

State of California
AIR RESOURCES BOARD

RESEARCH PROPOSAL

Resolution 05-71

December 8, 2005

Agenda Item No.: 05-12-2

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 2592-250, entitled "Physicochemical and Toxicological Assessment of the Semi-Volatile And Non-Volatile Fractions of PM from Heavy- and Light-Duty Vehicles Operating with and without Emissions Control Technologies", has been submitted by the University of Southern California;

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

WHEREAS, the South Coast Air Quality Management District has agreed to co-sponsor this proposal for a total amount not to exceed \$338,975; and

WHEREAS, the Air Resources Board will fund this proposal for a total amount not to exceed \$338,975; and

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

Proposal Number 2592-250 entitled "Physicochemical and Toxicological Assessment of the Semi-Volatile and Non-Volatile Fractions of PM from Heavy- and Light-Duty Vehicles Operating with and without Emissions Control Technologies", submitted by the University of Southern California, for a total amount not to exceed \$677,950.

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 2592-250 entitled "Physicochemical and Toxicological Assessment Of The Semi-Volatile And Non-Volatile Fractions of PM from Heavy- and Light-Duty Vehicles Operating with and without Emissions Control Technologies", submitted by the University of Southern California, for a total amount not to exceed \$677,950.

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 \$677,950.

I hereby certify that the above is a true and correct copy of Resolution 05-71, as adopted by the Air Resources Board.

Lori Andreoni, Clerk of the Board

ATTACHMENT A

Physicochemical and Toxicological Assessment of the Semi-Volatile and Non-Volatile Fractions of PM from Heavy- and Light-Duty Vehicles Operating with and without Emissions Control Technologies

Background

Recent emissions testing in either dynamometer or on-road testing facilities have shown that particles emitted from vehicles are externally mixed; i.e., different particles of the same size can have different chemical compositions. Depending on vehicle type, age, and ambient conditions, between 70-90 percent of the particles by number (10-30% by mass) may consist of more volatile material (known as semi-volatile) than the other particles, and upon heating, will partially or completely evaporate. The exposure and health implications of these findings have not yet been investigated. There are several factors in regulatory development that require knowledge of the relative toxicities of these non-volatile and semi-volatile particles. They include: 1) based on particle number, people's exposure during commute is dominated by semi-volatile particles; 2) some control technologies for diesel PM, such as diesel particulate filters, effectively remove the non-volatile PM, but have a mixed impact on the semi-volatile fraction; and 3) European authorities are moving ahead with a particle number standard for diesel and some gasoline engines, considering only non-volatile particles. As California considers its own need to augment the current mass-based standards, the association between any proposed number-based standard and toxicity must be better understood.

Objective

The objective of this project is to determine the physicochemical and toxicological properties of the semi-volatile and non-volatile fractions of PM from heavy- and light-duty vehicles operating with and without emissions control technologies.

Methods

Heavy- and light-duty vehicle emission PM samples will be collected from vehicles operated on chassis dynamometers using filters and bio-samplers. Thermal denuders will be used to separate the volatile and non-volatile fractions. Particle concentrators will be employed to allow collection of sufficient amounts of exhaust PM for subsequent biological analysis. Gaseous emissions will also be measured. The heavy-duty technologies to be tested will include a diesel with no after-treatment, a diesel with an oxidation catalyst, a diesel with a diesel particulate filter, and a diesel with SCRT, possibly a diesel fueled with biodiesel, a CNG bus without exhaust after-treatment, a CNG bus with an oxidation catalyst, and a gasoline truck. Light-duty vehicles to be tested will include an old high-emitting vehicle and a new low-emission vehicle. The collected samples will be analyzed for toxicity using assays developed by Dr. Froines at the University of California, Los Angeles. These assays measure the collected samples' potential to induce redox chemistry and oxidative stress in biological tissues.

Expected Results

This study will provide data on the toxicities of the volatile and non-volatile PM fractions of vehicle exhaust. The study will also provide data on the relative toxicities of PM from different automotive and control technologies.

