Ford Ranger Fleet Evaluation Report

January - December 1999

SOUTHERN CALIFORNIA EDISON
An EDISON INTERNATIONAL Company

ELECTRIC TRANSPORTATION DIVISION
with
TRANSPORTATION SERVICES DEPARTMENT

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PURPOSE

The purpose of SCE’s evaluation of electric vehicles (EVs), EV chargers, batteries, and related items is to support their safe and efficient use and to minimize potential utility system impacts. The following facts support this purpose:

- As a fleet operator and an electric utility, SCE uses EVs to conduct its business.
- SCE must evaluate EVs, batteries, and charging equipment in order to make informed purchase decisions.
- SCE must determine if there is any safety issues with EV equipment and their usage.
- SCE has a responsibility to educate and advise its customers about the efficient and safe operation of EVs.

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I. INTRODUCTION

Southern California Edison (SCE) operates one of the largest electric vehicle fleets in the nation. The fleet is composed of EVs from all major auto manufacturers. Currently the fleet has a total of 315 EVs and has accumulated over 3.2 million miles. By far the Toyota RAV4 makes up the majority of the vehicles in the fleet, at 245 vehicles. Although the RAV4 satisfies a great deal of missions, there are still some missions that are more properly met with a pick up truck. To satisfy this need, SCE, in cooperation with the Department of Energy, acquired a total of seven Nickel/Metal-Hydride powered Ford Rangers.

When the vehicles were originally acquired, there were three main missions they were intended to meet. Vehicle 23642 was used for SCE's Fleet Trials Program, which makes various models of EVs available for periods of one to two months to SCE customers who are also fleet operators. Vehicle 23643 was used for SCE's communications program, which involves taking various EVs to internal and external public relations programs. The remaining five EVs were intended for meter reading applications. See Table 1-1 below for additional details.

Table 1.1 Vehicle History

Vehicle #	In Service Date	Initial Range	Application
23639	12/98	78 (1/99)	Fleet Testing
23640	12/98	68 (1/99)	Fleet Testing
23641	12/98	77 (1/99)	Fleet Testing
23642	12/98	85 (1/99)	Fleet Testing
23643	12/98	83 (1/99)	Fleet Testing
24470	12/98	84 (1/99)	Fleet Testing
24471	12/98	78 (1/99)	Fleet Testing

II. FLEET OPERATION

The following tables and figures summarize the performance of the seven NiMH equipped Ford Rangers in 1999.

Table 2.1 Fleet Operation Overview

	1st Qtr. '99	2nd Qtr. '99	3rd Qtr. '99	4th Qtr. '99
Active EVs	7	7	7	7
Miles Driven	6260	7041	7576	8225
Miles/EV	894	1006	1082	1175
Miles/EV/Week	69	77	83	90

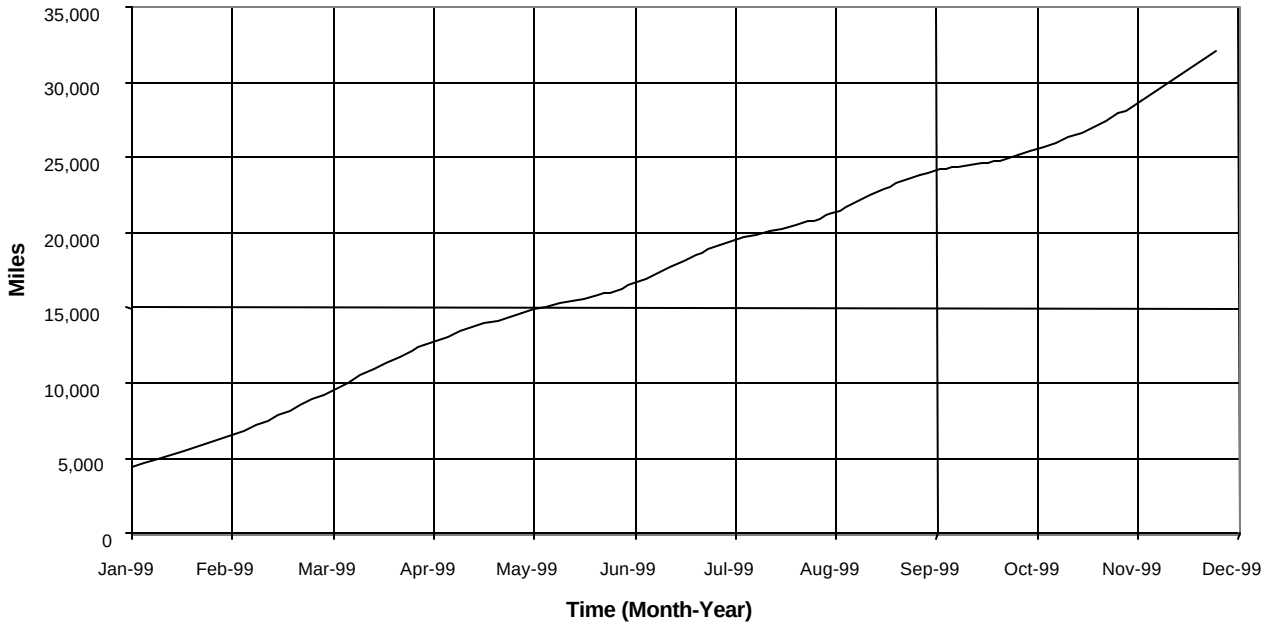


Figure 2.1 Cumulative mileage of the Ranger fleet during the evaluation period

Table 2-2 Monthly Mileage Report

Mileage For the Month of:		Jan-99	Feb-99	Mar-99	Apr-99	May-99	Jun-99
Vehicle#	Model						
23639	Ranger	176	441	488	473	95	465
23640	Ranger	190	202	604	975	206	79
23641	Ranger	303	586	649	151	177	0
23642	Ranger	201	126	293	576	291	385
23643	Ranger	208	63	135	399	301	277
24470	Ranger	206	539	140	419	576	302
24471	Ranger	140	155	415	246	524	124

Mileage For the Month of:		Jul-99	Aug-99	Sep-99	Oct-99	Nov-99	Dec-99
Vehicle#	Model						
23639	Ranger	31	592	33	0	1,579	2,127
23640	Ranger	108	154	120	197	188	70
23641	Ranger	427	92	1,624	337	3	11
23642	Ranger	106	173	179	206	253	373
23643	Ranger	703	468	552	51	126	99
24470	Ranger	1,306	285	216	237	0	458
24471	Ranger	220	7	180	202	637	1,071

