

## SUMMARY OF BOARD ITEM

**ITEM # 03-4-4:** Public Meeting to Consider Proposed Grants for Developing New Air Monitoring Instruments

**STAFF RECOMMENDATION:** Approve grants totaling \$435,000 for two projects.

**DISCUSSION:** The Air Resources Board (ARB) is pursuing the development of new air monitoring instruments via the Innovative Clean Air Technologies (ICAT) grant program. Our ultimate goal is commercial availability of inexpensive, easily-used instruments that can be deployed widely to assess local air quality. The purpose of the ICAT program is to co-fund projects that will end with practical demonstrations of new instruments.

ICAT will fund grantees' projects up to 50 percent. Half of the funds for grants will be provided by the California Energy Commission (CEC), via a contract with ARB.

The Research Division issued a general call for abstracts of proposals for projects to develop and demonstrate new air monitoring instruments. We received 67 abstracts in response. After reviewing the abstracts, we invited full proposals from 19 applicants, of whom 13 responded.

Staff from the Research Division, Monitoring and Laboratory Division, CEC, U.S. Environmental Protection Agency, and academia reviewed the 13 proposals. We have selected three of the proposals to recommend to the Board for new grants. They are:

- University of Southern California; "A Simple, Low-Cost Beta Attenuation Monitor (BAM) for Continuous Measurement of PM10, PM2.5 or Ultrafine Particle Concentrations"; \$144,000
- Berkeley Sensor and Actuator Center (UCB with LBNL); "Development of a Low-Cost Particulate Matter Monitor"; \$291,000

**SUMMARY AND IMPACTS:** The staff expects these projects to hasten the commercial availability of simple, portable, easily

deployed new monitoring instruments. Together, the instruments will apply to ambient and indoor concentrations of PM, diesel PM, ozone, NO<sub>x</sub>, and gaseous toxic air contaminants. We anticipate each instrument to be substantially cheaper to buy and operate than its current alternative technologies. They will facilitate the characterization of exposures on a much finer spatial scale than is now practical.

## PROPOSED

State of California  
AIR RESOURCES BOARDResolution 03-11  
May 22, 2003

Agenda Item No.: 03-4-4

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 proposal number 03-17, entitled "A Simple Low-Cost Beta Attenuation Monitor (BAM) for Continuous Measurement of PM<sub>10</sub>, PM<sub>2.5</sub> or Ultrafine Particle Concentrations", has been submitted by the University of Southern California in response to the 2003 Innovative Clean Air Technologies (ICAT) Program solicitation;

WHEREAS, the California Energy Commission will provide half the funds for grants made under the 2003 Innovative Clean Air Technologies (ICAT) Program;

WHEREAS, the proposal has been independently reviewed for technical and business merit by highly qualified individuals; and

WHEREAS, the Research Division staff and the Executive Officer and Deputy Executive Officers have reviewed and recommend for funding:

Proposal Number 03-17, entitled "A Simple Low-Cost Beta Attenuation Monitor (BAM) for Continuous Measurement of PM<sub>10</sub>, PM<sub>2.5</sub> or Ultrafine Particle Concentrations", submitted by the University of Southern California, for a total amount not to exceed \$143,830.

NOW, THEREFORE BE IT RESOLVED, that the Air Resources Board, pursuant to the authority granted by Health and Safety Code Section 39703, hereby approves the following:

Proposal Number 03-17, entitled "A Simple Low-Cost Beta Attenuation Monitor (BAM) for Continuous Measurement of PM<sub>10</sub>, PM<sub>2.5</sub> or Ultrafine Particle Concentrations", submitted by the University of Southern California, for a total amount not to exceed \$143,830

BE IT FURTHER RESOLVED, that the Executive Officer is hereby authorized to initiate administrative procedures and execute all necessary documents and agreements for the efforts proposed herein, and as described in Attachment A, in an amount not to exceed \$143,830.

## ATTACHMENT A

## Innovative Clean Air Technologies (ICAT) Grant Proposal:

"A Simple Low-Cost Beta Attenuation Monitor (BAM) for Continuous Measurement of PM<sub>10</sub>, PM<sub>2.5</sub> or Ultrafine Particle Concentrations"**Background**

The instruments now available for monitoring the ambient concentration of PM<sub>2.5</sub> are not practical for widespread deployment by untrained persons or organizations of modest means. The weaknesses of the existing instruments include price (typically over \$10,000), the need for laboratory analyses of samples, the need for pre-sampling preparation, and poor portability. Thus, it is generally impractical to directly determine exposures to PM distant from the fixed-site air monitors run by the ARB and other regulatory agencies. Local concentrations of PM can only be estimated by modeling applied to estimates of source strengths and meteorological data obtained from distant stations.

