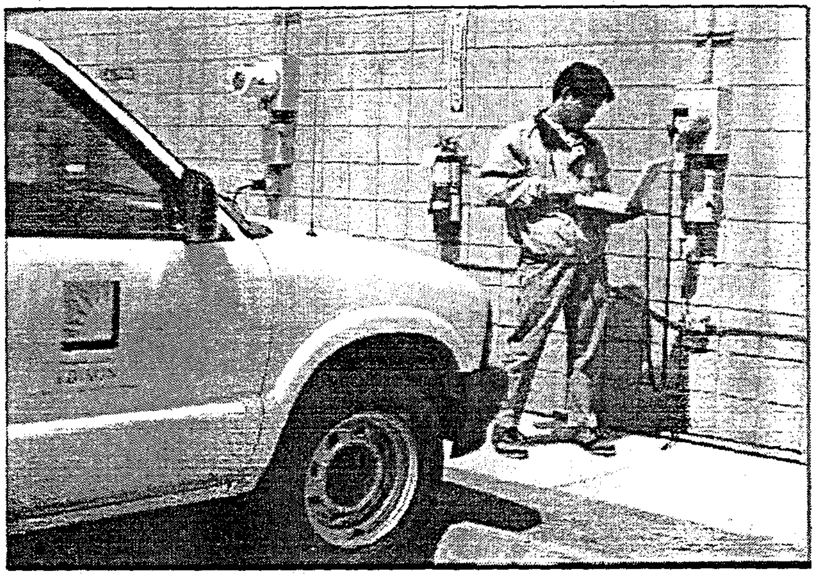
SITE OPERATOR TECHNICAL REPORT

FINAL REPORT

DOE/ID/13077--T1

(1992 - 1996)



SOUTHERN CALIFORNIA EDISON

An *EDISON INTERNATIONAL* Company

for COOPERATIVE AGREEMENT No. DE-FC07-91ID13077 with

the U.S. DEPARTMENT OF ENERGY for participation in the

ELECTRIC & HYBRID VEHICLE SITE OPERATOR PROGRAM

Electric Transportation Division

December 1996

DISCLAIMER

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SOUTHERN CALIFORNIA EDISON COMPANY

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U.S. DEPARTMENT OF ENERGY ELECTRIC AND HYBRID VEHICLE PROGRAM

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1. PREFACE

The Southern California Edison Company (SCE) and the U.S. Department of Energy (DOE) entered into cooperative agreement no. DE-FC07-91ID13077 on August 23, 1991, which expired on August 3, 1996. This cooperative agreement provided SCE with DOE cofunding for participation in the DOE's Electric & Hybrid Vehicle Site Operator Program. In return, SCE provided the DOE with quarterly progress reports which include operating and maintenance data for the electric (EVs) vehicles in SCE's fleet.

Herein is SCE's final report for the 1992 to 1996 agreement period. As of September 1, 1996 the SCE fleet had 65 electric vehicles in service. A total of 578,200 miles had been logged. During the agreement period, SCE sent the DOE a total of 19 technical reports (Appendix "B"). This report summarizes the technical achievements which took place during a long, productive and rewarding, relationship with the DOE.

2. VEHICLE DEVELOPMENT AND TESTING

Technology assessment and project definition activities, supplemented by a survey of the Edison service territory, were the focus of early EV activities at Edison. After joining the EPRI EV Program, Edison received two proof-of-concept G-Vans in early 1988. During that year agreements were executed with EPRI to support the design and certification of a production version of the G-Van, and the development of more advanced EV based on the Chrysler mini-van platform (the TEVan). The development of a lithium-air battery powered mini-van, with significant range potential, was also initiated.

Early experience with the G-Vans led Edison to support the improvement of critical EV components: air conditioning systems, battery state-of-charge gages and on-board chargers. Edison was instrumental in the development of a very successful electric shuttle bus with Santa Barbara MTA in 1989. *Also in 1989 Edison was awarded its first contract from DOE for participation in the Site Operator Program.* In 1990, Edison and the Los Angeles Department of Water and Power (LADWP) signed a co-funding agreement to support the development by Clean Air Transport (CAT) of an hybrid electric EV under the Los Angeles Initiative. Research assumed a technical management role for the program until early 1991. Edison withdrew its participation in the project, when key financial milestones were not met by CAT. Two prototype LA 301 vehicles were completed by CAT. Fifteen pre-production G-Vans were placed in a test and evaluation program and loaned throughout the Edison service territory to interested parties while at the same time also used in Edison's own fleet operation. Several G-Van reliability problems were investigated and addressed. Extensive technical liaison was maintained with the manufacturer.

Two Solectria passenger cars and an electric shuttle bus were added to the Edison EV fleet in 1991.

In 1992, Edison's shuttle bus, a pick-up truck, three passenger cars, and another electric shuttle bus were tested. In addition, a side-by-side energy efficiency test of a Solectria and its gasoline counterpart (the GEO Metro) was done. Working relationships were established between Edison, SCAQMD and CARB through cooperation on vehicle testing. Participation in the DOE Site Operator program continued and $300,000 of California Energy Commission Demonstration funds were designated for the Ford Ecostars to be used on Edison's service territory. Two G-Vans were accepted into the local Federal Express feet under the two year SCAQMD Alternative Fuels Test Program. Local conversion firms were used to convert two depreciated Edison fleet vehicles (a pick-up and a passenger car).

Edison's Transportation Research (TR) group tested two light duty pick-up trucks, one passenger car, one converted electric school bus and a full size van upgraded with nickel-cadmium batteries in 1993. TR tested the Hughes inductive charger in two Edison-owned electric vans: one for performance characterization at Edison's facilities, the other for field evaluation under a cooperative loan arrangement with PG&E.

TR transferred eight EVs to the Edison corporate fleet and transferred vehicle maintenance to Edison's Transportation Services Division (TSD). EV component repairs were increasingly performed by Edison's Shop Services and Instrumentation Division (SSID).

TR and TSD prepared a Joint Fleet Vehicle Conversion Plan. Under the terms of that plan, TR selected and procured an advanced AC Propulsion powertrain that was used by TSD to convert a depreciated Edison fleet light duty pick-up truck. Also as part of the plan, TR and TSD selected the Hughes powertrain for evaluation in the Edison fleet. A converted S-10 light duty pick-up truck was shipped to Edison in December 1993.

TR markedly improved the performance of an electric van loaned to Federal Express by retrofitting nickel-cadmium batteries provided by EPRI. This project included the design and fabrication of an air cooled battery tray, the adaptation of a new battery charger and the installation of an improved battery state-of-charge gauge.

Edison's participation in the DOE Site Operator program continued with the preparation of four comprehensive quarterly reports on vehicle testing.