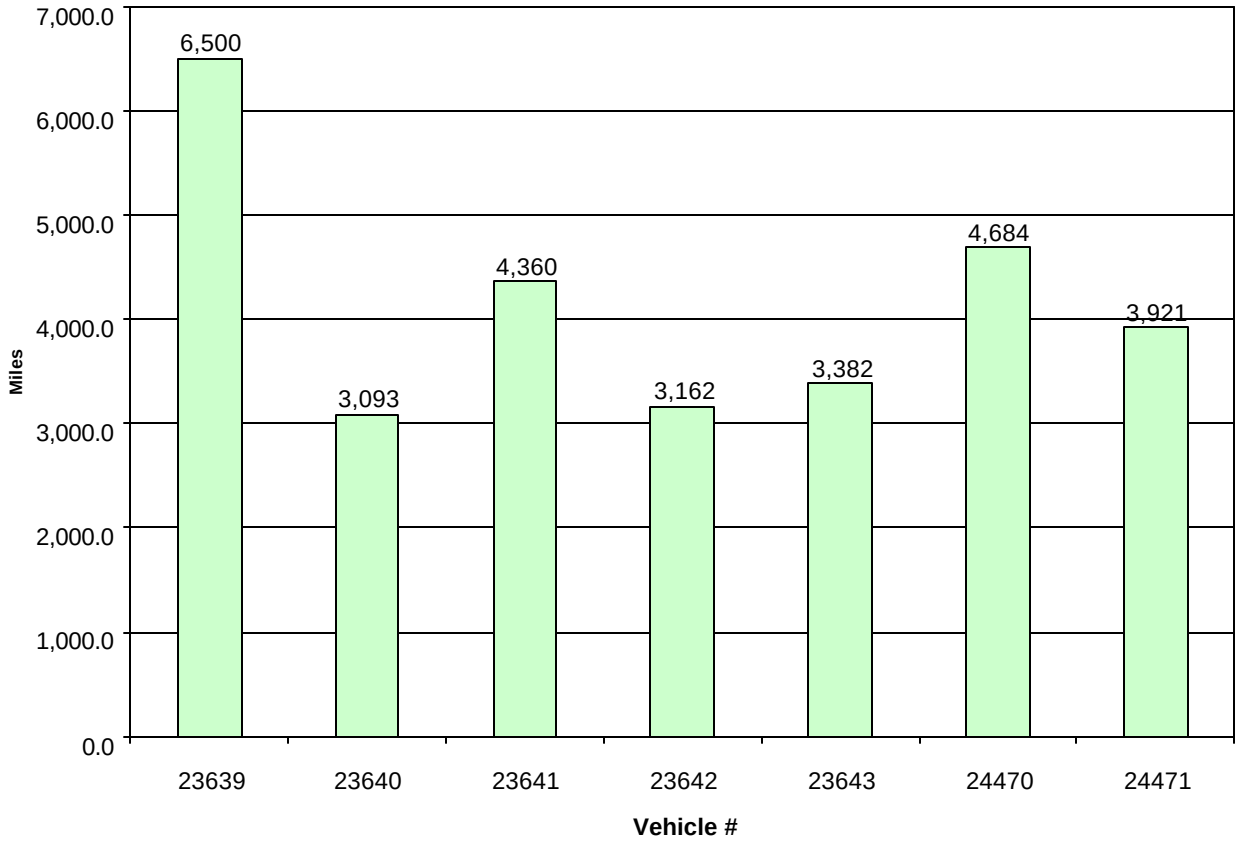


Figure 2.2 Total mileage by vehicle number

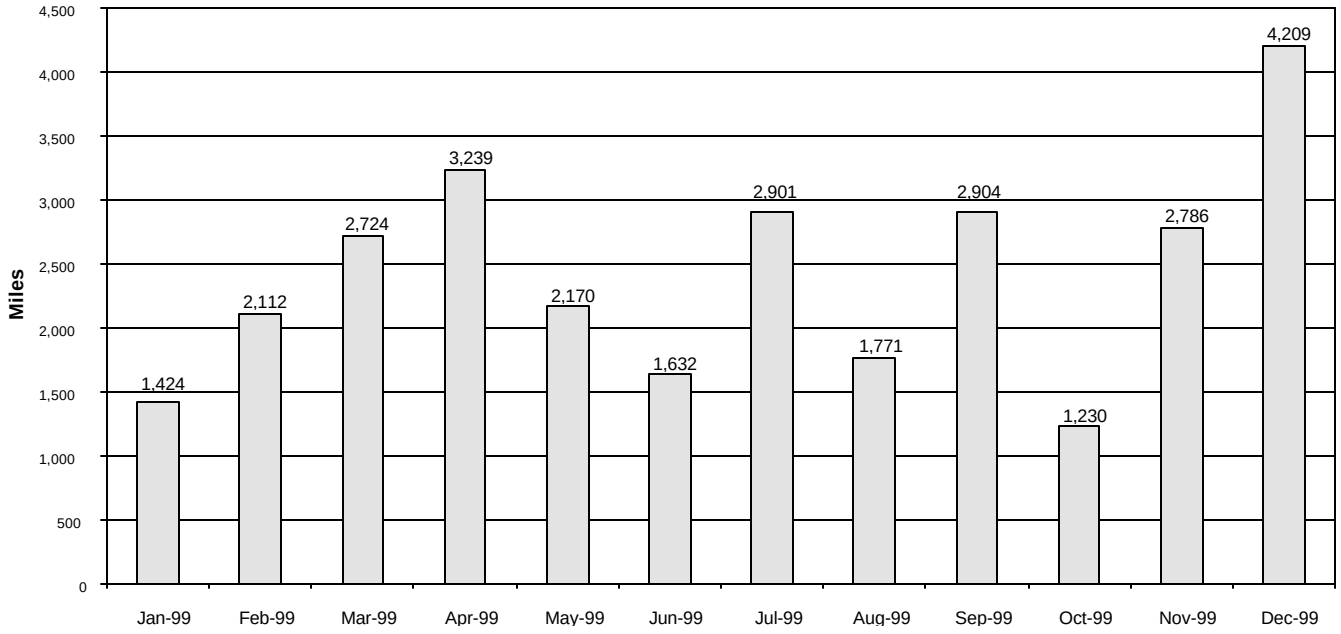


Figure 2-3 Monthly mileage summary

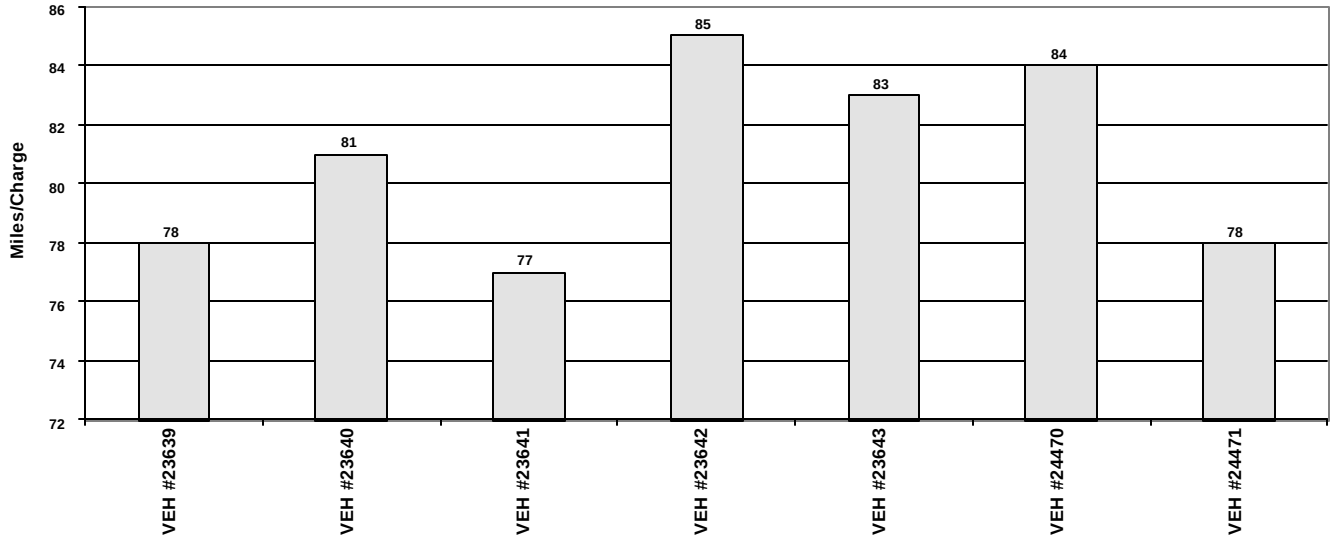


Figure 2.4 Average miles per charge by vehicle number

III. VEHICLE MAINTENANCE AND RELIABILTY

First Quarter 1999

Veh. No.	Vehicle Model	Component Name	Odometer Reading	Reported Problem	Date Reported	Date Repaired	Downtime (Days)*	Man Hours	Corrective Action
23639	RANGER	POWER STEERING CONTROLLER	296	AIR IN POWER STEERING SYSTEM	02/02/99	02/08/99	4	1.5	CYCLE STEERING LOCK TO LOCK 15 TIMES
23639	RANGER	TRACTION BATTERY	175	VEHICLE DOES NOT CHARGE. CHARGER STOPS WHEN PLUGGED IN AND PACK DISCHARGES.	01/26/99	02/04/99	7	15.5	R&R BATTERY PACK
23640	RANGER	BATTERY MODULE	192	LOW RANGE ~ 25 MILES	02/02/99	02/11/99	7	8	R&R BATTERY MODULE #1
23640	RANGER	AUXILIARY BATTERY	63	VEHICLE WILL NOT START - AUXILIARY BATTERY LOW	01/18/99	01/18/99	0	1	CHARGED AUXILIARY BATT. & PLACED VEH. ON CHARGE
23640	RANGER	BATTERY MODULE	392	VEHICLE SOC DROPPED TO 25% FROM 50%	02/22/99	03/10/99	12	24.5	R&R TWO BATTERY MODULES
23641	RANGER	AUXILIARY BATTERY	145	VEHICLE WILL NOT START - AUXILIARY BATTERY LOW	01/18/99	01/18/99	0	1	CHARGED AUXILIARY BATT. & PLACED VEH. ON CHARGE
23642	RANGER	AUXILIARY BATTERY	62	VEHICLE WILL NOT START - AUXILIARY BATTERY LOW	01/19/99	01/19/99	0	1	CHARGED AUXILIARY BATT. & PLACED VEH. ON CHARGE
23643	RANGER	AUXILIARY BATTERY	59	VEHICLE WILL NOT START - AUXILIARY BATTERY LOW	01/19/99	01/19/99	0	1	CHARGED AUXILIARY BATT. & PLACED VEH. ON CHARGE
24470	RANGER	AUXILIARY BATTERY	63	VEHICLE WILL NOT START - AUXILIARY BATTERY LOW	01/18/99	01/18/99	0	1	CHARGED AUXILIARY BATT. & PLACED VEH. ON CHARGE

