PROPOSED

State of California
AIR RESOURCES BOARD

OFF-ROAD DIESEL LOW-EMISSION DEMO FOR NITROGEN OXIDES, PARTICULATE MATTER, AND TOXICS

RESEARCH PROPOSAL

Resolution 19-3

February 21, 2019

Agenda Item No.: 19-2-1

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 18RD006, titled "Off-Road Diesel Low-Emission Demo for Nitrogen Oxides, Particulate Matter, and Toxics," has been submitted by Southwest Research Institute for a total amount not to exceed $499,990;

WHEREAS, the Research Division staff has reviewed Proposal Number 18RD006 and finds that in accordance with Health and Safety Code section 39701, the results of this study will increase the understanding of emissions of Tier 4 final off-road diesel engines with different aftertreatment configurations; and inform potential engine and aftertreatment configurations for laboratory demonstration of low NO_X engines; 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 $499,990.

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Attachments to Board Resolution 19-3

"Off-Road Diesel Low-Emission Demo for Nitrogen Oxides, Particulate Matter, and Toxics"

Attachment A: Summary entitled, "Off-Road Diesel Low-Emission Demo for Nitrogen Oxides, Particulate Matter, and Toxics," including a Budget Summary

ATTACHMENT A

"Off-Road Diesel Low-Emission Demo for Nitrogen Oxides, Particulate Matter, and Toxics"

Background

Off-road diesel engines will contribute an increasing fraction of air pollutant emissions from the transportation sector. To meet the stringent Tier 4 final emission standards, most new off-road diesel engines with power ratings in the range of 56 to 560 kW (75 to 750 hp) employ either a combined diesel particulate filter (DPF) and selective catalytic reduction (SCR) system or an SCR-only configuration. While all these engines meet the certification standards for both Particulate Matter (PM) and Nitrogen Oxides (NOx) there are other aspects of the emissions with important health implications that need to be characterized as a function of which aftertreatment configuration is used. These include various toxics, black carbon, formaldehyde, and polycyclic aromatic hydrocarbons.

Objective

The objectives of this project are to characterize the emission rates of criteria pollutants and non-criteria pollutants of two Tier 4 final off-road diesel engines with similar power ratings but different aftertreatment configurations, and identify potential engine and aftertreatment configurations strategies to maximize emission reductions using a numerical model.

Methods

The contractor will conduct a comprehensive literature and California market review of the current Tier 4 off-road engine and aftertreatment technologies. The contractor will then acquire two Tier 4 final off-road diesel engines with similar power ratings in the range of 56 to 560 kW. One engine must be equipped with a combined DPF and SCR aftertreatment system, and the other engine must be equipped with an SCR-only system. The contractor will test the acquired engines on an engine dynamometer over the certification cycles and at least one vocational cycle. The contractor will conduct comprehensive speciation of criteria pollutants and non-criteria pollutants. Finally, the contractor will conduct numerical simulations to identify engine and aftertreatment strategies that potentially optimize system operation and maximize the reduction of NO_X emissions without increasing emissions of other pollutants and fuel consumption.

Expected Results

The contractor will provide literature about and a market review of the current Tier 4 off-road engine and aftertreatment technologies in California, and develop vocational cycles for engine and aftertreatment evaluation. The contractor will provide CARB a final data file and a comprehensive report that includes descriptions, analyses, discussions of engine dynamometer testing, emissions measurements, and numeric simulations.

Significance to the Board
The findings from this project will increase the understanding of emissions characteristics of Tier 4 final off-road diesel engines with different aftertreatment configurations. The results will also inform laboratory demonstration of low NO_X off-road diesel engines about potential engine and aftertreatment configurations.

Contractor:
Southwest Research Institute (SwRI)

Contract Period:
24 months

Principal Investigators (PIs):
Christopher Sharp
Thomas Reinhart
Svitlana Kroll
Jason Miwa

Contract Amount:
$499,990

Basis for Indirect Cost Rate:
The State and SwRI have agreed to an all-inclusive rate rather than specifying indirect cost rates.

Past Experience with this Principal Investigator:
SwRI has extensive technical expertise in emissions testing, chemical analysis, and numerical simulation of the engine and advanced aftertreatment systems. SwRI has been supporting CARB to demonstrate low NO_X emissions on engine platforms on certification cycles and the low load cycles

Prior Research Division Funding to SwRI:

Year	2018	2017	2016
Funding	$ 0	$ 0	$ 0

BUDGET SUMMARY

"Off-Road Diesel Low-Emission Demo for Nitrogen Oxides, Particulate Matter, and Toxics"

Contractor: *Southwest Research Institute (SwRI)*

Tasks	Description of Services	Total Cost Each Task
Task 1	**Current Technology and Emission Impact Assessment**	$ 51,743
Task 2	**Engine and Test Cycle Selection**	$ 30,531
Task 3	**Emissions Testing Laboratory Requirements**	$ 14,399
Task 4a	**Engine Dynamometer Testing**	$ 125,894
Task 4b	**Comprehensive Emission Analysis**	$ 142,019
Task 5	**Numerical Computer Simulation of Potential Low-NO_X Pathways**	$ 100,684
Task 6	**Draft and Final Report**	$ 34,720
Tasks 1-6	**Total Cost Offer**	**$ 499,990**