PROPOSED

State of California
CALIFORNIA AIR RESOURCES BOARD

Real-world Tire and Brake-wear Emissions

RESEARCH PROPOSAL

Resolution 18-38

October 25, 2018

Agenda Item No.: 18-8-1

WHEREAS, the California Air Resources Board (CARB 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 2817-289, titled "Real-world Tire and Brake-wear Emissions," has been submitted by the University of California, Riverside for a total amount not to exceed $400,000;

WHEREAS, the Research Division staff has reviewed Proposal Number 2817-289 and finds that, in accordance with Health and Safety Code section 39701, the results of this study will further CARB's understanding of the composition, characteristics, and emission factors of non-exhaust particulate matter and estimate the exposure to non-exhaust experienced by the communities located downwind of the sampling sites; and

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

NOW, THEREFORE BE IT RESOLVED, that CARB, pursuant to the authority granted by Health and Safety Code section 39700 through 39705, hereby accepts the recommendations of the Research Screening Committee and staff and approves the Research Proposal.

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 Proposal as further described in Attachment A, in an amount not to exceed $400,000.

Resolution 18-38

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Identification of Attachments to Board Resolution 18-38

Attachment A: "Real-world Tire and Brake-wear Emissions" Summary and Budget Summary

ATTACHMENT A

"Real-world Tire and Brake-wear Emissions"

Background

CARB has a legislative mandate to set ambient air quality standards and perform research to guide regulations that protect the health of the public (Health and Safety Code §39003; §39606). This research has often included determining the major sources of particulate matter (PM), a major health concern. Regulations have sought to lower PM emissions such as those from vehicle exhaust and other mobile sources. These regulations have resulted in much lower tailpipe PM emissions but have not affected non-exhaust PM emissions. Thus, non-exhaust sources, including brake and tire-wear PM, have become increasingly important. However, the concentration and impact of non-exhaust PM on total near-roadway PM have not been well characterized. Current knowledge suggests driving and roadway conditions (speed, traffic, road configuration/surface type) can affect concentrations and physical characteristics of brake and tire-wear PM. CARB is currently funding research to measure laboratory generated airborne brake-wear PM emissions in order to better characterize brake-wear PM and update the emissions inventory model (EMFAC). However, the laboratory results need to be compared to roadside measurements. Using pure source profiles from laboratory tests and properly designing a roadside measurement study can help verify whether theoretical emission factors derived from the laboratory setting are reflective of the real-world situation. An additional concern is that this particular source has high metal content, which could result in negative outcomes for impacted communities. Therefore it is critical to improve our understanding of the impact of brake-wear PM emissions. The results of this study will support ambient air quality attainment strategies and state implementation plans as well as health studies related to toxic PM constituents.

Objective

The objective of this research is to measure the real-world impact of tire and brake-wear particles on particulate matter (PM) concentrations near roadways. Brake and tire-wear PM will be characterized, and its importance relative to tailpipe exhaust and other regional background sources will be calculated. The results of this study will be used to verify laboratory generated brake and tire-wear PM emissions factors and quantify PM contributions from vehicular sources (tailpipe and non-tailpipe) near roadways. The results will also help provide exposure information to examine the possible impacts of these sources on nearby receptor populations.

Methods

The contractor will sample at three locations in Southern California during winter. Locations will be chosen based on vehicle fleet mix, proximity to existing monitoring stations and Weight-in-Motion (WIM) stations, proximity to environmental justice communities, and other considerations. A PM sampling system will be designed and deployed at the chosen locations such that real-time PM mass, size distribution and

chemical composition can be monitored and recorded. Additionally, the contractor will collect filters for offline analysis and deploy a comprehensive weather station. Offline chemical analysis will include analytical methods able to identify specific markers for tire and brake-wear as well as road dust. Prior to sampling, the contractor shall develop pure source profiles using data collected from current research projects or from samples collected in their laboratory. After the sampling period is over, the contractor shall analyze real-time and off-line data collected to derive emission factors of non-exhaust PM while using the source profiles to separate the different non-exhaust sources and then use weather station and PM emissions data in a dispersion model. The model will help to determine the potential exposures that this fraction of vehicle PM emissions could have on downwind populations.

Expected Results
The contractor shall derive emission factors for the different non-exhaust sources, if possible, as a function of fleet mix, traffic speed, and external factors such as meteorology. These emission factors will be compared to emission factors for brake-wear PM derived from laboratory testing. They will also be compared to the current emission factor inventory model (EMFAC) predictions for tire and brake-wear PM and determine the importance of non-exhaust PM relative to exhaust PM. The dispersion model results will help CARB better understand the impact that non-exhaust PM has on near-roadway environments.

