FINAL REPORT

UNITED STATES DEPARTMENT OF ENERGY'S

"ELECTRIC AND HYBRID
VEHICLE SITE OPERATOR" PROGRAM

DE-FC07-91ID13071

APRIL, 1991 - SEPTEMBER, 1996

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BACKGROUND

Orcas Power and Light Company (OPALCO) is a rural electric distribution cooperation serving nineteen islands in San Juan County. The county has a population of 12,000 and a two lane road system with speed limits between 25 and 45 miles per hour. The San Juan Islands are a mecca for tourists, offering unmatched pastoral and marine vistas in a rural setting. A 1% tax on real estate transactions provides funds for the San Juan County Land Bank. The purpose of the Land Bank is to help preserve the unique character of San Juan County by purchasing designated property that might otherwise be developed. This “bank” was created in 1989 with the passage of a state referendum in San Juan County that was not approved by voters in any other county in Washington State. Recently, county commissioners approved an ordinance banning the operation of jet skis on the waters of San Juan County. In 1995, the Sustainable Technology Center was completed. This campus incorporates several state-of-the-art technologies aimed at reducing building owner and tenant costs. Electric transportation is included as a feature of the Center. Seventy two percent of the electric distribution system in San Juan County is underground. At one electric vehicle (EV) for every 750 internal combustion (IC) vehicles, San Juan County boasts the highest ratio of EVs to IC vehicles of any county in the United States.
INTRODUCTION

Orcas Power and Light Company is an electric cooperative owned by those it serves. The membership has a high environmental consciousness. Early in 1991, the Board of Directors encouraged management to explore the possibility of operating electric vehicles in San Juan County.

A grant proposal was submitted to the United States Department of Energy in April of 1991. OPALCO would purchase, operate, maintain, document and educate the public on the experiences learned while operating EVs.

These activities would be reported on quarterly to the U.S. D.O.E. The program that the grant was applied for under called for a five year plan. OPALCO, along with twelve other utilities and universities, was selected to participate in the D.O.E. "Electric and Hybrid Vehicle Site Operator Program". The cooperative agreement between OPALCO and D.O.E. specified that OPALCO would cost share 59% and D.O.E. 41% of the activities of the five year project. The proposal outlined costs amounting to $184,000.
UNITED STATES DEPARTMENT OF ENERGY
SITE OPERATOR PROGRAM

SUMMARY

1991:
September - OPALCO received notice of grant award from U.S. D.O.E.
October - OPALCO took delivery of General Motors G-Van #98.
November - OPALCO took delivery of Selectria Force Unit #24.

1992:
January - Olympia Ride and Drive Electric Vehicle demonstration during legislative session.
March - Washington State Energy Office publication, “Dispatch Article on OPALCO EV Program”.
April - Utility Board candidate runs on anti-EV platform.
June - Establish relations with Dr. Seale at Western Washington State College.
August - Started EV charge substation project with first installation at Roche Harbor Resort.

1993:
February - Selectria Force battery pack replaced after 2600 miles.
1993 (continued):

May - San Juan County Department of Public Works and the Town of Friday Harbor participate in 30 day EV loan program.

August - OPALCO hosts D.O.E. Site Operator Users Task Force quarterly meeting.

September - Beginning of Crane Island Project (conversion of four wheel drive Suzuki Samurai.

October - OPALCO presentation at University of Washington Institute for Environmental Studies Conference on Termination of Tail Pipe Toxins.

November - Displayed OPALCO EVs at Seattle International Auto Show. Attendance was approximately 500,000.

1994:

March - OPALCO’s demonstration charge station is featured on Seattle’s NBC affiliate, King TV program on EVs.

March - consulted with Seattle City Light regarding possible EV program in conjunction with the Clean Cities Program.

May - Participant in NRECA study on the impact of electric vehicles on rural electric cooperatives.

June and July - Doug Bechtel makes presentations on D.O.E./OPALCO EV program to over seventy utility managers from across the United States.

August - San Juan County Electric Vehicle Association is established.

October - Parking meter style Charge Station #3 is installed at Key Bank in Friday Harbor.

November - San Juan County Electric Vehicle Association Meeting is held via interactive video, allowing participation by members from Lopez, Orcas and San Juan Islands.
1994 (Continued)
December - OPALCO partners with San Juan County Sustainability Group in a demonstration of new technologies including an EV charging station.

