PROPOSED

State of California
AIR RESOURCES BOARD

RESEARCH PROPOSAL

Resolution 11-3

February 24, 2011

Agenda Item No.: 11-1-1

WHEREAS, the Air Resources Board (ARB or 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 2705-269, entitled "Air Movement as an Energy Efficient Means Toward Occupant Comfort," 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 2705-269, entitled "Air Movement as an Energy Efficient Means Toward Occupant Comfort," submitted by the University of California Berkeley, for a total amount not to exceed $170,000.

NOW, THEREFORE, BE IT RESOLVED that ARB, pursuant to the authority granted by Health and Safety Code section 39703, hereby accepts the recommendation of RSC and approves the following:

> Proposal Number 2705-269, entitled "Air Movement as an Energy Efficient Means Toward Occupant Comfort," submitted by the University of California Berkeley, for a total amount not to exceed $170,000.

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 $170,000.

ATTACHMENT A

"Air Movement as an Energy Efficient MeansToward Occupant Comfort"

Background

California's commercial sector compressor-based cooling constitutes roughly 15% of total electricity consumption. Recent studies of occupant comfort during the warmer seasons confirms over-cooling by some that could account for 1/3 excess use of energy in commercial buildings. A series of recent publications has demonstrated occupant control of near environment comfort through mini ventilation systems are extremely effective in energy conservation and can potentially improve indoor air quality. The American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) has long opposed near occupant space air movement as a means of increasing ventilation and reducing indoor air temperatures during warmer seasons, preferring to rely on mechanical ventilation, sealed buildings, and central air conditioning. As recent studies have demonstrated, most commercial buildings are not properly sealed, and mechanical ventilation, if it is operational at all, is available for only a minority of these buildings. Heating and ventilation equipment rarely have outside air inlets and air filtering operations are in general sub-standard. Recognizing these facts, ASHRAE has recently revised existing standards to allow near occupant air movement as a means of cooling and saving energy. Personal environmental control (PEC) systems such as micro fans and nozzles have been demonstrated to improve thermal comfort, reduce or eliminate potential overcooling, and potentially improve indoor air quality if handled properly. Numerous fan and nozzle configurations can be attached to office furniture, partitions, and ceilings, but the market may best be characterized by lack of innovation.

Objective

This project will optimize the design of air movement devices suitable for mounting in a range of positions within a room and quantify their ability to produce fast-acting personal environmental control for the occupants. Researchers will investigate how buildings can transition from air conditioning systems to PEC-equipped systems and recommend optimal devices as stand alone devices or integrated into architecture systems.

Methods

The research team will use advanced PEC instruments and equipment available through the Center for the Built Environment (CBE) as well as thermal manikins and anemometers to arrive at optimum air movements and cooling effects. The team will assess the physiological consequences of having the building temperature set point higher during the warmer seasons. Using human subjects and selected PEC instruments, investigators will characterize exposure to higher temperature set points and personal human subject use of PEC in a controlled environment chamber. Assuring human subject satisfaction using surveys and other instruments, the team will investigate optimum energy savings and highest central temperature set points. For example, using mathematical and thermo dynamic models of buildings in southern and northern California, the team will simulate the energy saving potential of shifting the

building operation strategy from strict temperature conditioning to higher indoor temperatures and increased air movement.

Expected Results
Study results will provide ARB and the California Energy Commission (CEC) with a tool to refine Title 24 energy efficiency and mitigation programs in support of AB 32 and other goals related to energy conservation, climate change, and financial savings.

Significance to the Board
Study results could have significant implications with regard to reducing energy consumption and avoiding associated anthropogenic emissions, thus supporting the Title 24 California Energy Efficiency standards as well as AB 32. Avoided anthropogenic emissions may also reduce ambient ozone and aerosol concentrations, which are critical challenges for the upcoming State Implementation Plan.

Contractor:
University of California, Berkeley

Contract Period:
36 months

Principal Investigator (PI):
Edward Arens, Ph.D.

Contract Amount:
$170,000

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:
Professor Edward Arens and Dr. Hui Zhang of the Center for the Built Environment have extensive experience with the CEC and the federal Department of Energy and extensive experience with the Lawrence Berkeley National Laboratory. ARB has not previously contracted with this research team, but expects good results based on feedback from colleagues at the CEC as well as Lawrence Berkeley National Laboratory.

Prior Research Division Funding to University of California, Berkeley:

Year	2009	2008	2007
Funding	$1,507,702	$1,140,572	1,350,484

BUDGET SUMMARY

Contractor: University of California, Berkeley

"Air Movement as an Energy Efficient Means Toward Occupant Comfort"

DIRECT COSTS AND BENEFITS				
1.	Labor and Employee Fringe Benefits	$	147,653	
2.	Subcontractors	$	0	
3.	Equipment	$	0	
4.	Travel and Subsistence	$	3,500	
5.	Electronic Data Processing	$	0	
6.	Reproduction/Publication	$	305	
7.	Mail and Phone	$	300	
8.	Supplies	$	3,649	
9.	Analyses	$	0	
10.	Miscellaneous	$	434	
	Total Direct Costs			$155,841
INDIRECT COSTS				
1.	Overhead	$	14,159	
2.	General and Administrative Expenses	$	0	
3.	Other Indirect Costs	$	0	
4.	Fee or Profit	$	0	
	Total Indirect Costs			$14,159
TOTAL PROJECT COSTS				**$170,000**