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Department of Energy – Field Operations Program

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North American Electric Vehicle Infrastructure 1999

BECHTEL BWXT IDAHO, LLC

DEPARTMENT OF ENERGY – FIELD OPERATIONS PROGRAM

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INTRODUCTION

The Field Operations Program is an advanced-technology alternative fuel vehicle testing and evaluation program sponsored by the U.S. Department of Energy's (DOE's) Office of Technology Utilization. This Office is located within the Office of Transportation Technologies. The Program evaluates advanced-technology alternative fuel vehicles in real-world applications and environments, focusing on commercially viable vehicles that represent the "leading edge" in on-road transportation technologies. In the near-term, this includes hybrid electric vehicles and pure electric vehicles with advanced energy storage systems. In the long-term, this may include advanced natural gas vehicles, fuel cell vehicles utilizing a variety of fuels, and vehicles powered by advanced combinations of hybrid technologies.

This paper discusses the Program's activities to support the procurement of electric vehicles by Federal fleets. These activities include:

- National Loaner Program – sponsored by DOE in conjunction with six electric utilities, electric vehicles are loaned free to Federal fleets
- Incremental Funding Program – provides incremental funding for electric vehicle leasing by any Federal Fleet
- Electric Vehicle Testing – provides fleet managers and others leasing electric vehicles with unbiased operations, performance, and life-cycle information.

NATIONAL LOANER PROGRAM

In an effort to increase electric vehicle awareness and acceptance, DOE is conducting a National Loaner Program that makes electric vehicles available to Federal fleets on a trial basis. This allows Federal fleets to test-drive the electric vehicles, usually for 1- or 2-month periods. This activity is being conducted in partnership with five electric utilities around the country as part of the Field Operations Program. The five utilities are Virginia Power, Southern California Edison, San Diego Gas and Electric, Georgia Power, and Boston Edison. Potomac Electric Power Company was previously a Loaner Program partner, but their contract has expired. Each utility has three to ten vehicles that are loaned to Federal Fleets within the utilities' respective service territories. The utilities are responsible for procuring and maintaining the vehicles; identifying, contacting, and coordinating with the Federal fleets for the temporary placement of the loaner vehicles;

and, providing temporary charging infrastructure. The utilities have also committed to supporting the Federal fleets by:

- Supporting the fleets that lease an electric vehicle by helping to install permanent charging infrastructure
- Helping the Federal fleets decide which electric vehicle is the "right" vehicle for the Federal fleet's mission needs
- Providing assistance with any maintenance problems.

If a Federal Fleet is interested in borrowing a vehicle, they should contact the utility within whose service area the vehicle will be used.

• Virginia Power	Greg Frahm	804 257-4005
• Southern California Edison	Cecilia Mushinskie	626 302-3934
• San Diego Gas and Electric	Deborah Newell	619 654-1280
• Georgia Power	Polly Prater	404 506-4640
• Boston Edison	David Dilts	617 424-3590

As of October 1999, 28 Federal entities (Table 1) have participated in the National Loaner Program. Thirty-four vehicle loans have been made and 105 different Federal employees have used the vehicles. These loans have been more than a cursory type of "ride-n-drive" activity; the drivers are driving the loaner vehicles an average of 115 miles each.

The Potomac Electric Power Company's contract ran from September 1998 through September 1999. The contracts for the other five utilities were initiated during the spring of 1999 and the contracts run for twelve months after the first loaner vehicle is placed. Note: Virginia Power has placed loaner vehicles in the motor pools at Fort Monroe and Fort Eustis (Army) and the motor pool directors report 2 to 3 vehicle loans per day; approximately 12 personnel are using the vehicles at each Fort.

Table 1. Federal Fleets and the Agencies using the Loaner vehicles.