**Objective**

The principle of operation of the proposed device is based upon the well-characterized measurement of beta rays across a filter medium that is collecting particulate matter. The extinction coefficient, to an excellent approximation, is dependent only upon mass; it is significantly independent of chemical composition and particle size. Beta attenuation devices have a long track record of producing highly accurate, highly reliable measurements. The objective of this project is to design a low-cost BAM to measure PM<sub>10</sub>, PM<sub>2.5</sub> and ultrafine PM levels in a wide range of environments.

**Methods**

The principle methods to be used in carrying out the project are:

1. Manufacture a prototype unit;
2. Perform comprehensive testing of the prototype unit via inter-comparison with existing continuous and time-integrated sampling techniques, including FRM methods;
3. Evaluate and demonstrate the unit's performance with respect to accuracy, repeatability, etc., under a wide range of sampling conditions including indoor environments, outdoor environments, stack sampling, temperature fluctuations, wind speed, and particle chemical compositions;
4. Offer the unit for sale on a commercial basis.

**Expected Results**

Upon completion of this project a prototype unit will be fully tested and ready for commercial availability. The results of the testing of the unit will be published in a

leading peer-reviewed scientific journal, thus providing wide visibility and scientific legitimacy for the final product. The potential users for the proposed device would be governmental entities engaged in ambient particulate monitoring for enforcement and compliance purposes. In addition, governmental or research institutions involved in health studies involving the impact of fine particles would be prime candidates for using this device.

### **Significance to the Board**

Completion of the grant project will greatly promote the commercial availability of a new instrument for measuring the ambient concentration of particulate matter. A new instrument will make it more practical for persons and organizations concerned with local exposures of particulate matter to monitor air quality themselves.

By making and managing the recommended grant, the Board will fulfill in part contract R01-356 with the California Energy Commission.

**Applicant:** University of Southern California

**Project Period:** June 1, 2003 through May 31, 2005

**Principal Investigator:** Phillip M. Fine                      **ICAT Funding:** \$143,830

**Co-funding :** \$149,849

**Past Experience with This Principal Investigator:** None. However, the extent of review of the ICAT proposal provides an adequate basis for recommending a grant. The application was reviewed externally by academic engineers and scientists, other agencies, and academic business reviewers and internally by the Research Division and Monitoring and Laboratory Division. In addition, staff has previously entered into contracts with other PIs at the University of Southern California with satisfactory results.

### **Prior ICAT Funding to University of Southern California**

Year	2002	2001	2000
Funding	0	0	0

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

University of Southern California

"A Simple Low-Cost Beta Attenuation Monitor (BAM) for Continuous Measurement of  
PM<sub>10</sub>, PM<sub>2.5</sub> or Ultrafine Particle Concentrations"

<u>Direct Costs and Benefits</u>	<u>ICAT</u>	<u>Total</u>
1. Labor	\$ 38,218	\$ 82,109
2. Employee Fringe Benefits	\$ 12,612	\$ 17,885
3. Subcontractors	\$ 49,000	\$ 49,000
4. Equipment	\$ 0	\$ 0
5. Travel and Subsistence	\$ 2,872	\$ 2,872
6. Materials and Supplies	\$ 12,325	\$ 52,325
7. Other Direct Costs	<u>\$ 1,150</u>	<u>\$ 1,150</u>
Total	\$116,177	\$205,341
<u>Indirect Costs</u>		
1. Overhead	\$ 27,653	\$ 88,338
2. Other Indirect Costs	<u>\$ 0</u>	<u>\$ 0</u>
Total	<u>\$ 27,653</u>	<u>\$ 88,338</u>
<b>Total Project Costs</b>	<b>\$143,830</b>	<b>\$293,679</b>

## PROPOSED

State of California  
AIR RESOURCES BOARDResolution 03-12  
May 22, 2003

Agenda Item No.:03-4-4

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 proposal, number 03-57, entitled "Development of a Low-Cost Particulate Matter Monitor", has been submitted by the University of California, Berkeley, in response to the 2003 Innovative Clean Air Technologies (ICAT) Program solicitation;

WHEREAS, the California Energy Commission will provide half the funds for grants made under the 2003 Innovative Clean Air Technologies (ICAT) Program;

WHEREAS, the proposal has been independently reviewed for technical and business merit by highly qualified individuals; and

WHEREAS, the Research Division staff and the Executive Officer and Deputy Executive Officers have reviewed and recommend for funding:

Proposal number 03-57, entitled "Development of a Low-Cost Particulate Matter Monitor", submitted by the University of California, Berkeley, for a total amount not to exceed \$291,000.

