

State of California  
AIR RESOURCES BOARD

Research Proposals

Research Division

November 15, 2001



## INTRODUCTION

Contained herein for Board review are two resolutions and accompanying summaries from the Extramural Research Program recommended to the Board by the Research Screening Committee.

Item 1 is a research proposal from the University of California, Los Angeles, entitled, "Development and Application of Ambient Aerosol Concentrators to Conduct Health Effects Studies in the Los Angeles Basin". The principal investigator will be Dr. John Froines.

Resolution No. 01-53

Item 2 is a research proposal from the University of California, Riverside, entitled, "Improved Reactivity Estimates for Volatile Organic Compounds Used in Architectural Coatings". The principal investigator will be Dr. William Carter.

Resolution No. 01-54



## PROPOSED

State of California  
AIR RESOURCES BOARD

Resolution 01-53

November 15, 2001

Agenda Item No.: 01-9-4

WHEREAS, the Air Resources Board has been directed to carry out an effective research program in conjunction with its efforts to combat air pollution, pursuant to Health and Safety Code sections 39700 through 39705;

WHEREAS, a research proposal, number 2502-222, entitled "Development and Application of Ambient Aerosol Concentrators to Conduct Health Effects Studies in the Los Angeles Basin," has been submitted by the University of California, Los Angeles;

WHEREAS, the Research Division staff has reviewed and recommended this proposal for approval; and

WHEREAS, the Research Screening Committee has reviewed and recommends for funding:

Proposal Number 2502-222 entitled "Development and Application of Ambient Aerosol Concentrators to Conduct Health Effects Studies in the Los Angeles Basin," submitted by the University of California, Los Angeles, for a total amount not to exceed \$1,200,000.

NOW, THEREFORE BE IT RESOLVED, that the Air Resources Board, pursuant to the authority granted by Health and Safety Code section 39703, hereby accepts the recommendation of the Research Screening Committee and approves the following:

Proposal Number 2502-222 entitled "Development and Application of Ambient Aerosol Concentrators to Conduct Health Effects Studies in the Los Angeles Basin," submitted by the University of California, Los Angeles, for a total amount not to exceed \$1,200,000.

BE IT FURTHER RESOLVED, that the Executive Officer is hereby authorized to initiate administrative procedures and execute all necessary documents and contracts for the research effort proposed herein, and as described in Attachment A, in an amount not to exceed \$1,200,000.

**ATTACHMENT A****“Development and Application of Ambient Aerosol Concentrators to Conduct Health Effects Studies in the Los Angeles Basin”****Background**

Exposure to ambient particulate matter (PM) contributes to mortality and morbidity around the world. The harmful health effects from ambient PM exposures include exacerbation of asthma and respiratory illness, decreased lung function, and premature deaths. Up to 17,000 premature deaths per year in California can be linked to air pollution exposure. Despite substantial evidence of the harmful health effects from PM exposure, little is known of the mechanisms involved in PM toxicity, or the differences in the toxicity of the different size fractions of PM.

Previous investigations of PM toxicity have primarily emphasized the use of synthetic systems comprised of two or more components of ambient PM. These systems have the advantage of precise characterization, but they lack the complexity and variability seen in ambient PM. The new concentrator technology makes it possible to selectively concentrate different size fractions of ambient PM to be used in exposure studies. The mobile nature of the concentrator facilities allows investigation of site and seasonal variability as well.

**Objective**

This proposal is for years 3-5 of a five-year program and the overall objective of this five-year program is to develop a mobile inhalation exposure facility to concentrate coarse, fine, and ultrafine ambient particles in the Los Angeles Basin. The inhalation facility will be used to investigate the cardiopulmonary effects of size-specific ambient PM in human volunteers, sensitive animals (mice and rats) and cellular assays. During the first two years of this program, the investigators designed and characterized the performance of the fine, ultrafine, and coarse concentrators to be used in animal inhalation studies. In addition, animal exposures and cell culture studies were initiated to investigate the toxicity of particles at different locations in the Los Angeles Basin. The specific aims of years 3-5 include: the development of an ultrafine concentrator for human exposures, diesel and gasoline freeway emission studies in an allergic animal model, study of source and receptor site emissions in sensitive animal models, and collection of particles for cell toxicity studies.

