

# **Electric and Hybrid Vehicle Program Site Operator Program Quarterly Progress Report for April through June 1995 (Third Quarter of Fiscal Year 1995)**

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## Executive Summary

The DOE Site Operator Program was initially established to meet the requirements of the Electric and Hybrid Vehicle Research, Development, and Demonstration Act of 1976. The Program has since evolved in response to new legislation and interests. Its mission now includes three major activity categories:

1. Advancement of Electric Vehicle (EV) technologies
2. Development of infrastructure elements needed to support significant EV use
3. Increasing public awareness and acceptance of EVs.

The 12 Program participants, their geographic locations, and the principal thrusts of their efforts are identified in [Table ES-1](#). The EV inventories of each participant are summarized in Table ES-2.

A perspective of the Program since its inception in 1976 shows progress toward its major goals once the

purpose of the Program was more clearly defined, the principal problems -- related to data collection, interpretation, and availability -- were identified, and remedial efforts were undertaken when the contract for managing the Program was transferred to the INEL, in 1987.

The primary functions of the Program continue to be collection, analysis, and dissemination of operating and maintenance data; and demonstrations of the technology to promote public awareness. Both efforts have been fruitful; in particular, practical methods and equipment for handling operating data are now in use, and the data are widely available via computer networks.

The data represent more than 200 vehicles, of which about 50 are the latest generation vehicles. The vehicles are either Doe-owned, participant-owned, or participant-monitored units.

The participants – electric utilities, academic institutions, and Federal agencies – are widely spread within the USA and their vehicles see a broad spectrum of service conditions. The contributions of the first two groups go well beyond the basic Program scope:

- The utilities have worked towards infrastructure development, battery recharging scenarios, and identification of operation/maintenance problems.
- Academic institutions have investigated alternative charging technologies (curbside and solar) and have developed a practical mobile data acquisition system. Other contributions are training materials for maintenance and operation, and field testing of experimental or prototype systems and components.

The program participants have generally established working relationships with the industrial community where common interests exist.

Experience to date emphasizes problems specific to electric vehicles:

- Climate effects
- Battery technology
- Vehicle conversions versus ground-up design

In the context of existing or impending legislative mandates to increase electric vehicle usage for environmental reasons, two national organizations have joined DOE and the major vehicle manufacturers in EV promotion.

- The Partnership for a New Generation of Vehicles (PNGV) in America will identify and evaluate alternatives in vehicular technology.
- EV America, a utility-led program, will conduct performance and evaluation tests to support market development for electric vehicles.

Program redirection in the near and medium term is expected to involve hybrid systems, advanced EV's, add-on or upgraded components, and inputs from PNGV studies.

**Table ES-1.** Site Operator Program Participants.

<b>Entity</b>	<b>Principal Thrusts of Program Effort</b>
Arizona Public Service Co. Phoenix, AZ	a. Fleet evaluation, vehicle test b. Infrastructure development c. Technical education d. Public awareness
Kansas State University Manhattan, KS	a, b, c, d
Los Angeles Dept. of Water & Power Los Angeles, CA	a
Orcas Power and Light Co. Eastsound, WA	a, b, d
Pacific Gas and Electric Co. San Ramon, CA	a, b, d
Platte River Power Authority Fort Collins, CO	a, b, d
Potomac Electric Power Co. Washington, DC	a, b, d
Sandia National Laboratory* Albuquerque, NM	a

Southern California Edison Co. Rosemead, CA	a, b, d
Texas A&M University College Station, TX	a, c, d
University of South Florida Tampa, FL	a, b, c, d
U.S. Navy Port Hueneme, CA	a
York Technical College Rock Hill, SC	a, b, c, d
* Information-sharing agreement	

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**Table ES-2.** Site Operator Program active vehicle inventory.