TR prepared an eight-year Low Emission Vehicle RD&D Test Plan and a three-year Ford Ecostar Testing and Evaluation Plan. The layout of an EV Technical Center at TSD's facilities in Pomona, California, was finalized. Remodeling work was initiated to dedicate and equip three garage bays.

With Edison's support, CALSTART was selected by CEC to convert two school buses to battery power. Edison provided technical and financial assistance to the manufacturers in the areas of battery and test instrumentation, and to the school district who will operate the buses, in the area of recharge infrastructure.

TR tested EVs for electromagnetic fields (EMF) and prepared a fact sheet on EVs and EMF. EMF test protocols were developed in cooperation with ERRI and PG&E. Edison also prepared procurement specifications for fleet EVs and participated in a Technical Advisory Committee created by the Santa Barbara APCD to develop electric hybrid ultra low emission buses.

Edison initiated test and evaluation of the first of twelve prototype Ford Ecostar electric vans to be used in the Edison fleet and by selected fleets and private parties served by Edison over a thirty-month period.

TR tested two mini-vans, two light duty pick-up trucks and six passenger cars. A full size electric van (G-Van) was modified to evaluate pre-cooling in a desert environment. Fast charging of a Peugeot 106 subcompact sedan was tested while the vehicle was loaned to Edison.

Eleven Ford Ecostars were received. Two Chrysler TEVans and one U.S. Electricar Sedan were purchased. A total of 23 EVs have been transferred to the Edison fleet.

The EV Technical Center was made fully operational when the charging infrastructure was completed and energized.

EMF testing of vehicles and chargers continued. Edison contributed to the development of an EPRI-sponsored EMF test procedure.

Evaluation of an electric school bus continued. Performance and energy usage were analyzed and documented.

Edison's participation in the DOE Site Operator Program continued. Six light duty pick-ups were ordered with cofunding received from DOE under a 1994 "group buy" program. Edison performed the acceptance tests of the U.S. Electricar S-10 pick-ups for the Site Operator Program.

TR performed an EV Efficiency "side by side" test with a gasoline Prizm and its converted counterpart (the U.S. Electricar Sedan). Both vehicles were driven 200 miles on SCE's test route (the "Pomona Loop") under identical driving conditions and their energy usage was compared.

In 1995 and 1996, SCE developed and implemented a Fleet Evaluation Program to systematically and consistently document the performance of its EV fleet. As of September 1, 1996, the Edison fleet had 65 EVs in service. A total of 578,200 miles had been logged. (See Table 2 - 1).

SCE EV Fleet

(as of 9/1/96)

MAKE	MODEL	BATTERY	QUANTITY	MILES
Conceptor	G-Van	Lead Acid	9	140,600
Conceptor	G-Van	Nickel Cadmium	1	14,300
Specialty Mfg.	Shuttle	Lead Acid	1	21,500
Solectria	Force (Metro)	Lead Acid	7	36,600
Solectria	E-10 (P.U.)	Lead Acid	2	6,900
U S Electricar	ES-10 (P.U.)	Lead Acid	10	35,100
U S Electricar	Sedan (Prizm)	Lead Acid	10	40,400
Ford	Ecostar	Sodium Sulfur	12	114,200
Honda	CUV4 (Civic)	Lead Acid/Nickel Metal Hydride	3	26,800
Toyota	RAV4 EV	Lead Acid/Nickel Metal Hydride	2	10,700
Nissan	Avenir EV	Lead Acid	1	1,700
Chrysler	TEVan	Lead Acid	1	1,000
Chrysler	TEVan	Nickel Iron	1	900
TDM	Ranger EV	Lead Acid	2	3,700
AC Propulsion	CX	Lead Acid	1	6,500
B.A.T.	Metro	Lead Acid	1	1,400
B.A.T.	Electric Ranger Truck	Lead Acid	1	200
"Retired" EVs	G-Van, etc.	Lead Acid	(12)	115,700
		TOTALS:	**65**	**578,200**

TABLE 2 - 1

3. ENERGY STORAGE DEVELOPMENT AND TESTING

Edison's earliest work was with lead acid battery testing. The first batteries tested were those in the two proof-of-concept G-Vans in 1988 and subsequent prototype G-Vans from Conceptor, both of which had Chloride flooded lead acid packs.

As part of EPRI's efforts to extend the range of EVs, Edison co-funded the development of a high energy density nickel iron battery at Eagle-Picher. While these efforts were successful in producing prototype batteries for incorporation into Chrysler TEVans, the high hydrogen gassing of this battery during recharge contributed to the eventual dropping of a plan to proceed to a pilot plant stage of development.

A number of ENSCI sealed bipolar lead-acid battery prototypes were built and tested in 1990 and 1991, but shorts occurred due to mechanical failures and Edison discontinued funding.

In a joint Edison-Electrotek project, a Griffon van with a CSPL sodium-sulfur battery achieved 154 miles on a C-Cycle. The battery developed internal problems and a replacement battery was built and shipped to Electrotek in Chattanooga in December 1990. Tests at the Electrotek test track in 1991 demonstrated 130-160 mile range. About 15,000 miles were logged, using 170 discharge cycles, which was the highest mileage achieved to date on a sodium-sulfur battery. Tests were terminated in late 1991, when battery capacity began to drop.

Edison became part of a Department of Energy (DOE)-sponsored working group to identify and resolve regulatory obstacles to commercial use of sodium-sulfur batteries for electric vehicles.

A light-weight 168-cell zinc-air battery pack has been produced and has achieved a range of 120 miles in a Chrysler mini-van. A range of 65 miles has been achieved with an 84-cell half-pack. Current work will provide improved cells with nearly three times the power (discharge rate) of the cells previously used. This power increase was needed to provide adequate driveability of the van. Edison and DEMI plan to provide cells to the DOE Idaho National Engineering Laboratory (INEL), to be tested at INEL at DOE expense. Discharge rate and cell life are the main areas where work is needed.

The three major U.S. automakers proposed a cooperative battery development consortium to focus and bring together resources of the federal government, the utility industry, and the automakers. Several near-term batteries were to be jointly selected, and the consortium would sponsor the development of the batteries to assure that commercial production readiness would be achieved in time for electric vehicle mass production later this decade. Edison joined this consortium, under the EPRI umbrella, which also had four other utilities participating. During 1991, the Consortium prepared a Request for Proposal solicitation and received proposals from a large number of suppliers. Preferred technologies and suppliers had been selected and contract negotiations were underway.

In_a joint project with Arizona Public Service, a Honda CRX was equipped with a new bipolar zinc-air battery design by Dreisback Electromotive Inc. (DEMI). The vehicle won first place in the 1991 Solar and Electric 500 race in Phoenix, averaging 54 mph for 108 miles. In another test the CRX set an EV distance record of 251 miles on a single charge. DEMI is designing two improved zinc-air batteries for use by SCE in mini-vans.

