State of California
AIR RESOURCES BOARD

RESEARCH PROPOSAL

Resolution 05-9

January 20, 2005

Agenda Item No.: 05-1-2

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 2571-246, “Characterization of Versatile Aerosol Concentration Enrichment System”, has been submitted by the University of California at 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 2571-246 “Characterization of Versatile Aerosol Concentration Enrichment System”, submitted by the University of California at Davis, for a total amount not to exceed $94,739.

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 2571-246 “Characterization of Versatile Aerosol Concentration Enrichment System”, submitted by the University of California at Davis, for a total amount not to exceed $94,739.

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 $94,739.

I hereby certify that the above is a true and correct copy of Resolution 05-9, as adopted by the Air Resources Board.

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Lori Andreoni, Clerk of the Board

ATTACHMENT A

"Characterization of Versatile Aerosol Concentration Enrichment System"

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 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).

Previous characterization studies of VACES have been conducted by several different groups of researchers and have shown minor or negligible changes in several properties of concentrated particles, such as bulk chemical composition, indicators of single particle chemistry, size, and morphology. Some recent work has indicated that high volatility, water-soluble compounds may be affected by repartitioning within the concentrator and that the concentration factor may vary with time. These aspects of the concentration system are addressed by the proposed research.

Objective

The objective of this project is to characterize possible artifacts from high volatility, water-soluble gas phase species and the time variation of the concentration factor in the aerosol generated by VACES. The proposed experiments will investigate various aspects of two hypotheses: 1) VACES perturbs the concentration of highly water soluble gas-phase compounds (hydrogen peroxide, nitric acid and ammonia), and 2) the concentration factor of VACES changes with time.

Methods
The proposed work will be a collaborative effort between three groups that are widely recognized in the atmospheric sciences. Each of the co-principal investigators will bring unique strengths and abilities to the project: Prof. Anthony Wexler – aerosol measurements to test variation of the concentration factor; Prof. Cort Anastasio – nitrogen compound measurements (nitrate/ammonia) to test for artifacts; and Prof. Suzanne Paulson – peroxide measurements to test for artifacts. The laboratory of Prof. A. Wexler will be used in carrying out measurements; the laboratory contains a VACES instrument, two SMPSs and additional facilities/support for the other researchers.

Expected Results
The proposed experiments will help resolve various aspects of two hypotheses: 1) VACES perturbs the concentration of highly water soluble gas-phase compounds (hydrogen peroxide, nitric acid and ammonia will be investigated), and 2) the concentration factor of VACES changes with time. Highly specific experiments will be carried out to test these hypotheses and to determine the origins of non-ideal operation. In addition, if artifacts are found, then recommendations on how to limit their influence in VACES will be provided.

Significance to the Board
ARB staff are confident that the proposed work will answer many important questions concerning the possibility of artifacts and stability in VACES. These concentrators are currently used by several different institutes and agencies, including the ARB, to conduct toxicological studies of air pollutants. The results from this project will provide further understanding of VACES operation and help support and interpret the ARB's previous and ongoing health effects studies that utilize VACES.

Contractor:
University of California, Davis

Contract Period:
24 Months

Principal Investigator (PIs):
Anthony Wexler, Ph.D., Cort Anastasio, Ph.D., and Suzanne Paulson, Ph.D.

Contract Amount:
$94,739

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

Past Experience with this Principal Investigator:
Research Division staff have worked with two of the three PIs in the past: Profs. Suzanne Paulson and Cort Anastasio. In previous studies, the PIs demonstrated excellent analytical abilities and provided accurate and useful results. 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	2004	2003	2002
Funding	$0	$220,896	$0

B U D G E T S U M M A R Y

University of California, Davis

Characterization of Versatile Aerosol Concentration Enrichment System

DIRECT COSTS AND BENEFITS			
1.	Labor and Employee Fringe Benefits	$65,188	
2.	Subcontractors	$ 0	
3.	Equipment	$ 0	
4.	Travel and Subsistence	$ 6,302	
5.	Electronic Data Processing	$ 0	
6.	Reproduction/Publication	$ 100	
7.	Mail and Phone	$ 212	
8.	Supplies	$14,265[1]	
9.	Analyses	$ 0	
10.	Miscellaneous	$ 60	
	Total Direct Costs		$86,127
INDIRECT COSTS			
1.	Overhead	$ 8,612	
2.	General and Administrative Expenses	$ 0	
3.	Other Indirect Costs	$ 0	
4.	Fee or Profit	$ 0	
	Total Indirect Costs		$ 8,612
TOTAL PROJECT COSTS			**$94,739**

[1] Supply costs cover all materials for experiments by three separate research groups: expendables (filters, etc.), chemicals, miscellaneous parts, and instrument maintenance.