

**State of California  
AIR RESOURCES BOARD**

Resolution 01-17  
April 26, 2001

Agenda Item No.: 01-3-4

**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 2489-219, entitled "On-Vehicle Emissions Testing System," has been submitted by Analytical Engineering, Inc.

**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 2489-219 entitled "On-Vehicle Emissions Testing System," submitted by Analytical Engineering, Inc., for a total amount not to exceed \$100,004.

**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 2489-219 entitled "On-Vehicle Emissions Testing System," submitted by Analytical Engineering, Inc., for a total amount not to exceed \$100,004.

**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 \$100,004.

I hereby certify that the above is a true and correct copy of Resolution 01-17, as adopted by the Air Resources Board.

  
Marie Kavan, Clerk of the Board

## Attachment A

### “On-Vehicle Emissions Testing System”

#### Background

Analytical Engineering, Inc., (AEI) with support from the United States Environmental Protection Agency (U.S. EPA), has been engaged in a three-tiered technology development and hardware delivery program of the Simple Portable On-board Testing (SPOT) system. Phase one of the program involved development and validation of AEI's exhaust mass flow measurement technology. The Trombone Mass Flow Module was developed in cooperation with the U.S. EPA. AEI's concept is based on dilution air entrainment and is the only system available that is easy to install, light, robust, and fouling-proof. Modifications to the in-stack probe may make it more versatile. The goal is to address the needs of virtually all exhaust configurations and as many stack sizes as possible with a single device.

The second phase of the program is critical to the long-term success of on-board measurement of in-use emissions. The program focuses on the preliminary development and integration of near real-time total particulate matter (PM) measurement capabilities. Although the work involves the evaluation of various potential methods, AEI's efforts will focus primarily on the feasibility and integration of Rupprecht & Patashnick's (R&P) personal Tapered Element Oscillating Microbalance (TEOM) technology. This technology has been identified by the U.S. EPA as the likely instrument of choice for on-vehicle, real-time PM measurements.

The third and last phase will culminate in the delivery of a first-generation SPOT unit. AEI will deliver the system to the ARB and provide subsequent training and on-call support. The SPOT unit will be identical to the one delivered to the U.S. EPA. SPOT is capable of simple and quick installation on a wide variety of on- and off-road diesel powered vehicles. The system can also be used for non-vehicle or small engine applications.

AEI is considering other analyte measurement modules which may allow the SPOT system to be used on spark ignition (SI), turbine, and other emissions sources. Funding for this work has come primarily from the U.S. EPA. On-vehicle calibration methodologies are also being explored. These features will greatly enhance the versatility of SPOT and can potentially make it a universal system for on-board emissions measurements.

#### Objective

The primary objective of this project is to gain on-board measurement capabilities via a simple system with extensive portability for sampling from on- and off-road vehicles/engines in stationary and mobile sources. The project will focus primarily on gaseous emissions from diesel engines. Near real-time PM emissions measurements will eventually be integrated into one portable unit.

### **Expected Results**

This project will provide a proven system for on-board gaseous emission measurements. It will use *in-situ* measurement technology, exhaust mass flow, NO<sub>x</sub> and O<sub>2</sub> concentrations, and fuel-specific emissions data are acquired on a second-by-second basis. Brake-specific emissions may be inferred from brake-specific fuel consumption maps available from the engine manufacturer. The ARB would benefit from results already achieved by AEI and the U.S. EPA. This includes initial durability trial runs and extensive pilot testing on construction equipment. The SPOT system is scalable and additional measurement modules, such as the Flame Ionization Detector module for hydrocarbon measurements, may be added for expanded application. The system meets or exceeds the initial requirements for data gathering, storage, and communication capabilities established by the U.S. EPA. The NGK ceramic electrochemical sensor for NO<sub>x</sub> and O<sub>2</sub> measurements was recently tested in an extensive research program by Southwest Research Institute (SwRI) for the ARB. The sensor was shown to be reliable, stable, and was proven for on-vehicle use. The on-vehicle calibration capabilities of the Trombone Mass Emission Module is a very significant feature of SPOT with potential for wide applicability.

### **Significance to the Board**

Regulatory agencies, like the U.S. EPA and the ARB, increasingly need "real-world" emissions data as a screening tool and to create realistic emission inventories and air quality models for all emission sources. The SPOT system benefits a number of current ARB projects that need on-vehicle emissions measurements. The I/M test method for heavy-duty diesel vehicles, which is mandated in the M17 of the State Implementation Plan, is one of the projects that will benefit from the SPOT system. Other projects that will benefit include the Construction Equipment Retrofit Demonstration program in the Mobile Source Operations Division, and the development of a test method for screening stationary and portable engine emissions for the Stationary Source Division. Although some of these projects already include hardware development and/or acquisition, the SPOT system may emerge as an additional viable alternative to current concepts.

**Contractor:**  
Analytical Engineering, Inc.

**Contract Period:**  
12 months

**Principal Investigator (PI):**  
David F. May

**Contract Amount:**  
\$100,004

### **Cofunding:**

The U.S. EPA has funded AEI for \$1.2 million over the last one year for the development of the SPOT system.

### **Basis for Indirect Cost Rate:**

The indirect costs used by AEI are the same as those used in the U.S. EPA contract and therefore, have been approved by the U.S. EPA.

**Past Experience with this Principal Investigator:**

Although the Research Division has not worked with AEI in the past, some of their employees have worked with the same US EPA employees who are also involved in this project.

**Prior Research Division Funding to Analytical Engineering, Inc.:**

| Year    | 2000 | 1999 | 1998 |
|---------|------|------|------|
| Funding | \$0  | \$0  | \$0  |

# BUDGET SUMMARY

Analytical Engineering, Inc.

On-Vehicle Emissions Testing System

## DIRECT COSTS AND BENEFITS

|     |                                    |             |
|-----|------------------------------------|-------------|
| 1.  | Labor and Employee Fringe Benefits | \$35,781    |
| 2.  | Subcontractors                     | \$ 0        |
| 3.  | Equipment                          | \$ 0        |
| 4.  | Travel and Subsistence             | \$ 1,500    |
| 5.  | Electronic Data Processing         | \$ 0        |
| 6.  | Reproduction/Publication           | \$ 55       |
| 7.  | Mail and Phone                     | \$ 200      |
| 8.  | Supplies                           | \$16,810    |
| 9.  | Analyses                           | \$ 0        |
| 10. | Miscellaneous                      | <u>\$ 0</u> |

Total Direct Costs

**\$54,346**

## INDIRECT COSTS

|    |                                     |                 |
|----|-------------------------------------|-----------------|
| 1. | Overhead                            | \$30,879        |
| 2. | General and Administrative Expenses | \$ 6,522        |
| 3. | Other Indirect Costs                | \$ 0            |
| 4. | Fee or Profit                       | <u>\$ 8,255</u> |

Total Indirect Costs

**\$45,657**

## TOTAL PROJECT COSTS

**\$100,004**