Second Quarter 1999

Veh. No.	Vehicle Model	Component Name	Odometer Reading	Reported Problem	Date Reported	Date Repaired	Downtime (Days)*	Man Hours	Corrective Action
23639	RANGER	BATTERY MANAGEMENT SYSTEM	1,335	VEH. WILL NOT CHARGE, SOC VERY LOW, WRENCH LIGHT ON	05/14/99	05/19/99	4	10	R&R BATTERY CONTROL MODULE
23641	RANGER	BATTERY SYSTEMS	1,866	VEHICLE DIED IN YARD, WRENCH LIGHT ON	05/27/99	06/18/99	16	19	R&R CONTACTOR BOX
24470	RANGER	AUXILIARY BATTERY	1,768	REMOVE AUX. BATT. NEGATIVE TO CLEAR POWER LOSS LIGHT	05/27/99	05/27/99	1	1	REMOVED NEGATIVE POWER CABLE FROM AUX. BATT.

Third Quarter 1999

Veh. No.	Vehicle Model	Component Name	Odometer Reading	Reported Problem	Date Reported	Date Repaired	Downtime (Days)*	Man Hours	Corrective Action
23641	RANGER	AUXILIARY BATTERY	2,293	AUXILIARY BATTERY DEAD	08/09/99	08/09/99	1	1	RECHARGED AUXILIARY BATTERY
23641	RANGER	NON EV RELATED	2,371	CHARGE DOOR BROKEN	08/20/99	08/23/99	2	2	R&R CHARGE DOOR
24471	RANGER	ONBOARD CHARGING	1,613	VEHICLE WILL NOT CHARGE	07/09/99	07/15/99	5	8	R&R ONBOARD CHARGER

Fourth Quarter 1999

Veh. No.	Vehicle Model	Component Name	Odometer Reading	Reported Problem	Date Reported	Date Repaired	Downtime (Days)**	Man Hours	Corrective Action
23639	RANGER	TIRE	5,703	LEFT REAR TIRE FLAT	12/23/99	12/23/99	1	1.5	REPAIRED TIRE
23642	RANGER	CHARGE PORT	2,648	CHARGE PORT NOT CLOSING CORRECTLY	10/20/99	10/28/99	7	2.5	R&R CHARGE PORT
23643	RANGER	BACKUP ALARM	3,104	INSTALL BACKUP ALARM	12/13/99	12/13/99	1	2.5	INSTALLED BACKUP ALARM
24471	RANGER	ABB METER	2,212	INSTALL ABB METER	10/29/99	10/29/99	1	1.5	INSTALLED ABB METER FROM 24078