NOW, THEREFORE BE IT RESOLVED, that the Air Resources Board, pursuant to the authority granted by Health and Safety Code Section 39703, hereby approves the following:

Proposal number 03-57, entitled "Development of a Low-Cost Particulate Matter Monitor", submitted by the University of California, Berkeley, for a total amount not to exceed \$291,000.

BE IT FURTHER RESOLVED, that the Executive Officer is hereby authorized to initiate administrative procedures and execute all necessary documents and agreements for the efforts proposed herein, and as described in Attachment A, in an amount not to exceed \$291,000.

## ATTACHMENT A

Innovative Clean Air Technologies (ICAT) Grant Proposal:  
**Development of a Low-Cost Particulate Matter Monitor**

**Background**

The instruments now available for monitoring the ambient concentration of PM<sub>2.5</sub> are not practical for widespread deployment by untrained persons and organizations of modest means. The weaknesses of the existing instruments include price (typically over \$10,000), the need for laboratory analyses of samples, the need for pre-sampling preparation, and poor portability. Thus, it is generally impractical to directly determine exposures to PM distant from the fixed-site air monitors run by the ARB and other regulatory agencies. Local concentrations of directly emitted PM must be estimated by modeling applied to estimates of source strengths, using meteorological data obtained from distant stations.

**Objective**

The grant work will be to improve a prototype PM monitoring instrument that combines miniature piezo-electric resonators with infrared/UV absorption and to demonstrate its ability to measure the mass of fine PM and the combustion-generated fraction. This device should operate unattended for substantial periods and produce data without pre- or post-sampling laboratory work. It should be very portable, fairly inexpensive, and usable by relatively untrained personnel. It should be suitable for community organizations and power-plant siting proponents to make their own measurements of local PM<sub>2.5</sub> concentrations.

**Methods**

UCB and its partner, Lawrence Berkeley National Laboratory, will design, fabricate, and evaluate alternative methods for placing multiple micro-resonators on single disposable chips. The chosen technology will be integrated into a thermophoretic deposition channel with a UV/IR optics, electronic signal processing, and a size-selective flow inlet. The device will be optimized for signal-to-noise in laboratory simulations of PM-laden ambient air. The response of the optimized device to combustion-generated PM will be calibrated against integrated gravimetric samples and real-time instruments such as a quartz crystal microbalance and an optical counter. Finally, the device will be compared to the FRM method for PM<sub>2.5</sub> in ambient monitoring.

**Expected Results**

At the end of the project, the device should be ready for initiating commercialization work.

### Significance to the Board

Completion of the grant project will greatly promote the eventual commercial availability of a new instrument for measuring the ambient concentration of fine PM and its combustion-generated fraction. A new instrument will make it more practical for persons and organizations concerned with local PM exposures to monitor air quality themselves.

By making and managing the recommended grant, the Board will fulfill in part contract R01-356 with the California Energy Commission.

**Applicant:** University of California, with participation by the Berkeley Sensor and Actuator Center and Lawrence Berkeley National Laboratory

**Project Period:** June 1, 2003, to May 31, 2005

**Principal Investigator:** Richard M. White, Ph.D.

**ICAT Funding:** \$291,000

**Co-funding :** UC Berkeley -- \$63,000

LBNL -- \$40,625

Tobacco-Related Disease Research Program - \$222,337

### Past Experience with This Principal Investigator

None. However, the extent of review of the ICAT proposal provides an adequate basis for recommending a grant. The application was reviewed externally by academic engineers and scientists, other agencies, and academic business reviewers and internally by the Research Division and Monitoring and Laboratory Division.

### Prior ICAT Funding to UC Berkeley

Year	2002	2001	2000
Funding	0	0	0

## BUDGET SUMMARY

University of California, Berkeley

### Development of a Low-Cost Particulate Matter Monitor

<u>Direct Costs and Benefits</u>	<u>ICAT</u>	<u>Total</u>
1. Labor	\$ 82,137	\$139,065
2. Employee Fringe Benefits	\$ 5,669	\$ 13,966
3. Subcontractors	\$144,000	\$144,000
4. Equipment	\$ 0	\$ 0
5. Travel and Subsistence	\$ 108	\$ 108
6. Materials and Supplies	\$ 14,759	\$ 14,759
7. Other Direct Costs	<u>\$ 29,612</u>	<u>\$251,949</u>
Total	\$276,285	\$563,847
<u>Indirect Costs</u>		
1. Overhead	\$ 14,715	\$ 53,115
2. Other Indirect Costs	<u>\$ 0</u>	<u>\$ 0</u>
Total	<u>\$ 14,715</u>	<u>\$ 53,115</u>
 <b>Total Project Costs</b>	 <b>\$291,000</b>	 <b><u>\$616,962</u></b>