Other ongoing work included investigations of possible improvements of lead acid battery technology in areas of life improvement; quality control, hydrogen evolution reduction, sealed maintenance free designs, etc.

In 1992, several activities were completed in the USABQ battery development program. Midterm and long-term battery development contracts were finalized and awarded on nickel-and lithium-based batteries. Edison participated in the Executive Management Committee and working committees, such as the Ovonics contract team and the testing standards team.

Edison completed the development of advanced DEMI zinc-air batteries through direct Edison contract. Design procurement and assembly of advanced zinc-air batteries is complete and ready for testing in a mini-van field evaluation. Complimentary development has facilitated the delivery of zinc-air batteries to the Idaho National Engineering Laboratory (INEL) for DOE testing. Cooperative testing of a modular lead-acid battery from Electric Vehicles Corporation was undertaken with the Electric Power Research Institute (EPRI).

Testing was performed on several alternative lead acid batteries, G-Vans were used to complete tests on battery packs produced by Chloride, Sonneschein and Trojan. A Teledyne-supplied pack is currently being tested. To date, the Sonnenschein pack appears to be the best replacement candidate for original Chloride batteries.

Reviews of near-term battery options, such as ARIAS Bipolar and Electrosource lead-acid batteries, were completed. Based on these Edison has concluded that the Electrosource batteries demonstrated probability of achieving consistently satisfactory performance.

A study of battery/fuel cell hybrid combinations demonstrated that the optimal hybrid combination is a 50/50 battery and fuel cell mix.

Edison support to USABC was provided both financially and through active participation on the Technical Advisory Committee, battery contract working groups, and the Management Committee. During the past year, USABC awarded contracts to 3M for a Lithium PolymerBattery, and to RWE Silent Power for a Sodium Sulfur battery This is in addition to on-going battery development contracts that began prior to 1993; including: Ovonic Battery Corp.- Nickel Metal Hydride; W.R. Grace - Lithium Polymer; Saft Lithium Iron Disulfide and Nickel Metal Hydride.

Edison supported the advanced lead-acid battery development by Electrosource for optimization of a quasi bi-polar design. The development effort, which is being coordinated and cofunded thorough EPRI, began in 1993 and is scheduled to be completed in late 1994. Electrosource is achieving breakthroughs in lead-acid battery performance. For example, its bi-polar horizontal plate battery has a life of 600 cycles, offers 45 Wh/kg specific energy and 440/W/kg specific power at 100% state of charge.

Edison has provided lead-acid batteries, developed by the Trojan battery company, for both AC drive and DC drive buses in the CALSTART Electric School Bus Project. This program will extend into 1994 for performance testing of both systems.

TR tested lead acid and nickel cadmium batteries for use in Edison's electric vehicle fleet. Edison obtained lead acid batteries from Teledyne, East Penn, Sonnenschein, Trojan, and Gates. Edison obtained nickel cadmium batteries from SAFT and DEMI. Test results provided Edison with first-hand information on today's technology and assist in determining future Research strategy.

To increase the energy and power performance of a G-Van, Edison converted a Chloride lead acid battery pack to a NI-Cd battery pack that was provided by EPRI. Both a lead acid and the NI-Cd G-Van continued long-term durability testing as part of the Federal Express test fleet cosponsored by SCAQMD.

TR evaluated lead acid development programs by AECT/PEP, GNB and several bipolar developers. Edison also monitored the progress of alternate energy storage technologies for EV applications such as fuel cells, ultracapacitors, and flywheels.

During 1994, two new battery systems were introduced for testing: (1) valve regulated spiral wound absorbed electrolyte lead-acid battery pack from Optima, and (2) nickel-iron battery pack manufactured by Eagle Picher. These new battery packs underwent initial characterization and equalization in the laboratory followed by in-vehicle road testing and life cycle testing in Edison's EV fleet.

Life cycle testing continued on the EV maintenance-free valve regulated lead-acid battery packs from Hawker Energy Products (four battery packs), Sonnenchein (two battery packs), East Penn Battery Company (two battery packs) arid Teledyne Battery Company (one battery pack).

Edison continued efforts to integrate EV battery packs with battery chargers produced by different manufacturers such as La Marche, Enerpro and Soleq. The main goal of this task was to improve overall energy efficiency of the electric vehicle by meeting charging regimes required by battery manufacturers.

Edison started investigation of battery pack life and charge acceptance during quick charging using a Norvik fast charger. This charger may allow the recharging of EV batteries from 20% state of charge to 80% state of charge within 10-30 minutes.

Edison continued its support of advanced lead-acid battery development by Electrosource to optimize a quasi-bipolar design. This development effort is coordinated and cofunded through EPRI.

Edison provided both financial and management support for the development of advanced mid and long-term USABC batteries. In 1994, USABC awarded new contracts to Duracell/Varta for the development of the lithium-ion battery and to Yardney Technical Products for a development of a low cost nickel electrode.

Edison monitored the progress of alternate energy sources in EV applications such as fuel cells, ultracapacitors and flywheels. A report was prepared by Praxis Engineering Company, which evaluates the visibility of flywheels in the EV applications.

4. INFRASTUCTURE

In 1992, Edison initiated RD&D activities in support of the creation of an EV recharge infrastructure by 1995. A multi-year program plan was drafted. Research efforts with outside firms (e.g., Hughes) and internal divisions (e.g., Shop Services and Instrumentation Division) were initiated. Edison participated on the EVAA/EPRI Infrastructure Working Committee and the CALSTART Infrastructure Team.

TR developed a multi-year Transportation Infrastructure Research Plan for the years 1993 through 2000. In the initial years, the plan's focus is on electric vehicle recharging load management device testing and evaluation, while projects in the later years develop and test other EV recharging equipment, on-site energy storage, and distributed generation concepts that minimize the utility's electrical demand, and consider the electrical demand impacts from other alternative fuels, i.e., CNG, and hydrogen. The identified activities include:

- the function of battery rechargers (including advanced prototypical designs), and their impacts on the utility electrical system;
- standards for EV connectors;
- the communication link between the battery charger and utility, needed for effective load management;
- strategies for effective EV recharging facilities;
- ways to shift EV recharging load through on-site energy storage or distributed generation;
- electrical infrastructure requirements of alternative fuels;
- safety issues raised by EV battery recharging;
- ways to provide billing for EV recharging; and
- standards for EV recharging power quality.

TR completed and delivered studies to internal Edison client organizations that deal with EV emergency safety response, EV recharging billing options, and building code impacts on EV charger installations. These reports are used by the clients to develop EV infrastructure deployment plans that include Edison's model EV fleet.

TR developed conceptual EV recharging station designs for residential commercial parking lot, and fleet environments. These designs will be used by internal client organizations, i.e., Electric Transportation, Customer Service and Transportation Services, as a resource to satisfy customer inquiries and for deployment of EV recharging facilities on Edison property. Furthermore, Edison designed upgrades to the Edison research test facility for EV recharging technology. EPRI expressed interest in using this facility for cooperative research projects.

