

State of California
AIR RESOURCES BOARD

Resolution 04-12

March 25, 2004

Agenda Item No.: 04-3-2

WHEREAS, the Air Resources 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 2549-235, entitled "Evaluation of Mechanisms of Exhaust Intrusion into School Buses and Feasible Mitigation Measures," has been submitted by University of California, Riverside;

WHEREAS, the Research Division staff has reviewed and recommended this proposal for approval; and

WHEREAS, the Research Screening Committee has reviewed and recommends for funding:

Proposal Number 2549-235 entitled "Evaluation of Mechanisms of Exhaust Intrusion into School Buses and Feasible Mitigation Measures," submitted by University of California, Riverside, for a total amount not to exceed \$299,999.

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 recommendation of the Research Screening Committee and approves the following:

Proposal Number 2549-235 entitled "Evaluation of Mechanisms of Exhaust Intrusion into School Buses and Feasible Mitigation Measures," submitted by University of California, Riverside, for a total amount not to exceed \$299,999.

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 \$299,999.

I hereby certify that the above is a true
And correct copy of Resolution 04-12, as
Adopted by the Air Resources Board.

Lori Andreoni, Clerk of the Board

ATTACHMENT A

“Evaluation of Mechanisms of Exhaust Intrusion into School Buses and Feasible Mitigation Measures”

Background

The recently-completed Children’s School Bus Exposure Study was conducted to measure children’s exposures during school bus commutes and commute-related activities such as waiting at bus stops. One of the primary findings of the study was the importance of intrusion of the tailpipe exhaust back into the bus cabin. Intrusion rates were determined using an inert tracer gas (SF_6) added to the exhaust within the tailpipe, and intrusion fractions (the fraction of exhaust infiltrating back into the bus cabin) ranged from 0.02 to 0.3 percent. Such fractions, although small, made self-pollution a major contributor to on-board concentrations of diesel vehicle-related pollutants.

Intrusion rates were higher when bus windows were closed, indicating intrusion was occurring at least in part through the bus chassis. Intrusions rates also appeared to be higher for older buses, suggesting that the condition of window and door seals may be a factor in the extent of the intrusion. The older buses were also more strongly impacted by intrusion because their exhaust tends to be dirtier. Overall, the self-pollution effect, along with high roadway concentrations from dense traffic, combined to produce very high exposure situations for those children with long bus commutes on older and/or dirtier buses.

Objective

The objective of the follow-up study is to better understand the phenomenon of bus self-pollution and to investigate whether simple measures such as window and door seal replacement or enhancement might provide a cost-effective and simple way to reduce children’s exposures to school bus exhaust.

The study will also attempt to determine the extent of how conditions such as speed, acceleration or deceleration, wind speed and direction, window position, and bus characteristics affect intrusion rates. These results may allow the ARB to determine whether specific operating methods and maintenance activities may also help reduce children’s exposures.

Methods

The pilot study phase of the study will have the following objectives:

- To field-test and prove the feasibility and sensitivity of the sampling and analytical methods to be used in the main study.
- To determine typical bus exhaust intrusion locations.
- To test the relative effectiveness of possible intrusion mitigation methods and select which methods will be studied in more detail.

Expected Results

Interim recommendations for school bus mitigation methods will be made after the pilot study is completed, to be completed within six months of the beginning of the project. Final recommendations will be made at the completion of the main study.

The main study should provide a better understanding of how buses typically allow exhaust intrusion—where, how much under different conditions, what can be done to reduce or eliminate the intrusion, and how effective these methods should be at reducing exposures.

Significance to the Board

The findings of this study will allow the ARB to make cost-effective exposure reduction recommendations to school districts, bus fleet managers and mechanics. This will allow school districts and fleet managers to implement exposure reduction methods immediately, rather than having to wait for the replacement or retrofitting of school buses, which typically have long lives.

Contractor:

University of California, Riverside, College of Engineering—Center for Environmental Research and Technology
University of California, Los Angeles (subcontractor)

Contract Period:

24 months

Principal Investigator (PI):

Dennis Fitz

Contract Amount:

\$299,999

Cofunding:

We approached the SCAQMD, USEPA and the Engine Manufacturers Association but they were unable to cofund.

Basis for Indirect Cost Rate:

The State and the UC System have agreed to a ten percent indirect cost rate.

Past Experience with this Principal Investigator:

Same contractors performed previous study upon which this study continues.

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

Year	2003	2002	2001
Funding	\$336,131	\$0	\$268,633

BUDGET SUMMARY

University of California, Riverside

Evaluation of Mechanisms of Exhaust Intrusion into School Buses and Feasible Mitigation Measures

DIRECT COSTS AND BENEFITS

1.	Labor and Employee Fringe Benefits	\$ 92,818
2.	Subcontractors	\$ 105,055
3.	Equipment	\$ 15,000 ¹
4.	Travel and Subsistence	\$ 2,849 ²
5.	Electronic Data Processing	\$ 0
6.	Reproduction/Publication	\$ 0
7.	Mail and Phone	\$ 0
8.	Supplies	\$ 41,800 ³
9.	Analyses	\$ 0
10.	Miscellaneous	<u>\$ 28,730⁴</u>

Total Direct Costs \$286,252

INDIRECT COSTS

1.	Overhead	\$ 13,747
2.	General and Administrative Expenses	\$ 0
3.	Other Indirect Costs	\$ 0
4.	Fee or Profit	<u>\$ 0</u>

Total Indirect Costs \$ 13,747

TOTAL PROJECT COSTS

\$299,999

¹ Equipment Details:

Data Acquisition Computer and Software	\$ 5,000
Bus Enclosure	<u>\$10,000</u>
TOTAL	\$15,000

² Airfare (\$800) and car rental (\$2,049)

³ Supply Details:

Gases	\$ 2,000
Plumbing and Electronic	\$ 6,800
Instrument Repairs	\$11,000
Bus Rental	\$16,800
Hardware	\$ 4,000
Batteries	<u>\$ 1,200</u>
TOTAL	\$41,800

⁴ Miscellaneous Details:

Off-Campue Facilities Rental	\$28,730
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SUBCONTRACTORS' BUDGET SUMMARY

University of California, Los Angeles

The subcontractor will share responsibility with the PI for study design and conducting the field measurements. Graduate students, under Co-PI supervision, will conduct most of the post-QC data analysis and reporting.

DIRECT COSTS AND BENEFITS

1.	Labor and Employee Fringe Benefits	\$ 82,657
2.	Subcontractors	\$
3.	Equipment	\$ 0
4.	Travel and Subsistence	\$ 4,000
5.	Electronic Data Processing	\$ 0
6.	Reproduction/Publication	\$ 0
7.	Mail and Phone	\$ 0
8.	Supplies	\$ 2,610
9.	Analyses	\$ 0
10.	Miscellaneous	<u>\$ 6,790</u>
	Total Direct Costs	\$96,057

INDIRECT COSTS

Total Indirect Costs	\$8,998
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<u>TOTAL PROJECT COSTS</u>	<u>\$105,055</u>
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