Participant	G-Van	EVcort	Force	S-10	Jet*	Unique	Griffon	TEVan	Other	Total
APS	4	3	1	9	–	2	–	1	1 Solar Colt sedan, 1 Bus	22
KSU	–	2	–	–	–	–	–	–	–	2
LADWP	6	–	–	4	–	1 **	–	4	5 Prizms	20
OPALCO	–	–	1	–	1	–	–	–	–	2

PG&E	3	1	-	-	-	-	-	-	2 Ford Ecostars	6
PRPA	-	2	-	-	-	-	-	-	-	2
PEPCO	1	1	1	-	-	-	-	-	-	3
SANDIA	-	-	-	-	-	-	-	-	12 Electrica (Escort conversion)	12
SCE	15	-	6	4	-	-	-	2	12 Ford Ecostars, 4 Prizm Sedans, 1 Ranger pickup, 1 bus, 1 Dodge Caravan, 1 BAT sedan, 3 Honda sedans	50
TAMU	15	-	-	3	1	-	-	8	2 race cars	29
NAVY	5	-	-	6	42	-	11	-	2 Grumman	66
USF	2	-	-	10	-	-	-	-	1 Mirage, 1 Dakota	14
YORK	1	-	-	8	-	2	-	-	1 Solectria Force 1 Escort (Bearskin)	13
<b>TOTALS</b>	<b>52</b>	<b>9</b>	<b>9</b>	<b>44</b>	<b>44</b>	<b>5</b>	<b>11</b>	<b>15</b>	<b>53</b>	<b>242</b>

\* = various manufacturers

\*\* = hybrid

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# Introduction

The Site Operator Program was initially established by the Department of Energy (DOE) to incorporate the electric vehicle activities dictated by the Electric and Hybrid Vehicle Research, Development and Demonstration Act of 1976. In the ensuing years, the Program has evolved in response to new legislation and interests. The Program currently includes twelve sites located in diverse geographic, metrologic, and metropolitan areas across the United States (see [Figure 1](#) ). Information is shared reciprocally with a thirteenth site, not under Program contract. The vehicles are operator- owned.

The Mission Statement of the Site Operator Program includes three major activities:

1. Advancement of electric vehicle technologies
2. Development of infrastructure elements necessary to support significant electric vehicle use; and
3. Increasing the awareness and acceptance of electric vehicles (EVs) by the public.

The current participants in the Site Operator Program are shown in [Figure 1](#). Table 1 indicates the EVs in each of the Site Operator fleets. Table 2 provides baseline information on several EVs currently in use by the Site Operators, or which have evolved to the point that they may be introduced in the near future.

The Program is currently managed by personnel of the Electric and Hybrid Vehicle Program at the Idaho National Engineering Laboratory (INEL). The current principal management functions include:

- Coordination of Site Operator efforts in the areas of public awareness and infrastructure development (program- related meetings, and educational presentations).
- Technical and financial monitoring of programmatic activities, including periodic progress reports to DOE.
- Data acquisition, analysis, and dissemination. The data from the Site Operators are made available to authorized users through the INEL Site Operator Database.

The ultimate thrust of program activities varies among sites, reflecting not only the Operator's business interests but also geographic and climate-related operating conditions. These considerations are identified below for each Program Status entry.

In this issue of the Site Operator Program Quarterly Report, a brief perspective of the Program history and goals is presented. The current status is summarized, and the contributions of the participants to the promotion of a soundly-based electric vehicle capability are identified. Finally, some of the interfaces between the Program (and its DOE sponsor) and relevant portions of our industrial base, particularly vehicle manufacturers, are identified.

**Table 1.** Site Operator vehicle fleet.

## **Arizona Public Service Company (APS)**

1. Unique sedan 2 ea.
2. G-Van (cargo) 2 ea.
3. G-Van (passenger) 2 ea.
4. EVcort sedan 3 ea.
5. Solar Colt sedan 1 ea.
6. TEVan 1 ea.
7. Bus 1 ea.
8. Solectria 1 ea.
9. S-10 9 ea.