Agency Vehicle Loaned to	Dates Loaned	# Vehicles	# Drivers	Miles
Boston Edison				
Longfellow Olmstead Park	Apr – Jul 99	1	5	1,220
National Historical Park	Apr – Jul 99	1	1	1,710
Coast Guard	Apr – Jul 99	1	4	360
Department of Transportation	Aug – Sep 99	1	5	650
Environmental Protection Agency	Aug – Sep 99	1	1	175
Subtotal		5	16	4,115
Georgia Power				
Environmental Protection Agency	Aug – Sep 99	4	22	627
Federal Highway Administration	Aug – Sep 99	1	10	157
Subtotal		5	32	784

Agency Vehicle Loaned to	Dates Loaned	# Vehicles	# Drivers	Miles
Potomac Electric Power Company				
White House	Sep – Oct 98	1	1	
Senate	Nov 98 – Feb 99	1	1	
Environmental Protection Agency (DC)	Sep – Oct 98	1	1	
Environmental Protection Agency (VA)	May – Sep 99	1	1	
Department of Energy (DC)	Sep – Oct 98	1	1	
Department of Energy (MD)	May – Sep 99	1	1	
Department of Transportation	Sep – Oct 98	1	1	
	May – Jul 99	1	1	
Patuxent Research Refuge (USFW)	Nov 98 – Sep 99	1	3	
Rock Creek Park (NPS)	Nov 98 – Apr 99	1	1	
	Jul – Sep 99	1	1	
National Institute of Standards & Tech.	Mar – Apr 99	1	1	
Smithsonian Institute	Sep – Oct 98	1	3	
	Mar –Apr 99	1	1	
Architect of the Capital	Nov 98 – Jan 99	1	1	
General Services Administration	May – Sep 99	1	1	
National Security Agency	Nov 98 – Feb 99	1	1	
Marine Corps	Nov 98 – Feb 99	1	1	
National Institute of Health	Mar – Apr 99	1	1	
Subtotal		19	23	
Southern California Edison				
Border Patrol	Jun – Sep 99	1	4(+)	1,118
Subtotal		1	4	1,118
Virginia Power				
Fort Monroe (Army - Motor pool)	Jun 99 - (Start)	1	12+	
Fort Eustis (Army - Motor pool)	Jun 99 - (Start)	1	12+	
Naval Security - Northwest	Sep 99 - (Start)	1	6	
Subtotal		3	30	
San Diego Gas and Electric				
US Navy (32nd St. Transportation)	Aug – Sep 99	1		
Subtotal		1		
Total		**34**	**105**	**6,017**

Some of the reactions the drivers are expressing after driving the loaner vehicles include:

- They do not want to give the loaner vehicle back when the loan period is up
- The stiff suspension took some time getting use to
- The driving distance between charges is not far enough
- The loaner vehicle works just like a gas-powered pickup, only better
- They were amazed at the cruising speed and acceleration
- Most are pleased with the experience, but are somewhat afraid of the range
- Vehicles are being driven everyday and there have been no mechanical problems.

Some of the obstacles encountered by the utilities when they try to loan electric vehicles to the Federal agencies have included:

- Unwillingness by Federal agencies to indemnify the utility company for liability
- Very slow in getting a response from management
- Very long time in having a simple 220-Volt outside plug installed at a parking site
- Too many different people being involved from the Agency (no one in charge)
- Hurry up and wait attitude
- Very slow in reviewing and/or approving the loaner agreement
- Lots of time spent with legal staff questioning the agreements for the loaner and leased vehicles
- Only 480-volt power was available; 480 to120/208-volt transformers had to be installed
- There is still a need for more public charging
- Contract approval on the Federal level takes too long
- U.S. Military branches are not responding to the offer
- U.S. Post office is not responding to the offer
- Lack of familiarity with the technology
- Because one utility uses utility fleet vehicles for the loan program, the receiving party must sign a Loan Agreement Contract. This has proven to be very challenging when dealing with federal agencies.

Some of the same obstacles as above, as well as additional obstacles have been encountered when trying to encourage Federal agencies to lease electric vehicles. The obstacles and utility comments include:

- The driving range between charges is too short. They would buy one in a minute if reliably were 100+ miles under real world driving conditions.
- Contract approval by lawyers is very slow.
- Until we have vehicles with NiMH batteries available here in the Northeast, it is going to be a tough sell. More vehicle varieties and advanced batteries will solve all the problems associated with interest in leasing by just about all the agencies.
- Price and charging unavailability.
- It has been a “reeducation” process in introducing electric vehicles into the fleets. The existing way of thinking is that internal combustion engine (ICE) vehicles are best and nothing compares, so we try to discuss alternatives and explain that while electric vehicles can’t replace all ICE vehicles, there is an opportunity for a mix of technologies to do the job.