TR continued participation on the Infrastructure Working Council's (IWC) Connectors and Connecting Stations Committee. The committee established recharging standards for voltage, current, and time. Additional standards for a charger test protocol and connector evaluation were proposed. These recommendations and proposals were sent to standards organizations, e.g., the Society of Automotive Engineers (SAE), and Underwriters Laboratory (UL) for adoption.

To allow the utility to communicate with EV chargers, TR developed and submitted to the IWC's Data Interface Committee a communication protocol for recommended standards consideration. The proposed protocol provides a format for information to flow between the utility and the EV charger. This information flow may be used in utility demand side management programs. TR also developed conceptual designs for communication hardware that would use the communication protocol.

The General Office Recharging Test Station (GORTS) was designed and built with the help of other Edison departments. This facility was commissioned in October 1994 and it will be a test bed for EV recharging technology along with communication, load management and billing interfaces. Data collected at GORTS will be disseminated to utility and appropriate industry groups and will be used for development plans for Edison's own EV Fleet and charging station infrastructure.

Edison analyzed and tested the Hughes Power Control Systems (HPCS) inductive charger technology. The HPCS has remarkably good power quality with a very high power factor and very low harmonics. The inductive paddle was found to be safe and convenient from the users standpoint.

Edison issued a contract for the development of Electric Vehicle Interface (EVI) device. The purpose is to design, develop and test a device that can be used for communication between the battery charger and the utility to better interface EV loads with overall utility system loads. The utility could also then give the customer real-time billing information, including per-unit energy costs, total energy purchased so far and the total cost.

Edison participated in the creation of a seminar designed for EV fleets. This seminar was prepared by York Technical College under a contract equally funded by SCE, PG&E, DWP and SMUD and will be used to train fleet operators. Edison's role was to input current technology data on EVs. Edison participated in Infrastructure Working Committee (IWC), Society of Automotive Engineers (SAE) and Japanese Electric Vehicle Association (JEVA) meetings to standardize recharge electrical and hardware interfaces.

Edison participated in SCAQMD/CALSTART/APRA sponsored projects and helped deploy the electric bus in the Goleta and Antelope Valley School Districts by addressing their electrical recharging needs. EV charging stations were planned for Edward's Air Force Base and the AQMD office in Diamond Bar.

Edison studied various approaches to respond to the 72-hour service installation objective. Temporary and permanent approaches are being considered.

Edison performed tests on various chargers to assess safety, efficiency, reliability, and power quality. These chargers included a 150 kW quick charge Norvik charger and the previously mentioned Hughes 6.6 kW inductive charger.

Please refer to Appendix "A" for a list of test reports published by Edison since January 1989.

5. LESSONS LEARNED

5.1 Vehicles

1. Vehicle development is being addressed by small and large assembliers and the technology is evolving for many powertrain components. Edison should not, however, assume that the size of the manufacturer is directly relevant to the quality of the EV. Chrysler, a large OEM, has consistently had poor quality EVs. While on the other hand, Solectria, a very small firm, has emerged with higher quality products.

2. Historically, small unfit firms have all failed to continue business operations from decade to decade. Therefore, larger OEMs, e.g., Ford and GM offer the greatest promise for high volume products aimed at building a sustainable market.

3. Edison testing is essential to verify manufacturer vehicle performance data. Even as standardization of testing protocol is obtained, Edison should continue to test vehicles for corporate fleet and general ratepayer knowledge.

4. Vehicle development support by utilities is a high risk activity with minimal payback. For example, after numerous years of R&D and about 100 vehicles built, the G-Van was not able to move into volume production. Although the Chrysler TEVan program helped Chrysler determine which technology approaches to abandon, the utility supported technologies, i.e., in-house powertrain and Ni Fe battery, were unsuccessful. At best, these early utility supported R&D efforts helped to jump start the modern EV technology movement.

5. Feedback of utility test data to vehicle and component developers is of high value in order to assure that utility fleet and customer needs are recognized and accommodated.

5.2. Energy Storage

1. Far more so than any other component, better energy storage remains the technological and commercialization weak point for EVs. No stakeholder, including utilities should ignore the need to continue development support. Because of the large magnitude of support needed and the typically long time duration required to finish the development process, cooperative efforts among the stakeholders are essential.

2. Chemical batteries are appropriately receiving the largest magnitude of support for EV applications. Many developers continue to make incremental improvements in nearterm batteries, e.g., lead acid; but for EVs to be a sustainable market, there must be technology advancements to meet midterm and long term performance parameters. Battery costs are just as critical to success as are technical parameters. R&D support for any battery type must be evaluated continuously for commercial cost viability.

3. Edison should continue to test promising new chemical batteries at both the prototype and production stages of developmen1t. Surprising quality problems have frequently occurred as manufacturers move from the laboratory to automated production lines.

4. About every ten years, mechanical battery, i.e., flywheel, developers forecast commercial product availability in five years. Healthy skepticism should be applied to these forecasts and only when working units are demonstrated and acceptable costs are verified, should high confidence be assumed for their use in EVs.

5. Fuel cells do offer the potential for use in EVs. Their use in combination with batteries at about a 50-50 mix seems most viable, but not until the mid-2000's.

6. Although Edison's EV program has not involved continuing development and testing of hybrid EVs (HEVs), HEVs are a viable lower emission vehicle. The LA. Initiative's L.A. 301 developed in the early 1990's was never commercialized. Major U.S. automakers are working on hybrids with DOE support. These vehicles put less of a range and cost demand on batteries, since the battery can be small in size. Range extension is likely to come from combustion engines or turbines. Battery parameters for HEVs are quite different than those for EVs, as specified by the national Partnership for New Generation Vehicles (PNGV).

7. Feedback to developers is of high value to achieve a product suitable for utility and customer needs. Laboratory and auto manufacturer testing alone is not sufficient Real world testing over extended periods in actual user environments has exposed the need for numerous product improvements.

5.3. Infrastructure

1 Standardization and code accommodation of EVs in this segment of the industry have been glaringly deficient. A combined utility and automaker effort under the Infrastructure Working Council has begun and needs to be nurtured to assure recharge infrastructure has a solid base from which to grow.

2. Component suppliers of early recharge equipment were not sufficiently sensitive to power quality parameters. Edison testing revealed undesirable feedback into the utility system and high value was obtained from these tests by identifying improvement needs to suppliers. Equipment tests by Edison or by neutral certification parties should be expanded and efforts should be directed to establishing industry standards.

3. Industry has shown the ability to agree on some common parameters for recharging, i.e., power levels 1, 2 and 3. However, a major controversy continues to exist between inductive and conductive charging. Edison has tested both approaches with neither emerging as the overwhelming winner. With IWC/EPRI development and testing completion for both alternatives forecast for early 1996, a decision maker between the two should be – but has not been identified.

