State of California
AIR RESOURCES BOARD

RESEARCH PROPOSAL

Resolution 05-73

December 8, 2005

Agenda Item No.: 05-12-2

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 2607-250, entitled "Augmentation to Ventilation and Indoor Air Quality in New Homes", has been submitted by Indoor Environmental Engineering;

WHEREAS, the Research Division staff has reviewed and recommended this proposal for approval; and

WHEREAS, the California Energy Commission has agreed to fund this proposal in its entirety for a total amount of $96,861; and

WHEREAS, the Research Screening Committee has reviewed and recommends for funding:

> Proposal Number 2607-250 entitled "Augmentation to Ventilation and Indoor Air Quality in New Homes", submitted by Indoor Environmental Engineering, for a total amount not to exceed $96,861.

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 2607-250 entitled "Augmentation to Ventilation and Indoor Air Quality in New Homes", submitted by Indoor Environmental Engineering, for a total amount not to exceed $96,861.

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 $96,861.

I hereby certify that the above is a true and correct copy of Resolution 05-73, as adopted by the Air Resources Board.

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Lori Andreoni, Clerk of the Board

## ATTACHMENT A

## "Augmentation to Ventilation and Indoor Air Quality in New Homes"

### Background

Concerns have been raised over the health risks of indoor air pollutants in new California homes, and whether they have adequate ventilation for removing indoor air pollutants and excess moisture. In March 2005, ARB approved a study to obtain information on ventilation characteristics and indoor air quality (IAQ) in new, single-family, detached homes. The California Energy Commission (Commission) has funded this study, entitled "Ventilation and Indoor Air Quality in New Homes." The specific objectives of this study include: determining the occupants' use of windows, doors, exhaust fans and central heating and cooling systems; measuring indoor air pollutant levels, environmental conditions, building ventilation rates, and fan and central system use; and examining the relationships among home ventilation characteristics, indoor air quality, and house and household characteristics. The Contractor will measure indoor and outdoor air concentrations of several volatile organic compounds, formaldehyde, PM2.5, nitrogen dioxide, carbon monoxide, and carbon dioxide (for assessing ventilation adequacy). Another study objective is to identify incentives and barriers that influence household actions to improve ventilation and indoor air quality. The current study is in the planning stages for the pilot and main field study. Additional Commission funding has become available, and the Commission has agreed to fund certain improvements to the study.

### Objective

The objectives of this augmentation are: 1) to increase the number of study homes with whole house mechanical (fresh air) ventilation systems from 12 to 20 homes; 2) to use an improved method for measuring home air exchange rates; 3) to provide lock boxes on homes to allow researcher access while maintaining the security of the study homes; 4) to deploy canisters to obtain data on acrylonitrile concentrations in new homes, and 5) to fund the Contractor's participation in the annual meeting of the Commission's Public Interest Environmental Research Program. The augmentation also includes Quantum Consulting, a well-qualified replacement for RLW Analytical, the subcontractor responsible for recruiting study participants and managing and analyzing data. This replacement was necessitated by the departure of the original RLW project manager, and is by mutual consent of the contractor and RLW.

### Methods

In the current field study, the contractor is studying 100 new, single family homes from two climatic regions of the state and in two seasons. Included is a subset of 12 homes with mechanical (fresh-air) ventilation systems for the whole house. The Contractor will extensively measure and record ventilation characteristics, indoor and outdoor pollutant concentrations, residents' ventilation practices, residents' IAQ perceptions, and residents' decision factors for ventilation and IAQ-related actions. The contractor will also examine relationships among ventilation characteristics, measured and perceived IAQ, and house and household characteristics.

Through the Augmentation, 8 more homes with mechanical ventilation will be tested and inspected in the same manner as the other homes, making a total of 20 mechanical ventilation homes in the study and a total of 108 homes altogether. In addition, air

exchange rates will be measured in all 108 study homes over 24 hours using a safe, non-toxic tracer gas and sampling tubes. The method originally proposed was a calculation method based on a one-hour measurement with a different tracer gas. The augmentation also will provide lockboxes, to allow access by the investigators while retaining security when homeowners cannot be home on a test day but are willing to grant access. Finally, canisters or other appropriate samplers will be deployed for air sampling of acrylonitrile in 50 homes, plus quality control and outdoor air samples; ARB will provide the samplers, shipping, and laboratory analyses.

**Expected Results**
This study will provide representative, accurate, and current information on both IAQ and ventilation in new California homes. This augmentation will substantially increase the number and diversity of study homes with mechanical ventilation, thereby improving our understanding of home ventilation system performance. This augmentation will also provide more accurate ventilation rate measurements during the 24 hours of indoor air sampling. This will improve the contractor's assessment of the impacts of indoor pollutant sources and the comparison to results from other studies. The use of lock boxes is expected to increase homeowner response rates and increase the efficiency of field teams and recruiters. The collection of acrylonitrile samples is expected to yield current measurements of acrylonitrile concentrations in California homes, which can be used to assess the risk posed by acrylonitrile, a compound with high cancer potency.