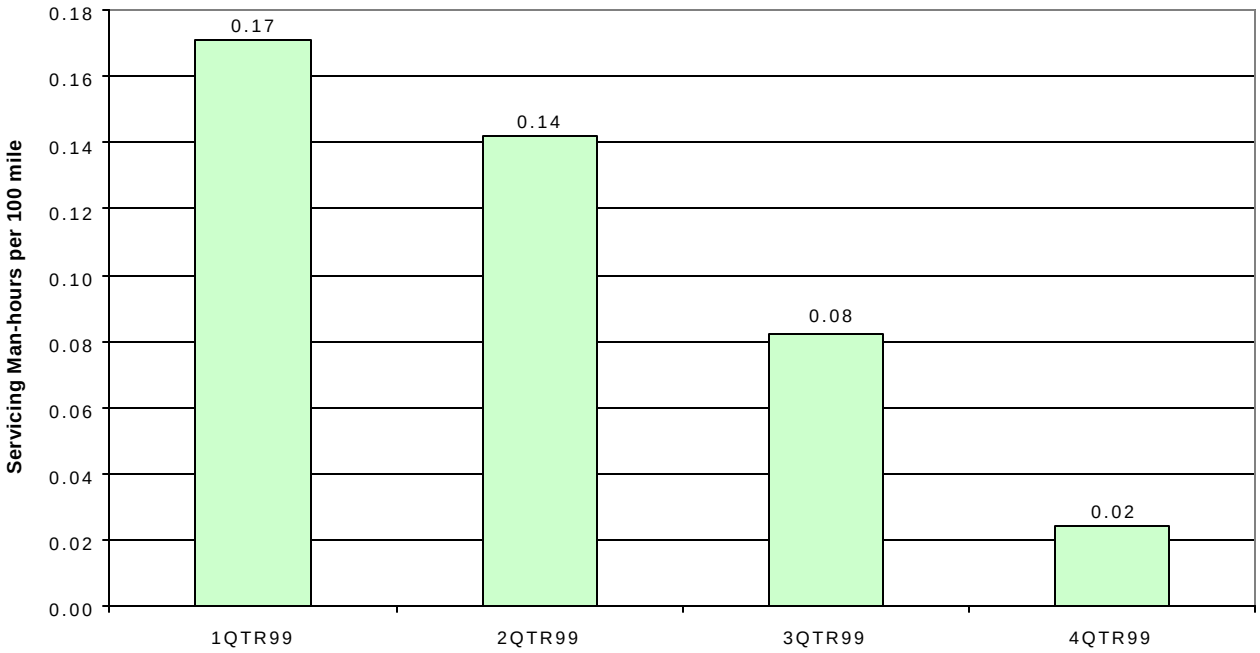


Figure 3.1 Servicing Man-hours

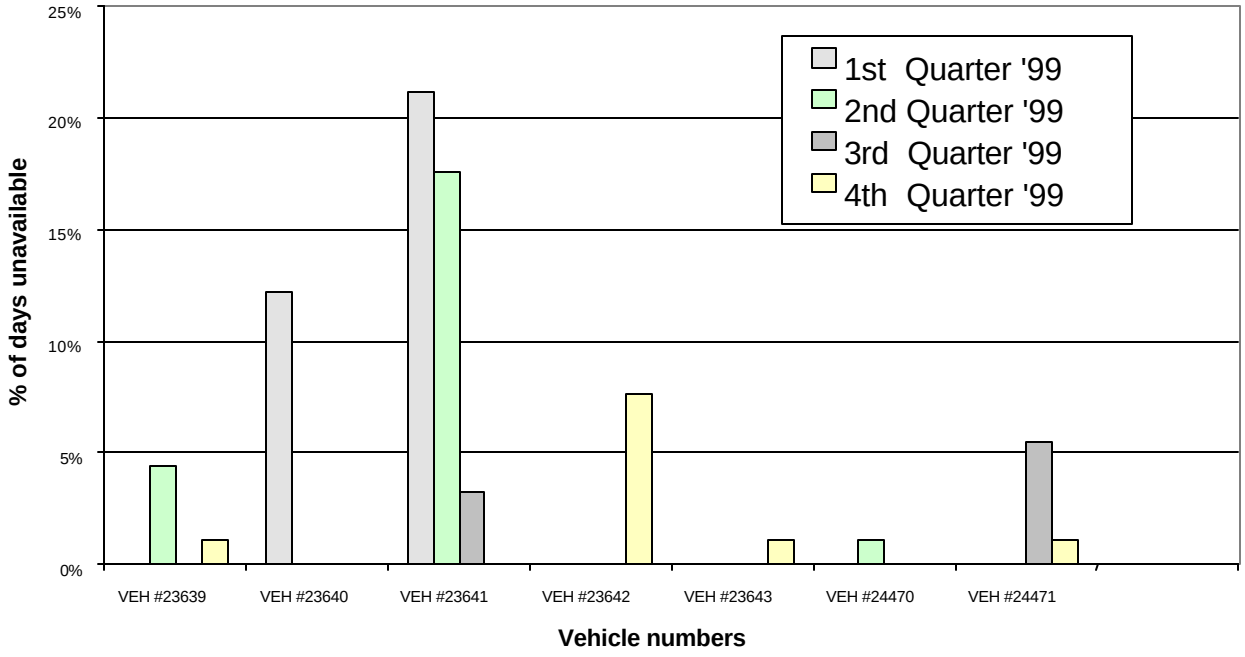


Figure 3.2 Service downtime by vehicle number

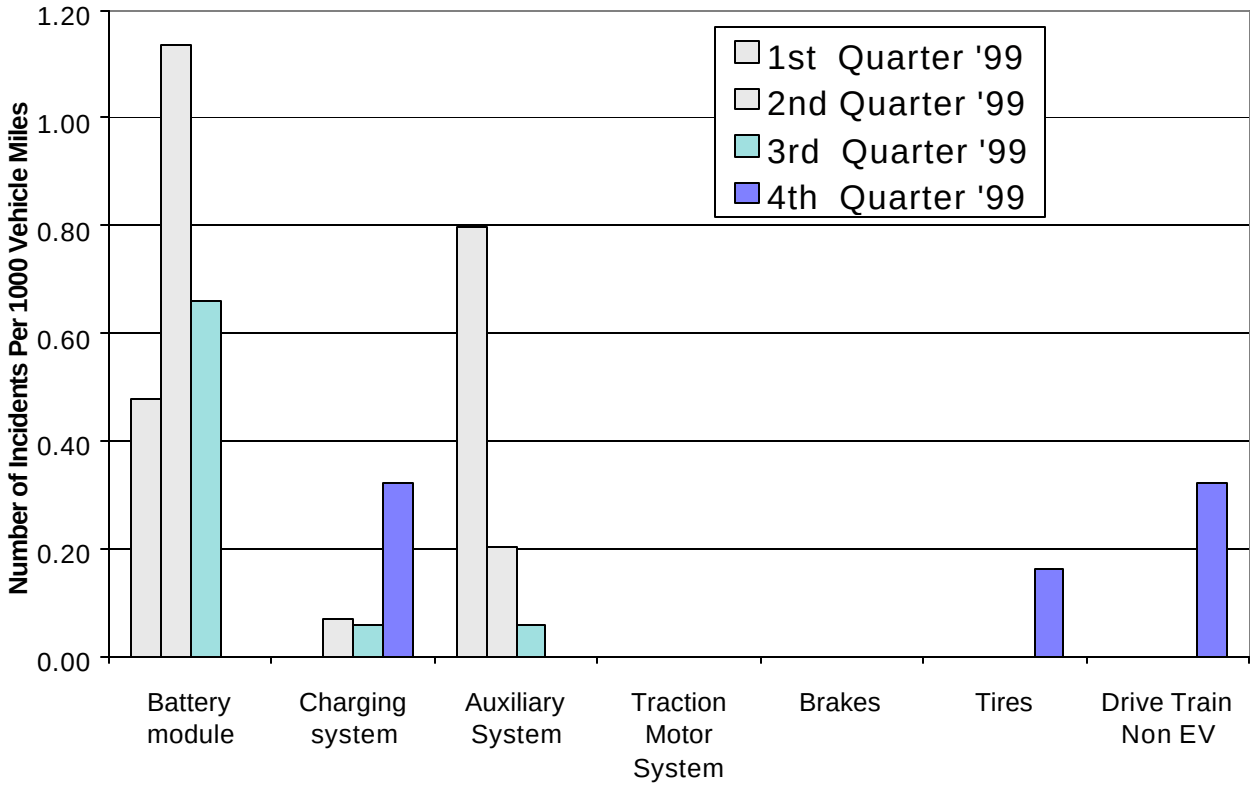


Figure 3.3 Vehicle system or component reliability

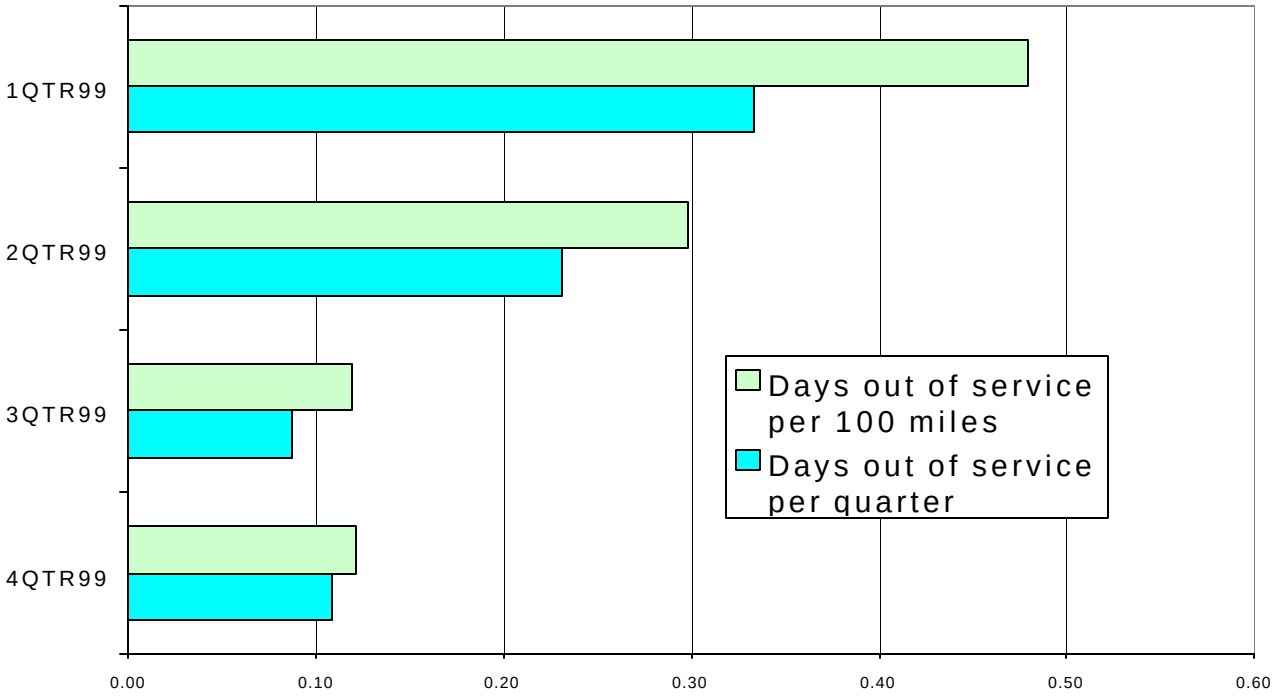


Figure 3.4 Total "Out of Service" fleet summary

IV. BATTERY REPORT

SCE Batt. Nbr.	Manufacturer	Model	Chemistry	Battery Type	In Service Date	Manuf. Rated Capacity	Last lab Certified Capacity	Total Miles	Total Module Replacements in 1999
	Ford Ranger								
23639	Panasonic	MHB-100	NiMH	Sealed VR	Dec-98	100Ah C/3	na	6,500	0
23640	Panasonic	MHB-100	NiMH	Sealed VR	Dec-98	100Ah C/3	na	3,093	3
23641	Panasonic	MHB-100	NiMH	Sealed VR	Dec-98	100Ah C/3	na	4,360	0
23642	Panasonic	MHB-100	NiMH	Sealed VR	Dec-98	100Ah C/3	na	3,162	0
23643	Panasonic	MHB-100	NiMH	Sealed VR	Dec-98	100Ah C/3	na	3,382	0
24470	Panasonic	MHB-100	NiMH	Sealed VR	Dec-98	100Ah C/3	na	4,684	0
24471	Panasonic	MHB-100	NiMH	Sealed VR	Dec-98	100Ah C/3	na	3,921	0

VRLA = Valve Regulated Lead Acid

VRLA (AE) = VRLA Absorbed Electrolyte

VRLA (Gel) = VRLA Gelled Electrolyte

kWh = kilowatt hours

Ah = amp hours

C/rate = Ah capacity at an established current over time in hours discharge.

An alphabet notation following a battery number indicates the number of battery pack changeouts. i.e. 1742b is the 2nd pack installed since it was new.

Cycles = the number of times the vehicle has been taken off charge, driven and put back on charge.

V. DISCUSSION AND CONCLUSION

Vehicle 23642, which was used for fleet loans, was able to meet the requirements of the mission that it was assigned to. A total of three loans were made to local entities. A sample report for a trial with a local city is included in Appendix A, page 13. Vehicle 23643 worked well for the communications group. The mission requirements in this application were not very demanding. The remaining five vehicles were intended for SCE fleet applications. Full deployment of the NiMH Ford Ranger into the SCE Fleet has not been achieved to date. These vehicles were evaluated in Pomona before being sent out to regular fleet users.

