

State of California  
AIR RESOURCES BOARD

Resolution 06-24

September 28, 2006

Agenda Item No.: 06-8-2

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 2610-252, entitled "Ventilation and Indoor Air Quality (IAQ) in Small and Medium Commercial Buildings (SMCB) Phase II Field Study," 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 2610-252 entitled "Ventilation and Indoor Air Quality (IAQ) in Small and Medium Commercial Buildings (SMCB) Phase II Field Study," submitted by the University of California, Davis, for a total amount not to exceed \$1,059,996;

WHEREAS, the California Energy Commission has agreed to cosponsor this proposal for a total amount of \$1,059,996; and

WHEREAS, the Air Resources Board will fund this proposal for a total amount not to exceed \$1,059,996.

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 2610-252 entitled "Ventilation and Indoor Air Quality (IAQ) in Small and Medium Commercial Buildings (SMCB) Phase II Field Study," submitted by the University of California, Davis, for a total amount not to exceed \$1,059,996;

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, for a total amount not to exceed \$1,059,996.

I hereby certify that the above is a true and correct copy of Resolution 06-24, as adopted by the Air Resources Board.

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Lori Andreoni, Clerk of the Board

## **ATTACHMENT A**

### **“Ventilation and Indoor Air Quality (IAQ) in Small and Medium Commercial Buildings (SMCB) Phase II Field Study”**

#### **Background**

Previous work sponsored by CEC on SMCB have included studies which looked at demand control ventilation, schools, fast food restaurants, and a few other types of businesses. CEC also funded the California End Use Survey (CEUS) which solicited data from thousands of California businesses and includes Heating Ventilation and Air Conditioning (HVAC) information such as single or multiple zones, code descriptions, chillers, square footage, number of single HVAC units, types of business, number of employees, and much more information of critical use to study of SMCB in California. The CEUS information also includes data on HVAC controls such as energy management/control systems, optimal start-stop, chiller sequencing, static pressure retest on HVAC system demand, outside air intake controls (CO<sub>2</sub>, VOC, or other sensors), night ventilation, and demand control ventilation (DCV). However confidentiality requirements have limited the availability of the CEUS data. Subject to certain limits some CEUS information summaries have now been made available for this SMCB program.

The United States Environmental Protection Agency’s Building Assessment Survey and Evaluation Study (BASE) of 100 buildings remains the most open source of data on SMCB. Analyses of the ventilation data have greatly improved our understandings of indoor air quality and HVAC practices. However, there were only fifteen California buildings; thus, the sample size of SMCB remains too narrow of a database to build a statistically representative sample for California. The Department of Energy’s Commercial Building Energy Consumption Survey (CBECS) is another resource for this work and includes information on space heating and cooling activities. The phase I survey part of this program is expected to bring together the lessons learned from these other studies and to systematically address SMCB issues in California for the first time. The survey program is also designed to develop participant lists that allow further solicitation for participation in this study. While the survey data will be useful, this phase II field study will collected actual HVAC and IAQ data and is thus of key importance to CEC and ARB staff.

#### **Objective**

The objectives of this field study are:

1. Obtain data on SMCB field study building characteristics, and operation and maintenance of their HVAC and air filtration systems.
2. Obtain field data on the design and performance parameters of HVAC and air filtration systems in SMCB.
3. Obtain data on indoor pollutant levels, especially toxic air contaminants, and potential pollutant sources in a variety of SMCB. To the extent feasible study the moisture related history and parameters for the selected buildings. To the extent

feasible, obtain information on history of IAQ complaints and problems in the buildings.

4. Measure particulate matter inside and outside of buildings and air exchange rates so that one can estimate penetration rates for particulate matter in a variety of SMCB, including those with IAQ complaints.
5. Analyze relationships between and among building ventilation, filtration, operation and IAQ pollutant levels and problems.

Phase II data on design and performance of HVAC and air filtration systems for buildings visited would be critical to developing Title 24 rulemaking by circa 2011 and are needed in 2008 to begin the rulemaking process.

