State of California
AIR RESOURCES BOARD

RESEARCH PROPOSAL

Resolution 03-2

January 31, 2003

Agenda Item No.: 03-1-2

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 2525-227, entitled "Source Apportionment of Fine and Ultrafine Particles in California: Tailpipe and Roadside Measurement of Ultrafine Particles," has been submitted by the University of California, Davis;

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 2525-227 entitled "Source Apportionment of Fine and Ultrafine Particles in California: Tailpipe and Roadside Measurement of Ultrafine Particles," submitted by the University of California, Davis, for a total amount not to exceed $114,907.

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 2525-227 entitled "Source Apportionment of Fine and Ultrafine Particles in California: Tailpipe and Roadside Measurement of Ultrafine Particles," submitted by the University of California, Davis, for a total amount not to exceed $114,907.

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 in an amount not to exceed $114,907.

I hereby certify that the above is a true and correct copy of Resolution 02-10, as adopted by the Air Resources Board.

Stacey Dorais, Clerk of the Board

## ATTACHMENT A

## "Source Apportionment of Fine and Ultrafine Particles in California: Tailpipe and Roadside Measurement of Ultrafine Particles"

### Background

Mobile source fuel combustion is one of the most prevalent sources of ultrafine particulate air pollution in California. A preliminary inventory of ultrafine particulate matter for southern California estimates that mobile sources account for more than half of the ultrafine particulate matter emissions in that region. Tests that measured the size distribution of particles released from light duty vehicles have detected ultrafine particles in the exhaust. A sample of ultrafine particles released from light duty vehicles must be collected so that chemical tracer compounds can be identified that will help to quantify the contribution that light duty vehicles make to the overall atmospheric burden of ultrafine particles. A roadside study is also needed to examine how ultrafine particles are transformed after release to the atmosphere in the polluted roadway environment.

### Objective

The objectives of this project augmentation are to collect cascade impactor and filter samples from on-road light duty vehicles at the ARB's Haagen-Smit Laboratory in El Monte, and to collect samples of airborne particulate matter at a roadside location in southern California. Particle samples collected during the source sampling study and ambient field monitoring will be analyzed and a new ultrafine particle source library will be developed.

### Methods

In this study, the investigators propose to enhance a current ARB research contract for source apportionment of ultrafine particulate matter by carrying out a source test for light duty vehicles (LDV). The investigators will construct a dilution system for this project, and the ARB's Haagen-Smit Laboratory in El Monte will provide a unique opportunity to conduct LDV source sampling. Airborne particle samples collected with filter-based samplers and Micro Orifice Uniform Deposit Impactors will be analyzed for unique chemical tracers that can be used in a source apportionment analysis. In the second phase of the enhanced project, the investigators propose to carry out a roadside test to study the evolution of ultrafine particulate matter in the polluted roadside environment. These transformations must be studied so that the signature for ultrafine particulate matter released from mobile sources can be recognized at receptor sites far from roadways.

### Expected Results

As a part of the parent research project, source profiles collected during the proposed research augmentation will be used to support source apportionment studies of ultrafine particulate matter in California. Three major parts of research include:

1) characterization of ultrafine particles at the source, 2) characterization of fine particles collected during 1997 Southern California Air Quality Study and ultrafine particles collected during California Regional PM10/PM2.5 Air Quality Study, and 3)

source apportionment analysis for collected fine and ultrafine particles. Source apportionment results will be compared with results from similar studies of fine particulate matter (PM) in southern California including the 1982 and 1993 studies made by Professor Cass's research group. Trends in fine PM sources among the 1982, 1993, and 1997 samples will provide a measure of the effectiveness of fine PM control strategies over this period. Finally, the results of all parts of the project will be documented as a technical report submitted to ARB and as technical papers submitted to peer-reviewed journals.

**Significance to the Board**

This research project will enhance the current ARB research contract for source apportionment of ultrafine particulate matter by carrying out a source test for light duty vehicles. By making these measurements more quantitative, more detailed, and more frequent, source apportionment studies can be conducted to identify the contribution that light duty vehicles make to overall airborne particle concentrations.

Statistical source apportionment techniques proposed in this study can provide valuable insight about the contribution that different sources make to airborne particle concentrations. Information of this type plays a vital role in the design of emissions control programs to reduce airborne particle concentrations that are suspected of causing adverse health effects. Very little is currently known about the contribution of different urban sources to airborne ultrafine particle concentrations. The sources of atmospheric ultrafine particles should also be understood in preparation for the design of abatement strategies.

**Contractor:**
University of California, Davis

**Contract Period:**
18 months

**Principal Investigator (PI):**
Dr. Michael Kleeman

**Contract Amount:**
$114,907

**Co-funding:**
No co-funding but this project has cost savings through a cooperative effort with an ongoing major diesel study, i.e., CRC Project E55/59.

**Basis for Indirect Cost Rate:**
The Indirect Cost Rate is 10% as previously agreed upon by the State of California and the University of California.

**Past Experience with this Principal Investigator:**
Dr. Kleeman has extensive previous experience in the construction of air quality models that describe aerosol processes and in the measurement of airborne particulate matter in the ambient atmosphere and his work is well-published. In addition, staff has found Dr. Kleeman very willing to put extra effort into his projects.

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

| Year | 2002 | 2001 | 2000 |
|---|---|---|---|
| Funding | $591,094 | $267,986 | $606,286 |

# BUDGET SUMMARY

University of California, Davis

Source Apportionment of Fine and Ultrafine Particles in California: Tailpipe and Roadside Measurement of Ultrafine Particles

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|---|---|---|---|---|
| **DIRECT COSTS AND BENEFITS** | | | | |
| 1. | Labor and Employee Fringe Benefits[1] | $ | 43,525 | |
| 2. | Subcontractors | $ | 0 | |
| 3. | Equipment[2] | $ | 5,050 | |
| 4. | Travel and Subsistence[3] | $ | 15,650 | |
| 5. | Electronic Data Processing | $ | 0 | |
| 6. | Reproduction/Publication | $ | 0 | |
| 7. | Mail and Phone | $ | 0 | |
| 8. | Supplies[4] | $ | 3,145 | |
| 9. | Analyses[5] | $ | 36,550 | |
| 10. | Miscellaneous[6] | $ | 1,000 | |
| | Total Direct Costs | | | $104,920 |
| **INDIRECT COSTS** | | | | |
| 1. | Overhead | $ | 9,987 | |
| 2. | General and Administrative Expenses | $ | 0 | |
| 3. | Other Indirect Costs | $ | 0 | |
| 4. | Fee or Profit | $ | 0 | |
| | Total Indirect Costs | | | $9,987 |
| **TOTAL PROJECT COSTS** | | | | **$114,907** |

[1] Labor and employee fringe benefits include the salary for Dr. Kleeman that reflects 1.5 months of compensation for an Assistant Professor at the University of California at Davis. The salary also listed for Graduate Student Research Assistant reflects 6 months of compensation. The graduate student will weigh sampling media, bake foil / quartz sampling media, clean sampling equipment, set up sampling equipment during testing, dismantle sampling equipment after testing, extract filters for chemical analysis, perform chemical analysis using IC, ICP-MS, GC-MS, and analyze data. The salary listed for Undergraduate Research Assistant reflects 9 months of compensation to assist the Graduate Student Research Assistant in his/her duties. Rates for University of California at Davis personnel reflect the standard fringe benefit rates of 12.7% for faculty, 4.3% for research assistants, and 1.3% for undergraduate students.

[2] The UCD investigator will construct a dilution system for this project.

[3] The travel portion of the budget will provide funds for sampling events and sample analysis at the University of Colorado. It is anticipated that two researchers will be in the field for approximately 22.5 days. Van rental covers the expense of moving equipment from UC Davis to the sampling site and back, as well as transportation at the sampling site. Airfare for Dr. Kleeman covers the expense for the PI to travel to the sampling site during the experiments (start and end of sampling event). The cell phone charges are included for convenience and safety of the graduate student during the sample collection phase.

[4] Supplies include items needed to collect source samples (filter media, etc) in addition to items needed for trace organics analysis (solvents, standards, etc).

[5] Sample analyses include:
<u>Soluble Ion analysis (UC Davis)</u>
Species: Na+, NH4+, K+, Cl-, NO3-, SO4=, PO4=
Cost: $5/sample
<u>Trace inorganic analysis (UC Davis)</u>
Species: Na, Mg, Al, Si, P, S, Cl, K, Ca, Ba, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zz, Ga, Au, Hg, As, Pb, Se, Br, Rb, Sr, Y, Zr, Cd, Ag, others...
Cost: $40/sample
<u>Carbon Analysis (UC Davis)</u>
Species: elemental carbon, organic carbon
Cost: $5/sample
<u>Trace Organics Analysis (University of Colorado)</u>
Species: organic tracers
Cost: $200/sample
Extended costs for 17 samples

[6] Additional van rental and cleaning for use of dilution system.

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