TOTAL 22

NOTE: Does not include 3 vehicles donated to local organizations

## **Kansas State University (KSU)**

1. EVcort sedan 2 ea.

TOTAL 2

## **Los Angeles Department of Water and Power (LADWP)**

1. G-Van (passenger) 4 ea.
2. G-Van (cargo) 2 ea.
3. Unique hybrid passenger 1 ea.
4. TEVan 4 ea.
5. S-10 pickup 4 ea.
6. Prizm sedan 5 ea.

TOTAL 20

## **Orcas Power and Light Company (OPALCO)**

1. Escort 1 ea.
2. Solectria Force 1 ea.

TOTAL 2



## **Pacific Gas and Electric Company (PG&E)**

1. G-Van (passenger) 2 ea.
2. G-Van (cargo) 1 ea.
3. Ecostars 2 ea.
4. EVCORT 1 ea

TOTAL 6

## **Platte River Power Authority (PRPA)**

1. EVCORT sedan 2 ea.

TOTAL 2

## **Potomac Electric Power Company (PEPCO)**

1. G-Van (passenger)\* 1 ea.
2. Solectria Force 1 ea
3. EVcort 1 ea

TOTAL 3

## **Sandia National Laboratory**

1. Electrica (Escort conversion) 12 ea.

TOTAL 12

**\* Not currently in service**

## **Southern California Edison Company (SCE)**

1. G-Van (passenger) 9 ea.
2. G-Van (cargo) 6 ea.
3. Ford Ecostar 12 ea.
4. Solectria Force 6 ea.
5. Electricar pickup (S-10) 4 ea.
6. BAT sedan 1 ea.
7. Pickup (Venus Motors) (Ranger) 1 ea.

8. Sedan, Prizm 4 ea.
9. TEVan 2 ea.
10. Bus (Clean Air Transit) 1 ea.
11. Honda sedans 3 ea.
12. Van, Dodge Caravan 1 ea.

TOTAL 50

## **Texas A&M University (TAMU)**

1. G-Van 15 ea. (Includes consortium vehicles)
2. Jet 1 ea.
3. TEVan 8 ea.
4. Race Car 2 ea.
5. S-10 Pickup 3 ea.

TOTAL 29

## **U.S. Navy (NAVY)**

1. Jet (various) 42 ea.
2. Grumman Van 2
3. S-10 6
4. G-Vans 5
5. Bedford Vans 5
6. Griffon Van 6 ea.

TOTAL 66

## **University of South Florida (USF)**

1. G-Van (passenger) 2 ea.
2. Chevy S-10 Pickup 10 ea.
3. Dakota 1 ea.
4. Mirage 1 ea.

TOTAL 14

## **York Technical College (YORK)**

1. G-Van 1 ea.

2. Escort (Bearskin) 1 ea.
3. Unique Sedan 2 ea.
4. S-10 Pickup 8 ea.
5. Solectria Force 1 ea.

TOTAL 13

## TOTAL - SITE OPERATOR PROGRAM 242

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**Table 2.** Baseline vehicle information on selected electric vehicles.

VEH NAME	G-Van	EVCORT	Force	S-10	TEVan	ECOSTAR
MFG	Conceptor	Soleq	Solectria	Solar Car	CHRYSLER	FORD
BODY	VAN- PSG/CRGO	SEDAN	SEDAN	PICK-UP	MINI-VAN	STAT. WAG.
NO. PASS	7/2	4	2+2	2	7	2
BATT TYPE	LEAD- ACID	LEAD- ACID	LEAD- ACID	LEAD- ACID	NI-FE	NA-S
MODUL VLT	6	6	12	6	6	–
NO. MODUL	32	18	12	20	30	–
SYST VOLT	216	108	144	120	180	336
CHARGER	OFF BOARD	ON BOARD	ON BOARD	ON BOARD	ON BOARD	–

