State of California
AIR RESOURCES BOARD

Resolution 02-10

March 21, 2002

Agenda Item No.: 02-2-2

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 2510-224, entitled “Indoor Air Chemistry: Cleaning Agents, Ozone, and Toxic Air Contaminants,” 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 2510-224 entitled “Indoor Air Chemistry: Cleaning Agents, Ozone, and Toxic Air Contaminants,” submitted by the University of California, Berkeley, for a total amount not to exceed $446,865.

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 2510-224 entitled “Indoor Air Chemistry: Cleaning Agents, Ozone, and Toxic Air Contaminants,” submitted by the University of California, Berkeley, for a total amount not to exceed $446,865.

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 $446,865.

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

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Marie Kavan, Clerk of the Board

ATTACHMENT A

"Indoor Air Chemistry: Cleaning Agents, Ozone, and Toxic Air Contaminants"

Background

Household products such as cleaning agents, polishes, and air fresheners contain many volatile constituents that can contribute to indoor pollutant levels, including both directly emitted Toxic Air Contaminants (TACs) and pollutants formed by chemical reaction. Many volatile constituents of household cleaning agents have been identified as TACs, such as toluene, ethyl benzene, styrene, glycol ethers, formaldehyde, acetaldehyde, and methyl ethyl ketone. Therefore, the use of cleaning products in residences, schools, and commercial and institutional buildings can result in inhalation exposure to TACs. Additionally, ozone, a very reactive gas, has been found to react with some common cleaning agent constituents to form respiratory irritants and/or carcinogens such as formaldehyde, acrolein, and numerous carboxylic acids, among others.

Formulations of cleaning products have undergone considerable change in response to ARB's regulations limiting percent by weight of VOCs in consumer products, with regulations requiring further reductions for some products (to 4% VOC by weight) to be implemented in 2004. As a result, there is concern that many household cleaners are evolving to have a larger contribution to the total composition from unsaturated, lower volatility hydrocarbons (e.g., d-limonene, selected terpenes and glycol ethers), a class of compounds generally more available to participate in reactions with ozone. Additionally, accurate and realistic information on indoor exposure to TACs, both directly emitted and formed by chemical reaction, is crucial because of the importance of such exposures in determining health risks from these chemicals.

Objective

The objective of the proposed research is to identify and quantify primary emissions of TACs from cleaning products, as well as secondary emissions resulting from reactions between cleaning agent emissions and ozone under realistic indoor conditions. Tests will be conducted using realistic indoor use scenarios, so that the potential exposure of product users and room occupants can be assessed. In addition to obtaining product emissions and exposure information, the investigators will identify the conditions under which these processes contribute to elevated indoor levels of TACs.

Methods

The investigators propose to conduct a series of chamber tests at the Lawrence Berkeley National Laboratory (LBNL) to examine cleaning product emissions and associated indoor chemistry in realistic use scenarios. A set of screening tests will be performed in a small-scale chamber to identify cleaning products with a high potential either for primary TAC emissions or for formation of TACs as secondary emissions. These products will be further tested in a full-scale chamber under simulated indoor use conditions to better quantify emissions and user/occupant exposure during cleaning product application. A subset of these experiments will be conducted with and without the introduction of ozone into the chamber to assess reaction products. Analytes for all

chamber experiments will include a large number of VOCs, aldehydes, acids, glycol ethers, and terpenes and related compounds.

Expected Results
Results from the study will include semi-quantitative data on the primary emissions of TACs from approximately 20 cleaning products, and more specific, quantitative data on the primary emissions and exposure concentrations for approximately nine of these products. Also, the proposed study will provide quantitative data on the secondary (reaction) emissions of TACs (including formation and removal processes) resulting from cleaning agent-ozone reactions under realistic use scenarios for at least three of the cleaning products selected in screening tests as described above. In addition to obtaining product emissions and exposure information, the investigators will identify the conditions under which these processes contribute to elevated indoor levels of TACs.

Significance to the Board
Results from this study will be used by ARB to assess the need for further refinement of ARB's consumer products regulations to protect public health, and to provide guidance to the public on ways to reduce any potentially harmful exposure that may occur when using cleaning products.

Contractor:
University of California, Berkeley

Contract Period:
36 months

Principal Investigator (PI):
William W. Nazaroff, Ph.D.

Contract Amount:
$446,865

Cofunding:
None

Basis for Indirect Cost Rate:
The indirect cost rate of 10 percent is a negotiated rate agreed to by the State and University of California campuses.

Past Experience with this Principal Investigator:
Dr. William Nazaroff is a Professor in the Department of Civil and Environmental Engineering at the University of California, Berkeley, and is a leader in the field of indoor air quality, aerosol physics, air pollution control, and contaminant transport processes. Dr. Nazaroff also serves as a member of ARB's Research Screening Committee. Dr. Nazaroff has completed one ARB-funded project in the past, entitled "Assessing Exposure to Air Toxicants From Environmental Tobacco Smoke" (ARB contract

#94-344). In that work, Dr. Nazaroff demonstrated his excellent analytical abilities and the ability to oversee the administration and management of research projects.

