State of California
AIR RESOURCES BOARD

Investigating Semi-Volatile Organic Compound Emissions from Light-Duty Vehicles

RESEARCH PROPOSAL

Resolution 13-12

March 21, 2013

Agenda Item No.: 13-3-2

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 2750-275, entitled: "Investigating Semi-Volatile Organic Compound Emissions from Light-Duty Vehicles," has been submitted by the University of California, Berkeley;

WHEREAS, in accordance with Health and Safety Code section 39705, the Research Screening Committee has reviewed and recommends for funding:

> Proposal Number 2750-275 entitled: "Investigating Semi-Volatile Organic Compound Emissions from Light-Duty Vehicles," submitted by the University of California, Berkeley, for a total amount not to exceed $500,000.

WHEREAS, the Research Division staff has reviewed Proposal Number 2750-275 and finds that in accordance with Health and Safety Code section 39701, research is needed to improve ARB's understanding of secondary organic aerosol (SOA) formation which will inform the evaluation and development of cost-effective control of SOA precursor emissions sources. Results from this project will inform ARB policy makers about the effectiveness of current light-duty vehicles emissions regulations in controlling SOA precursor emissions. Research Division staff recommends this proposal for approval;

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 recommendations of the Research Screening Committee and Research Division staff and approves the following:

> Proposal Number 2750-275 entitled: "Investigating Semi-Volatile Organic Compound Emissions from Light-Duty Vehicles," submitted by the University of California, Berkeley, for a total amount not to exceed $500,000.

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 $500,000.

I hereby certify that the above is a true and correct copy of Resolution 13-12, as adopted by the Air Resources Board.

Tracy Jensen

Tracy Jensen, Clerk of the Board

Attachment A

"Investigating Semi-Volatile Organic Compound Emissions from Light-Duty Vehicles"

Background

Recent research, including vehicle testing at the Air Resources Board (ARB) vehicle test laboratories, has suggested that emissions of semi-volatile organic compound (SVOCs) from light-duty gasoline vehicles can contribute to ambient organic aerosol, due to secondary organic aerosol (SOA) formation in the atmosphere. Limited testing of vehicles and smog chamber results do not show SOA formation reductions commensurate with reductions in the hydrocarbon standards. Vehicles certified to ARB's super ultra-low emission vehicle (SULEV) standards may have control technology that is effective in reducing SVOC emissions and SOA formation. Thus, there is a need to characterize SVOC emissions from the individual vehicles certified to the various emission standards in order to improve emissions estimates for the light-duty fleet. Many of the SVOCs have not been identified, and there is also a need to understand what specific compounds are present in order to evaluate their potential for SVOC formation.

SVOC emissions are not explicitly regulated, and hence SVOC measurements are not typically made in the vehicle test cell. In addition, SOA formation measurements are also not generally made, so this project will include the means to measure both SVOC emissions in the test cell, as well as SOA formation in a smog chamber. In this way, tailpipe emissions can be compared against smog chamber results.

Objectives

The objectives of this project are to: 1) investigate the effectiveness of current SULEV emissions control technology in reducing directly emitted tailpipe SVOC emissions and subsequent SOA formation, and the emissions and air quality impact of SULEV technology on fleet-wide emissions; and 2) study lower cost alternatives to the current methods presently used to quantify SVOC emissions that might be used in a conventional vehicle/engine emissions test cell.

Methods

The project focus will be vehicle emissions testing, but would also include a suite of emissions measurements targeted at SVOC emissions and SOA formation. The project will consist of the following major tasks: 1) Vehicle procurement; 2) Vehicle emissions testing; 3) SVOC emissions measurements; 4) Smog chamber experiments; and 5) Data analyses and reporting

The research team will collect filter and sorbent emissions samples and will analyze them using high resolution two-dimensional gas chromatography to quantify SVOCs. They will also be involved in sample collection, conduct smog chamber experiments and operate a modified version of the Aerodyne Aerosol Mass Spectrometer (AMS).

The smog chamber experiments will quantify SOA formation within the chamber over a period of about three hours. Results will both provide data about SULEV performance in controlling SVOCs emissions and subsequent SOA formation, and also data that can be used for future emissions and chemical transport modeling.

Data analyses will be performed for each task (CVS testing, SVOCs measurements, and smog chamber experiments), and results summarized in the final report. Project objectives will be accomplished by vehicle emissions testing, SVOCs measurements, and smog chamber experiments, followed by data analyses and reporting of results. The project will rely on in-kind emissions testing to be performed by ARB staff at the ARB Haagen-Smit Laboratory in El Monte, California, an approach which was successfully used during a previous project which was funded by United States Environmental Protection Agency and the Coordinating Research Council.

Expected Results
The results from this project will consist of vehicle emissions data for regulated emissions, vehicle emissions data for unregulated emissions such as SVOCs, and smog chamber results.