Significance to the Board
Currently, EMFAC predicts that non-exhaust PM is similar in magnitude to exhaust and will dominate vehicle emissions in the future. This project will provide a real-world measurement of non-exhaust emissions and help determine its importance relative to exhaust PM emissions. Additionally, there is concern that this fraction of PM has high metal content and complex organics, which may have important health implications. The results of this project will further our understanding of the composition, characteristics, and exposure of non-exhaust PM on near-road environments and, in particular, communities located downwind of major roadways.

Contractor:
University of California, Riverside

Contract Period:
24 months

Principal Investigator (PI):
Heejung Jung, Ph.D.

Contract Amount:
$400,000

Basis for Indirect Cost Rate:
The State and University of California, Riverside have agreed to a twenty-five percent indirect cost rate.

Past Experience with this Principal Investigator:
The principal investigator, Dr. Heejung Jung, is an associate professor in the Department of Mechanical Engineering and CE-CERT at the University of California, Riverside. He has worked with CARB on other projects for RD including contract 12-320 titled "Very Low PM Measurements for Light-Duty Vehicles (E-99)." His prior work includes extensive experience measuring exhaust PM from both light-duty and heavy-duty vehicles on-road and in the laboratory. His experience level makes him highly qualified to lead this project.

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

Year	2017	2016	2015
Funding	$ 450,818	$ 500,000	$ 0

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

Contractor: University of California, Riverside

Real-world Tire and Brake-wear Emissions

DIRECT COSTS AND BENEFITS				
1.	Labor and Employee Fringe Benefits	$	105,112	
2.	Subcontractors	$	73,582	
3.	Equipment	$	0	
4.	Travel and Subsistence	$	17,108	
5.	Electronic Data Processing	$	0	
6.	Reproduction/Publication	$	0	
7.	Mail and Phone	$	0	
8.	Supplies	$	63,618	
9.	Analyses	$	20,000	
10.	Miscellaneous	$	61,472[1]	
	Total Direct Costs			$ 340,892
INDIRECT COSTS				
1.	Indirect (F&A) Costs	$	59,108	
	Total Indirect Costs			$ 59,108
TOTAL PROJECT COSTS				**$ 400,000**

NOTE:

[1]The principal investigator (PI), Dr. Heejung Jung, is an associate professor in the Department of Mechanical Engineering and CE-CERT at the University of California, Riverside. CE-CERT is an offsite campus affiliated facility that incurs additional rental fees. All projects awarded to CE-CERT affiliated PIs have budgets including this facility rental fee which is calculated as twenty-six percent of the total indirect cost of the project.

ATTACHMENT 1

SUBCONTRACTOR'S BUDGET SUMMARY

Subcontractor: Desert Research Institute

Description of subcontractor's responsibility: DRI faculty member, Dr. Xiaoliang Wang, will lead the filter sampling and data analysis activity. He will participate in two one-week sampling at two locations and spend 117 hours on filter data QA/QC and data analysis.

DIRECT COSTS AND BENEFITS					
1.	Labor and Employee Fringe Benefits	$	39,989		
2.	Subcontractors	$	0		
3.	Equipment	$	0		
4.	Travel and Subsistence	$	0		
5.	Electronic Data Processing	$	0		
6.	Reproduction/Publication	$	0		
7.	Mail and Phone	$	0		
8.	Supplies	$	0		
9.	Analyses	$	0		
10.	Miscellaneous	$	0		
	Total Direct Costs			$	39,989
INDIRECT COSTS					
1.	Indirect (F&A) Costs	$	9,997		
	Total Indirect Costs			$	9,997
TOTAL PROJECT COSTS				**$**	**49,986**

ATTACHMENT 2

SUBCONTRACTOR'S BUDGET SUMMARY

Subcontractor: University of Nevada, Las Vegas (UNLV)

Description of subcontractor's responsibility: Salary support is requested for Dr. Lung Wen Antony Chen, who will be responsible for identifying and quantifying non-exhaust particles at near-road samples and their controlling factors using advanced receptor model techniques. He will also contribute to data analysis, reporting, and dissemination.

DIRECT COSTS AND BENEFITS				
1.	Labor and Employee Fringe Benefits	$	16,609	
2.	Subcontractors	$	0	
3.	Equipment	$	0	
4.	Travel and Subsistence	$	2,268	
5.	Electronic Data Processing	$	0	
6.	Reproduction/Publication	$	0	
7.	Mail and Phone	$	0	
8.	Supplies	$	0	
9.	Analyses	$	0	
10.	Miscellaneous	$	0	
	Total Direct Costs			$ 18,877
INDIRECT COSTS				
1.	Indirect (F&A) Costs	$	4,719	
	Total Indirect Costs			$ 4,719
TOTAL PROJECT COSTS				**$ 23,596**