**Methods**

Animal models, cell culture systems, and human volunteers will be exposed to coarse, fine, and ultrafine particles in transportable facilities. These studies will be used to determine cardiac and respiratory effects from particle exposure and will investigate size, site, and seasonal differences in ambient PM. Animal models (ovalbumin-sensitized Balb/c mice and Brown Norway rats) will be used to study asthma-like responses. These models are well characterized and exhibit several hallmarks of allergic air way disease including increased IgE, nonspecific airway hyperresponsiveness and eosinophil influx. Physiological, chemical, and structural endpoints will be studied to assess changes in cardiopulmonary function. Cellular

toxicity studies will be conducted by exposing human cell cultures to coarse, fine, and ultrafine ambient particles. Exposures will examine seasonal and site-specific changes in particle toxicity. Although the human exposure studies will be funded through sources other than ARB, the human subject approval was included as an appendix in this proposal.

### **Expected Results**

This five-year program will result in the development of a mobile inhalation exposure facility to concentrate coarse, fine, and ultrafine ambient particles in the Los Angeles Basin. The inhalation facility will be used to study the cardiac and respiratory effects of ambient particle exposures in animal models, cell systems, and human volunteers. These investigations will provide data on the relative effects of different size fractions and compositions of PM and their contribution to the toxicity from PM exposure.

### **Significance to the Board**

These investigations will result in important new information on the effect of particle exposure on asthma and allergy. The effects of season and site-specific ambient particles on sensitive subpopulations will also be studied. One of the many questions in the regulation of particle pollution has been the relative toxicity of different size fractions and different components of PM, as well as their effects on sensitive subpopulations. The information resulting from these studies is vital to developing future ambient air quality standards and control programs for different size fractions of PM.

#### **Contractor:**

University of California, Los Angeles

#### **Contract Period:**

36 Months

#### **Principal Investigator (PI):**

John R. Froines, Ph.D.

#### **Contract Amount:**

\$1,200,000

#### **Cofunding:**

The ARB's portion of this concentrator program is considerably strengthened by interactions and linkages with other Federal and State programs. Sites from the Children's Health Study will be used to perform both animal and cell studies using coarse, fine and ultrafine particle exposure. The complete characterization of the PM exposures in this program will be performed using a mobile Particle Instrument Unit, in coordination with the U.S. Environmental Protection Agency (USEPA)-funded Southern California Particle Center and Supersite program. In addition, the US EPA will fund all the human exposure studies, the cell toxicity studies, and the primary funding for the Brown Norway rat source/ receptor studies. The overall effort is a multicampus study involving experts in their fields from the University of California at Los Angeles (UCLA), the University of California at Irvine, the University of California at Davis, the University of Southern California, and Michigan State University. In addition, the cell systems studies involve collaboration with Dr. Andre Nel (UCLA) and Dr. Robert Devlin (USEPA). Dr. Henry Gong (Rancho Los Amigos) will direct the human exposure studies, which are funded by USEPA and the Health Effects Institute.

**Basis for Indirect Cost Rate:**

The indirect cost rate of 10 percent is a negotiated rate agreed to by the State and University of California campuses.

**Past Experience with this Principal Investigator:**

Dr. John Froines is a senior toxicologist and exposure assessment scientist who currently serves as the Principal Investigator for the USEPA-funded Southern California Particle Center and Supersite. Dr. Froines is also the Director of the UCLA Center for Occupational and Environmental Health. Dr. Froines is the Chair of the California Air Resources Board's Scientific Review Panel which is the key body evaluating ARB proposed designation of Toxic Air Contaminants (TACs). Dr. Froines has demonstrated that he has the expertise and ability to oversee the administration, management, and scientific content of the project.

**Prior Research Division Funding to the University of California, Los Angeles:**

Year	2001	2000	1999
Funding	\$0	\$938,693	\$0

## BUDGET SUMMARY

University of California, Los Angeles

Development and Application of Ambient Aerosol Concentrators to Conduct Health  
Effects Studies in the Los Angeles Basin

### DIRECT COSTS AND BENEFITS

1.	Labor and Employee Fringe Benefits	\$179,237 <sup>1</sup>
2.	Subcontractors	\$976,909 <sup>2</sup>
3.	Equipment	\$ 0
4.	Travel and Subsistence	\$ 10,500
5.	Electronic Data Processing	\$ 0
6.	Reproduction/Publication	\$ 1,800
7.	Mail and Phone	\$ 3,600
8.	Supplies	\$ 5,400
9.	Analyses	\$ 0
10.	Miscellaneous	<u>\$ 0</u>
Total Direct Costs		\$1,177,446