Significance to the Board
Ambient particulate matter (PM) is associated with adverse health effects, and is a combination of directly emitted PM emissions, as well as PM formed in the atmosphere, of which SOA is a constituent. Research to improve the understanding of SOA formation will inform the evaluation and development of cost-effective control of SOA precursor emissions sources. Results from this project will inform ARB policy makers about the effectiveness of current light-duty vehicles emissions regulations in controlling SOA precursor emissions.

Contractor:
University of California, Berkeley

Contract Period:
36 months

Principal Investigators (PI):
Allen Goldstein, Ph.D.
Allen Robinson, Ph.D.
Jesse Kroll, Ph.D.

Contract Amount:
$500,000

Basis for Indirect Cost Rate:
The State, Carnegie Mellon University, and the University of California, Berkeley, have agreed to a ten percent indirect cost rate.

Past Experience with these Principal Investigators:
ARB staff have successfully managed several previous contracts with Dr. Goldstein, and recently worked with Dr. Robinson and his team of researchers during a collaborative aerosol project that was conducted at ARB vehicle emissions testing laboratories. The new project with Dr. Goldstein and Dr. Robinson will build on these previous projects.

Prior Research Division Funding to the University of California, Berkeley:

Year	2012	2011	2010
Funding	$ 1,320,000	$ 754,264	$ 801,587

BUDGET SUMMARY

Contractor: University of California, Berkeley

"Investigating Semi-Volatile Organic Compound Emissions from Light-Duty Vehicles"

DIRECT COSTS AND BENEFITS			
1.	Labor and Employee Fringe Benefits	$ 191,382	
2.	Subcontractors	$ 248,985[1]	
3.	Equipment	$ 0	
4.	Travel and Subsistence	$ 9,400	
5.	Electronic Data Processing	$ 0	
6.	Reproduction/Publication	$ 4,000	
7.	Mail and Phone	$ 0	
8.	Supplies	$ 20,400	
9.	Analyses	$ 0	
10.	Miscellaneous	$ 0	
Total Direct Costs			$ 474,167
INDIRECT COSTS			
1.	Overhead	$ 25,833	
2.	General and Administrative Expenses	$ 0	
3.	Other Indirect Costs	$ 0	
4.	Fee or Profit	$ 0	
Total Indirect Costs			$ 25,833
TOTAL PROJECT COSTS			**$ 500,000**

[1] The project includes two subcontractors – Carnegie Mellon University at $240,835 and MIT at $8,150. These subcontractors will play critical supporting roles with respect to the measurement of semi-volatile organic compound emissions, and SOA formation in the smog chamber.

Attachment 1

SUBCONTRACTORS' BUDGET SUMMARY

Subcontractor: Carnegie Mellon University

Description of subcontractor's responsibility: The subcontractor will be involved in sample collection and analyses, data analysis, and reporting

DIRECT COSTS AND BENEFITS			
1.	Labor and Employee Fringe Benefits	$ 166,393	
2.	Subcontractors	$ 3,600	
3.	Equipment	$ 0	
4.	Travel and Subsistence	$ 10,716	
5.	Electronic Data Processing	$ 0	
6.	Reproduction/Publication	$ 1,500	
7.	Mail and Phone	$ 0	
8.	Supplies	$ 22,032[1]	
9.	Analyses	$ 0	
10.	Miscellaneous	$ 14,700	
Total Direct Costs			$ 218,941
INDIRECT COSTS			
1.	Overhead	$ 21,894	
2.	General and Administrative Expenses	$ 0	
3.	Other Indirect Costs	$ 0	
4.	Fee or Profit	$ 0	
Total Indirect Costs			$ 21,894
TOTAL PROJECT COSTS			**$ 240,835**

[1] The project involves vehicle emissions sample collection and chemical analyses, necessitating the use of supplies such as sample collection media, calibration standards, solvents, compressed gases, and general laboratory supplies.

Attachment 2

SUBCONTRACTORS' BUDGET SUMMARY

Subcontractor: Massachusetts Institute of Technology

Description of subcontractor's responsibility: The subcontractor will be involved in sample collection and analyses, data analysis, and reporting

DIRECT COSTS AND BENEFITS				
1.	Labor and Employee Fringe Benefits	$	0	
2.	Subcontractors	$	0	
3.	Equipment	$	0	
4.	Travel and Subsistence	$	2,226	
5.	Electronic Data Processing	$	0	
6.	Reproduction/Publication	$	0	
7.	Mail and Phone	$	2,998[1]	
8.	Supplies	$	0	
9.	Analyses	$	0	
10.	Miscellaneous	$	0	
Total Direct Costs				$ 5,224
INDIRECT COSTS				
1.	Overhead	$	2,926	
2.	General and Administrative Expenses	$	0	
3.	Other Indirect Costs	$	0	
4.	Fee or Profit	$	0	
Total Indirect Costs				$ 2,926
TOTAL PROJECT COSTS				**$ 8,150**

[1] Dr. Kroll will be shipping his SVOCs measurement instrument from MIT to California and back, and this line item reflects this shipping cost.