Experience to date has shown that a vehicle in the SCE fleet needs a minimum range of 65 miles on the Pomona Loop at full payload and A/C on maximum in order to be accepted favorably by the users. The vehicle must also be highly reliable. Unfortunately the Ranger did not perform well in at least three different field locations. For example, in the first quarter the Rangers were in service for a combined thirty days (see Table 3-4, page 10). Problems included charging anomalies, quit-on-road incidents, and lower than expected range (40 miles approx. in some cases). Once this information was relayed to other field locations, placing the Rangers became a nearly impossible task. Therefore, for most of 1999, these five Rangers were based out of Pomona and were used for relatively undemanding tasks. As a result there were months when the vehicles were driven very few miles (see Table 2-2, page 6).

Vehicle acceptance can be very subjective and although the Ranger didn't meet SCE's range and reliability requirements, 50% of surveyed drivers preferred the electric Ford Ranger to a gasoline-fueled truck for their work. As seen in the enclosed driver questionnaires, Appendix B, page 14, features that fared well with drivers were the ease of operation, quick acceleration and refueling at home or work rather than at a service station. But drivers also noted a need for longer range between charging.

Ford has made great efforts in remedying the problems with the Rangers. Software and hardware upgrades have been made on the vehicles and as of the time this report was being

written the changes made seem extremely promising - SCE is willing to give the Ranger “a second chance” and deploy it in its fleet in 2000 and beyond.

Appendix A

Vehicle Trial Report

October 4, 1999

Dear Program Participant:

Thank you for participating in Southern California Edison's *EV Trials* program. We hope that the program was a positive experience for your organization. In addition to exposing you to new vehicles and opportunities to be in the forefront of future transportation technologies, this program is very important to SCE. The data collected from your trial will help us evaluate load management scenarios, customer power quality, and the effects of EV charging on the overall power supply system. Information collected about your EV use and the opinions of your drivers will also be instrumental to our plans for meeting future charging infrastructure needs.

The information presented in this report was compiled from on-site metering and surveys of your drivers. In this report you will find summaries of energy use and cost, graphs illustrating your site's load profile, and results from the driver survey.

We believe electric transportation can benefit your organization financially as well as through positive public relations. We encourage you to contact us any time in the future if you have questions about this particular program or electric transportation in general—including questions about vehicles, costs, infrastructure needs, and project financing opportunities. In particular, we can show you how to take advantage of "Subvention" funds which are available to some cities. Further, we offer special time-of-use (TOU) Electric Vehicle Rates so that you can take maximum advantage of off-peak charging.

Again, thank you for helping us promote a cleaner future through electric transportation.

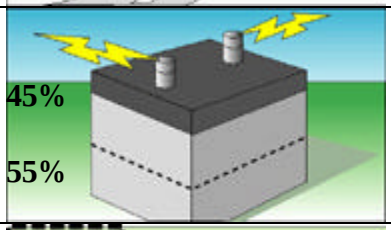
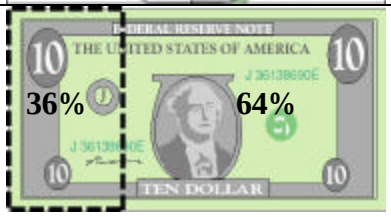
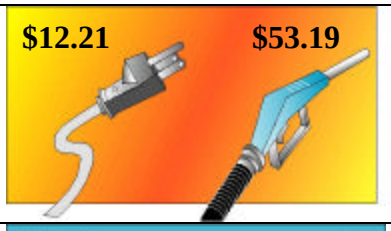
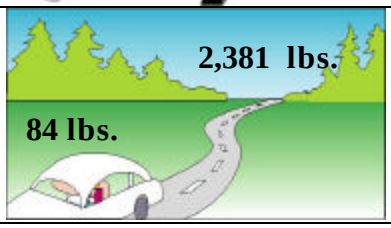
Sincerely,

Cecilia Mushinskie
Technical Specialist
Southern California Edison
Electric Transportation
626.302.3934

Summary

The following illustration highlights your organization's experience with an EV. The information summarizes key facets of EV use and charging, as well as user benefits. This information, collected during the EV Trials program, provides insights into how the EV was actually used by your drivers and how EVs may eventually fit in as an integral part of your fleet.

Key Findings

USE: Vehicle range (mfg. specification): **65** miles Average daily miles: **17** miles Total miles driven: **353** miles Trial duration: **71** days (Vehicle used **27** days)	
DRIVING CHARACTERISTICS: **45%** of driving with charge above 50% **55%** of driving with charge below 50%	
CHARGING: **36%** occurred off-peak **64%** occurred on-peak	
ENERGY USE: Total kWh consumed during Trials: **271 kWh** Average kWh per mile: **0.77**	
ENERGY COST:* Electric**: $12.21** if 100% of charging was off-peak Gasoline equivalent: **$53.19** Driving 10000 miles you would save **$636.78**	
EMISSIONS BENEFITS: While driving your EV **353** miles, you reduced air pollution by over **84 lbs.** If you drove 10000 miles a year, you would reduce pollution by **2,381 lbs.**	

* Energy Costs—reflect current SCE TOU EV rates.

Trial Results and Analysis

This section provides detailed information about your use of the EV during the Trials Program.

Trial Duration

The trial period was July 21, 1999 to September 30, 1999 (71 days), during which the EV was operated 27 days.

Vehicle Use Characteristics

During the Trials, your organization drove the EV a total of 353 miles. The average driving distance was 17 miles a day, with an average trip of 16 miles. 45% of the driving occurred when the vehicle was over 50% state-of-charge. This is not unusual during a trial period because of operator concerns over range. Once drivers are more familiar with the vehicle, they are more comfortable driving further, increasing average daily mileage, and the depth of charge between charges.

Vehicle Charging

A critical advantage of EVs is their low “fuel” costs due to their ability to be charged during off-peak hours (9:00 PM to 12 PM) when electricity rates are lowest. EV owners receive a further advantage through SCE’s special EV time-of-use (TOU) rate, which costs even less than standard off-peak rates during these off-peak hours.

During the Trials period, 36% of your EV charging occurred during off-peak hours, the best time to charge. The remaining 64% occurred on-peak at a higher electricity rate. Your driver indicated that the charging process was acceptable and that the EV was adequately charged in the morning and ready for use. When operating an EV for 17 miles per day it is not necessary to "top-off" the vehicle charge. Ultimately, the most cost-effective approach to EV charging is to—whenever possible—charge your EV during off-peak hours when the lowest TOU rate is in effect.

Energy Use

SCE installed separate electricity meters at your facility to monitor EV charging during the Trials period. This enabled us to determine how much electricity was used and what time of the day charging occurred. The figure on the following page graphically depicts electricity consumption for EV charging by hour intervals during the Trials period. This information can be used to analyze individual charging patterns and optimize charging for off-peak periods.

Energy Costs

Based on your driving patterns, and applying SCE's TOU-EV3 rate, your energy cost for operating the EV was $12.21 for the entire trial. This assumes that all charging occurred off-peak. If you were operating a gasoline vehicle that got 15 mpg at $2.26 per gallon, your energy cost would be $53.19 for the same number of miles driven. Therefore, your net savings came to $40.98. Over 10,000 miles, total fuel savings would be $637.

Emissions Benefits

A major benefit of EV use is a reduction in harmful emissions. Even when power plant emissions in the Los Angeles basin are taken into consideration, your use of an EV during the trial program reduced emissions by 84 lbs. If you operated this vehicle for one year, assuming 10,000 miles per year, the emissions reduction would be 2,381 lbs. The composition of the emissions reductions are shown in Table 1:

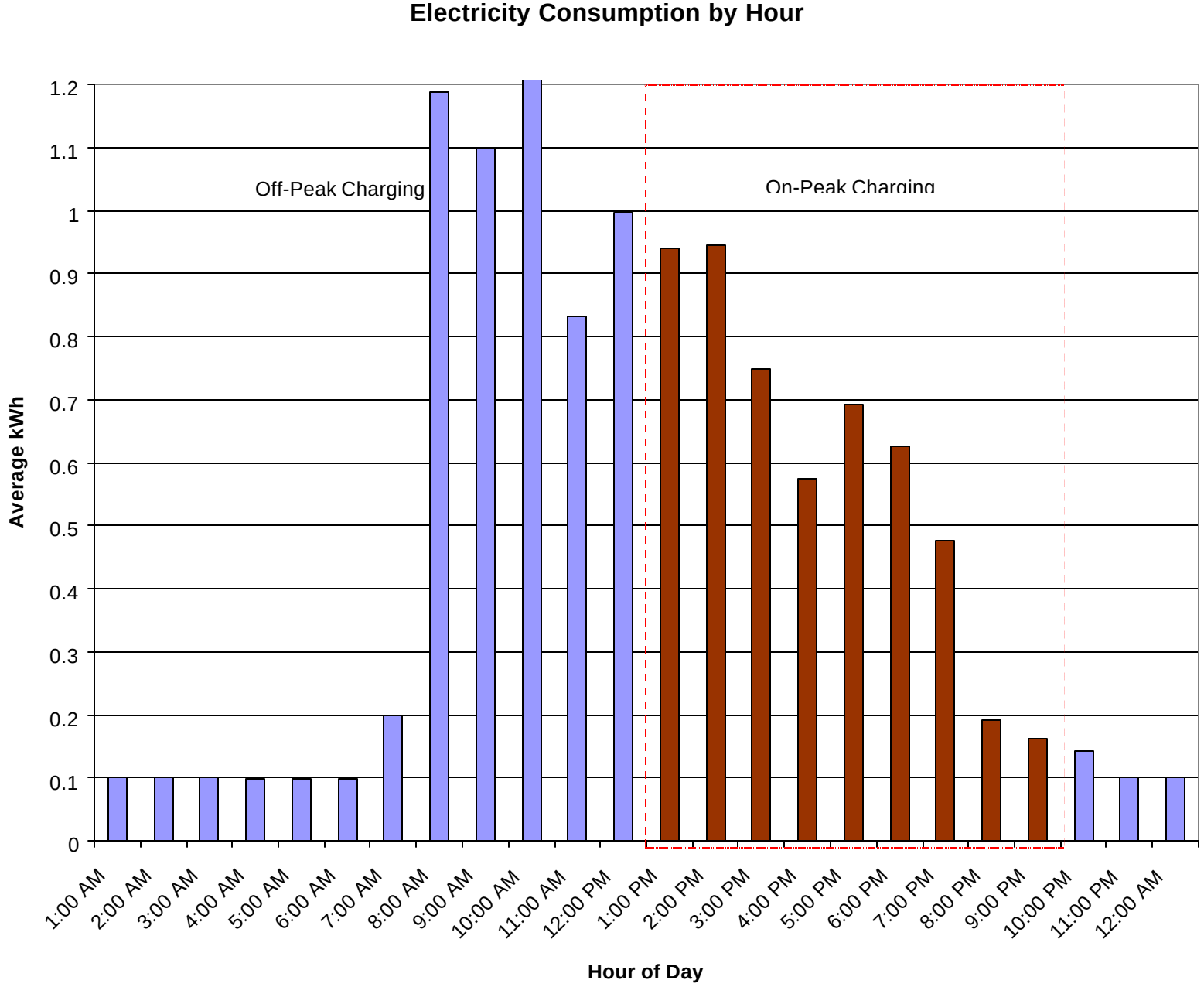
Table 1. Emissions Reductions

Emission	Trials Reduction (lbs.)	Annual Reduction (lbs.)
Carbon Monoxide (CO)	68.6	1943.1
Reactive Organic Gases (ROG)	8.6	244.5
Nitrogen Oxides (NO_X)	5.5	155.0
Sulfur Oxides (SO_X)	1.0	27.6
Particulates (PM_{10})	0.4	10.6
Total	**84**	**2381**

User Response

A critical issue tied to future EV use is what drivers think about operating the EV. The figure on the following page graphically depicts your drivers' opinions on 21 attributes related to their experience with the vehicle. Drivers were most pleased with the drivability. In general, drivers were favorably impressed with the performance and amenities provided by the vehicle.

In addition to the tabulated data, written comments were submitted by drivers. While opinions vary, rapid acceleration is what your drivers liked best and the limited range is what they liked least.


Electricity Consumption by Hour
Off-Peak Charging
On-Peak Charging
Average kWh
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1:00 AM
2:00 AM
3:00 AM
4:00 AM
5:00 AM
6:00 AM
7:00 AM
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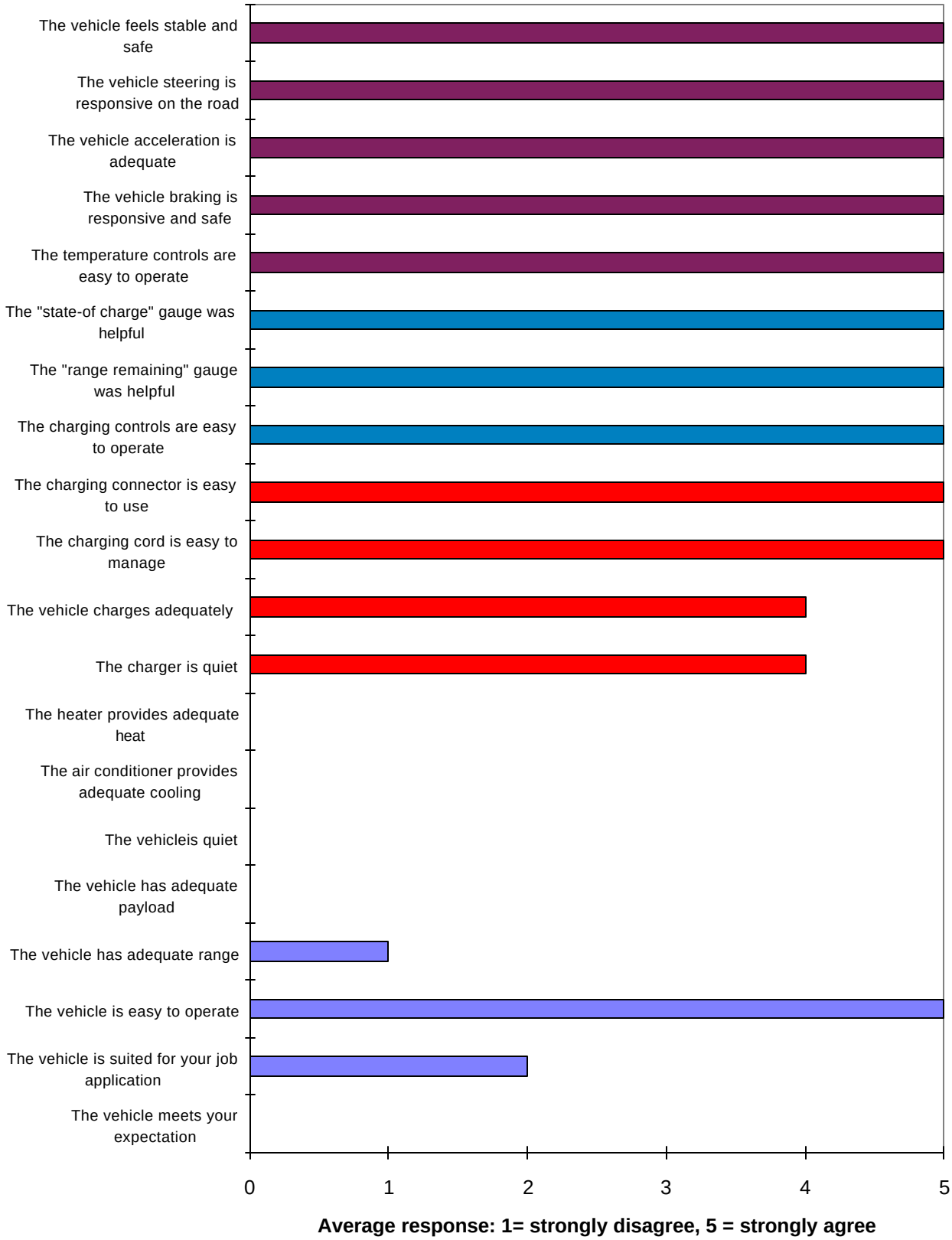
12:00 AM
Hour of Day

Driver Questionnaire Responses



Appendix B

Driver Questionnaires

Electric Vehicle Driver Questionnaire

Participant [redacted]

DRIVER NAME: PASTOR LOPEZ JR. LOCATION: _____

VEHICLE NUMBER: _____ VEHICLE MAKE & MODEL: FORD RANGER

VEHICLE APPLICATION: _____ DATE: 27 SEPT. 1999

	SA	A	NS	D	SD	NA
DRIVEABILITY						
1. The vehicle feels stable and safe	✓					
2. The vehicle steering is responsive	✓					
3. The vehicle acceleration is adequate	✓					
4. The vehicle braking is responsive and safe	✓					
DRIVING CONTROLS AND GAUGES						
1. The cabin temperature controls are easy to operate	✓					
2. The "state-of-charge" gauge is helpful and easy to read	✓					
3. The "range remaining" gauge is helpful and easy to read	✓					
CHARGING CONTROLS AND GAUGES						
1. The charging controls are easy to operate	✓					
2. The charging connector (plug) is easy to use	✓					
3. The charging cord is easy to manage	✓	✓				
4. The vehicle charges adequately (full in the morning)		✓				
5. The charger is reasonably quiet		✓			✓	

