

State of California
AIR RESOURCES BOARD

Resolution 02-28
July 25, 2002

Agenda Item No.: 02-6-5

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 02-06, entitled "Integrated Autothermal Cyclic Reformer and PEM Fuel Cell", has been submitted by GE Energy and Environmental Research Corporation in response to the 2002 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 02-06, entitled "Integrated Autothermal Cyclic Reformer and PEM Fuel Cell", submitted by GE Energy and Environmental Research Corporation, for a total amount not to exceed \$200,000.

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 02-06, entitled "Integrated Autothermal Cyclic Reformer and PEM Fuel Cell", submitted by GE Energy and Environmental Research Corporation, for a total amount not to exceed \$200,000.

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 \$200,000.

I hereby certify that the above is a true and correct copy of Resolution 02-28, as adopted by the Air Resources Board.

Stacey Dorais, Clerk of the Board

ATTACHMENT A

Innovative Clean Air Technologies (ICAT) Grant Proposal: “Integrated Autothermal Cyclic Reformer and PEM Fuel Cell”

Background

The critical barriers for commercialization of proton exchange membrane (PEM) fuel cells in the market are the high capital costs and low efficiencies of existing small-scale fuel reformers. GE Energy and Environmental Research Corporation (GE EER) is developing an economical fuel cell system based on Autothermal Cyclic Reforming (ACR). ACR produces hydrogen from many fuels, including natural gas, diesel fuel, coal, and renewable feed-stocks. The ACR process has significant advantages in comparison with the competing technologies of autothermal reforming and partial oxidation: the ACR-produced hydrogen is not diluted with nitrogen, and sulfur from the fuel is rejected in-situ. Also, in comparison to conventional steam reforming, the ACR process has significantly lower capital costs, higher conversion efficiency, higher hydrogen purity, and lower emissions.

Objective

This proposed program will demonstrate and optimize an integrated fuel processor and PEM fuel cell system. The National Fuel Cell Research Center will supply a PEM fuel cell and will assist GE EER in the integration of the fuel cell with the ACR reformer. The goals are to:

- Produce at least 10 kW with a system availability of at least 90%.
- Exceed the US Department of Energy’s target of 40% for electrical efficiency.
- Achieve NO_x emissions of less than 1 ppm.

Methods

A fuel processor prototype will be operated in the laboratory for an extended period, and monitored for durability, efficiency, and purity of the hydrogen output. Then a single processor will be integrated with at least two PEM fuel cells, and the combined system will be operated for extended periods to collect data on electrical efficiency, durability and robustness. Simultaneously, the proponent will analyze the system using its rigorous methods and criteria to ascertain the sensitivity of the system’s performance to various parameters. Finally, all data and analysis results will be used to optimize the system design for maximum efficiency and robustness.

Expected Results

The project will demonstrate that the ACR for reforming natural gas for fuel cell use is cleaner, more efficient, less expensive, and more robust than alternative technologies.

Significance to the Board

The novel reforming process, when combined with PEM fuel cells, represents a significant improvement in pollutant emissions resulting from electricity production. The pollutant emissions from the ACR unit are <1 ppm NOX and <10 ppm CO. These numbers are substantially lower than the emissions from conventional steam generating power plants and distributed generation technologies such as micro-turbines and reciprocating-engines. The advanced hydrogen production using ACR along with fuel cell technologies will allow distributed power generation to be economically competitive with central power generation. When fully commercial, the technology could benefit California rate-payers with lower emissions and reliable low-cost power.

Applicant: GE Energy and Environmental Research Corporation

Project Period: 30 months

Principal Investigator: Ravi Kumar, Ph.D. **ICAT Funding:** \$200,000
(\$100,000 provided by SCAQMD)

Co-funding

GE Energy and Environmental Research Corporation	\$200,000
U.S. Department of Energy	\$100,000
California Energy Commission	\$300,000

Past Experience with This Principal Investigator

Staff has no prior experience with GE EER. However, the extent of review of the ICAT proposal provides an adequate basis for recommending a grant. The application was reviewed externally by academic engineers and scientists, other agencies, and academic business reviewers, and internally by Stationary Source Division, Research Division, and the Executive Office.

Prior ICAT Funding to GEE EER

Year	2001	2000	1999
Funding	0	0	0

BUDGET SUMMARY

GE Energy and Environmental Research Corporation

Integrated Autothermal Cyclic Reformer and PEM Fuel Cell

<u>Direct Costs and Benefits</u>	<u>ICAT</u>	<u>Total</u>
1. Labor	\$ 71,716	\$190,005
2. Employee Fringe Benefits	\$ 0	\$ 0
3. Subcontractors	\$ 0	\$200,000
4. Equipment	\$ 0	\$ 58,500
5. Travel and Subsistence	\$ 2,000	\$ 2,000
6. Materials and Supplies	\$ 5,850	\$ 23,400
7. Other Direct Costs	<u>\$ 0</u>	<u>\$ 0</u>
Total	\$ 79,566	\$473,905
 <u>Indirect Costs</u>		
1. Overhead	\$120,434	\$326,095
2. Other Indirect Costs	<u>\$ 0</u>	<u>\$ 0</u>
Total	<u>\$120,434</u>	<u>\$326,095</u>
Total Project Costs	\$200,000 *	\$800,000

* \$100,000 will be provided by SCAQMD