APPENDIX "A"

EV TECHNOLOGY TESTING TESTS/REPORTS STATUS.

Test	Lead Responsibility	Test Completion Date	Report Completion Date	Remarks
G-Van Range	Wehrey	Jan-89	Jan-89	
EV Battery Pack Recycling and Disposal	Schweinberg	N/A	Dec-89	By TBA
SOLEQ Portable EV Battery Charger	Wehrey	Feb-90	Feb-90	
G-Van Preparation & Acceptance	Wehrey	Feb-90	May-90	
ABB Sodium Sulfur Jetta	Wehrey	May-90	May-90	
LA 301 Technical Review	Wehrey	N/A	Oct-90	Confidential
G-Van Operation & Maintenance-First 6 Months	Wehrey	Sep-90	Nov-90	
LA 301 Technical Review	Wehrey	N/A	Feb-91	Confidential
BMI Electric Shuttle Bus	Ware	Feb-91	Mar-91	With MTD/BMI
G-Van Heater Emissions	Ware	Jan-91	Mar-91	
CEN Ferroresonnant Charger	Ware	May-91	Jun-91	
G-Van EMF Levels	Ware	Jul-91	Aug-91/Mar-93	With Research Center
City Bike Electric Motorcycle	Ware	Dec-91	Dec-91	For SCAQMD
Rose Parade Float Powertrain	Wehrey	Jan-92	Feb-92	
Electric Transp. Technology Center Feasibility Study	Wehrey	N/A	Feb-92	
DOE Site Operator-Through February 1992	Ware	Feb-92	Mar-92	
DOE Site Operator-First Quarter 1992	Ware	Mar-92	Mar-92	
EV Efficiency (Force vs. Geo Metro)	Wehrey	Apr-92	Apr-92	
Energy Impact of Using EVs	Scheffler	N/A	May-92	By U.C. Davis
"Gasoline Alley" Ride Conversion Benefits	Wehrey	N/A	May-92	Confidential
Solectria "5 Speed" Charger	Weeks	Apr-92	Jun-92	
"Autopia" Ride Conversion Benefits	Wehrey	N/A	Jun-92	Confidential
Destiny 2000 Performance & Charger	Weeks	May-92	Jul-92	For SCAQMD
Solectria Powertrain Efficiency (AC vs. DC)	Wehrey	Jun-92	Jul-92	
DOE Site Operator-Second Quarter 1992	Ware	Jun-92	Aug-92	
Advanced DC Motor Testing (Advanced DC, Uniq, Solectria)	Weeks	Sep-92	Nov-92	With Cal State L.A.

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Test	Lead Responsibility	Test Completion Date	Report Completion Date	Remarks
In-Vehicle Lead-Acid Battery Tests (Trojan and Sonnenschein vs. Chloride)	Pinsky	Jun-92	Nov-92	
DOE Site Operator Third Quarter 1992	Ware	Sep-92	Dec-92	
Battery/Fuel Cell Hybrid Configuration	Pinsky	Aug-92	Dec-92	By Praxis Engineers
Automatic Force EMF Levels	Ware	Nov-92	Dec-92	With Research Center
Teledyne Lead-Acid Battery Tests	Pinsky	Nov-92	Dec-92	By Teledyne
City Bike MK-1	Weeks	Nov-92	Jan-93	For SCAQMD
Solar Electric P.U. Truck Conversion Performance & Charger	Weeks	Dec-92	Jan-93	
Passenger Car (Tempo) Conversion Performance & Charger	Weeks	Nov-92	Jan-93	
DOE Site Operator-Fourth Quarter 1992	Ware	Dec-92	Mar-93	
SVMC Electric Shuttle EMF Levels	Ware	Sep-92	Mar-93	With Research Center
Solar Electric Pick Up Truck EMF Levels	Rivas	Dec-92	Mar-93	With Research Center
Converted Ford Tempo EMF Levels	Rivas	Nov-92	Mar-93	With Research Center
Venus Motors P.U. Truck Conversion Performance & Charger	Argueta	Mar-93	Apr-93	
Electric Vehicle and Battery Testing at SCE	Wehrey/Pinsky	N/A	May-93	
DOE Site Operator First Quarter 1993	Ware	Mar-93	Jun-93	
DOE Site Operator Second Quarter 1993	Ware	Jun-93	Aug-93	
Hughes Induction Charger System	Rivas	Jun-93	Aug-93	
AC Propulsion ELX (Cocconi)	Argueta	Jun-93	Nov-93	For SCAQMD
B.A.T. International Pickup Truck Conversion and Charger	Argueta	Jun-93	Jul-93	
FUDS Evaluation of Lead Acid Batteries	Pinsky	Sep-93	Oct-93	By Solectria
Nickel-Cadmium G-Van Performance and Charger	Schutty	Oct-93	Dec-93	
APS (AC) Converted Elec School Bus Perform & Chrgr	Argueta	Dec-93	Feb-94	
Ford Ecostar EMF Characterization	Griffing	Dec-93	Jan-94	With Research Center

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EV Technology Testing Tests/Reports Status

Test	Lead Responsibility	Test Completion Date	Report Completion Date	Remarks
APS (AC) School Bus EMF Characterization	Argueta	Feb-94	Mar-94	With Research Center
Westinghouse Powertrain Characterization	Argueta	Jan-94	April-94	
DOE Site Operator Fourth Quarter 1993	Ware	Dec-93	Feb-94	
CALSTART School Bus Interim Report	Wehrey	N/A	Feb-94	
Iwon Motronics Multiphase DC Motor	Wehrey	N/A	April-94	By Cal State LA
Honda EV Charger Test	Argueta	Apr-94	Apr-94	
Analysis of Ultraforce Catalyst (BAT)	Pinsky	Apr-94	May-94	Confidential
DOE Site Operator First Quarter 1994	Ware	Mar-94	May-94	
AC Propulsion ELX Range Test	Argueta	Jun-94	Jun-94	With A. Cocconi
TSD Converted Ranger (AC Propulsion) EMF Levels	Griffing	Jun-94	Jul-94	With Research Center
TSD Converted Ranger (AC Propulsion) Perf. Characterization	Moran	Jun-94	Jul-94	
CEC Electric School Bus Route Characterization	Argueta	Jun-94	Aug-94	
Electric Vehicle (G-Van) Precoolinig Evaluation	Schutty	Jul-94	Aug-94	Preliminary Report
DOE Site Operator 2nd Quarter 1994	Ware	Jun-94	Sept-94	
Ford Ecostar Initial Performance and Characterization	Moran	May-94	Sept-94	
Solectria Force Drive System Upgrade	Argueta	Aug-94	Sept-94	For DOE SOUTF
U.S. Electricar ES-10 Performance Characterization	Moran	Sept-94	Oct-94	
Magnetic Field Characterization of Norvik Charger	Baker/Banh	Sept-94	Oct-94	With Research Center
B.A.T. Metro Performance Characterization	Moran	Sept-94	Oct-94	
Electric Shuttle Vehicle (ESV Project) 1992 AB2766	Davis/Schutty	May-94	Oct-94	With E.T.
AC Propulsion ELX & 200 HP CX Pomona Loop Tests	Argueta	Oct-94	Nov-94	
Evaluation of Advanced DC Motors	Wehrey	Oct-94	Nov-94	By Cal State LA
U.S. Electricar Sedan Performance Characterization	Lovato/Argueta	Dec-94	Jan-95	
DOE Site Operator 3rd Quarter 1994	Ware	Sep-94	Dec-94	
Chrysler Electric Minivan Performance Characterization	Mendoza	Dec-94	Dec-94	NiFe Battery
Peugeot 106 Fast Charging with SAGEM BR 2000	Argueta	Dec-94	Jan-95	

