Development of a Digital Control Unit to Displace Diesel Fuel With Natural Gas

Federal Manufacturing & Technologies

A. D. Talbott

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Project Accomplishments Summary CRADA Number 96-KCP-1039

Date: 1/28/97

Revision: 0

A. Parties

The project is a relationship between

AlliedSignal FM&T
2000 E 95th Street
P.O. Box 419159
Kansas City, MO 64141-6159

Full Circle Engineering
P.O. Box 335716
Northglenn, CO 80233

B. Background

Full Circle Engineering (FCE), supported by the Colorado School of Mines (CSM), proposed a Small Business CRADA with AlliedSignal Federal Manufacturing & Technologies/Kansas City (FM&T/KC) for the development of a fumigation digital control unit (DCU) that would allow the displacement of diesel fuel with natural gas.

Nationwide, diesel trucks and buses consumed over 21 billion gallons of fuel in 1992. The development of systems that allow the use of alternative fuels, natural gas in particular, for transportation would significantly reduce emissions and pollutants. It would also help implement DOE's mandate for energy security (use of domestic fuels) required by the Energy Policy Act (EPACT).

Dual-fuel, or fumigation technology, allows natural gas to displace a portion (in theory over 90%) of the diesel fuel used in large truck and bus engines. This technology introduces clean burning natural gas to fleet operators as an alternative to pure diesel fuel. Fumigation is economically attractive to fleet operators if 70% or more of the diesel is displaced with lower cost natural gas. At this high level of displacement, detonation in the engine cylinders may occur. This is caused by the burning fuel/air mixture compressing unburned portions of the cylinder charge, causing them to burn violently or explode, creating large stresses in the cylinder. This technology is especially important for vehicles used in high altitude locations because altitude is known to have a major impact on heavy duty engine power output and emissions.

This CRADA effort was expected to enhance FM&T/KC's electronics and interfacing design capabilities as well as to expand design skills in

microprocessor-based systems, severe environmental testing, and sensor interfacing. The experience gained on this project would have been valuable on any future work in test equipment design involving microprocessors, chassis interfacing, and overall system architecture.

It was expected that a collaborative design team effort between FM&T/KC and FCE would develop an engine control and fuel management system that significantly lowers emissions and eliminates detonation. This would allow natural gas fumigation to be economically attractive to heavy duty vehicle and fleet operators in the absence of any tax incentives or emissions credits.

C. Description

The project scope was for FM&T/KC and FCE to develop a digital control unit for a fumigation system that would have high diesel fuel displacement with natural gas, low emissions, and safe and economic engine operation. FCE, with the assistance of the Colorado Institute for Fuels and High Altitude Engine Research (CIFER), would have determined the emission measurements to be performed as a function of engine operation and diesel displacement. FM&T/KC would have designed the digital control unit system based on the FCE controller specifications. Once a prototype DCU had been built, the unit would have been tested and analyzed at FCE facilities.

Because FCE went out of business shortly after the CRADA was signed, the project was terminated.

D. Expected Economic Impact

Had this project come to full completion as scheduled, it is anticipated that Full Circle Engineering (FCE) would have gained a technological advantage in the area of dual-fuel automotive controllers. This would have helped to market their business in the high altitude Colorado region by providing efficient alternate fuel for heavy duty vehicle conversions. The energy industry also would have benefited with greater engine efficiencies for dual-fuel vehicles, thus making it more economically feasible to convert diesel engines. Lastly, the impact would have been felt by the taxpayers. A significant increase in fuel economy and decreased emissions from engines using the new fumigation technology would have been seen. In the long term, alternative fuel technologies such as fumigation would lessen the United States' dependency on foreign sources of oil by using this country's abundant supply of natural gas.

E. Benefits to DOE

Had this project come to full completion as scheduled, it is anticipated that this project would have benefited DOE programs by increasing the core technical capabilities in the areas of microprocessor systems design and external sensor

interfacing. This new work would have added to the overall technical expertise of the Test Equipment organization at FM&T/KC, because test systems developed at FM&T/KC grow more electronically complex as production unit complexity is increased. Future test equipment design must keep up with all new developments in electronics to maintain the capability to test any part produced in the weapons complex. Because FM&T/KC is the consolidated manufacturing site for the nuclear weapons complex, there must be sufficient test equipment design knowledge to be able to electronically test any new weapons production unit.

F. Industry Area

The heavy duty vehicle and energy industries would have benefited from the use of dual-fuel automotive controllers.

G. Project Status

Terminated because Full Circle Engineering went out of business shortly after the CRADA was signed.

H. Point of Contact for Project Information

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I. Company Size and Point of Contact

Size of Company: Small Business

Point of contact:

Eric Nilsson
13847 W 65th Drive
Arvada, CO 80004

J. Project Examples

Not applicable

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K. Technology Commercialization

Not applicable

L. Release of Information

I have reviewed the attached Project Accomplishment Summary prepared by AlliedSignal FM&T and agree that the information about our CRADA may be released for external distribution.

R. J. [Signature], F&E Vice President 3/10/97
Name: Date
Organization:
Title: