

**PROPOSED**

State of California  
AIR RESOURCES BOARD

**Activity Data of Off-Road Engines in Construction**

RESEARCH PROPOSAL

Resolution 17-35

**October 26, 2017**

Agenda Item No.: 17-10-3

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 2811-287, titled "Activity Data of Off-Road Engines in Construction," has been submitted by University of California, Riverside; for a total amount not to exceed \$200,000;

WHEREAS, the Research Division staff have reviewed Proposal Number 2811-287 and finds that in accordance with Health and Safety Code section 39701, the results of this study will characterize the activity profiles for heavy-duty off-road equipment used for construction; and greatly help the State of California evaluate emissions control strategies and develop effective regulations for the off-road sector; 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 sections 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 \$200,000.

**Resolution 17-35**

October 26, 2017

**Identification of Attachments to Board Resolution 17-35**

**Attachment A:** “Activity Data of Off-Road Engines in Construction” Summary and Budget Summary

## **ATTACHMENT A**

### **Activity Data of Off-Road Engines in Construction**

#### **Background**

Off-road diesel equipment represents one of the most important sources of emissions in California, and a key area where NO<sub>x</sub> and PM reductions are needed to meet air quality standards. In order to better understand the emissions contribution from off-road sources, it is important to have activity patterns that can be used to accurately portray their in-use operation. Proper characterization of the activity profiles is also important for the design and determining the effectiveness of current generation aftertreatment systems. It is also important to identify typical equipment operating modes where the greatest contributions to emissions are made. Although some studies of off-road construction activity have been conducted over the years, the available data for off-road equipment is still considerably more limited compared to on-road mobile sources.

#### **Objective**

The objective of this research is to characterize the activity profiles for heavy-duty off-road equipment used for construction or other off-road purposes. The research will also put these results in the context of emission certification test cycles, and provide an analysis of the representativeness of the certification cycles to real-world emissions of NO<sub>x</sub> for the types of off-road vehicles and engines considered.

#### **Methods**

Activity measurements will be made from 10 individual pieces of equipment representing a range of engine sizes, from each of 10 different equipment categories, for a total of 100 pieces of equipment. Activity measurement will be conducted for at least one month per piece of equipment. After the data processing and QA/QC, data analyses will be conducted to obtain summary statistics for each vehicle and vocational use. The obtained statistics will be compared with certification cycles, and new cycles will be developed if substantial differences are observed.

#### **Expected Results**

The expected results are activity profiles collected from heavy-duty off-road equipment used for construction. The summary statistics will include the number of starts per day, soak time distribution per day, and other trip statistics (e.g., average distance, average duration, average speed, etc.) for each vehicle and vocational use. The deliverables of this project include a final report detailing of the screening analysis and sampling design, recruiting efforts, data collection methods, raw data, and data analyses.

#### **Significance to the Board**

Collecting data on construction equipment activity will greatly help the State of California evaluate emissions control strategies and develop effective regulations for the off-road sector. The data from this project will be used to evaluate the effectiveness of SCR systems for control of NO<sub>x</sub> from off-road equipment. This project will provide critical

information for the design of realistic off-road engine certification cycles that can better represent the in-use average engine load factors.

**Contractor:**

University of California, Riverside

**Contract Period:**

24 months

**Principal Investigators (PIs):**

Dr. Thomas D. Durbin (PI),  
Dr. Kanok Boriboonsomsin (Co-PI)  
Dr. Kent Johnson (Co-PI)

**Contract Amount:**

\$200,000

**Basis for Indirect Cost Rate:**

The State and the UC system have agreed to a 25 percent indirect cost rate.

**Past Experience with the Principal Investigators:**

The team of investigators had a previous project with CARB to collect and analyze heavy-duty vehicle activity data. They completed the project successfully within 3 years and provided a comprehensive final report. Additionally, CARB has had successful collaborations with the University of California, Riverside team on other projects in the past. The team published over 100 peer reviewed papers about mobile source emissions. Currently they are completing a tractor-trailer project where various types of exempt vehicles are being logged to determine if additional aerodynamic devices added to this class of vehicles would provide advantageous emissions reductions. This team is experienced in handling large data sets and have good working relationships with various fleet operations.

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

Year	2016	2015	2014
Funding	\$ 500,000	\$ 0	\$1,288,560

## B U D G E T   S U M M A R Y

Contractor: University of California, Riverside

“Activity Data of Off-Road Engines in Construction”

### **DIRECT COSTS AND BENEFITS**

1.	Labor and Employee Fringe Benefits	\$	113,886
2.	Subcontractors	\$	12,514
3.	Equipment	\$	0
4.	Travel and Subsistence	\$	3,050
5.	Electronic Data Processing	\$	0
6.	Reproduction/Publication	\$	0
7.	Mail and Phone	\$	500
8.	Supplies	\$	2,500
9.	Analyses	\$	0
10.	Miscellaneous	\$	<u>34,437</u>
	Total Direct Costs	\$	166,887

### **INDIRECT COSTS**

1.	Indirect (F&A) Costs <sup>1</sup>	\$	<u>33,113</u>
	Total Indirect Costs	\$	<u>33,113</u>

**TOTAL PROJECT COSTS** **\$ 200,000**

NOTE:

<sup>1</sup> Facilities & Administrative costs.