Some of the reasons the agencies are giving for not leasing electric vehicles include:

- Costs are too high
- Auxiliary batteries are not strong enough to jump-start multiple cars

- Driving range between charges is not far enough
- Uncomfortable with the range and technology
- Prefer sedans
- An unwillingness to "take the risk." It seems the Fleet Manager will take the blame if a procured vehicle does not work out.

Some of the vehicle related problems encountered while loaning the vehicles include:

- One vehicle died at a tollbooth. It turned out to be failed component in the controller.
- One of vehicles had a flashing wrench display on the dashboard that turned out to be several problems; including the charge module under hood needed to be replaced and the battery pack also needed to be replaced. This took two weeks to fix.
- Some vehicles have had bad on-board chargers. Each of one utility's vehicles has had the charger replaced at least once. Some have had 2nd replacements.
- One of each utility's vehicles had to have its battery packs replaced.
- Some of one utility's vehicles have had to have battery control modules replaced.

INCREMENTAL FUNDING PROGRAM

To support and encourage Federal Fleets to lease electric vehicles, DOE provides 50% of the incremental cost when a Federal agency leases an electric vehicle. This activity is driven by Executive Order 13031 (Federal Alternative Fueled Vehicle Leadership). Section 6 (Funding Alternative Fueled Vehicle Acquisition) of the Executive Order states:

> "(a) The Department of Energy will no longer request or require specific appropriations to fund the incremental costs of alternative fueled vehicles, including any incremental costs associated with acquisition and disposal, for other agencies. Agencies shall formulate their compliance plans based on existing and requested funds, but shall not be exempt from the requirements of the Act or this order due to limited appropriations.
>
> "(b) An exception regarding funding assistance shall be made for electric vehicles, which are in an earlier stage of development than other alternative fueled vehicles. The Secretary of Energy shall establish a program beginning in FY 1997 to provide partial funding assistance for agency purchases of electric vehicles. Up to $10,000 or one-half the incremental cost over a comparable gasoline-powered vehicle, whichever is less, may be provided as funding assistance for each electric vehicle, subject to the availability of funds."

The incremental funding is provided by DOE to the Federal agency when they lease an electric vehicle directly from the vehicle manufacturer or, through the General Service

Administration (GSA) if the Federal agency leases the electric vehicle through GSA. GSA has signed pass-through leases with Chrysler and Ford. The Nickel Metal Hydride battery (NiMH) Ford Ranger and NiMH Chrysler EPIC are available through GSA in California. In the other 49 states, the lead-acid battery Ford Ranger is available through GSA.

The incremental cost is the difference between GSA cost to lease a gasoline-powered vehicle and the cost to lease an electric version. For example, the GSA lease rate for a gasoline-powered small pickup is $220 per month (including 4,500 miles), while an electric Ford Ranger with lead-acid batteries can be leased for $349 per month. The difference, or incremental cost, is $129 per month; DOE pays half of this amount, or $64.50. GSA adds an additional cost of $12 per month to the monthly lease cost of the electric vehicles. The total monthly cost to Federal agencies leasing a lead acid Ford Ranger is $296.50.

As of October 1999, 17 Federal entities (Table 2) have taken advantage of the incremental funding and they have ordered 113 electric vehicles. The 89 Ford Rangers and 24 Chrysler EPICs represent a total of $600,000 in incremental funding from DOE.

Table 2. Federal Agencies receiving incremental funding from DOE and the number of vehicles ordered.

Federal Agency Receiving Incremental Funding	**Number of Vehicles Funded**
Architect of the Capitol	1
Bonneville Power Administration (DOE)	1
Department of Agriculture (Miami)	14
Department of Energy (DC)	2
General Services Administration (DC)	2
Gettysburg National Military Park (DOI/NPS)	1
Grand Canyon National Park (DOI/NPS)	2
Lawrence Berkeley Laboratory (DOE)	22
Los Alamos National Laboratory (DOE)	20
National Renewable Energy Laboratory (DOE)	3
Patuxent Research Refuge (DOI/USFW)	1
Rock Creek Park (DOI/NPS)	4
Department of Transportation (DC)	1
Sandia National Laboratory (DOE)	10
Smithsonian Institute (DC)	1
Tennessee Valley Authority	5
US Postal Service (Harbor City/Huntington Beach, CA)	16
US Navy (San Diego)	7
Total	113