### INDIRECT COSTS

1.	Overhead	\$22,554
2.	General and Administrative Expenses	\$ 0
3.	Other Indirect Costs	\$ 0
4.	Fee or Profit	<u>\$ 0</u>
Total Indirect Costs		<u>\$22,554</u>

**TOTAL PROJECT COSTS** **\$1,200,000**

<sup>1</sup> \$46,216 for the PI, \$51,875 for staff, and \$81,146 for students (postdoctoral, graduate, and undergraduate)

<sup>2</sup> There are two subcontractors included in this project:  
*The University of Southern California* will construct, install, and test the Fine plus Ultrafine Particle Concentrator. In addition, USC will collect particles for animal and cell studies and characterization of the atmospheres. Also, "proof-of-concept" studies will be done to evaluate the physical and chemical characteristics of concentrated aerosols and to demonstrate their relevance to ambient air exposures. The total budget for USC is \$384,264.

*The University of California, Irvine* will conduct animal studies in preparation for field operations at the Children's Health Study sites and for the freeway study. In addition, studies will be performed on the effects of freeway emission on the increase the severity of asthma and inflammatory responses in a sensitive animal model at two freeways, each with well-documented heavy diesel and gasoline traffic, respectively. An additional study will examine the effect of source and receptor site emissions in animal models. The total budget for UCI is \$592,645.



## PROPOSED

State of California  
AIR RESOURCES BOARD

Resolution 01-54

November 15, 2001

Agenda Item No.: 01-9-4

WHEREAS, the Air Resources Board has been directed to carry out an effective research program in conjunction with its efforts to combat air pollution, pursuant to Health and Safety Code sections 39700 through 39705;

WHEREAS, a research proposal, number 2503-222, entitled "Improved Reactivity Estimates for Volatile Organic Compounds Used in Architectural Coatings," has been submitted by the University of California, Riverside;

WHEREAS, the Research Division staff have reviewed and recommended this proposal for approval; and

WHEREAS, the Research Screening Committee has reviewed and recommends for funding:

Proposal Number 2503-222 entitled "Improved Reactivity Estimates for Volatile Organic Compounds Used in Architectural Coatings," submitted by the University of California, Riverside, for a total amount not to exceed \$240,102.

NOW, THEREFORE BE IT RESOLVED, that the Air Resources Board, pursuant to the authority granted by Health and Safety Code section 39703, hereby accepts the recommendation of the Research Screening Committee and approves the following:

Proposal Number 2503-222 entitled "Improved Reactivity Estimates for Volatile Organic Compounds Used in Architectural Coatings," submitted by the University of California, Riverside, for a total amount not to exceed \$240,102.

BE IT FURTHER RESOLVED, that the Executive Officer is hereby authorized to initiate administrative procedures and execute all necessary documents and contracts for the research effort proposed herein, and as described in Attachment A, in an amount not to exceed \$240,102.

**ATTACHMENT A****“Improved Reactivity Estimates for Volatile Organic Compounds  
Used in Architectural Coatings”****Background**

Emissions from architectural coatings are an important component of the stationary source volatile organic compounds (VOC) inventory. The ARB approved the implementation of additional controls for VOC emissions in architectural coatings in June 2000. The ARB is investigating a reactivity-based control strategy because it can potentially make control strategies more cost-effective and flexible. There are a number of factors that need to be considered in the decision as to whether reactivity is an appropriate control strategy for architectural coatings. One of the factors is the level of confidence in estimating the ozone formation potential of VOC emissions from architectural coatings. This project will improve the ARB's ability to quantify ozone impacts associated with architectural coatings.

Earlier this year, the ARB approved the research proposal entitled “Evaluation of Atmospheric Impacts of Selected Coatings VOC Emissions,” submitted by Dr. William Carter at the University of California, Riverside. Due to the limited funding allocated at that time, only three tasks were selected for this project after discussion with ARB staff and the Reactivity Research Advisory Committee (RRAC), a group of representatives from the solvent and coatings industries and the California Air Districts.

This proposal is an extension of the existing project and will complete the remaining tasks. Additional compounds and petroleum distillates will be selected after discussion with ARB staff and the RRAC.

**Objective**

The overall objective of both the existing project and this proposal is to reduce uncertainties in ozone reactivity estimates for selected VOCs in architectural coatings. The specific objective of this proposal is to conduct additional environmental chamber and direct reactivity screening measurement research. This information is needed to reduce the uncertainties associated with quantifying the ozone formation potential of VOCs in architectural coatings.

**Methods**

Two methods proposed in this project are (1) environmental chamber studies of selected coatings VOCs, and (2) application of direct reactivity measurement methods to coatings constituents. Environmental chamber experiments are needed to fully evaluate all aspects of the mechanism that may affect reactivity under atmospheric conditions. This is an important component when assessing the reactivity estimates of coatings VOCs with respect to ozone formation. Direct reactivity measurement of a VOC can provide not only useful data for the evaluation of VOC reaction rate in the atmosphere but also the amount of ozone formation attributed to its reactions. It can potentially be carried out easily and inexpensively than chamber studies.

**Expected Results**

The product from this effort will be reactivity estimates for selected VOCs associated with architectural coatings.

**Significance to the Board**

The results of this project will provide necessary information regarding the feasibility of a reactivity-based control strategy for architectural coatings.

**Contractor:**

University of California, Riverside

**Contract Period:**

36 months

**Principal Investigator (PI):**

William P. L. Carter, Ph.D.

**Contract Amount:**

\$240,102

**Cofunding:**

The U. S. Environmental Protection Agency (USEPA) is funding a four-year project (\$2.9 million) to develop the next-generation environmental chamber facility needed for evaluating gas-phase and gas-to-particle atmospheric reaction mechanisms. The ARB project will use the USPEA-funded facility to conduct chamber experiments for selected VOCs in architectural coatings.

**Basis for Indirect Cost Rate:**

The indirect cost rate of 10 percent is a negotiated rate agreed to by the State and University of California campuses.

**Past Experience with this Principal Investigator:**

The principal investigator, Dr. William Carter, is one of the pioneers in determining and quantifying VOC reactivity. He is the leader of the VOC reactivity assessment team for NARSTO, an organization that represents all North American groups involved in air pollution research. He has published approximately 75 journal articles and almost 70 technical reports in the areas of atmospheric chemistry, chemical mechanism development, and VOC reactivity assessment. He compiled the list of compound reactivities codified in California's Low-emissions Vehicles/Clean Fuels and aerosol coatings regulations. He has completed several studies on VOC reactivity for the ARB and has always delivered a quality product at a reasonable cost.

**Prior Research Division Funding to the University of California, Riverside:**

Year	2001	2000	1999
Funding	\$79,884	\$654,788	\$484,943

## BUDGET SUMMARY

University of California, Riverside

Improved Reactivity Estimates for Volatile Organic Compounds Used in Architectural Coatings

### DIRECT COSTS AND BENEFITS

1.	Labor and Employee Fringe Benefits	\$ 84,104 <sup>1</sup>
2.	Subcontractors	\$ 0
3.	Equipment	\$ 0
4.	Travel and Subsistence	\$ 750
5.	Electronic Data Processing	\$ 0
6.	Reproduction/Publication	\$ 0
7.	Mail and Phone	\$ 100
8.	Supplies	\$ 17,150 <sup>2</sup>
9.	Analyses	\$ 88,406 <sup>3</sup>
10.	Miscellaneous	<u>\$ 30,542<sup>4</sup></u>
Total Direct Costs		\$221,052

### INDIRECT COSTS

1.	Overhead	\$19,050
2.	General and Administrative Expenses	\$ 0
3.	Other Indirect Costs	\$ 0
4.	Fee or Profit	<u>\$ 0</u>
Total Indirect Costs		\$19,050

**TOTAL PROJECT COSTS** **\$240,102**

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<sup>1</sup> \$22,088 for the PI, \$36,125 for staff, and \$25,890 for students (postdoctoral, graduate, and undergraduate)

<sup>2</sup> \$10,500 for chamber light power and \$6,650 misc. laboratory supplies such as chemicals and compressed gases

<sup>3</sup> Usage fees of chamber laboratory: 135.8 days @ \$651/day

<sup>4</sup> Office rental fees at CE-CERT: 15.29 months @ \$2,000/month