State of California
AIR RESOURCES BOARD

RESEARCH PROPOSAL

Resolution 10-14

February 25, 2010

Agenda Item No.: 10-2-1

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 2701-266, entitled "In-Duct Air Cleaning Devices: Ozone Emission Rates and Test Methodology," has been submitted by the Missouri University of Science and Technology;

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

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

> Proposal Number 2701-266 entitled "In-Duct Air Cleaning Devices: Ozone Emission Rates and Test Methodology," submitted by the Missouri University of Science and Technology, for a total amount not to exceed $325,000.

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 2701-266 entitled "In-Duct Air Cleaning Devices: Ozone Emission Rates and Test Methodology," submitted by the Missouri University of Science and Technology, for a total amount not to exceed $325,000.

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 $325,000.

I hereby certify that the above is a true and correct copy of Resolution 10-14, as adopted by the Air Resources Board.

Sandra Bannerman, Clerk of the Board

ATTACHMENT A

In-Duct Air Cleaning Devices: Ozone Emission Rates and Test Methodology

Background
In 2007, Air Resources Board (ARB or Board) adopted a regulation that limits ozone emissions from indoor air cleaning devices. In-duct devices, i.e., those physically integrated within a central ventilation system, were exempted from the requirements of ARB's regulation because no suitable test method was available for measuring ozone emissions from such devices, and few data were available on their ozone emissions. The ozone chamber test method required by the current ARB regulation, Section 37 of Underwriters Laboratories, Inc. Standard 867, does not include a suitable test method for measuring ozone emissions from in-duct devices.

However, there are a number of in-duct air cleaner technologies marketed in California that can emit ozone. These technologies include intentional ozone generators, electrostatic precipitators, ionizers, filters enhanced by electrical power, and some air cleaners using ultraviolet light. Some of these technologies may generate significant amounts of ozone and/or ozone reaction byproducts such as formaldehyde.

In a few published studies, indoor ozone concentrations in homes and test homes with in-duct electronic air cleaners have ranged from 10 parts per billion (ppb) to 200 ppb. Current ARB air cleaner regulation limits ozone emission concentrations of portable air cleaners to 50 ppb. Therefore, the potential for in-duct electronic air cleaners to increase indoor ozone exposures to indoor ozone and its toxic by-products, and to produce the associated health effects, is substantial.

Objective
The primary objectives of the proposed research are to: 1) develop and test a method of measuring the ozone emissions from in-duct electrically-connected air cleaners ("device"), and 2) obtain real-world data on indoor ozone concentration increases due to use of these devices in field sites. Two secondary objectives are to: 3) apply the method to a number of commercially available units in a laboratory setting to measure emission rates, and 4) estimate the impact of in-duct air cleaners in typical California buildings.

Methods
The principal investigators (PIs) will first generate a list of in-duct electronic air cleaner models and their relative market share in California. Electronic air cleaner technologies, as well as other potential ozone-emitting technologies, will be identified and ranked. Next, the PIs will conduct laboratory experiments on available in-duct devices to measure ozone emission rates. This testing will be completed on approximately ten (but no less than seven) air cleaners to cover the most popular types of air cleaner technologies, and will include at least one ozone generator model. Then, these data will be used to develop a robust laboratory test method that can be applied by commercial testing laboratories to measure the ozone emission rates from such devices.

Concurrent with laboratory testing, the PIs will measure ozone increases from in-duct devices in three homes in Tulsa, Oklahoma, similar to types of homes found in California, in order to develop robust field data and techniques so that California home testing can be performed most efficiently. Next, the investigators will conduct field tests in California buildings with installed in-duct air cleaners, to measure any increase in indoor ozone concentrations that may result from the use of in-duct air cleaners. At least six buildings (five homes and one small commercial building) will be recruited and tested. Finally, PIs will use data from this study and from published research and reports to estimate the impact of ozone emissions from these devices on typical California homes. Modeling parameters appropriate for California homes will be used.

Expected Results
This contract will also provide information on levels of ozone emitted from in-duct air cleaners under a range of common conditions. It is expected that some of the devices tested produce indoor concentrations exceeding the federal eight-hour ozone standard of 75 ppb for outdoor air, and the state limit of 50 ppb for portable air cleaners. In addition, this study will provide a comprehensive test method for measuring the levels of ozone emitted from in-duct air cleaners.

Significance to the Board
The current regulation to limit ozone emissions from indoor air cleaning devices exempts in-duct air cleaners because there is currently no standardized test method for measuring ozone emissions from such devices, and because there is limited verified data on the amount of ozone emitted from them. This contract will provide both a test method for the levels of ozone emitted from in-duct air cleaners, and laboratory and real-world data on the levels of ozone emitted by devices currently in use. These data will help the board determine whether future regulation of in-duct air cleaners is warranted, and if so, provide a basic test method that can be used in such a regulation.