Prior Research Division Funding to the University of California, Berkeley:

Year	2001	2000	1999
Funding	$0	$0	$392,027

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

University of California, Berkeley

Indoor Air Chemistry: Cleaning Agents, Ozone, and Toxic Air Contaminants

DIRECT COSTS AND BENEFITS			
1.	Labor and Employee Fringe Benefits	$207,531	
2.	Subcontractors	$190,695	
3.	Equipment	$ -0-	
4.	Travel and Subsistence	$ 1,820	
5.	Electronic Data Processing	$ -0-	
6.	Reproduction/Publication	$ 1,400	
7.	Mail, Phone, and FAX	$ 1,100	
8.	Materials and Supplies	$ 15,620	
9.	Analyses	$ -0-	
10.	Miscellaneous	$ 1,158	
	Total Direct Costs		$419,324
INDIRECT COSTS			
1.	Overhead	$ 27,541	
2.	General and Administrative Expenses	$ -0-	
3.	Other Indirect Costs	$ -0-	
4.	Fee or Profit	$ -0-	
	Total Indirect Costs		$27,541
TOTAL PROJECT COSTS			**$446,865**

Two subcontractors will be part of this project: Lawrence Berkeley Laboratory and a private consultant, Dr. Charles J. Weschler.

Labor	116,891	
Miscellaneous	14,364	
Total Direct Cost		$131,255
Indirect Cost	59,440	
Subcontractors Total		$190,695

Attachment 1

S U B C O N T R A C T O R S' B U D G E T S U M M A R Y

Subcontractor: Lawrence Berkeley National Laboratory

Description of subcontractor's responsibility: The PI on the LBNL subcontract, Al Hodgson, has an international reputation as one of the leading analytical chemists in the field of indoor air quality. He has extensive experience and is widely published on the topic of emission testing for indoor air sources of volatile organic compounds. He will be responsible for leading the efforts on Tasks 2 and 3, in which measurements will be made in emissions chambers under varying conditions. The experimental research in Tasks 2 and 3 will be conducted using the LBNL experimental facilities, including sophisticated analytical instrumentation (GC/MS, HPLC, etc.) and unique, state-of-the art test facilities (room-sized and small emissions chambers designed for indoor air quality studies).

DIRECT COSTS AND BENEFITS			
1.	Labor and Employee Fringe Benefits	$ 81,891	
2.	Subcontractors	$ -0-	
3.	Equipment	$ -0-	
4.	Travel and Subsistence	$ -0-	
5.	Electronic Data Processing	$ -0-	
6.	Reproduction/Publication	$ -0-	
7.	Mail and Phone	$ 504	
8.	Supplies	$ 5,300	
9.	Analyses	$ -0-	
10.	Miscellaneous	$ 8,560	
	Total Direct Costs		$96,255
INDIRECT COSTS			
1.	Overhead	$ 43,510	
2.	General and Administrative Expenses	$ 13,922	
3.	Other Indirect Costs	$ 2,008	
4.	Fee or Profit	$ -0-	
	Total Indirect Costs		$59,440
TOTAL PROJECT COSTS			**$155,695**

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Attachment 2

S U B C O N T R A C T O R S' B U D G E T S U M M A R Y

Subcontractor: Charles J. Weschler, Ph.D.

Description of subcontractor's responsibility: Dr. Charles Weschler is widely regarded as one of the world's leading physical chemists addressing indoor air quality problems. Moreover, he has specific research experience in some key aspects of this project. He has undertaken substantial studies of ozone chemistry in indoor air, including secondary production of pollutants from interactions with primary emissions. He has specifically studied ozone-terpene interactions in buildings, including the production of OH radicals. He will be responsible for leading the effort on Task 1, which will consist of a thorough literature review specific to the indoor air quality impacts of cleaning products, and will serve in an advisory role on the other tasks.

DIRECT COSTS AND BENEFITS			
11.	Labor and Employee Fringe Benefits	$ 35,000	
12.	Subcontractors	$ -0-	
13.	Equipment	$ -0-	
14.	Travel and Subsistence	$ -0-	
15.	Electronic Data Processing	$ -0-	
16.	Reproduction/Publication	$ -0-	
17.	Mail and Phone	$ -0-	
18.	Supplies	$ -0-	
19.	Analyses	$ -0-	
20.	Miscellaneous	$ -0-	
	Total Direct Costs		$35,000
INDIRECT COSTS			
5.	Overhead	$ -0-	
6.	General and Administrative Expenses	$ -0-	
7.	Other Indirect Costs	$ -0-	
8.	Fee or Profit	$ -0-	
	Total Indirect Costs		$35,000
TOTAL PROJECT COSTS			**$35,000**

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