

**State of California
AIR RESOURCES BOARD**

Resolution 01-2
January 25, 2001

Agenda Item No.: 01-01-2

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 proposal, number 00-01-08, entitled "Demonstration of Catalytic NO_x Reduction System Using Trace Hydrogen Injection," has been submitted by Makel Engineering, in response to the 2000 Innovative Clean Air Technologies (ICAT) Program solicitation;

WHEREAS, the proposal has been independently reviewed for technical and business merit by highly qualified individuals; and

WHEREAS, the Research Division staff, and the Executive Officer and Deputy Executive Officers have reviewed and recommend for funding:

Proposal Number 00-01-08 entitled "Demonstration of Catalytic NO_x Reduction System Using Trace Hydrogen Injection," submitted by Makel Engineering, for a total amount not to exceed \$149,635.

NOW, THEREFORE BE IT RESOLVED, that the Air Resources Board, pursuant to the authority granted by Health and Safety Code section 39703, hereby approves the following:

Proposal Number 00-01-08 entitled "Demonstration of Catalytic NO_x Reduction System Using Trace Hydrogen Injection," submitted by Makel Engineering, for a total amount not to exceed \$149,635.

BE IT FURTHER RESOLVED, that the Executive Officer is hereby authorized to initiate administrative procedures and execute all necessary documents and agreements for the efforts proposed herein, and as described in Attachment A, in an amount not to exceed \$149,635.

I hereby certify that the above is a true and correct copy of Resolution 01-2, as adopted by the Air Resources Board.

Marie Kavan, Clerk of the Board

ATTACHMENT A

INNOVATIVE CLEAN AIR TECHNOLOGIES (ICAT) PROPOSAL

“Demonstration of Catalytic NO_x Reduction System Using Trace Hydrogen Injection”

Background

Conventional catalytic converter technology is relatively low-cost and widely available, but is not effective in reducing NO_x from lean-burning combustion devices such as gas turbines and compression ignition engines. The proposed system contains a hydrogen production source, an injection system, a catalytic converter, sensors and controls. Hydrogen is injected upstream of a catalytic converter to achieve NO_x reduction. Laboratory tests on a natural gas-powered turbine demonstrated that less than 200 parts per million of hydrogen achieved an 80 percent reduction in NO_x emissions.

Objective

The objective of this project is to build an integrated prototype of a low cost NO_x reduction system for lean burn combustion devices, perform design optimization tests, and conduct a field test demonstration on a natural gas-powered turbine.

Expected Results

A low-cost integrated system for NO_x reduction from stationary sources will be built and tested. The demonstration on a natural gas-powered turbine (250 kW class) is expected to show an 80 percent reduction in NO_x emissions.

Significance to the Board

If successful, a new clean air technology will be demonstrated that should have large domestic and international markets, such as large stationary power generators and distributed power generation for industrial and residential buildings. This technology promises to provide NO_x emission reductions at a lower cost than otherwise achievable, and with no toxic by-products. Ultimately, this technology should be adaptable to stationary and mobile diesel applications, in conjunction with new particulate control systems or clean burning fuels that are being developed.

Proponent:

Makel Engineering

Project Period:

12 months

Principal Investigator:

Darby B. Makel, Ph.D

ICAT Funding:

\$149,635

Co-Funding:

Makel Engineering

\$ 114,439

University Of California, Berkeley

\$ 49,600

Lubrizol Corporation

\$ 50,400

Total \$ 214,439

Basis for Indirect Cost Rate:

Rates are within the ICAT limits.

Past Experience with this Principal Investigator:

Although staff may not have any prior experience with the PI, the extent of review that each ICAT proposal is subjected to provides a sufficient level of confidence for staff to recommend the proposal for an ICAT award. The ICAT evaluation process includes reviews by five external technical and four external business advisors, as well as internal reviewers from Mobile Source Control and Operations Divisions, Stationary Source Division, Research Division, and the Executive Office.

Prior ICAT Funding to Makel Engineering:

| | | | |
|---------|------|------|------|
| Year | 1999 | 1998 | 1997 |
| Funding | \$0 | \$0 | \$0 |

BUDGET SUMMARY

Makel Engineering

Demonstration of Catalytic NOx Reduction System Using Trace Hydrogen Injection

| <u>DIRECT COSTS AND BENEFITS</u> | | <u>ICAT</u> | <u>TOTAL</u> |
|---|-------------------------------------|--------------------------|--------------------------|
| 1. | Labor and Employee Fringe Benefits | \$ 89,406 | \$ 149,009 |
| 2. | Subcontractors | \$ 50,000 | \$ 75,000 |
| 3. | Equipment | \$ 0 | \$ 20,000 |
| 4. | Travel and Subsistence | \$ 68 | \$ 68 |
| 5. | Electronic Data Processing | \$ 0 | \$ 0 |
| 6. | Reproduction/Publication | \$ 0 | \$ 0 |
| 7. | Mail and Phone | \$ 0 | \$ 0 |
| 8. | Supplies | \$ 0 | \$ 74,900 |
| 9. | Analyses | \$ 0 | \$ 10,000 |
| 10. | Miscellaneous | \$ <u>0</u> | \$ <u>0</u> |
| | Total Direct Costs | \$ 139,474 | \$ 328,977 |
| <u>INDIRECT COSTS</u> | | | |
| 1. | Overhead | \$ 0 | \$ 0 |
| 2. | General and Administrative Expenses | \$ 10,161 | \$ 35,097 |
| 3. | Other Indirect Costs | \$ 0 | \$ 0 |
| 4. | Fee or Profit | \$ <u>0</u> | \$ <u>0</u> |
| | Total Indirect Costs | \$ <u>10,161</u> | \$ <u>35,097</u> |
| <u>TOTAL PROJECT COSTS</u> | | <u>\$ 149,635</u> | <u>\$ 364,074</u> |