6. Do you know the differences between Inductive and Conductive charging? ____ Yes ✓ No

   If yes, which do you prefer? ____ Inductive ____ Conductive ____ No preference

7. Did you have any problems charging? ✓ Yes ____ No

   If yes, please describe* WE ARE ON CALL 24 HRS A DAY IT IS NOT FEASABLE TO HAVE A VEHICLE ON CHARGE

INTERIOR						
1. The heater provides adequate heat						
2. The air conditioner provides adequate cooling						
3. The vehicle is quiet						

4. Did you use electronic equipment (cell phone, radio, etc.) inside the EV? ____ Yes ____ No

   If yes, please list equipment(s) and describe any problems encountered* _____

GENERAL						
1. The vehicle has adequate payload					✓	✓
2. The vehicle has adequate range	✓				✓	
3. The vehicle is easy to operate	✓			✓		
4. The vehicle is suited for your job application				✓		✓
5. The vehicle meets your expectations						

6. If you had to choose between this vehicle or a similar gasoline vehicle ***for use in your work***, which one would you select? **(Circle One)** **Electric Vehicle** **(Gasoline Vehicle)** **Either**

COMMENTS*

What did you like best? ACCELERATES RAPIDLY

What did you like least? THE RANGE DIMINISHED AFTER TIME AND THE CHARGE WENT DOWN RAPIDLY WHILE CARRYING A PASSENGER OR A LOAD

SA: Strongly Agree; A: Agree; NS: Not Sure; D: Disagree; SD: Strongly Disagree; NA: Not Applicable

* Please use the back of this form if you need additional space.

Revised: 03/03/99

Electric Vehicle Driver Questionnaire

Participant SCE

DRIVER NAME: Suzan Boyer LOCATION: Rosemead

VEHICLE NUMBER: 23643 VEHICLE MAKE & MODEL: Ford Ranger

VEHICLE APPLICATION: Fleet Testing DATE: 5/21/99

DRIVEABILITY	***SA***	***A***	***NS***	***D***	***SD***	***NA***
1. The vehicle feels stable and safe	✓					
2. The vehicle steering is responsive	✓					
3. The vehicle acceleration is adequate	✓					
4. The vehicle braking is responsive and safe	✓					
DRIVING CONTROLS AND GAUGES						
1. The cabin temperature controls are easy to operate	✓					
2. The "state-of-charge" gauge is helpful and easy to read	✓					
3. The "range remaining" gauge is helpful and easy to read			✓			
CHARGING CONTROLS AND GAUGES						
1. The charging controls are easy to operate	✓					
2. The charging connector (plug) is easy to use	✓					
3. The charging cord is easy to manage	✓					
4. The vehicle charges adequately (full in the morning)	✓					
5. The charger is reasonably quiet	✓					

6. Do you know the differences between Inductive and Conductive charging? ✓ **Yes** ___ **No**

   If yes, which do you prefer? ✓ **Inductive** ___ **Conductive** ___ **No preference**

7. Did you have any problems charging? ___ **Yes** ✓ **No**

   If yes, please describe*_____

INTERIOR						
1. The heater provides adequate heat			✓			
2. The air conditioner provides adequate cooling			✓			
3. The vehicle is quiet	✓					

4. Did you use electronic equipment (cell phone, radio, etc.) inside the EV? ___ **Yes** ✓ **No**

   If yes, please list equipment(s) and describe any problems encountered*_____

GENERAL						
1. The vehicle has adequate payload	✓					
2. The vehicle has adequate range	✓					
3. The vehicle is easy to operate	✓					
4. The vehicle is suited for your job application	✓					
5. The vehicle meets your expectations	✓					

6. If you had to choose between this vehicle or a similar gasoline vehicle ***for use in your work***, which one would you select? **(Circle One)** **Electric Vehicle** **Gasoline Vehicle** **Either**

COMMENTS*

What did you like best? NO GAS STATION VISITS

What did you like least? —

SA: *Strongly Agree;* ***A:*** *Agree;* ***NS:*** *Not Sure;* ***D:*** *Disagree;* ***SD:*** *Strongly Disagree;* ***NA:*** *Not Applicable*

* Please use the back of this form if you need additional space.

Revised: 03/03/99

Electric Vehicle Driver Questionnaire

Participant SCE

DRIVER NAME: Cecilia Mushinskie LOCATION: Rosemead

VEHICLE NUMBER: 23642 VEHICLE MAKE & MODEL: Ford Ranger

VEHICLE APPLICATION: Fleet Testing DATE: 5/21/99

	SA	A	NS	D	SD	NA
DRIVEABILITY						
1. The vehicle feels stable and safe	X					
2. The vehicle steering is responsive	X					
3. The vehicle acceleration is adequate	X					
4. The vehicle braking is responsive and safe	X					
DRIVING CONTROLS AND GAUGES						
1. The cabin temperature controls are easy to operate	X					
2. The "state-of-charge" gauge is helpful and easy to read	X					
3. The "range remaining" gauge is helpful and easy to read	X					
CHARGING CONTROLS AND GAUGES						
1. The charging controls are easy to operate	X					
2. The charging connector (plug) is easy to use	X					
3. The charging cord is easy to manage	X					
4. The vehicle charges adequately (full in the morning)	X					
5. The charger is reasonably quiet	X					

6. Do you know the differences between Inductive and Conductive charging? X **Yes** ___ **No**

   If yes, which do you prefer? X **Inductive** ___ **Conductive** ___ **No preference**

7. Did you have any problems charging? ___ **Yes** X **No**

   If yes, please describe*_____

	SA	A	NS	D	SD	NA
INTERIOR						
1. The heater provides adequate heat	X					
2. The air conditioner provides adequate cooling	X					
3. The vehicle is quiet		X				

4. Did you use electronic equipment (cell phone, radio, etc.) inside the EV? ___ **Yes** X **No**

   If yes, please list equipment(s) and describe any problems encountered*_____

	SA	A	NS	D	SD	NA
GENERAL						
1. The vehicle has adequate payload	X					
2. The vehicle has adequate range		X				
3. The vehicle is easy to operate	X					
4. The vehicle is suited for your job application		X				
5. The vehicle meets your expectations	X					

6. If you had to choose between this ~~vehicle or a similar~~ gasoline vehicle ***for use in your work***, which one would you select? **(Circle One)** **Electric Vehicle** **Gasoline Vehicle** **Either**

COMMENTS*

What did you like best? _____

What did you like least? _____

SA: *Strongly Agree;* ***A:*** *Agree;* ***NS:*** *Not Sure;* ***D:*** *Disagree;* ***SD:*** *Strongly Disagree;* ***NA:*** *Not Applicable*

* Please use the back of this form if you need additional space.

Revised: 03/03/99

SCE Electric Vehicle Driver Questionnaire

DRIVER NAME: Roger Thornton **LOCATION:** General Office 1
VEHICLE #: 24471 **VEHICLE MAKE & MODEL:** Ford Ranger
VEHICLE APPLICATION: Reliability Testing **DATE:** Dec 29, 99

DRIVEABILITY	*SA*	*A*	*NS*	*D*	*SD*	*NA*
1. The vehicle feels stable and safe		X				
2. The vehicle steering is responsive		X				
3. The vehicle acceleration is adequate		X				
4. The vehicle braking is responsive and safe			X			
DRIVING CONTROLS AND GAUGES						
1. The cabin temperature controls are easy to operate		X				
2. The "state-of-charge" gauge is helpful and easy to read		X				
3. The "range remaining" gauge is helpful and easy to read		X				
CHARGING CONTROLS AND GAUGES						
1. The charging controls are easy to operate		X				
2. The charging connector (plug) is easy to use		X				
3. The charging cord is easy to manage			X			
4. The vehicle charges adequately (full in the morning)		X				
5. The charger is reasonably quiet		X				

6. Do you know the differences between Inductive and Conductive charging? X **Yes** ___ **No**
   If yes, which do you prefer? ___ **Inductive** ___ **Conductive** X **No preference**
7. Did you have any problems charging? ___ **Yes** X **No**
   If yes, please describe*_____

INTERIOR						
1. The heater provides adequate heat			X			
2. The air conditioner provides adequate cooling		X				
3. The vehicle is quiet		X				

4. Did you use electronic equipment (cell phone, radio, etc.) inside the EV? X **Yes** ___ **No**
   If yes, please list equipment(s) and describe any problems encountered* Cell phone, pager

GENERAL						
1. The vehicle has adequate payload		X				
2. The vehicle has adequate range			X			
3. The vehicle is easy to operate		X				
4. The vehicle is suited for your job application		X				
5. The vehicle meets your expectations			X			

6. If you had to choose between this vehicle or a similar gasoline vehicle ***for use in your work*** which one would you select? **(Circle One)** (**Electric Vehicle**) **Gasoline Vehicle** **Either**

COMMENTS*

What did you like best? I enjoy the ease of charging at home and work.