WEIGHT(GVW)	8600 lbs	3980 lbs	2450 lbs	3200 lbs	~6000 lbs	3950 lbs
WEIGHT(CURB)	7670 lbs(Pass) 7050 lbs(Cargo)	3560 lbs	–	3500 lbs	–	3200 lbs
MOTOR/HP	DC/60 HP	DC/42 HP	AC/25- DC/32	DC/28	DC/55	AC/75 HP
EST RANGE	60 MI.	60 MI.	46 MI.(FUDS)	40-70 MI	120 MI.	100 MI.
REGEN BRK	YES	YES	YES	OPTIONAL	YES	YES

VEH NAME	IMPACT	LA 301	ELECTRON- TWO	FEV	RAM 50 TRUCK	E1
MFG	GM	CLN AIR TRNS	SOLAR ELECTR	NISSAN	EVA	BMW
BODY	SEDAN	SEDAN	SEDAN	SEDAN	PICK-UP	SEDAN
NO. PASS	2	4	2	2	2	4
BATT TYPE	LEAD- ACID	PB-A w/HYBRID	LEAD-ACID	NI-CAD	LEAD- ACID	NA-S
MODUL VLT	10	6	6	–	6	–
NO. MODUL	32	32	18	–	20	–

SYST VOLT	320	216	108	–	120	120
CHARGER	ON BOARD	ON BOARD	–	ON BOARD	–	–
WEIGHT	2200 lbs	3894 lbs	3100 lbs	1984 lbs	3500 lbs	2600 lbs
MOTOR/HP	2 ea AC/57 HP	57	DC/23	2 ea	DC/38	DC/45
EST RANGE	80 MI	40-60 MI*	45-65 MI	100 MI	50-70 MI	155
REGEN BRK	YES	YES	–	YES	–	–
<b>*BATT. ONLY; 150+ MI AS HYBRID</b>						

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## Program Management

- The Program report for the second quarter of FY-95 was issued.
- The Site Operator Users Task Force Meeting, hosted by Platte River Power Authority, was held April 27, 1995 in Denver, CO.

## Program Experience Overview

The Site Operator Program has evolved substantially since its inception in response to the Electric Vehicle Research and Demonstration Act of 1976. In its original form, a commercialization effort was intended, but was less than feasible for lack of vehicle suppliers and infrastructure. Nonetheless, with DOE sponsorship and technical participation, a few results (primarily operating experience and data) were forthcoming.

In the early 1980s, DOE emphasis shifted to data collection and interpretation. A mechanism was set up to give money to participating sites and justify continuing the program. Several problems soon became apparent:

- Too much data was required

- Data collection methods were primitive
- Data quality was suspect
- Database operation was ineffective.

The contract for the Program was transferred to the INEL in 1987.

The basic premises of the Program were refined subsequent to the INEL takeover, to emphasize the following efforts:

- Operating and maintenance data collection, analysis, and dissemination
- Public demonstrations to promote general awareness of this developing technology.

Both of these efforts have been fruitful. In particular, practical methods and equipment now exist for acquiring and handling operating data, with increasingly broad distribution of relevant information.

The current Program comprises twelve (12) sites, and over 240 vehicles, of which about 50 are latest generation vehicles. DOE funds about 10% of Program participant expenditures overall; as a co-sponsor, INEL receives operating and maintenance data for both DOE-owned and participant-owned or monitored vehicles, as well as Program reports.

As noted elsewhere in this report, participants represent several widely differing categories: electric utilities, academic institutions, and federal agencies. Noteworthy additional benefits have accrued to the Program from the first two categories.

The utilities have been concerned with infrastructure needs for electric vehicle operation, particularly those required for battery recharging. Several candidate technologies have been investigated and developed for commercial use. In addition, the problems associated with operating and maintaining an EV fleet have been scoped and workable solutions devised and implemented.

The academic institutions and electric utilities have been productive beyond the original Program scope in the areas of:

- Charging methods, both curbside and solar
- Vehicle operating data acquisition and transmittal, via mobile data acquisition systems (MDAS)
- Training courses and related materials for maintenance personnel and operators
- Field testing of experimental or prototype vehicles and components.