c:\data\documents\wehrey\EVSTATUS: 10/24/96

EV Technology Testing Tests/Reports Status

Test	Lead Responsibility	Test Completion Date	Report Completion Date	Remarks
EV Efficiency Test (Prizm vs. Sedan)	Wehrey	Nov-94	NA	Charger Problems
Norvik Charger Tests	Argueta	Ongoing	Ongoing	
Lead Acid (Delco Remi) Battery Tests	Wehrey	Dec-94	Dec-94	By Cal Poly
Peugeot 106 Electric EMF Characterization	Holte/Stevens	Dec-94	Jan-95	With Research Center
GM Impact EMF Characterization	Holte/Stevens	Dec-94	Jan-95	With Research Center
Honda EV EMF Characterization	Holte/Stevens	Dec-94	Jan-95	With Research Center
US Electricar Sedan EMF Characterization	Holte/Stevens	Dec-94	Jan-95	With Research Center
Hughes Dolphin Systems Investigation	Argueta	Jan-95	Jan-95	
Hawker Battery Pack Test	Pinsky	Sept-94	Jan-95	
GM Impact Performance Testing	Argueta	Dec-94	Feb-95	Confidential
DOE Site Operator - Fourth Quarter 1994	Ware	Dec-94	Mar-95	
DOE Site Operator Fourth Quarter 1995	Ware	Dec-95	Mar-95	Also Fleet Evaluation
EV Fleet Evaluation First Quarter 1995	Schutty	Mar-95	Apr-95	With TSD
Delco Remi Battery Characterization	Pinsky	Mar-95	May-95	With Cal-Poly
DOE Site Operator First Quarter 1995	Ware	Mar-95	May-95	
Delco/Impact Battery Characterization	Pinsky/Mendoza	Mar-95	May-95	
Honda EV Performance Characterization	Argueta	Feb-95	Jun-95	Confidential
Nissan Avenir EV Performance Characterization	Argueta	Apr-95	Jun-95	With Nissan
Honda CUV-4 Fleet Evaluation Oct. 94 to Jan. 95	Wehrey	Jun-95	Jul-95	With TSD-Confidential
EV Fleet Evaluation Second Quarter 1995	Schutty	Jun-95	Jul-95	
EPTI Charger Power Quality Test	Argueta	Jun-95	Jul-95	
Enerpro Charger Power Quality Test	Argueta	Jun-95	Aug-95	
Electric Vehicles and EMF	Wehrey et al	N/A	Sept-95	With Holte, Sahl, & Judy
DOE Site Operator Second Quarter 1995	Ware	Jun-95	Oct-95	
EV Fleet Evaluation Third Quarter 1995	Schutty	Sept-95	Nov-95	
Peugeot 106 Electric Performance Testing	Argueta	Dec-94/95	Dec-95	Confidential
DOE Site Operator Third Quarter 1995	Ware	Sept-95	Dec-95	Also Fleet Evaluation
Oldham Battery Characterization	Mendoza	Dec-95	Jan-96	
Aerovironment AV-Partoller Electric Bicycle	Tcheng	Dec-95	Jan-96	

N/A: Not Applicable
NA: Not Assigned
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Test	Lead Responsibility	Test Completion Date	Completion Date	Remarks
EV Fleet Evaluation 4th Quarter 1995	Schutty	Dec-95	Feb-96	
Field Test Prototype Battery Packs at Selected Utilities	Pinsky	N/A	Feb-96	With EPRI
Sonnenschein/SAFT/Teledyne Battery Field Test Update	Pinsky	Sept-94	Mar-96	
Solectria E-10 Fleet Pick-up Performance Characterization	Tcheng	Jan-96	Mar-96	
U.S. Electricar S-10 with OBC NiMH	Mendoza	Feb-96	May-96	USABC Restricted
Aerovironment E-Tric 40 Motorcycle Performance	Tcheng	Mar-96	May-96	
EV Fleet Evaluation First Quarter 1996	Schutty	Mar-96	Jul-96	
DOE Site Operator First Quarter 1996	Ware	Mar-96	Jul-96	Also Fleet Evaluation
DOE Site Operator Second Quarter 1996	Wehrey	June-96	Sept-96	
EV Fleet Evaluation Second Quarter 1996	Wehrey	June-96	Sept-96	
Solectria Force Sedan Performance Characterization	Argueta	Sept-96	Oct-96	
TDM 1996 Ranger Performance Characterization	NA			
BMI (DC) Convert. Elec. School Bus Perf. Characterization	NA			Bus Not Available
AEG Na-$NiCl_2$ Force Integration and Characterization	Cabrera			

N/A: Not Applicable
NA: Not Assigned

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APPENDIX "B"

COVER PAGES AND TABLES OF CONTENTS OF 18 TECHNICAL REPORTS.