What did you like least? Range. I would like to travel further between charges.

SA: *Strongly Agree;* ***A:*** *Agree;* ***NS:*** *Not Sure;* ***D:*** *Disagree;* ***SD:*** *Strongly Disagree;* ***NA:*** *Not Applicable*

* **Please** use the back of this form if you need additional space.

Revised: 03/03/99

Electric Vehicle Driver Questionnaire

Participant CITY OF AVALON

DRIVER NAME: PASTOR LOPEZ JR. LOCATION: _____

VEHICLE NUMBER: 23642 VEHICLE MAKE & MODEL: FORD RANGER

VEHICLE APPLICATION: _____ DATE: 17 SEPT 1999

	SA	A	NS	D	SD	NA
DRIVEABILITY						
1. The vehicle feels stable and safe	✓					
2. The vehicle steering is responsive	✓					
3. The vehicle acceleration is adequate	✓					
4. The vehicle braking is responsive and safe	✓					
DRIVING CONTROLS AND GAUGES						
1. The cabin temperature controls are easy to operate	✓					
2. The "state-of-charge" gauge is helpful and easy to read	✓					
3. The "range remaining" gauge is helpful and easy to read	✓					
CHARGING CONTROLS AND GAUGES						
1. The charging controls are easy to operate	✓					
2. The charging connector (plug) is easy to use	✓					
3. The charging cord is easy to manage	✓	✓				
4. The vehicle charges adequately (full in the morning)		✓				
5. The charger is reasonably quiet		✓			✓	

6. Do you know the differences between Inductive and Conductive charging? ___ Yes ✓ No

   If yes, which do you prefer? ___ Inductive ___ Conductive ___ No preference

7. Did you have any problems charging? ✓ Yes ___ No

   If yes, please describe* WE ARE ON CALL 24 HRS A DAY IT IS NOT FEASABLE TO HAVE A VEHICLE ON CHARGE

INTERIOR						
1. The heater provides adequate heat						
2. The air conditioner provides adequate cooling						
3. The vehicle is quiet						

4. Did you use electronic equipment (cell phone, radio, etc.) inside the EV? ___ Yes ___ No

   If yes, please list equipment(s) and describe any problems encountered* _____

GENERAL						
1. The vehicle has adequate payload						✓
2. The vehicle has adequate range	✓				✓	
3. The vehicle is easy to operate	✓			✓		
4. The vehicle is suited for your job application				✓		✓
5. The vehicle meets your expectations						

6. If you had to choose between this vehicle or a similar gasoline vehicle ***for use in your work***, which one would you select? **(Circle One)** **Electric Vehicle** **(Gasoline Vehicle)** **Either**

COMMENTS*

What did you like best? ACCELERATES RAPIDLY

What did you like least? THE RANGE DIMINISHED AFTER TIME AND THE CHARGE WENT DOWN RAPIDLY WHILE CARRYING A PASSENGER OR A LOAD

SA: Strongly Agree; A: Agree; NS: Not Sure; D: Disagree; SD: Strongly Disagree; NA: Not Applicable

* Please use the back of this form if you need additional space.

Revised: 03/03/99

SCE Electric Vehicle Driver Questionnaire

DRIVER NAME: _____ **LOCATION:** _____

VEHICLE #: 23641 **VEHICLE MAKE & MODEL:** Ranger

VEHICLE APPLICATION: _____ **DATE:** _____

DRIVEABILITY	***SA***	***A***	***NS***	***D***	***SD***	***NA***
1. The vehicle feels stable and safe		X				
2. The vehicle steering is responsive		X				
3. The vehicle acceleration is adequate		X				
4. The vehicle braking is responsive and safe		X				
DRIVING CONTROLS AND GAUGES						
1. The cabin temperature controls are easy to operate				X		
2. The "state-of-charge" gauge is helpful and easy to read			X			
3. The "range remaining" gauge is helpful and easy to read		X				
CHARGING CONTROLS AND GAUGES						
1. The charging controls are easy to operate		X				
2. The charging connector (plug) is easy to use				X		
3. The charging cord is easy to manage		X				
4. The vehicle charges adequately (full in the morning)		X				
5. The charger is reasonably quiet		X				

6. Do you know the differences between Inductive and Conductive charging? **X Yes** **___ No**

   If yes, which do you prefer? **___ Inductive** **___ Conductive** **X No preference**

7. Did you have any problems charging? **___ Yes** **X No**

   If yes, please describe* _____

INTERIOR						
1. The heater provides adequate heat		X				
2. The air conditioner provides adequate cooling		X				
3. The vehicle is quiet		X				

4. Did you use electronic equipment (cell phone, radio, etc.) inside the EV? **___ Yes** **X No**

   If yes, please list equipment(s) and describe any problems encountered* _____

GENERAL						
1. The vehicle has adequate payload			X			
2. The vehicle has adequate range					X	
3. The vehicle is easy to operate		X				
4. The vehicle is suited for your job application				X		
5. The vehicle meets your expectations			X			

6. If you had to choose between this vehicle or a similar gasoline vehicle ***for use in your work***, which one would you select? **(Circle One)** **Electric Vehicle** **Gasoline Vehicle** **(Either)**

COMMENTS*

What did you like best? _____

What did you like least? _____

SA: *Strongly Agree;* ***A:*** *Agree;* ***NS:*** *Not Sure;* ***D:*** *Disagree;* ***SD:*** *Strongly Disagree;* ***NA:*** *Not Applicable*

* Please use the back of this form if you need additional space.

Revised: 03/03/99

Electric Vehicle Driver Questionnaire
Participant SCE

DRIVER NAME: V. J. Sreedharan **LOCATION:** Pomona
VEHICLE NUMBER: 23639 **VEHICLE MAKE & MODEL:** Ranger
VEHICLE APPLICATION: _____ **DATE:** _____

DRIVEABILITY	***SA***	***A***	***NS***	***D***	***SD***	***NA***
1. The vehicle feels stable and safe		X				
2. The vehicle steering is responsive		X				
3. The vehicle acceleration is adequate		X				
4. The vehicle braking is responsive and safe		X				
DRIVING CONTROLS AND GAUGES						
1. The cabin temperature controls are easy to operate		X				
2. The "state-of-charge" gauge is helpful and easy to read			X			
3. The "range remaining" gauge is helpful and easy to read			X			
CHARGING CONTROLS AND GAUGES						
1. The charging controls are easy to operate	X					
2. The charging connector (plug) is easy to use	X					
3. The charging cord is easy to manage		X				
4. The vehicle charges adequately (full in the morning)		X				
5. The charger is reasonably quiet		X				

6. Do you know the differences between Inductive and Conductive charging? ___ **Yes** X **No**
   If yes, which do you prefer? ___ **Inductive** ___ **Conductive** ___ **No preference**
7. Did you have any problems charging? ___ **Yes** X **No**
   If yes, please describe*_____

INTERIOR						
1. The heater provides adequate heat		X				
2. The air conditioner provides adequate cooling		X				
3. The vehicle is quiet	X					

4. Did you use electronic equipment (cell phone, radio, etc.) inside the EV? ___ **Yes** X **No**
   If yes, please list equipment(s) and describe any problems encountered*_____

GENERAL						
1. The vehicle has adequate payload		X				
2. The vehicle has adequate range				X		
3. The vehicle is easy to operate		X				
4. The vehicle is suited for your job application		X				
5. The vehicle meets your expectations			X			

6. If you had to choose between this vehicle or a similar gasoline vehicle ***for use in your work***, which one would you select? **(Circle One)** **Electric Vehicle** **Gasoline Vehicle** **Either**

COMMENTS*
What did you like best? EASE OF OPERATION

What did you like least? Limited range

SA: *Strongly Agree;* ***A:*** *Agree;* ***NS:*** *Not Sure;* ***D:*** *Disagree;* ***SD:*** *Strongly Disagree;* ***NA:*** *Not Applicable*

* Please use the back of this form if you need additional space.

Revised: 03/03/99