

State of California  
AIR RESOURCES BOARD

RESEARCH PROPOSAL

Resolution 05-12

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 2560-246, entitled "Nighttime Chemistry: Observations of NO<sub>3</sub> and N<sub>2</sub>O<sub>5</sub>", has been submitted by the University of California, Berkeley;

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 2560-246 entitled "Nighttime Chemistry: Observations of NO<sub>3</sub> and N<sub>2</sub>O<sub>5</sub>", submitted by the University of California, Berkeley, for a total amount not to exceed \$122,778.

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 2560-246 entitled "Nighttime Chemistry: Observations of NO<sub>3</sub> and N<sub>2</sub>O<sub>5</sub>", submitted by the University of California, Berkeley, for a total amount not to exceed \$122,778.

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 \$122,778.

I hereby certify that the above is a true and correct copy of Resolution 05-12, as adopted by the Air Resources Board.

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Lori Andreoni, Clerk of the Board

## ATTACHMENT A

### “Nighttime Chemistry: Observations of $\text{NO}_3$ and $\text{N}_2\text{O}_5$ ”

#### Background

Amendments to the federal Clean Air Act (1991) provided the basis for setting new standards for particulate matter size 2.5 micrometer ( $\text{PM}_{2.5}$ ) and 10 micrometer in aerodynamic diameter ( $\text{PM}_{10}$ ). States were then required to identify air basins where ambient measurements demonstrated compliance with these new standards (attainment) and those where data could not show compliance (non-attainment). South Coast, San Joaquin Valley, and San Diego air basins, and the city of Calexico were initially designated non-attainment for  $\text{PM}_{2.5}$ .

A major component of  $\text{PM}_{2.5}$  is ammonium nitrate ( $\text{NH}_4\text{NO}_3$ ). Ammonia is emitted from dairies, confined animal facilities, fertilizer application, sewage and waste treatment, and most processes where vegetation or other living matter decomposes. Because of these diverse sources, ammonia is considered nearly ubiquitous in the ambient air. Nitric acid is generally an end product of reactions of  $\text{NO}_x$  and has a photochemical origin. Nitric acid acting with the ammonium ion and other cations (organic and inorganic) forms ammonium nitrate and other nitrates ( $\text{NO}_3$ ). Nitrate ion can combine with  $\text{NO}_2$  to form  $\text{N}_2\text{O}_5$ . Nitric acid, ammonia,  $\text{N}_2\text{O}_5$ , and  $\text{NO}_3$  are trace level gaseous species for which research groups have, until recently, measured with substantial difficulty and uncertainty. Nitric acid and  $\text{N}_2\text{O}_5$  ambient air data sets are extremely valuable to test our understanding and simulation of the general ammonium nitrate chemistry and are invaluable in testing our understanding of this same chemistry at nighttime.

#### Objective

The objectives of this research project include completing development of an instrument capable of making routine measurements of  $\text{NO}_3$  and  $\text{N}_2\text{O}_5$ , deploying the instrument at Fresno and Blodgett Forest and analyzing the data to provide an improved understanding of the nighttime chemistry of  $\text{NO}_3$  and  $\text{N}_2\text{O}_5$ .

#### Methods

The contractor will improve the prototype laser-Induced Fluorescence instrument to measure  $\text{NO}_3$  and  $\text{N}_2\text{O}_5$  at 15 to 25 ppt for a one minute averaging time. Once the instrument is field-ready, it will be deployed for eight weeks (four weeks each during winter and summer) at Blodgett Forest. Additional relaxed eddy accumulation fluxes of nitrogen species, volatilized organic species (VOC), and many aerosol species will also be available at Blodgett to build a simulation input and validation data set for a location far away from direct emissions. In addition, the upgraded LIF instrument will be deployed for four weeks in the winter at the Fresno super site. Additional nitrogen species measurements including a continuous nitrate analyzer, particle counts in many sizes, and a continuous carbon analyzer would also be available at Fresno to build a simulation input and validation data set for a location close to direct emissions.

#### Expected Results

Collected ambient data will be analyzed to provide a better understanding of nighttime aerosol chemistry and to test our laboratory and environmental chamber assessments of nighttime nitrogen and aerosol chemistry. As part of this task, the investigator will

interact with the nitrogen measurement working group (NWG) to motivate additional thoughts, counsel, and collaborations that would expand our understanding of nighttime aerosol and nitrogen chemistry. In addition, the investigator will interact with the Planning and Technical Support Division and Research Division staff to assure that simulation data sets are of the quality and detail required for use in PM simulation platforms. Finally, a final report will be prepared and manuscript(s) for publication in a peer-reviewed journal will be written. As part of the final deliverables, quality assured and detailed data sets will be submitted to ARB for use as input and validation of the State Implementation Plan.

**Significance to the Board**

These measurements would act both as inputs and as validation tools for PM simulations. With these measurements, PM simulations would be well tested and verified, and compliance demonstrations relying on these simulations would well withstand substantive scrutiny.

**Contractor:**

University of California, Berkeley

**Contract Period:**

36 Months

**Principal Investigator (PI):**

Ron Cohen, Ph.D.

**Contract Amount:**

\$122,778

**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:**

We have worked with Professor Cohen for the last seven years. His contribution to substantial analyses at Blodgett Forest research station have helped the ARB mission with estimation of biogenic emissions (necessary for compliance demonstrations) and with analyses of effective lifetimes of nitrogen oxides within the Sacramento Valley plume (necessary for triennial transport assessment). These collaborations occurred long before Professor Cohen had any contractual obligations with ARB. As a key part of the Lake Tahoe Atmospheric Deposition Study (LTADS), Professor Cohen has been responsible for documenting and evaluating potential transport of nitrogen species from Central Valley and Bay Area to Lake Tahoe region. Throughout our working experience with Professor Cohen we have been pleased with his expertise, experience, and willingness to extend his and his staff's resources to aid us.

**Prior Research Division Funding to UCB:**

Year	2004	2003	2002
Funding	\$799,279*	\$715,194	\$2,406,873

\* funds provided by the California Energy Commission

# BUDGET SUMMARY

University of California, Berkeley

Nighttime Chemistry: Observations of NO<sub>3</sub> and N<sub>2</sub>O<sub>5</sub>

## DIRECT COSTS AND BENEFITS

1.	Labor and Employee Fringe Benefits	\$	69,400
2.	Subcontractors	\$	0
3.	Equipment	\$	0
4.	Travel and Subsistence	\$	2,000
5.	Electronic Data Processing	\$	0
6.	Reproduction/Publication	\$	1,000
7.	Mail and Phone	\$	1,000
8.	Supplies	\$	14,500 <sup>1</sup>
9.	Analyses	\$	0
10.	Miscellaneous	\$	<u>25,888<sup>2</sup></u>

Total Direct Costs \$113,788

## INDIRECT COSTS

1.	Overhead	\$	8,990
2.	General and Administrative Expenses	\$	0
3.	Other Indirect Costs	\$	0
4.	Fee or Profit	\$	<u>0</u>

Total Indirect Costs \$ 8,990

## TOTAL PROJECT COSTS

\$122,778

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<sup>1</sup> Chemicals: standards; zero air	\$1,000
Lab Supplies: tubing, fittings, glassware, electronics, etc.	5,200
Gases: 2 NO <sub>2</sub> cylinders @ 650 each	1,300
Optics	6,000
Laser	<u>1,000</u>
	14,500

<sup>2</sup> Publication fees (2 10 page reprint @ \$100/page)	\$ 2,000
Yr 1. Graduate student non-resident registration fees	11,376
Yr 2. Graduate student registration fees	<u>12,512</u>
	\$25,888