SITE OPERATOR PROGRESS REPORT

THROUGH FEBRUARY 1992

for COOPERATIVE AGREEMENT No. DE-FC07-91ID13077

between the SOUTHERN CALIFORNIA EDISON COMPANY

and the U. S. DEPARTMENT OF ENERGY for participation in the

ELECTRIC & HYBRID VEHICLE SITE OPERATOR PROGRAM

MARCH 19, 1992

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C. Battery Watering Records	

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FIRST QUARTER 1992

for COOPERATIVE AGREEMENT No. DE-FC07-91ID13077

between the SOUTHERN CALIFORNIA EDISON COMPANY

and the U. S. DEPARTMENT OF ENERGY for participation in the

ELECTRIC & HYBRID VEHICLE SITE OPERATOR PROGRAM

MARCH 29, 1992

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SITE OPERATOR PROGRESS REPORT

SECOND QUARTER 1992

for COOPERATIVE AGREEMENT No. DE-FC07-91ID13077
between the SOUTHERN CALIFORNIA EDISON COMPANY
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AUGUST 1992

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THIRD QUARTER 1992

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<u>SITE OPERATOR PROGRESS REPORT</u>

<u>FOURTH QUARTER 1992</u>

<u>(OCTOBER - DECEMBER 1992)</u>

for COOPERATIVE AGREEMENT No. DE-FC07-91ID13077

between the SOUTHERN CALIFORNIA EDISON COMPANY

and the U. S. DEPARTMENT OF ENERGY for participation in the

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SITE OPERATOR TECHNICAL PROGRESS REPORT

FIRST QUARTER 1993

(JANUARY - MARCH 1993)

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SECOND QUARTER 1993

(APRIL - JUNE 1993)

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SOUTHERN CALIFORNIA EDISON COMPANY

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THIRD QUARTER 1993

(JULY - SEPTEMBER 1993)

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SOUTHERN CALIFORNIA EDISON COMPANY

<u>SITE OPERATOR TECHNICAL PROGRESS REPORT</u>

<u>FOURTH QUARTER 1993</u>

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for COOPERATIVE AGREEMENT No. DE-FC07-91ID13077 with the U. S. DEPARTMENT OF ENERGY for participation in the <u>ELECTRIC & HYBRID VEHICLE SITE OPERATOR PROGRAM</u>

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(APRIL - JUNE)

for COOPERATIVE AGREEMENT No. DE-FC07-91ID13077 with

the U. S. DEPARTMENT OF ENERGY for participation in the

ELECTRIC & HYBRID VEHICLE SITE OPERATOR PROGRAM

OCTOBER 1995

PREFACE

The Southern California Edison Company (SCE) and the U.S. Department of Energy (DOE) entered into cooperative agreement no. DE-FC07-91ID13077 on August 23, 1991, which expires on March 31, 1996. This cooperative agreement provides SCE with DOE cofunding for participation in the DOE's Electric & Hybrid Vehicle Site Operator Program. In return, SCE provides the DOE with quarterly progress reports which include operating and maintenance data for the electric vehicles in SCE's fleet. At present, SCE's electric vehicle fleet consists of approximately 50 vehicles, and includes G-Vans, TEVans, Ford Ecostars and Honda CUV-4's, and pick-up trucks and passenger vehicles converted by Solectria, U.S. Electricar, B.A.T. and others. Herein is SCE's report for the 2nd Quarter (i.e., April - June) of 1995.

SCE's past quarterly reports were prepared specifically for the DOE, and have generally contained of four sections:

(1) Report Text.
(2) Summary Quarterly Operating Data; that is, a table of cumulative miles by each vehicle, its current assignment status, and a listing of its drivetrain technology (e.g., AC or DC motor, battery type, etc.).
(3) Maintenance Logs in a format specifically developed for the Site Operator quarterly report.
(4) Topical reports on other activities (e.g., "Pomona Loop" performance test results).

With this 1995 2nd Quarter Report, SCE is implementing significant changes to its quarterly report format. These changes are the result of SCE's progress in automating fleet operations data collection and reduction, and in more fully incorporating the maintenance of electric vehicles into SCE's long-standing gasoline/diesel fleet protocols. Essentially, SCE will now be submitting to the DOE (under special cover) SCE's own internal quarterly report of electric vehicle fleet performance, with this **PREFACE** added to provide further pertinent information which may be of interest to the DOE. This internal quarterly report is titled the "Electric Vehicle Fleet Evaluation Report."

As shown in this report, SCE is now able to provide more detailed fleet operations data summaries using the Data Acquisition Systems ("DAS") installed in several of SCE's electric vehicles. SCE has selected the combination of an "Alpha" kWhr meter, and a "Silent Witness" trip logger as the standard "DAS" for the SCE fleet. This combination provides much of the operating data found in this SCE quarterly report; and this data base will become more fully developed in future quarterly reports. SCE's standard "DAS" is sufficient for measuring the fleet operations performance metrics, such as "Miles per Vehicle", "Miles per AC kWh", "Miles per Trip", "Recharge Time and Time of Use", etc. To date, twelve SCE vehicles have been equipped with this "DAS" system, and over the next several months, most of the remaining vehicles will also be equipped.

Operating data is presented in Chapter II. Figure 2-1 and Figure 2-2 are constructed from odometer readings manually recorded for all vehicles. Figures 2-3, 2-4, 2-5 and 2-6 were produced from those vehicles having a fully operational SCE "DAS" system during the quarter (i.e., principally the U.S. Electricar "Sedan" number 22415, and the U.S. Electricar "S10" pick-up truck number 22360).

Incidentally, when viewing the figures contained in this report, the reader should note that the word "Sedan" is used as a model name (not a vehicle type) and, as such, refers specifically the U.S. Electricar vehicles. Similarly, "S10" refers specifically to U.S. Electricar trucks, while "Force" and "E10" refers to Solectria passenger cars and trucks (i.e., the reader should reference the "Model" column of Figure 2-1 when viewing all other figures).

SCE continues to use other on-board vehicle data acquisition systems as appropriate, such as the factory supplied systems with the Ford Ecostars, and the "MDAS" systems planned for a few targeted vehicles for Site Operator data base development. These systems are capable of measuring very detailed performance metrics (e.g., "Battery Current vs. Time for each trip", "Trip Mileage as a Function of Ambient Temperature", etc.). Such data is useful to vehicle manufacturers, and to better understand how regional weather patterns, etc. impact vehicle performance. However, SCE has concluded that supporting this higher level of operating data collection for the entire SCE electric vehicle fleet is not practical at this time.

For the collection of maintenance data, SCE has now integrated the electric vehicles into SCE's "Vehicle Information System" or VIS. The VIS is a tool used by SCE to manage its entire fleet, such as scheduling and recording maintenance activities, tracking maintenance costs, etc. Chapter III contains summary maintenance information for the entire 50 vehicle electric fleet, using the VIS. Specifically, Figure 3-1 presents service man-hours for each vehicle model, Figure 3-2 presents replacement part costs, and Figure 3-3 presents component reliability information.

Chapter IV contains battery information for each vehicle. SCE is now tracking battery life through the "number of charge cycles" as well as by vehicle mileage. As this is a fairly new effort, the cycle "count" is not available for some of the older battery packs which are still in service.

The Appendices include a table presenting additional information on the types of maintenance activities undertaken during the quarter, as well as the results from SCE's latest internal driver surveys. These driver surveys are used by SCE to better ascertain what types of duties encountered by SCE's fleet can be served by electric vehicles.

