Report No. 2301

The Status of 2010 CARB Rule Zero Emission Buses

Prepared by Arieli Associates for

Los Angeles County Metropolitan Transportation Authority

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BACKGROUND

In February 2000 California Air Resources Board (CARB) has adopted the Urban Transit Bus Fleet Rule. Under the rule a transit agency could opt for either diesel path or an alternative fuel path and had to stay on the same path through the year 2010. Under the rule both paths had to drop the NO_x emissions from 4.0 g/bhp-hr in 2000 to 0.2 g/bhp-hr in 2007. The large transit agencies (200 buses or more as of January 31, 2001) had to start purchase zero emission buses (ZEB's) at a rate of 15% of all new purchases in 2008 for the diesel path and in 2010 for the alternative fuel path, respectively. In addition, the diesel path large agencies had to buy 3 ZEB's each for demonstration purposes by 7/2003.

In June 2004 the diesel path transit agencies, being late to implement the demonstration programs that were to start in 2003, argued successfully by blaming slow technology development and showing that they have in place procurement programs for the demonstration ZEB's. In the process the diesel path transit agencies pushed for a rule modification allowing them to start the ZEB's demonstration programs in 2006. Ironically, the alternative path agencies, i.e. Los Angeles, still have to meet both the 2007 and 2010 requirements of the rule[1].

CURRENT STATUS

Friday, January 27, 2006, CARB held a public workshop in El Monte, CA to discuss the 2010 requirement of the rule. The rule as it exists today requires:

- Diesel path transit agencies having more than 200 bus fleets as of 1/31/2001 must start a ZEB demonstration program by 2/28/2006 with the final report by 7/31/2007.
- Diesel path transit agencies having fleets larger than 200 buses as of 1/1/2007 must buy ZEB's as15% of their fleet between 2008 and 2015.
- Alternative fuel path transit agencies with more than 200 buses in their fleets as of 1/1/2009 must buy ZEB's as 15% of their fleet between 2010 and 2015.

This is a major change in the rule interpretation. Previously, it was believed that ZEB's must represent 15% of new bus purchases. For Metro this would amount to about 150 ZEB's between 2010 and 2015. Now, when ZEB's represent 15% of the bus fleet the total number of ZEB's that Metro would have to purchase between 2010 and 2015 jumps to approximately 375.

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[1] As the rule has been in making long before the year 2000, LACTC in its 1992 "30-Year Integrated Transportation Plan" included a trolleybus plan that by the year 2010 will deploy 1,100 peak trolleybuses on 18 routes and 300 miles of overhead wires. SCRTD's 1993 SRTP 1993-1997 Guideway Plan still contains trolleybuses. A year later the LACMTA Board cancelled the program as being too expensive but without any consideration of the upcoming CARB rule and the LACMTA LRTP makes no mention of trolleybuses.

CARB considers the following technologies as being truly zero emissions:

- Fuel Cell Buses
- Electric Buses with external energy sources (e.g. trolleybuses)
- Electric Buses with internal energy sources (e.g. batteries)

SCAQMD has raised the possibility that HCNG with after treatment (they mention our joint program) might be near zero emissions with emissions below the ambient.

There are 2 fuel cell bus demonstration programs on-going. Oakland and Golden Gate Transit run one jointly and the other is a joint program between Santa Clara and San Jose. Both programs are in the procurement phase.

PROPOSED CHANGES TO THE RULE

ZEB regulation modifications are under consideration and will be presented for adoption at the CARB meeting in June 2006. The modifications are geared to help the fuel cell manufacturers mature their products and stay alive until then. CARB wants to impose a second demonstration requirement for the diesel path agencies and a demonstration requirement for the alternative fuel path agencies. To compensate for these new requirements they will propose moving the purchase requirement from 2010 back to 2012.

TECHNOLOGY STATUS

1. FUEL CELL BUSES

   The physics and chemistry of the fuel cells have been demonstrated a long time ago. Unfortunately, the engineering of the fuel cells as energy source for buses has been almost stagnant for the last 20 years. Consequently, there is little progress, if any, in reducing cost, increasing the reliability and extending the life of the fuel cells. CARB projects that in a few years, certainly by 2012, the acquisition cost of a 40 ft fuel cell bus will come down to $1.5 million (!!!) and will be warranted for up to 5 years (!!!). Even if these projections are true, the life cycle of a 40 ft fuel cell bus will be 11 times higher than a current 40 ft CNG bus, everything else being equal. CARB seems to believe that such an increase in cost is acceptable. However, CARB projections seem to be wildly optimistic. Last month at the AQMD annual workshop CALSTART which manages the National Fuel Cell Program for FTA and DOE announced that the goal is a 40 ft fuel cell bus priced around $3.5 million and warranted for 3 years. This will make its life cycle cost 43 times higher than the current 40 ft CNG bus. As of now I believe that even the more modest goal is a long way from becoming a reality.

2. TROLLEYBUSES

   This technology is mature and risk-free. Currently, Boston, MA; Dayton, OH; San Francisco, CA; Seattle, WA; and Vancouver, BC operate trolleybuses with great success and in parallel with the more conventional bus service. The capital cost of setting up a trolleybus line is higher than the equivalent conventional bus service but the operating costs are the same. For a more detailed discussion of trolleybuses see Arieli Associates Report No. 1302- Electric Trolleybuses for LACMTA's Bus System.

3. BATTERY-DRIVEN ELECTRIC BUSES

   Battery-driven buses suffer from being overweight and having a short range. The root of the problem is that batteries store a limited amount of energy that is released as electric energy to drive the bus. By contrast, internal combustion engines (ICE) and fuel cells generate energy from fuel on-board to drive the buses. As the fuels are lighter and pack 20 to 100 times more energy per pound than batteries, an ICE or fuel cell bus can operate much longer than a battery-driven bus when the weight of fuel and the weight of batteries are equal.

   The major advantages of battery-driven buses are zero emissions and noiseless operation. These advantages make battery-driven buses the choice type of vehicle to operate in neighborhoods. Neighborhood circulators with typical routes of 40 to 60 miles per day are ideal applications for the battery-driven buses. Typically such circulators will be less than 22 ft and carry up to 20 passengers. This will allow using small battery packs to avoid carrying too much parasitic weight and overnight charging. As of now the cost of these small battery-driven buses is ranging between $250,000 and $450,000. A more detailed report on circulators is forthcoming.

4. ICE BUSES USING HCNG FUEL

   A discussion of this technology is presented in Arieli Associates Report 1108- MIXED HYDROGEN/NATURAL GAS (HCNG) TECHNOLOGY-VISIT AT COLLIER TECHNOLOIES.

RECOMMENDATIONS

I recommend that Metro pursue the following approach in an effort to meet the ZEB regulation:

- Engage in a trolleybus demonstration project to pre-empt the CARB mandate for a fuel cell demonstration program. Such a demonstration program can follow the recommendations in the Report No. 1302 and, in addition, will probably qualify for Small New Starts Federal funding.
- Battery-driven small buses should be used for neighborhood circulators (as described by the LRSTP) to feed major bus and rail lines. The Metro Connections program is the ideal implementation vehicle.
- Adopt a wait and see attitude toward HCNG technology. As Metro is engaging in a major evaluation program of this technology it will be well positioned to take immediate advantage of it, should it pan out. **It is my professional opinion that this technology has the best payoff, now and in the future.**