A. Legal Citation: M.L. 93 Chpt. 172, Sect. 14, Subd. 4 (c)

Total Biennial LCMR Budget: $78,000

Program Manager: Aaron Isaacs
Agency Affiliation: Metropolitan Transit Commission
Address: 560-6th Avenue North, Minneapolis MN 55411
Phone: (612) 349-7690

ABSTRACT

Project Title: Operational Implications of Alternate Transit Bus Fuels

Statement of Objectives
In recent years, there has been a great deal of research and activity in the area of alternate fuels for transit buses. Most studies to date have concentrated solely on emissions testing. While that is important, equally important is the reliability, safety and cost effectiveness on alternate fuels compared to conventional diesel technology. In order for MCTO to successfully provide a reliable service that is an attractive alternative to the private automobile, and it must do so as cost effectively as possible, thereby maximizing the amount of bus service that can be deployed. The choice of a cleaner fuel technology to replace conventional diesel engines could have a significant impact on MCTO's costs and reliability, and thereby MCTO's ability to divert automobile trips to transit.

The goal of the project was to compare the emissions, fuel economy, operational advantages and disadvantages, environmental concerns, safety, reliability and operating costs within a test group of 37 identical new transit buses buses with different fuel technologies, including conventional diesel, conventional diesel with particle trap filters, blended ethanol and straight ethanol .

The general methodology was to run the buses in comparable transit service, testing emissions, recording fuel economy, reliability and operating costs, and observing and recording the effort required to service, maintain and repair the buses.

Overall Project Results
The ethanol buses produced higher emissions than the control group of diesel buses or the diesels with particle traps.

The life cycle costs of converting to ethanol or CNG are much higher than maintaining the current diesel fleet, because of the need to retrofit fueling, fuel storage and maintenance facilities, and because of higher maintenance costs. The 24 year incremental costs for ethanol and CNG were $248 million and $92 million respectively.

At the present time, manufacturers do not appear to be choosing alcohol as the fuel of choice for heavy duty engines, and this calls into question the long term availability of parts and technical support. CNG is a more popular alternative because of its support by utilities.

The consultant recommends delaying any conversion to alternate fuels at this time because of the potential high cost, and because the no alternate fuel has emerged as the choice of either manufacturers of government.

Project Result Use and Dissemination
Because the draft report was received in June 1995, dissemination of results has not yet occurred.

JUN 3 0 1995

Date of Report: July 1, 1995

LCMR Research Work Program 1993 - Detailed

I. Project Title: Operational Implications of Alternate Transit Bus Fuels

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Address: 560-6th Avenue North, Minneapolis MN 55411
Phone: (612) 349-7690

A. Legal Citation: M.L. 93 Chpt. 172, Sect. 14, Subd. 4 (c)

Total Biennial LCMR Budget: $78,000

Balance: $0 (request for payment in process)

Subd. 4 ENERGY

(b) E1-7 OPERATIONAL IMPLICATIONS OF ALTERNATE TRANSIT BUS FUELS
This appropriation is from the oil overcharge money to the commissioner of administration for a contract with the metropolitan transit commission to test alternate bus fuels to evaluate their potential for reduced fuel consumption and increased operational efficiency.

B. LMIC Compatable Data Language:

Not applicable.

C: Status of Match Requirement:
Match required: Not applicable
Funds Raised to Date: Not applicable

II. Project Summary:
The Twin Cities transit system is an important tool for the conservation of fuel. In order for MTC to successfully perform this function it must provide a reliable service that is an attractive alternative to the private automobile, and it must do so as cost effectively as possible, thereby maximizing the amount of bus service that can be deployed. The choice of a cleaner fuel technology to replace conventional diesel engines could have a significant impact on MTC's costs and reliability, and thereby MTC's ability to divert automobile trips to transit.

