State of California
AIR RESOURCES BOARD

RESEARCH PROPOSAL

Resolution 07-13

April 26, 2007

Agenda Item No.: 07-4-2

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 2515-224, "Improvements to Versatile Aerosol Concentration Enrichment System (amendment to 04-332)," has been submitted by the University of California, Davis;

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 2515-224 "Improvements to Versatile Aerosol Concentration Enrichment System (amendment to 04-332)," submitted by the University of California, Davis, for a total amount not to exceed $29,109.

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 2515-224 "Improvements to Versatile Aerosol Concentration Enrichment System (amendment to 04-332)," submitted by the University of California, Davis, for a total amount not to exceed $29,109.

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 $29,109.

I hereby certify that the above is a true and correct copy of Resolution 07-13, as adopted by the Air Resources Board.

Lori Andreoni

Lori Andreoni, Clerk of the Board

ATTACHMENT A

Improvements to Versatile Aerosol Concentration Enrichment System (Amendment to 04-332)

Background

Many epidemiological studies have demonstrated an association between respiratory and cardiopulmonary health effects and exposures to fine and ultrafine particles. A difficulty in the study of these effects is that the vast majority of human and animal subjects do not show measurable physiological changes when exposed to typical ambient concentrations of particles. One method to facilitate such studies is to increase particle concentrations to many times ambient levels. This approach has been developed by several groups at Harvard and University of Southern California (USC) and utilizes water-condensation technology. Briefly, this technique involves the following four stages: 1) passing ambient air through a warm humidifier, which warms and saturates the air with water vapor; 2) cooling the water vapor-saturated airstream in a condenser (20-21° C), thereby supersaturating the air and causing water vapor to condense onto particles; 3) concentrating the droplets in the minor flow of a virtual impactor, which causes very little drop in pressure; and finally, 4) drying the droplets back to their original size with a silica-gel diffusion dryer. The concentration factor in such instruments is equal to the ratio of the inlet flow to the minor flow of the virtual impactor, and is typically ~20 (for particles in the size range 0.02-10 um). The small size and modular design of the Versatile Aerosol Concentration Enrichment Systems (VACES, which was developed at USC) makes it well suited for studies involving mobile exposure platforms, such as locations inside vehicles and at several distances from roadways. In addition, the portability and high concentration factors make the system attractive for measurements of aerosol components that are at or below detection limits (for given sampling time intervals).

Recent work conducted by Prof. A. Wexler's group demonstrated that although VACES operates as claimed under most meteorological conditions of southern California, the system failed to concentrate aerosols for a range of conditions that are commonly encountered in northern California. This project will address these shortcomings by constructing improvements to VACES that will enable the system to operate well under a wider range of ambient conditions than is currently possible. Additional work will include the development of a theory of operation and a written operating manual for the improved system. These solutions will provide researchers with a stable aerosol concentration system that is capable of maintaining high concentration enrichment factors over a wide range of ambient conditions, and will help support the Air Resources Board's future health effects studies that utilize improved VACES.

Objective

The objective of this project is to construct improvements to VACES that will enable the system to stably concentrate aerosols over a wider range of meteorological conditions than is currently possible. The proposed alterations will address several engineering and conceptual shortcomings of VACES, the most important of which is a concentration

enrichment factor that is dependent on ambient temperature and relative humidity and bath temperature.

Methods
Solutions to the problems will involve construction of and/or replacement upgrades to VACES. These modifications and additions to the system will be tested over a wide range of ambient conditions to ensure that uniform concentration enrichment factors are achievable and independent of ambient relative humidity, temperature and particle concentration and that the system returns the outflow to back to ambient temperature and relative humidity. The goal for the improved system is to concentrate particles uniformly over the range 30 nm to 500 nm. A final report will document the above solutions and an operating manual will detail operational procedures for the improved VACES.

Expected Results
An improved aerosol concentration enrichment system will be provided. In conjunction with these improvements, an operating manual will be written for the improved system.

Significance to the Board
This project will improve the stability of VACES and improve the understanding of particle concentration systems that utilize water condensation technology. These concentrators are currently used by a several different institutes and agencies, including the ARB, to conduct toxicological studies of air pollutants. The results from this project will provide support for the operation of an improved VACES and help interpret the Air Resources Board's previous and ongoing health effects studies that utilize VACES.

Contractor:
University of California, Davis

Contract Period:
24 Months

Principal Investigator (PI):
Professor Anthony Wexler

Contract Amount:
$29,109

Basis for Indirect Cost Rate:
The State and the UC system have agreed to a ten percent indirect cost rate.

Past Experience with this Principal Investigator:
Research Division staff have previously worked with all of the three investigators involved in this project: Profs. Anthony Wexler, Suzanne Paulson, and Cort Anastasio. The PIs demonstrated excellent analytical abilities and provided accurate and useful results. In addition, Prof. Anthony Wexler has carried out many field and laboratory

experiments on aerosols and has developed a single-particle mass spectrometer (to chemically analyze single particles). He has made outstanding contributions to aerosol science and technology and has an extensive publication record.

Prior Research Division Funding to UCD:

Year	2006	2005	2004
Funding	$1,948,494	$1,539,052	$500,660

BUDGET SUMMARY

Contractor: University of California, Davis

"Characterization of Versatile Aerosol Concentration Enrichment System"

DIRECT COSTS AND BENEFITS			
1.	Labor and Employee Fringe Benefits	$21,463	
2.	Subcontractors	$ 0	
3.	Equipment	$ 0	
4.	Travel and Subsistence	$ 0	
5.	Electronic Data Processing	$ 0	
6.	Reproduction/Publication	$ 0	
7.	Mail and Phone	$ 0	
8.	Supplies	$ 5,000	
9.	Analyses	$ 0	
10.	Miscellaneous	$ 0	
	Total Direct Costs		$ 26,463
INDIRECT COSTS			
1.	Overhead	$ 2,646	
2.	General and Administrative Expenses	$ 0	
3.	Other Indirect Costs	$ 0	
4.	Fee or Profit	$ 0	
	Total Indirect Costs		$ 2,646
TOTAL PROJECT COSTS			**$ 29,109**