

Final Report 13309  
Cooperative Agreement DE-FC07-94ID00

Los Angeles Department of Water and Power  
Electric and Hybrid Vehicle Program Site Operator Program

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Introduction:

During the term of the above mentioned agreement, the Los Angeles Department of Water and Power (LADWP), a municipal utility serving the citizens of Los Angeles, marked its tenth year of involvement in testing and promoting electric vehicles as part of Los Angeles' overall air quality improvement program, and as a means of improving the regions' economic competitiveness through the creation of new industries.

LADWP maintained and operated twenty electric vehicles (EVs) during the test period. These vehicles consisted of six G-Vans, four Chrysler TEVans, five U.S. Electricar pickup trucks, and five U.S. Electricar Prizms.

LADWP's electric transportation program also included infrastructure, public transit development, public education and awareness, and legislative and regulatory activities.

**U.S. Electricar Pick-up Trucks**

**Background**

LADWP took delivery of the five U.S. Electricar pickup trucks during the fourth quarter of FY 1994. Real world driving tests performed on the vehicles showed a range of 50 to 60 miles under normal driving conditions. A complete charge consistently took approximately 21 kWh of energy and about 7 hours. The vehicles logged over 19,700 miles since delivery, which was during the fourth quarter of 1994.

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### **Specific Vehicle Problems**

Through the duration of the program, several issues were addressed with the trucks, and were identified as follows:

#### **Ground Fault Circuit Interrupter Incompatibility**

All U.S. Electricar vehicles showed a basic inability to charge on an outlet protected by a ground fault circuit interrupter (GFCI). This incompatibility causes the GFCI on the 220-volt receptacle to trip while charging the vehicle. U.S. Electricar never resolved this problem, and all charging stations had to be retrofitted with the "G-FIX" device manufactured by EVI, which cancels out electrical noise generated by the EV controller during charging. The vehicles cannot be charged on GFCI equipped receptacles without this device.

For these vehicles to be commercially viable, this problem must be resolved.

#### **Defective Battery Modules**

Soon after delivery, some of the trucks showed inadequate range due to defective battery modules.

LADWP replaced battery modules in many of the battery packs. Premature failure was attributed to the integrated charger under charging the battery. The charging algorithm was modified to fix this problem.

- Air conditioning was installed on two of the trucks.
- The trucks exhibited sluggish performance, especially on hills and when carrying a load. Because of this, one of the trucks was retrofitted with an automatic transmission, and two other trucks were retrofitted with 5-speed manual transmissions. These modifications improved performance considerably. The vehicle retrofitted with the automatic transmission showed a slight decrease in range (< 5 miles), while the trucks with manual transmissions showed no range reduction over the stock vehicle.
- MDAS units were installed in three of the trucks.

- The MDAS units operated somewhat unreliably, in some cases causing the auxillary batteries in the vehicles to fall after overnight charging, because they sometimes would not shut down when charge was complete. The data would also often be corrupted making evaluation impossible. Some of the data errors were found to be caused by floppy disks that had become damaged during use.
- Because of the problems with the MDAS units, the decision was made to install hard cards to replace the, often unreliable, floppy discs for data storage. Since the hard cards stay with the MDAS unit, confusion over configuration files, often a problem when using multiple floppy disks on multiple vehicles, was eliminated.
- After installation of the hard cards on the MDAS units, the problem of unexpected unit failures still persisted until the first quarter of 1997. At that time it was discovered, per discussions with the main processor board manufacturer, that bad memory chips had been installed on some boards back in 1995 around the time the units were delivered. These chips would fail intermittently when they heated up. The memory chips were immediately replaced, and no unexpected failures have occurred since.

### **Chrysler TEVans**

LADWP has continued to own and operate four Chrysler TEVans since the fourth quarter of 1994. Use of these vehicles has continued to be limited due to their very poor reliability. The vehicles have experienced significant problems from the first day that LADWP received them with most of the problems being of a repetitive nature and related to fundamental design flaws by Chrysler.

The vehicles logged over 15,000 miles since delivery, which was during fourth quarter of 1994. Several problems were encountered early on. Most have been corrected. These were identified as follows:

- The inability to charge the vehicle from a GFCI-equipped single phase outlet. These safety devices are required by the City of Los Angeles Building Code on all electric vehicle charging facilities.
- Repeated failures of the motor controller units and auxillary power units

### **U. S. Electric Sedans**

The five U.S. Electric sedans were driven under a variety of conditions. Vehicles continued to maintain a 50 to 55 mile range under city/highway conditions, sometimes dropping to 40 miles when battery packs had started to deteriorate. One of the vehicles is used daily for an employee car pool. A full charge continues to take 6-8 hours and requires 17 kWh of energy. The vehicles logged a total of 34,613 miles since delivery, which was during the first quarter of 1995. The following issues were encountered:

- It was determined that the charging algorithm provided with the sedans is undercharging the batteries. As a result, one battery pack was damaged and subsequently replaced. LADWP, with input from the manufacturer, modified the charging algorithm on one sedan.
- LADWP service technicians adjusted the state-of charge gage to increase accuracy. The gage is still inaccurate when batteries are nearly exhausted, and can show as much as ¼ charge when the vehicle has gone into reduced performance mode.
- Hill climbing ability for the sedans is adequate for most areas in Los Angeles, however, there are some hills that can only be climbed very slowly, and in one extreme case cannot be climbed at all.

### **Other Electric Vehicles**

LADWP continued to support the maintenance and operation of six G-Vans. Two of the G-Vans were operated at Los Angeles International Airport, and four operated in LADWP's fleet. The Unique Mobility minivan was not operational.