The goal of the project is to compare the emissions, fuel economy, operational advantages and disadvantages, environmental concerns, safety, reliability and operating costs within a test group of 37 identical new transit buses buses with different fuel technologies, including conventional diesel, conventional diesel with particle trap filters, blended ethanol and straight ethanol ~~and liquid natural gas (LNG)~~.

The general methodology is to run the buses in comparable transit service, testing emissions, recording fuel economy, reliability and operating costs, and observing and recording the effort required to service, maintain and repair the buses.

The findings will help determine which fuel technology should be adopted for MTC's fleet of 1000 buses, and ultimately MTC's ability to provide an inexpensive and reliable alternative to the private automobile.

III. Statement of Objectives

A. Achieve routine operation of the buses and fueling equipment.

B. Collect data on emissions, fuel economy, operational advantages and disadvantages, environmental concerns, safety, reliability and operating costs.

C. Evaluate emissions, fuel economy, operational advantages and disadvantages, environmental concerns, safety, reliability and operating costs.

IV. Research Objectives:

A. Title of Objective: Achieve routine operation of the buses and fueling equipment.

A. 1. Activity:
Before meaningful data can be collected, the buses must be received, and the fueling systems must be installed. Warranty issues that might affect the project.must be resolved. Routine servicing and maintenance of the buses.and fueling systems must be achieved, although it may be refined later in the project.

A.1.a. Context within the project:
This objective must be completed before data gathering begins. Much of it should be completed prior to July 1993. If so, then warranty issues and routine servicing and maintenance should be achieved by January 1994.

A.1.b. Methods:
The factory inspection, delivery and repair of warranty items on the buses are covered by the bus purchase contract and are not part of this project. The same applies to the installation and warranty of the fueling systems. Bus servicing and maintenance procedures will be determined by reviewing current MTC practices where applicable, and with the active participation of the manufacturer's representatives. The term "routine" is important. It implies that servicing and maintenance are occurring with sufficient ease and regularity that extraordinary measures are not necessary in order to supply buses for regular route service.

A.1.c. Materials:
The fueling equipment must be made to operate on a routine basis. Shop tools and equipment normally used to service and maintain the MTC bus fleet will be used to achieve this objective.

A.1.d. Budget: $5000

A.1.e. Timeline:

Receipt of buses and installation of fueling equipment will occur before 7/93.

7/93 1/94 6/94 1/95 6/95

Achievement of routine service and maintenance of buses.
xxxxxxxxxxx

A. Status: All buses have been received and are operating. All fueling systems have been installed and are operating.

Problems: Because of technical problems, the manufacturer was unable to meet its contractural commitment to provide LNG-fueled buses. These buses have been dropped from the demonstration.

Progress: This phase is complete.

B. Title of Objective: B. Collect data on emissions, fuel economy, operational advantages and disadvantages, environmental concerns, safety, reliability and operating costs.

B.1. Activity:
Monitor exhaust emissions and fuel economy on a regular basis. Record the time required to perform servicing and maintenance tasks. Note all environmental and safety concerns as they appear. Record equipment failures and miles operated. Record employee hours required to service and maintain the buses and fueling systems. Record the cost of replacement parts.

B.1.a. Context within the project:
Data collection will provide the information necessary to evaluate the different fuel technologies.

B.1.b. Methods:
Certain methods will be routine MTC practice, performed by MTC employees. These include the recording of miles operated, equipment failures, parts expended, and employee servicing and maintenance hours. Bus mileage is recorded by employees when the buses are fueled each day. Fuel use is entered into a computer which tracks and summarizes it. Equipment failures, work hours and replacement parts are tracked through work orders generated within the MTC fleet maintenance computer.

The grant will be used to retain a consultant, who will design the methodologies for monitoring exhaust emissions, fuel economy, and evaluating operating issues, including environmental problems and workplace safety. The consultant will also monitor the work of MTC employees, to ensure that correct procedures are followed and data collection is complete.MTC will seek outside comments on the project design and proposed methodologies and will submit the design to LCMR for its comments prior to the project implementation.