Significance to the Board

The study will examine the relative toxicities of the volatile and non-volatile fractions of PM emissions from vehicular exhaust. Several different control technologies will be evaluated. These results should provide insight into how best to reduce the toxic effects of these mobile sources on road and in the choice of control technology.

Contractor:

University of Southern California

Contract Period:

48 months

Principal Investigator (PI):

Constantinos Sioutas, Sc.D.

Contract Amount:

\$677,950

Cofunding:

The South Coast Air Quality Management District is contributing \$338,975 to the cost of this study.

Basis for Indirect Cost Rate:

The State and the University of Southern California have agreed to a 30 percent indirect cost rate. This the lowest overhead rate offered to any funding organization.

Past Experience with this Principal Investigator:

ARB staff have extensive previous experience with Dr. Sioutas. His expertise is based on developing technologies for measuring the physicochemical characteristics of air pollutants and determining their toxic properties. Staff's past experience with Dr. Sioutas has been positive and productive.

Prior Research Division Funding to USC:

| Year | 2005 | 2004 | 2003 |
|---------|------|------|------|
| Funding | \$0 | \$0 | \$0 |

BUDGET SUMMARY

University of Southern California

“Physicochemical and Toxicological Assessment of the Semi-Volatile and Non-Volatile Fractions of PM from Heavy- and Light-Duty Vehicles Operating with and without Emissions Control Technologies”

DIRECT COSTS AND BENEFITS

| | | |
|-----|------------------------------------|------------------|
| 1. | Labor and Employee Fringe Benefits | \$ 250,058 |
| 2. | Subcontractors | \$ 279,999 |
| 3. | Equipment | \$ 12,000 |
| 4. | Travel and Subsistence | \$ 1,600 |
| 5. | Electronic Data Processing | \$ 0 |
| 6. | Reproduction/Publication | \$ 1,500 |
| 7. | Mail and Phone | \$ 0 |
| 8. | Supplies | \$ 2,825 |
| 9. | Analyses | \$ 12,600 |
| 10. | Miscellaneous | <u>\$ 29,293</u> |
| | Total Direct Costs | \$589,875 |

INDIRECT COSTS

| | | |
|----|-------------------------------------|------------------|
| 1. | Overhead | \$ 88,075 |
| 2. | General and Administrative Expenses | \$ 0 |
| 3. | Other Indirect Costs | \$ 0 |
| 4. | Fee or Profit | <u>\$ 0</u> |
| | Total Indirect Costs | <u>\$ 88,075</u> |

TOTAL PROJECT COSTS \$677,950

Attachment 1

SUBCONTRACTORS' BUDGET SUMMARY

Subcontractor: University of California at Los Angeles.

Description of subcontractor's responsibility: Perform toxicological analysis on collected PM samples.

DIRECT COSTS AND BENEFITS

| | | | |
|-----|------------------------------------|----|------------|
| 1. | Labor and Employee Fringe Benefits | \$ | 229,229 |
| 2. | Subcontractors | \$ | 0 |
| 3. | Equipment | \$ | 0 |
| 4. | Travel and Subsistence | \$ | 3,316 |
| 5. | Electronic Data Processing | \$ | 0 |
| 6. | Reproduction/Publication | \$ | 0 |
| 7. | Mail and Phone | \$ | 0 |
| 8. | Supplies | \$ | 22,000 |
| 9. | Analyses | \$ | 0 |
| 10. | Miscellaneous | \$ | <u>0</u> |
| | Total Direct Costs | | \$ 254,545 |

INDIRECT COSTS

| | | | |
|----|-------------------------------------|----|------------------|
| 1. | Overhead | \$ | 25,454 |
| 2. | General and Administrative Expenses | \$ | 0 |
| 3. | Other Indirect Costs | \$ | 0 |
| 4. | Fee or Profit | \$ | <u>0</u> |
| | Total Indirect Costs | | <u>\$ 25,454</u> |

TOTAL PROJECT COSTS

\$279,999