lead exposure and blood lead are incorporated into the model, the model be limited to use in areas where soil lead levels do not exceed 4000 ppm. In addition, the model should not be used in areas where ingestion (pica) of paint fragments is an important route of intake because this variable was not considered in the case study validation. Finally, the biokinetic model should not be used for predicting adult blood lead levels at this time due to limited data regarding historical exposures and the possible confounding factor of blood lead coming from bone.

The Subcommittee was also asked for guidance on several technical issues that are summarized below. As to the range of

dirt ingestion rates used in the report (55-135 mg/day depending on age), the Subcommittee agreed that this is a relatively poorly defined parameter subject to climatic variations. Some members felt that the value of 100 mg/day represented an upper limit for a high risk child, whereas others felt that the use of the Binder et al. and Clausing et al. studies was as good a choice as any until further data are available. All members agreed that this is an important parameter in determining total intake and that the uncertainties have been adequately discussed in the document. In this regard, there was agreement that the emphasis in future research should focus on the lead levels in the surface layer of the soil and not on the older, deeper layers. There was general agreement that the model use a constant soil lead level in predicting future scenarios, but that the house dust component should track the air lead value. Finally, the approach of interfacing the biokinetic and disaggregate models for intermediate age groups was judged acceptable by the Subcommittee in the absence of any other available information to the contrary.