SCE trusts the DOE will find the new report format satisfactory. It is recognized that the ideal method of sharing data with all the Site Operators would be for each Site to use the exact same "DAS" system and maintenance tracking software. However, as the SCE electric vehicle fleet has grown to 50 vehicles (and is still growing), SCE has determined that its electric vehicles are best managed using tools already employed for the hundreds of gasoline and diesel vehicles in SCE's fleet (i.e., the "Silent Witness," the "VIS," etc.). SCE is striving to minimize the use of redundant O&M data collection systems.

Also included in this 2nd Quarter Report is a separate SCE document titled the "Electric Vehicle Fleet Evaluation Procedure." This document presents further explanation of the procedures used by SCE in producing the results presented in the quarterly "Electric Vehicle Fleet Evaluation Report."

SOUTHERN CALIFORNIA EDISON COMPANY

SITE OPERATOR TECHNICAL PROGRESS REPORT

THIRD QUARTER 1995

(JULY - SEPTEMBER)

for COOPERATIVE AGREEMENT No. DE-FC07-91ID13077 with

the U. S. DEPARTMENT OF ENERGY for participation in the

ELECTRIC & HYBRID VEHICLE SITE OPERATOR PROGRAM

DECEMBER 1995

PREFACE

The Southern California Edison Company (SCE) and the U.S. Department of Energy (DOE) entered into cooperative agreement no. DE-FC07-91ID13077 on August 23, 1991, which expires on March 31, 1996. This cooperative agreement provides SCE with DOE cofunding for participation in the DOE's Electric & Hybrid Vehicle Site Operator Program. In return, SCE provides the DOE with quarterly progress reports which include operating and maintenance data for the electric vehicles in SCE's fleet.

Herein is SCE's report for the 3rd Quarter (i.e., July - September) of 1995. This report uses SCE's "new" format, which was first introduced in the 2nd Quarter 1995 Report. This format is to combine SCE's internal quarterly report (i.e., the SCE "Electric Vehicle Fleet Evaluation Report") with this "Preface" which addresses specific items of interest to the DOE.

In summary, SCE's electric vehicle fleet consists of 57 active vehicles, and includes G-Vans, TEVans, Ford Ecostars and Honda CUV-4's, and pick-up trucks and passenger vehicles converted by Solectria, U.S. Electricar, B.A.T. and others. Additional electric vehicles are on order. The SCE fleet has logged over 365,000 miles.

As discussed in more detail in the "Electric Vehicle Fleet Evaluation Report," through the third quarter of 1995 SCE has fitted data acquisition systems on 14 of the fleet vehicles, and installation of these systems on many of the remaining vehicles is underway. Using this vehicle operations data, plus information obtained from fleet maintenance records, this report's graphical results include (as categorized by vehicle model type): mileage, energy efficiency, average trip length, average recharge time, charger time-of-day average load profile, service man-hours, repair parts cost and component reliability. As with the 2nd Quarter Report, some charts are "For Illustration Only" as the data acquisition systems are still being installed.

Other significant events, relative to the Site Operator Program since the last report, include SCE's submitting an "Expression of Interest" and program comments to the DOE regarding the new DOE electric vehicle field testing program to begin during 1996. We at SCE looks forward to receiving the DOE's "Request for Proposal" for the new program, and welcome feedback on the new Site Operator Report format.

SOUTHERN CALIFORNIA EDISON COMPANY

SITE OPERATOR TECHNICAL PROGRESS REPORT

FOURTH QUARTER 1995

(OCTOBER - DECEMBER)

for COOPERATIVE AGREEMENT No. DE-FC07-91ID13077 with

the U. S. DEPARTMENT OF ENERGY for participation in the

ELECTRIC & HYBRID VEHICLE SITE OPERATOR PROGRAM

MARCH 1996

PREFACE

The Southern California Edison Company (SCE) and the U.S. Department of Energy (DOE) entered into cooperative agreement no. DE-FC07-91ID13077 on August 23, 1991, which expires on May 30, 1996. This cooperative agreement provides SCE with DOE cofunding for participation in the DOE's Electric & Hybrid Vehicle Site Operator Program. In return, SCE provides the DOE with quarterly progress reports which include operating and maintenance data for the electric vehicles in SCE's fleet.

Herein is SCE's report for the 4th Quarter of 1995 (i.e., October - December). As with the past two quarterly reports, this report is a reproduction of SCE's internal "Electric Vehicle Fleet Evaluation Report" with this Preface added for transmittal to the DOE.

Other significant events relative to the Site Operator Program since the last quarterly report include a visit by Tien Duong (DOE, Washington D.C.) and Jim Francfort (Lockheed, INEL) to SCE's Pomona facility on February 28, 1996. Jim and Tien were in town for the Clean Cities Conference held at the South Coast Air Quality Management District offices in Diamond Bar the following day. They were shown the Diane O. Wittenberg Electric Vehicle Test Center, and toured SCE's "Pomona Loop" urban driving test course. Tien, Jim and SCE personnel had an informal exchange of ideas as they viewed the numerous vehicle, charging and battery technologies in various stages of testing and maintenance at Pomona. It was a very enjoyable visit. SCE sincerely hopes that DOE and INEL, and their associates, will continue to stop in whenever they have the opportunity as we almost always have something new and interesting to show off!

SOUTHERN CALIFORNIA EDISON COMPANY

SITE OPERATOR TECHNICAL PROGRESS REPORT

FIRST QUARTER 1996

(JANUARY - MARCH)

for COOPERATIVE AGREEMENT No. DE-FC07-91ID13077 with

the U. S. DEPARTMENT OF ENERGY for participation in the

ELECTRIC & HYBRID VEHICLE SITE OPERATOR PROGRAM

JULY 1996

PREFACE

The Southern California Edison Company (SCE) and the U.S. Department of Energy (DOE) entered into cooperative agreement no. DE-FC07-91ID13077 on August 23, 1991, which expires on August 31, 1996. This cooperative agreement provides SCE with DOE cofunding for participation in the DOE's Electric & Hybrid Vehicle Site Operator Program. In return, SCE provides the DOE with quarterly progress reports which include operating and maintenance data for the electric vehicles in SCE's fleet.

Herein is SCE's report for the 1st Quarter of 1996 (i.e., January - March). As with the past several quarterly reports, this report is a reproduction of SCE's internal "Electric Vehicle Fleet Evaluation Report" with this Preface added for transmittal to the DOE.

Other significant events relative to the Site Operator Program since the last quarterly report include a "No Cost Time Extension" to the Site Operator Agreement extending the Agreement end date three months from May to August, consistent with the pending conclusion of the DOE's Site Operator Program. SCE intends to submit a 2nd Quarter Report in the next month, to be followed by a comprehensive Final Program Report in October. Also, SCE submitted a Proposal to participate in the new DOE Electric Vehicle Field Test Program, and subsequently, the DOE has initiated negotiations with the SCE for such participation. SCE looks forward to successfully concluding these negotiations, and continuing our long and productive relationship with the DOE in advancing Electric Vehicle technology.