

Date: _____ January 24, 2008

Committee Meeting Date: _____ February 21, 2008

Board Meeting Date: _____ March 3, 2008

BOARD MEMORANDUM

INFORMATION ITEM

TO: Transportation and Planning Committee
Santa Clara Valley Transportation Authority
Board of Directors

THROUGH: Michael T. Burns
General Manager

FROM: Donald A. Smith, Jr.
Chief Operations Officer

SUBJECT: Zero Emissions Bus Program Update

FOR INFORMATION ONLY

BACKGROUND:

In February 2000, the California Air Resources Board (CARB), enacted new regulations to reduce transit bus emissions. As part of the regulations, transit agencies on the diesel path with 200 or more buses were required to implement a Zero Emission Bus (ZEB) demonstration program.

To accomplish this, VTA partnered with SamTrans to purchase three fuel cell buses. The VTA/SamTrans Zero Emission Fuel Cell Buses (ZEBs) first entered revenue service February 28, 2005. The buses have been used in extra revenue service on various routes throughout Santa Clara County.

DISCUSSION:

This memorandum reports that VTA has met the requirements of the CARB initial ZEB demonstration program based on the monitoring and evaluation of the program by the National Renewable Energy Laboratory (NREL), an independent testing laboratory. The NREL has completed their report representing the operation of the buses through July 2006, documenting progress and evaluating opportunities to improve vehicles, infrastructure and procedures.

The performance and the cost to operate the ZEBs was compared to VTA's 40 foot diesel bus fleet. Based on the information to date the cost to operate the ZEBs is significantly higher than the cost to operate diesel buses. In addition, ZEBs exhibit a limited service life, compared to diesel buses, while the reliability and availability remain significantly lower.

Operation

During the first year of operation, the buses were rotated through a number of different routes and schedules to expose them to a variety of service requirements in different areas of the county as well as minimize the impact on bus service and to our customers. As such, the buses were operated as extra service that included lines 22, 32, 33, 45, 46, 47, 53, 54, 62, 71 and 102. These routes include low capacity service routes, express service as well as our heaviest ridership route. The buses continue to operate on the following routes in extra service revenue beyond the conclusion of the demonstration program and have now accumulated an excess of 75,000 miles.

- 63: This route starts in downtown San Jose and travels south
- 22-71-46/47: This route includes a segment on line 22 (high ridership) traveling from Mountain View through downtown Sunnyvale and downtown San Jose to East San Jose (Eastridge Shopping Center), the 71 line traveling on the east side of San Jose and the 46/47 line in North San Jose/Milpitas area.

Performance

Bus Performance

The performance of the buses for this past year is measured in terms of miles operated, availability and reliability.

For revenue service operation, the fuel data indicates that the fuel consumption for the buses range between 2.52 and 4.81 miles per diesel gallon equivalent (DGE) and average approximately 3.5 miles per DGE for a range of approximately 150 miles.

Bus availability, has ranged from a low of 26% for the month of March 2007 to a high of 87% for the month of January 2006. On average, bus availability is approximately 65% as compared to better than 80% for the diesel fleet.

Reliability, as measured by miles between road calls (MBRC), has varied greatly since the start of revenue service. During the period of February 2005 through May 2007 the buses averaged 1100 MBRC. The 40 foot diesel fleet has a reliability of approximately 6,000 MBRC.

The durability is measured in terms of the life of a component or components. Because the fuel cell stack is the essential component and a major cost of the vehicle, a major purpose for this demonstration program is to determine the life and/or durability of the fuel cell stack. Fuel cell stacks averaged less than 17,000 miles before replacement.

Fueling Facility

The performance of the fueling facility was consistent and operated with an efficiency of approximately 50%: that is, for every DGE hydrogen dispensed into the bus, a DGE hydrogen is lost into the atmosphere

Operating Cost

Based on performance and fueling challenges, the cost to operate the hydrogen fuel cell buses is shown in Table 1. With the parts and fuel costs as the major factors, the operating cost is significantly higher for fuel cell bus operation than for diesel bus operation.

Table 1.
Average Cost Per Mile

Ave Cost Per Mile	Diesel	Fuel Cell
Parts Cost	\$ 0.21	\$ 34.40
Labor Cost	\$ 0.84	\$ 7.87
Fuel Cost	<u>\$ 0.56</u>	<u>\$ 2.86</u>
Total Maint. Cost	\$ 1.61	\$ 45.13
Fuel Loss Cost	N/A	\$ 2.86
Fuel Facility Lease Cost	<u>N/A</u>	<u>\$ 3.67</u>
Total Cost	\$ 1.61	\$ 51.66

Continued Operation

Although the CARB initial demonstration requirements have been completed, VTA currently plans to continue operating the fuel cell buses providing reasonable parts and fuel availability.

However, Ballard Power Systems (Ballard), the manufacturer of the fuel cells and integrator of the system, has indicated that the fuel cells in these buses are old technology; and Ballard will not develop new longer-life fuel cells of this design and no longer design vehicle integrations. Furthermore, Ballard Power Systems will no longer produce various components and parts for these vehicles. The specific parts and components have not been verified; nor the specific remaining supply.

The reliability and availability of the ZEBs continues to be substantially less than the diesel bus fleet. With the added potential of parts supply problems, the availability for these buses will not increase.

Advanced Demonstration Program

Additionally, VTA will implement an advanced ZEB demonstration program in a joint effort with AC Transit, Golden Gate Transit, Sam Trans and MTC in accordance with the new CARB regulations. This requires that the region operate a total of 12 advanced Zero Emissions Buses starting in 2009.

VTA is working with MTC and the other agencies to identify and secure capital funding for this program, which is estimated at \$36,000,000. The majority of the funds would be obtained through Federal 5307, BAAQMD and AB1811 and in partnership with SamTrans.

The VTA portion is anticipated to be approximately \$4,000,000 due to the experimental nature of this technology. We will continue to update the Board as funding and regional implementation is solidified.

SUMMARY

The Zero Emission Fuel Cell Bus demonstration has provided the industry with a significant amount of information and data regarding the status of fuel cell technology for transit bus service. The information and data have been used to make improvements in fuel cell technology for integration into a transit bus application, as well as to assess the future for fuel cell technology.

Prepared by: Art Douwes