### **Methods**

With CEC, ARB, and Lawrence Berkeley National Laboratory (LBNL) assistance, UC Davis (UCD) staff will use the Survey program supplied potential participants list and through interviews and additional solicitation develop a final list of 40 candidates (plus a few alternates) for participation in the field study. UCD staff will then choose a pilot group of 5 buildings to test the efficacy of procedures and operational forms adopted for this study from the BASE program. UCD staff will then conduct an inspection of the SMCB pilot participant and “walk through” to characterize buildings’ HVAC systems, filtration equipment, modes of operation and maintenance, and schedule of replacement/repairs. To characterize performance of the HVAC system, the National Institute of Standards (NIST) and Tests staff who support the goals of this project will return on a second day to complete a pressurization test sealing the HVAC unit and using blower doors. To better understand indoor air quality and penetration of outside air inside buildings UCD staff will accompany NIST staff on the second day to measure indoor v. outdoor ozone, NO<sub>2</sub>, aldehydes, air toxics, and particulate matter. We will present a report of the pilot study to the Expert Committee and seek their advice in proceeding to the full field program. When we have the consent of the Expert Committee, UCD staff will conduct the full scale field program. UCD staff will use an inert tracer gas in determining HVAC system performance. UCD staff will prepare monthly reports.

### **Expected Results**

The first representative field database of SMCB sector in California will be available for analysis of pertinent indoor air quality issues. Contractor analyses will provide the actual practices for indoor air quality and HVAC for SMCB sector. Contractor will provide the necessary data and options to identify indoor air quality and HVAC problems and address options for overcoming these problems. Contractor will supply their data and conclusions for use by the CEC staff in setting new energy efficiency standards and for ARB staff to develop new health-based indoor air quality guidelines.

### **Significance to the Board**

ARB ambient air quality standards and CEC indoor “thermal comfort” and “energy efficiency” building standards compliment each other. Successful execution of this contract significantly expands the Boards assistance to the CEC building standards

program and reinforces the historical role of ARB as the principal analytical state agency for indoor air quality.

**Contractor:**

University of California Davis and Lawrence Berkeley National Laboratory

**Contract Period:**

27 months

**Principal Investigator (PI):**

Debbie Bennett (UCD) and Michael G. Apte (LBNL)

**Contract Amount:**

\$1,059,996

**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:**

The LBNL investigators are the key partner in the survey phase of the SMCB project and have performed well in the New Home Survey project. UCD investigators hail from the LBNL indoor air quality program and have worked extensively in this area at Harvard University. We are quite pleased with LBNL staff's service and expect the same high standards the UCD staff demonstrated at Harvard and LBNL.

**Prior Research Division Funding to UCD:**

Year	2005	2004	2003
Funding	\$1,429,108	\$159,715	\$220,896

# BUDGET SUMMARY

University of California, Berkeley

Indoor Environmental Quality and HVAC Survey of Small And Medium Size Commercial Buildings

## **DIRECT COSTS AND BENEFITS**

1.	Labor and Employee Fringe Benefits	\$	263,604
2.	Subcontractors	\$	169,800
3.	Equipment	\$	0
4.	Travel and Subsistence	\$	4,380
5.	Electronic Data Processing	\$	12,329
6.	Reproduction/Publication	\$	2,300
7.	Mail and Phone	\$	14,850
8.	Supplies	\$	20,375
9.	Analyses	\$	0
10.	Miscellaneous	\$	<u>37,664</u>
	Total Direct Costs		\$525,302

## **INDIRECT COSTS**

1.	Overhead	\$	34,664
2.	General and Administrative Expenses	\$	0
3.	Other Indirect Costs	\$	0
4.	Fee or Profit	\$	<u>0</u>
	Total Indirect Costs		<u>\$34,664</u>

## **TOTAL PROJECT COSTS**

**\$559,966**

Attachment 1

**SUBCONTRACTORS' BUDGET SUMMARY**

Subcontractor: Lawrence Berkeley National Laboratory

Description of subcontractor's responsibility: Guide the Survey Program, Develop Survey Instruments, Support the Survey Program throughout Implementation, Analyze the Survey Data, Provide Conclusions about SMCB from Analyses.

**DIRECT COSTS AND BENEFITS**

1.	Labor and Employee Fringe Benefits	\$	84,432
2.	Subcontractors	\$	0
3.	Equipment	\$	0
4.	Travel and Subsistence	\$	1,750
5.	Electronic Data Processing	\$	0
6.	Reproduction/Publication	\$	0
7.	Mail and Phone	\$	0
8.	Supplies	\$	3,620
9.	Analyses	\$	0
10.	Miscellaneous	\$	<u>5,387</u>
	Total Direct Costs		\$95,189

**INDIRECT COSTS**

1.	Overhead	\$	48,438
2.	General and Administrative Expenses	\$	0
3.	Other Indirect Costs	\$	26,173
4.	Fee or Profit	\$	<u>0</u>
	Total Indirect Costs		<u>\$74,611</u>

**TOTAL PROJECT COSTS**

**\$169,800**