Contractor:
Missouri University of Science and Technology

Contract Period:
30 Months

Principal Investigator (PI):
Glenn Morrison, Ph.D.

Contract Amount:
$325,000

Basis for Indirect Cost Rate:
The State and Missouri University of Science and Technology have agreed to a ten percent indirect cost rate.

Past Experience with this Principal Investigator:
Dr. Morrison received funding in 2007 as partial funding for a scientific workshop he organized to examine new research on indoor air chemistry and the associated exposure and health implications. The workshop was extremely well-organized, and a scientific paper on the workshop conclusions was published soon after the workshop in *Environmental Science and Technology.*

Prior Research Division Funding to Missouri University of Science and Technology:

Year	2008	2007	2006
Funding	$0	$0	$4334

BUDGET SUMMARY

Contractor: Missouri University of Science and Technology

In-duct Air Cleaning Devices: Ozone Emission Rates and Test Methodology

DIRECT COSTS AND BENEFITS			
1.	Labor and Employee Fringe Benefits	$ 68,905	
2.	Subcontractors	$ 222,336[1]	
3.	Equipment	$ 0	
4.	Travel and Subsistence	$ 6,747	
5.	Electronic Data Processing	$ 0	
6.	Reproduction/Publication	$ 641	
7.	Mail and Phone	$ 820	
8.	Supplies	$ 1,230	
9.	Analyses	$ 0	
10.	Miscellaneous	$ 11,137	
	Total Direct Costs		$311,816
INDIRECT COSTS			
1.	Overhead	$ 13,184	
2.	General and Administrative Expenses	$ 0	
3.	Other Indirect Costs	$ 0	
4.	Fee or Profit	$ 0	
	Total Indirect Costs		$13,184
TOTAL PROJECT COSTS			**$325,000**

[1] The PI at the University of Texas at Austin, Dr. Seigel, has vast experience conducting research on heating, ventilation, and air conditioning systems, and has extensive connections to people in industry, which will aid in the market-share research. The PI at the University of Tulsa, Dr. Shaughnessy, led some of the early efforts to measure ozone emissions from air cleaners, and is highly qualified to conduct the fieldwork required for this research.

SUBCONTRACTOR'S BUDGET SUMMARY

Subcontractor: The University of Texas at Austin

Description of subcontractor's responsibility: The University of Texas, Austin will be responsible for market share analysis, laboratory testing, method development, and meeting with and reporting with the contractor on a regular basis.

DIRECT COSTS AND BENEFITS				
1.	Labor and Employee Fringe Benefits	$	77,005	
2.	Subcontractors	$	0	
3.	Equipment	$	0	
4.	Travel and Subsistence	$	1,889	
5.	Electronic Data Processing	$	0	
6.	Reproduction/Publication	$	0	
7.	Mail and Phone	$	0	
8.	Supplies	$	9,500	
9.	Analyses	$	0	
10.	Miscellaneous	$	14,611[2]	
	Total Direct Costs			$103,005
INDIRECT COSTS				
1.	Overhead	$	8,839	
2.	General and Administrative Expenses	$	0	
3.	Other Indirect Costs	$	0	
4.	Fee or Profit	$	0	
	Total Indirect Costs			$8,839
TOTAL PROJECT COSTS				**$111,844**

[2] Miscellaneous costs for this project will cover the tuition and fees for one graduate student. The cost is based on the two academic semesters and one summer semester that the student will work on the project and costs are based on 2009-2010 values from the Cockrell School of Engineering and assumed to increase by 5%.

SUBCONTRACTOR'S BUDGET SUMMARY

Subcontractor: The University of Tulsa

Description of subcontractor's responsibility: The University of Tulsa will be responsible for field testing in Tulsa, field testing in California, and meeting with and reporting to the contractor on a regular basis.

DIRECT COSTS AND BENEFITS			
1.	Labor and Employee Fringe Benefits	$ 72,542	
2.	Subcontractors	$ 0	
3.	Equipment	$ 0	
4.	Travel and Subsistence	$ 7,748	
5.	Electronic Data Processing	$ 0	
6.	Reproduction/Publication	$ 500	
7.	Mail and Phone	$ 1,300	
8.	Supplies	$ 3,250	
9.	Analyses	$ 0	
10.	Miscellaneous	$ 16,088[3]	
	Total Direct Costs		$101,428
INDIRECT COSTS			
1.	Overhead	$ 9,064	
2.	General and Administrative Expenses	$ 0	
3.	Other Indirect Costs	$ 0	
4.	Fee or Profit	$ 0	
	Total Indirect Costs		$9,064
TOTAL PROJECT COSTS			**$110,492**

[3] Miscellaneous costs will cover ozone equipment calibration ($1,000), Graduate student tuition for two semesters ($10,788; 6 hours/semester at $899/credit hour), incentive payments to occupants of California homes for participating in the study ($800), rental of one unoccupied test house ($1000), and payment for a contractor who will install and removed devices in Tulsa homes ($2,500)