

State of California  
AIR RESOURCES BOARD

Resolution 02-15

March 21, 2002

Agenda Item No.: 02-2-2

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 2505-223, entitled "Incidence of Malfunctioning and Tampering in Heavy-Duty Vehicles," has been submitted by the 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 2505-223, entitled "Incidence of Malfunctioning and Tampering in Heavy-Duty Vehicles," submitted by the University of California, Riverside, for a total amount not to exceed \$199,103.

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 2505-223, entitled "Incidence of Malfunctioning and Tampering in Heavy-Duty Vehicles," submitted by the University of California, Riverside, for a total amount not to exceed \$199,103.

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 \$199,103.

I hereby certify that the above is a true and correct copy of Resolution 02-15, as adopted by the Air Resources Board.

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Marie Kavan, Clerk of the Board

## ATTACHMENT A

### Incidence of Malfunctioning and Tampering in Heavy-Duty Vehicles

#### Background

The EMFAC2000 emission model estimates excess PM and NO<sub>x</sub> emissions due to 23 faults in diesel engines. For each fault and class of diesel vehicle, the calculation is:

$$I \times F \times E$$

where: I is an incidence estimate (fraction of all such vehicles operating with the fault).

F is an estimate of the fractional emission increase for the average occurrence of the fault.

E is the base (w/o fault) emission rate for the class.

Most of the estimates of incidence (I) are derived from a 1988 contract report. The scant empirical data on the incidence of faults available then were for trucks with engines whose controls were either mechanical-only or mechanical with rudimentary electronic controls. Much of the basis for the incidence estimates in the 1988 work was merely opinion expressed by fleet mechanics or engineering assumptions. Those opinions and assumptions applied to a situation before the ARB's current smoke inspection programs and before computerized electronic engine controls.

#### Objective

- To update estimates of the incidence (I) of 23 specified malfunctions and types of tampering ("faults") in on-road heavy-duty diesel vehicles. These faults have been identified as increasing NO<sub>x</sub> or PM emissions from diesel engines made before the advent of electronic controls on the engines.
- To assess the need to characterize types of faults to which electronically controlled engines may be susceptible. Such faults could be added to emission inventory calculations and included in an inspection-and-maintenance program.

#### Methods

CE-CERT will develop the new estimates by reviewing all the existing work on estimating fault incidence, reviewing data from past field work, obtaining new data by surveying several sources of information, and conducting roadside inspections.

Specific steps are:

##### 1. Review of Databases

- Open literature
- Data from ARB's roadside inspections and fleet inspections
- U.S. EPA data
- OEM supplier and manufacturer recalls
- Manufacturers' warranty data

## 2. Surveys to Obtain New Data

- Surveys of manufacturers, engine rebuilders, and parts wholesalers for repair information
- Surveys of repair and maintenance records of HDD fleets
- Surveys of commercial repair shop registries

## 3. Field Work

- Random roadside inspections (in concert with Enforcement Division) to count the occurrence of the faults that are visually detectable
- Retrieval with proprietary scanning tools of fault records from the memory chips of inspected vehicles that have electronic controls

Abbreviated versions of the tasks in 2 and 3, above, will be conducted first in a pilot project to assess the availability and quality of data from the various sources. The balance of the project will be conducted only if the Research Screening Committee agrees that the results of the pilot work indicate that further work will be worthwhile. The budget for the pilot work and its report is \$52,509.

### **Expected Results**

The project should provide more accurate estimates of the incidence of the 23 faults now recognized in the emission inventory calculations for heavy-duty vehicles. Also, it will provide a basis for identifying new faults specific to engines with electronic controls.

### **Significance to the Board**

Periodically, the ARB must update factors used in emission inventory calculations. Also, the ARB must analyze potential subjects for inclusion in a heavy-duty inspection-and-maintenance program.

### **Contractor**

College of Engineering - Center for Environmental Research and Technology, University of California, Riverside (CE-CERT)

**Contract Period:** 18 months

**Principal Investigator (PI):** Dr. J. Wayne Miller

**Contract Amount:** \$199,103

**Cofunding:** none

### **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**

The principal investigator, J. Wayne Miller, has a Ph.D. in Chemical Engineering from Caltech. Because he joined CE-CERT only recently (December 2000), the Research Division has not previously engaged him for research. However, Dr. Miller is a key participant in the California Energy Commission’s study “Methodology to Assess Air Quality Impacts of Distributed and Back-Up Generation”, is a reviewer for SSD on fuels regulations, and heads the ARB-supported Mobile On-Road Heavy-Duty Emissions Laboratory. Prior to joining CE-CERT, Dr. Miller was Vice President of Technology and Development for Sun Oil. Previously, at Unocal, he led a large research program related to reformulated gasoline.

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

Year	2001	2000	1999
Funding	\$ 79,884	\$654,788	\$659,987

## **BUDGET SUMMARY**

College of Engineering - Center for Environmental Research  
and Technology, University of California, Riverside

Incidence of Malfunctioning and Tampering in Heavy-Duty Vehicles

### **DIRECT COSTS AND BENEFITS**

1.	Labor and Employee Fringe Benefits	\$133,461
2.	Subcontractors	\$ 0
3.	Equipment	\$ 12,966
4.	Travel and Subsistence	\$ 7,045
5.	Electronic Data Processing	\$ 0
6.	Reproduction/Publication	\$ 0
7.	Mail and Phone	\$ 1,000
8.	Supplies	\$ 0
9.	Analyses	\$ 0
10.	Miscellaneous	<u>\$ 30,480</u> <sup>(1)</sup>

Total Direct Costs \$184,952

### **INDIRECT COSTS**

1.	Overhead	\$ 14,151
2.	General and Administrative Expenses	\$ 0
3.	Other Indirect Costs	\$ 0
4.	Fee or Profit	<u>\$ 0</u>

Total Indirect Costs \$ 14,151

### **TOTAL PROJECT COSTS**

**\$199,103** <sup>(2)</sup>

<sup>(1)</sup> a charge to cover CE-CERT's off-campus rent

<sup>(2)</sup> The budget will be implemented in two severable phases. The first phase, \$52,509, is for pilot work consisting of partial completion of certain tasks. The second phase, \$146,594, is for completing the balance of all the project's tasks. It will be implemented only if the Research Screening Committee finds that the pilot work provides a reasonable expectation of a successful project.