B.1.c. Materials:
MTC's fleet maintenance computer will be used to gather, store and manipulate data pertaining to bus mileage, fuel consumption, parts use, employee servicing and maintenance hours and equipment failures. The consultant will use appropriate air monitoring equipment to measure emissions.

B.1.d. Budget:
$50,000

B.1.e. Timeline:

7/93 1/94 6/94 1/95 6/95

Drafting, review and approval of study methodology
xxxxxxx

Data collection as described above
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

B. Status: All work has been completed.

Problems: None

Progress: On schedule

C. Evaluate emissions, fuel economy, operational advantages and disadvantages, environmental concerns, safety, reliability and operating costs.

C.1. Activity:
The performance of each of the fuel technologies will be compared to that of conventional diesel. Of particular concern is whether or not costs and bus reliability increase or decrease, and whether or not fueling can be performed indoors, as with conventional diesel.

C.1.a. Context within the project:
Evaluation is the final stage of the process, following data collection.

C.1.b. Methods: To determine capital costs for a replacement fleet, the price of the bus and the fueling facilities for five garages will be compared to the same costs for the present conventional diesel fleet.

To determine operating costs, maintenance employee hours required to service and maintain the each bus type will be multiplied by the applicable rates of pay, plus applicable fringe benefits. The cost of parts and fuel consumption will be added.

Bus reliability will be measured by dividing the number of maintenance failures by the bus miles operated for each bus type. In addition, the failures of key individual components will be recorded.

C.1.c. Materials: None

C.1.d. Budget:
$23,000

C.1.e. Timeline:

7/93	1/94	6/94	1/95	6/95
Evaluation of data			xxxxxxxxxxxxx	

B. Status: All work has been completed.

Problems:

Progress:

V. Evaluation:

The different fuel technologies will be judged on emissions, reliability, cost, safety and ease of use. It is probable that a technology will perform well in certain categories and poorly in others. It will be necessary to weigh the advantages and disadvantages to determine which technology is preferred.

In order to be considered for any fleetwide use, a technology must be safe and must meet the 1994 emissions standards. Beyond those criteria, preference will be given to technologies that are low cost and reliable. Once the bus fleet achieves the required air quality standards, the goal is then to maximize the effectiveness of the transit system as a tool to reduce energy consumption.

VI. Context within field:

There have been a number of other tests of alternate-fuel buses around the United States. Most sought to prove whether a given fuel was technologically feasible or not. In the past two years, several transit systems have ordered small groups of alternate fueled buses to test in regular service. MTC's project falls into this category, but is unique because:

a. it tests identical new buses equipped with four alternate fuel technologies against a control group of identical conventional diesel buses.
b. the climate in the Twin Cities is the coldest of any large American transit system.

VII. Benefits:
The conventional diesel engine has been the transit industry standard for over 40 years. It is rugged, reliable and economical. If a cleaner fuel technology performs poorly or is more expensive, it will reduce the quantity and quality of transit service. Any technology that is unreliable will drive away existing passengers because of excessive bus breakdowns. Any technology that increases MTC's operating expense will force service reductions that will drive passengers to the automobile. In either case, increased auto emissions would counteract any marginal improvements in emissions by the bus fleet.
The MTC bus fleet currently saves seven million gallons of fuel per year, all of which would be burned by gasoline engines which produce higher levels of monoxides than diesel bus engines. Identifying the best substitute for conventional diesel will ensure that those savings will continue at their current level.

VIII. Dissemination:
The findings of this project will be presented to the Minnesota Public Transit Association, the American Public Transit Association (the industry trade group) and any other state and local governmental units that request it.

IX: Time:
The project will not exceed two years.

X: Cooperation:
The primary cooperator is Detroit Diesel, the engine manufacturer for the buses.

XI: Reporting Requirements:
Semiannual status reports will be submitted not later than Jan. 1, 1994, July 1, 1994, Jan. 1, 1995 and a final status report by June 30, 1995.