ELECTRIC VEHICLE TESTING

When asked for some of the reasons that agencies are giving for not leasing electric vehicles (see above in the Loaner Program section), an often-given answer is that there is "An unwillingness to take the risk" and that "It seems the Fleet Manager will take the blame if a procured vehicle does not work out." Given this statement, the goal of the Field Operations Program seems very appropriate. The goal is:

> *To support the fleet manager and other advanced-technology alternative fuel vehicle purchasers with the information they require to make informed purchase or leasing decisions; and, to increase the overall awareness and acceptance of advanced-technology alternative fuel vehicles.*

In support of this goal, the Field Operations Program tests and evaluates advanced technology alternative fuel vehicles to document and disseminate vehicle performance. The vehicle testing and evaluation activities consists of three types of tests:

- Baseline Performance (EV America)
- Accelerated Reliability
- Fleet.

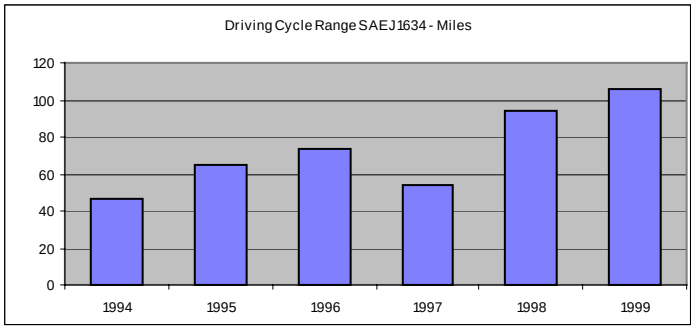
Of the three types of tests, the Baseline Performance testing results can best be used to demonstrate the performance and improvement trends that electric vehicles have demonstrated over the last five years. The testing results have been averaged on an annual basis and the results are presented here. The averages are the numerical means. The Baseline Performance test procedures and a testing results fact sheet for each vehicle are available from the Field Operations Program's website (http://ev.inel.gov/sop).

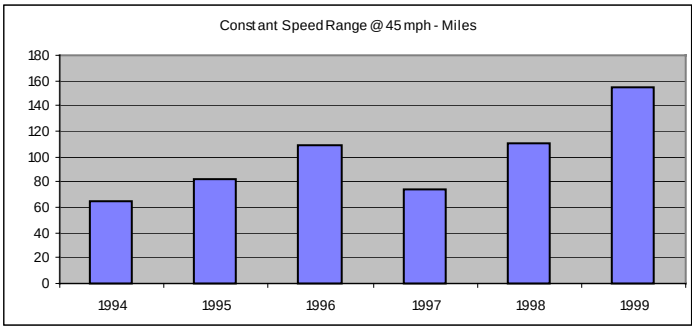
The average annual test results presented in the graphs incorporate the results for the 20 models (Table 3) of electric vehicles that have undergone Baseline Performance testing from 1994 through 1999.

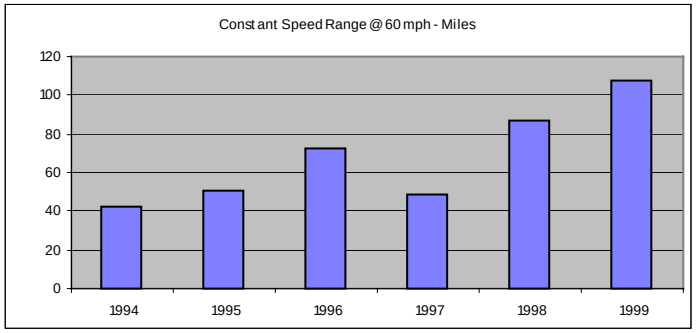
Table 3. Baseline Performance test vehicles, and battery technologies (Pb - lead acid, NiMH – nickel metal hydride, NiFe – nickel iron).

1999	General Motors EV1 NiMH	Ford Ranger NiMH	Chevrolet S-10 NiMH
1998	Toyota RAV4 NiMH		
1997	Ford Ranger Pb	Chevrolet S-10 Pb	
1996	General Motors EV1 Pb	Toyota RAV4 Pb	
1995	Solectria Force NiMH	Solectria E10 Pb	Baker EV100 NiMH
1994	Bat Intnl. Metro Pb	Bat Intnl. Metro Pb	Bat Intnl. Pickup Pb
	Dodge Caravan NiFe	Solectria Force Pb	Solectria E10 Pb
	Unique Mobility Pickup Pb	US Electricar Sedan Pb	US Electricar Pickup Pb

