State of California
AIR RESOURCES BOARD

Collection of Activity Data from On-Road Heavy-Duty Diesel Vehicles

RESEARCH PROPOSAL

Resolution 13-21

June 27, 2013

Agenda Item No.: 13-6-1

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 2761-276, entitled "Collection of Activity Data from On-Road Heavy-Duty Diesel Vehicles," has been submitted by the University of California, Riverside; and

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

> Proposal Number 2761-276 entitled "Collection of Activity Data from On-Road Heavy-Duty Diesel Vehicles," submitted by the University of California, Riverside, for a total amount not to exceed $371,724.

WHEREAS, the Research Division staff has reviewed Proposal Number 2761-276 and finds that in accordance with Health and Safety Code section 39701, this project will provide critical information to accurately quantify the NO_X emissions and SCR functionality from heavy-duty diesel trucks operating in California. The information will help ARB to update NO_X emissions inventories and to develop emissions reduction strategies for statewide air quality plans.

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 2761-276 entitled "Collection of Activity Data from On-Road Heavy-Duty Diesel Vehicles," submitted by the University of California, Riverside not to exceed $371,724.

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 $371,724.

I hereby certify that the above is a true and correct copy of Resolution 13-21, as adopted by the Air Resources Board.

Tracy Jensen

Tracy Jensen, Clerk of the Board

ATTACHMENT A

"Collection of Activity Data from On-Road Heavy-Duty Diesel Vehicles"

Background

Considerable reduction of nitrogen oxides (NO_X) emissions is needed for the State of California to meet ambient air quality standards for ozone and particulate matter. To achieve some of the reductions, the Board adopted a NO_X emission standard for model year 2010 and later heavy-duty on-road engines of 0.20 grams per brake horsepower-hour (g/bhp-hr). This represents a 90 percent reduction compared to the pre-2010 standard. To meet the new standard, diesel engine manufacturers are, in most cases, using selective catalytic reduction (SCR) in advanced engine exhaust aftertreatment systems. SCR reduces NO_X in the exhaust stream, but requires adequate temperatures for the reduction to take place. Typically, the SCR needs to be at least 200 degrees Celsius (°C) before significant NO_X reduction is achieved. However, there will be times when this temperature is not met, such as during cold engine startup, and during low loads experienced when the engine is idling or when the vehicle is moving slowly on flat terrain. The frequency of low temperature and low duty operations varies depending on the type of truck and on its vocational use. It is critical to characterize heavy-duty diesel truck activity profiles including duty cycles, number of engine starts, and engine soak time durations, by vocation type. The heavy-duty diesel truck activity profiles are fundamental for updating emission inventories and quantifying real-world NO_X emissions from trucks meeting the 2010 NO_X certification standard.

Objective

The objectives of this research are to improve understanding of the real world effectiveness of SCR for reducing emissions from heavy-duty trucks, and to evaluate whether certification test cycles are representative of how heavy-duty trucks are actually used.

Methods

The contractor will conduct a screening analysis to determine truck categories and truck vocation types that contribute the most to the state's NO_X emission inventories. Then 100 trucks will be recruited focusing on the truck categories and trucks vocations identified in the screening analysis. The recruited trucks will be instrumented with GPS or ECU+GPS data loggers, and their instantaneous activity data will be collected. The data collection will be continuous for at least one month and up to six months. For each truck category and vocation type, the investigators will analyze the ECU and GPS data to determine the number of starts per day, soak time distribution per day, and other trip statistics (e.g., average distance, average duration, average speed, etc.). Using the second-by-second vehicle speed from the GPS data, the investigators will develop a representative chassis-dynamometer duty cycle for each truck category and vocation type and compare it to the certification cycle.

Expected Results

The heavy-duty diesel truck activity profiles collected from this project will be used for updating emission inventories, quantifying real-world NO_X emissions from trucks

meeting the 2010 NO_X certification standard, and comparing duty cycles by vocation type to the certification duty cycles. The deliverables of this project include a final report detailing the screening analysis and sampling design, recruiting efforts, data collection methods, and data analyses. It will present the results from each task including the comparison between the developed duty cycles and the certification duty cycles in terms of speed, travel duration, acceleration, deceleration, and others.

Significance to the Board
This project will provide critical information to accurately quantify the NO_X emissions and SCR functionality from heavy-duty diesel trucks operating in California. The information will help ARB to update NO_X emissions inventories and to develop emissions reduction strategies for statewide air quality plans.

Contractor:
University of California, Riverside

Contract Period:
24 months

Principal Investigators:
Kanok Boriboonsomsin, Ph.D.
Kent Johnson, Ph.D.

Contract Amount:
$371,724

Basis for Indirect Cost Rate:
The State and the University of California, Riverside have agreed to a 10 percent indirect cost rate.

Past Experience with the Principal Investigators:
The team of investigators is very strong, having a great deal of experience in the collection and analysis of truck activity data. ARB has collaborated very successfully with this team at University of California, Riverside on a number of related projects. Prior work with ARB has included research on heavy-duty truck cold-starts and a number of projects to measure emissions for various fuels.

Prior Research Division Funding to the University of California, Riverside

Year	2012	2011	2010
Funding	$ 0	$ 390,004	$ 0

BUDGET SUMMARY

University of California, Riverside

"Collection of Activity Data from On-Road Heavy-Duty Diesel Vehicles"

DIRECT COSTS AND BENEFITS				
1.	Labor and Employee Fringe Benefits	$	148,425	
2.	Subcontractors	$	0	
3.	Equipment	$	0	
4.	Travel and Subsistence	$	9,000	
5.	Electronic Data Processing	$	70,000[1]	
6.	Reproduction/Publication	$	0	
7.	Mail and Phone	$	900	
8.	Supplies	$	0	
9.	Analyses	$	0	
10.	Miscellaneous	$	116,066[2]	
	Total Direct Costs			$344,391
INDIRECT COSTS				
1.	Overhead	$	27,333	
2.	General and Administrative Expenses	$	0	
3.	Other Indirect Costs	$	0	
4.	Fee or Profit	$	0	
	Total Indirect Costs			$ 27,333
TOTAL PROJECT COSTS				**$371,724**

[1] Data Processing Services provided by the University of California, Riverside are required to meet the research requirements for this project. These costs are estimated based on previous experience in similar projects and cover maintenance and management for the duration of this contract.

[2] Miscellaneous costs include $45,000 for consultants to assist with truck recruitment, and $71,066 for Facilities Fees to recover costs of off-campus facilities at 26% of modified total direct costs.