**Significance to the Board**
ARB will use the study results to improve its ability to identify current sources of indoor air pollutants; to assess Californians' current exposure to measured toxic air contaminants; and to recommend effective strategies for reducing indoor air pollution. The Commission will use the study results to revise the state’s building energy efficiency standards in order to provide more healthful, energy-efficient homes in California. The augmentation will improve the quality and quantity of information produced by this study, and will allow ARB to cost-effectively obtain needed information on acrylonitrile exposures and sources.

**Contractor:**
Indoor Environmental Engineering

**Contract Period:**
25 months.

**Principal Investigator (PI):**
Francis J. Offermann III

**Contract Amount:**
Augmentation of $96,861 to original contract for $1,042,935.

**Cofunding:**
The California Energy Commission is contributing the total cost of this Augmentation, which is $96,861.

**Basis for Indirect Cost Rate:**
Rates are similar to those of other firms performing similar work in northern California.

**Past Experience with this Principal Investigator:**
In the 1990's, the Principal Investigator performed well in conducting a small study to develop and test an indoor monitoring method for polycyclic aromatic hydrocarbons.

**Prior Research Division Funding to IEE:**

| Year | 2005 | 2004 | 2003 |
|---|---|---|---|
| Funding | $0 | $1,042,935* | $0 |

* Funded by the California Energy Commission

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

Indoor Environmental Engineering

"Augmentation to Ventilation and Indoor Air Quality in New Homes"

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|---|---|---|---|
| **DIRECT COSTS AND BENEFITS** | | | |
| 1. | Labor and Employee Fringe Benefits | $ 8,255 | |
| 2. | Subcontractors | $ 42,688[1] | |
| 3. | Equipment | $ 0 | |
| 4. | Travel and Subsistence | $ 98 | |
| 5. | Electronic Data Processing | $ 0 | |
| 6. | Reproduction/Publication | $ 0 | |
| 7. | Mail and Phone | $ 0 | |
| 8. | Supplies | $ 960 | |
| 9. | Analyses | $ 29,688[2] | |
| 10. | Miscellaneous | $ 1,700 | |
| | Total Direct Costs | | $83,389 |
| **INDIRECT COSTS** | | | |
| 1. | Overhead | $ 4,666 | |
| 2. | General and Administrative Expenses | $ 0 | |
| 3. | Other Indirect Costs | $ 0 | |
| 4. | Fee or Profit | $ 8,806 | |
| | Total Indirect Costs | | $13,472 |
| **TOTAL PROJECT COSTS** | | | **$96,861** |

1. The majority of this expense ($38,080) is for Davis Energy Group, a subcontractor in the current study, to install tracer gas sources for the air exchange rate measurements and to conduct additional field work for window and fan ventilation measurements. Other subcontractors will manage and analyze the data and assist in the additional field work.
2. The addition of 8 more mechanical ventilation homes, including quality control samples, requires laboratory analyses of 14 more samples for volatile organic compounds ($4,790), formaldehyde ($1,411), nitrogen dioxide ($722), and PM2.5 ($257). The air exchange rate measurements for 143 home tests and quality control samples requires tracer gas sources ($3,132), analysis of samplers ($28,380), and data analyses and reporting ($3,396); the cost of the tracer tests originally proposed ($12,400) is subtracted. Berkeley Analytical, DataChem, and Brookhaven National Laboratory will perform these analyses.

**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: Davis Energy Group

Ventilation team leader: Will deploy tracer gas sources in all homes and ventilation data loggers and questionnaires. They will also inspect homes, and download logger data for 8 additional homes.

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|---|---|---|---|
| **DIRECT COSTS AND BENEFITS** | | | |
| 1. | Labor and Employee Fringe Benefits | $15,239 | |
| 2. | Subcontractors | $ 0 | |
| 3. | Equipment | $ 0 | |
| 4. | Travel and Subsistence | $ 9,256 | |
| 5. | Electronic Data Processing | $ 0 | |
| 6. | Reproduction/Publication | $ 0 | |
| 7. | Mail and Phone | $ 0 | |
| 8. | Supplies | $ 713 | |
| 9. | Analyses | $ 0 | |
| 10. | Miscellaneous | $ 0 | |
| | Total Direct Costs | | $25,208 |
| **INDIRECT COSTS** | | | |
| 1. | Overhead | $ 9,410 | |
| 2. | General and Administrative Expenses | $ 0 | |
| 3. | Other Indirect Costs | $ 0 | |
| 4. | Fee or Profit | $ 3,462 | |
| | Total Indirect Costs | | $12,872 |
| **TOTAL PROJECT COSTS** | | | **$38,080** |