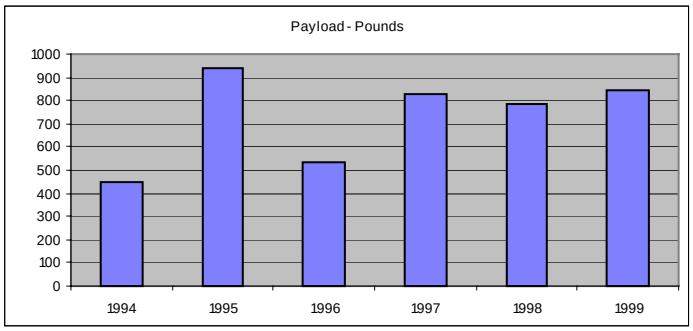
All three of the Range Tests (Driving Cycle, Constant Speed at 45 mph, and Constant Speed at 60 mph) exhibit similar trends – the test results improved every year except for the 1997 test vehicles. The 1999 results were driven by the Nickel-Metal-Hydride (NiMH) battery equipped EV1. The EV1 had the highest test results ever; it went 221 miles in the 45-mph constant speed test, 161 miles in the 60-mph constant speed test, and 140 miles in the drive-cycle range test. The two pickups tested during 1999 were also equipped with NiMH batteries and they averaged 89 miles in the drive-cycle test, 123 miles in the 45-mph constant speed test, and 81 miles in the 60-mph constant speed test.



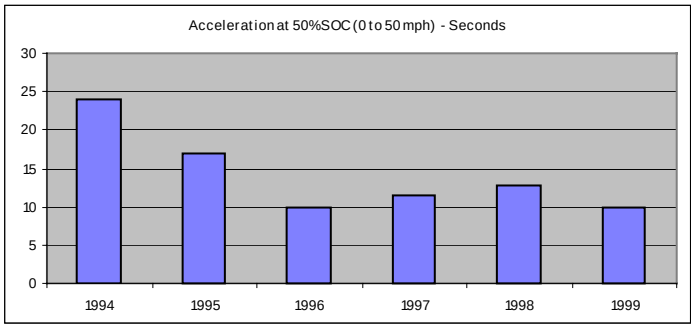




The 1997 decrease in range can be at least partially attributed to the type of vehicles tested during 1997. Both of the 1997 test vehicles were pickups with lead acid batteries, intended for use in utility-types of fleet applications. The vehicles (Chevrolet S-10 and Ford Ranger) have an average payload of 825 pounds. A single vehicle, the Baker pickup and its 1,719-pound payload, drove the payload average for the 1995 vehicles, while the other two 1995 test vehicles had an average payload of 546 pounds. The two 1996 test vehicles had an average payload of 533 pounds. One of these, the EV1, has a payload of 440 pounds. However, the EV1 is a sports coupe that clearly is not intended as a utility work vehicle .



The average annual acceleration tests performed when each vehicle's battery pack is at a 50% state-of-charge also shows an overall improvement in vehicle performance. The average annual time to accelerate from 0 to 50 mph has decreased from the 24-second average recorded during 1994 to 10 seconds for the 1999 test vehicles. The 1996 vehicles also averaged 10 seconds in the acceleration testing. The lead-acid EV1, tested during 1996, had a 0 to 50 mph acceleration time of 6.7 seconds at a 50% state-of-charge. At 100% state-of-charge, the EV1 accelerated from 0 to 50 mph in 6.3 seconds (averages not show for 100% state-of-charge testing).



The average annual maximum-speed testing results at 1 mile and a battery pack state-of-charge of 50%, shows an upward trend, especially when comparing the 1994/1995 averages to the 1996 through 1999 averages. The 1996 vehicles had the highest average maximum speed, led by the lead-acid EV1 with a speed of 80 mph.

The graphs provide a brief snapshot of several performance characteristics. These testing parameters suggest that the Baseline Performance tested electric vehicles continue to exhibit annual improvements in their performance capabilities. In addition, other factors such as the warranties offered by the original equipment manufactures (OEM) support the belief that overall vehicle performance continues to improve. The OEMs are now warranting their vehicles for 3 years and 36,000 miles, with most of the vehicles only being available as 3-year leases. During the next few years, the Field Operations Program will continue to test and evaluate advanced technology alternative fuel vehicles.