Both the utilities and the academic institutions tend to establish beneficial relationships with the industrial community.

The INEL has worked closely with Program participants to improve acquisition methods and data quality and in turn has established a central database for, and arranged for dissemination of, a spectrum of EV-

related information. Through Program reports, INEL also gains a broad picture of the state of EV technology and accompanying public awareness.

Some tentative conclusions can be drawn about the current state of EV technology and operation:

- The effects of climate are adequately documented by inputs from widely differing locations.
- Battery technology is a major limitation in achieving range and vehicle cost goals.
- Conversion of vehicles originally designed for internal combustion engine power can frequently severely reduce payload capability and the service life of key components.
- Production of useful data may be limited where up-to-date equipment is not available. Some of the operating units monitored by the program are approaching a 20-year service life.

Several states (notably, California and Massachusetts) have or are considering regulatory mandates to increase the use of electric vehicles for environmental benefit. Such laws occasion increased economic reaction and discussion. Their eventual effectiveness is dependent upon establishing a viable EV manufacturing industry and an adequate infrastructure for vehicle operation and service.

In the context of these requirements, two national organizations join DOE and the major auto manufacturers in promoting EV use.

- The Partnership for a New Generation of Vehicles (PNGV) in America has been established as a joint Federal- Industrial-Academic effort to identify and evaluate vehicular transportation alternatives, including energy storage devices and alternative fuels.
- EV America is a utility-led program to accelerate development and introduction of electric vehicles into the marketplace. A key effort is performance and field test evaluation, with an initial procurement goal of 500 units by the end of 1995. Tests are planned to qualify up to 100 units to Federal Motor Vehicle Safety

Standards, during 1995, and will include cold-weather exposures in the northern USA.

A third organization, Electric Vehicle Research Network, is an EPRI-sponsored group of 11 electric utilities who field test EVs, but are not Program participants.

A change of Program direction in the near and medium term is expected. Probable candidates for operator testing and data acquisition are hybrids, advanced EVs (i.e., designed as such rather than conversions), add-on or replacement key components (i.e., energy storage devices, system control, and driveline), and devices resulting from PNGV findings.

## Summary

The DOE Site Operator Program currently receives input from 13 sites in the U.S. The participants are public utilities, educational institutions, a National Laboratory, and the U.S. Navy. The number of electric

vehicles now in use or undergoing test evaluations exceeds 240, ranging in age from new to fifteen years. Body styles are mainly for utility (van or pickup) or passenger service.

Program participant efforts reflect varying combinations of day-to-day use, laboratory testing and evaluation, and successful promotion of public awareness by demonstrations, exhibits, and media dissemination of related activities and information.

The status entries in the [Appendix](#) provide more specific information concerning the Program participants and their overall interests, their programmatic activities, and their experiences with electric vehicles and accompanying problems.

An overview of the Program since its 1976 inception is presented. With a more rigorous definition of specific objectives, key problems of Program operation have been identified, and addressed successfully.

The two principal missions of the Program are well-served by the participants, and the gathered operation/maintenance data are now widely available from an extensive database at the INEL. The participants have also succeeded in day-to-day exposure and demonstration of a variety of electric vehicle configurations to the public. As a part of this effort, beneficial working relationships have been established with appropriate portions of the industrial community.

Experience to date emphasizes problems which are specific to electric vehicles:

- Climate effects
- Battery technology
- Reduced service life for components adapted from internal combustion engine vehicles.

Legislative mandates to increase EV use for environmental reasons are in place or impending in several states. In this context, two national organizations have undertaken related efforts.

- The Partnership for a New Generation of Vehicles (PNGV) in America will identify and evaluate vehicular technology alternatives.
- EV America will conduct performance and evaluation tests, to support EV market development.

Near- and medium-term Program redirection is expected to involve hybrid systems, advanced EV designs, add-on or improved components, and inputs from PNGV studies.