1995:
February - Charge Station #5 with dedicated parking sign is established at San Juan Technology Center.

August - Begin work with Underwriters Laboratories to field certify three EHV charge stations.
PUBLIC RESPONSE

Electric vehicles and recharging were demonstrated and kept in front of the public, locally and regionally in a variety of ways. Some of those opportunities were: OPALCO employee education, local media, county fairs, Seattle Auto Show, Earth Day celebrations, state legislative rallies, high school drivers training classes, Fourth of July parades, ride and drives, store openings and merely driving the vehicles which are clearly marked "Electric Vehicle". Numerous feature stories on the EV program in local newspapers and the novelty of the charging stations caused predictable small town grapevine conversations. As a result, over 75% of the adult population in San Juan County is aware that OPALCO operates electric vehicles. The membership can be characterized as being supportive rather than critical of the EV program.

One good indication of the public's feeling about the cooperative's involvement with EVs came in a board of directors election. One director candidate clearly disagreed with the company's involvement with EVs. His "As I see it" article in a local newspaper left no uncertainties as to how strongly he felt against the cooperative's EV activities. After the members voted, this candidate was a distant fourth place out of four. This was an encouragement to the board and management.

Certainly, another measure of the public's response to the OPALCO/D.O.E. EV Program is the number of EVs operating in San Juan County. Since the beginning of the program, eleven vehicles have taken to the roads of San Juan County.

Another description of the public's response might be termed "politely curious". That is, the person seemed to be thinking "these people have gone to all this trouble, so I should at least act interested".
While in-person presentations to the public were definitely upbeat and enthusiastic, they were also honest with regard to the limitations of the technology.

Over the five year period, more than 75 public presentations elicited thousands of comments from the audiences. Following are the most frequently voiced remarks:

- “How long will it run?”
- “How long does it take to charge?”
- “How much does it cost?”
- “What kind of batteries does it use?”
- “I think it’s important for the environment.”
- “They will not work until battery technology improves.”
- “My grandmother use to have an electric vehicle.”

There is another public response that is not measurable but does exist. That is the reaction to the very obvious parking meter style EHV charging stations. These five sites are strategically located and marked with signs stating “Electric Vehicle Recharge Station, Please Yield - Another Step for Clean Air”. These signs are made to the same specifications that typical traffic signs are. They are the same shape as a handicapped parking sign. Since San Juan County’s major industry is tourism, exposure to these novel installations is quite high. One can only imagine the discussions that occur with those who see, up close and personal, a real live installation for the purpose of accommodating electric transportation.

Students seem to represent a distinct group with regard to their response to EVs. Clearly, their comments convey interest in speed and power, but also evident as discussions go on is the recognition by these young adults that some things must change to improve our environment for the future.
DRIVER RESPONSE

Getting the public behind the wheel of an EV was an important goal of the OPALCO EV Program. In addition to the numerous ride and drive events, San Juan County residents have a standing invitation to “stop by and drive the car anytime”. Responses generally fall into the following categories:

- “Is it running?”
- “It’s so quiet!”
- “You really have to push on the brakes.”
- “It’s not too ‘peppy’.”

Regular drivers are those who are using or have used the vehicle on a daily basis for at least thirty days. In addition to initial responses similar to those above, these drivers commented as follows:

- A back-of-the-mind worry about running out of fuel.
- Negative effects of cold weather, reduction of range, and inability to heat/defrost.
- Grew to enjoy “one footed” driving with regenerative braking.
- Made a game of seeing how few amp hours a specific trip could be accomplished with.
- A sense of contributing towards the improvement of the environment.
- Considered distance of trip, state of charge and availability of charging at the destination.
OPERATIONS

OPALCO owned and operated three EVs under the U.S. D.O.E. Program. Because the vehicles were so different, the operations aspect will be discussed by specific vehicle.

1. **G-Van**

   This vehicle was a full size one-ton General Motors van. This vehicle was selected when space or seating were factors. Motor failure caused the motor and controller to be replaced. Also, intermittent starting meant replacement of some relays. Both of these problems were taken care of in a timely manner. In the case of the relays, they were overnight mailed, minimizing down time. The G-Van proved to be very dependable and had consistent range. Battery watering was simplified by a cart that had a water reservoir, pump and hoses making regular attention easy.

   The 4'x4'x4', 300 pound off board charger proved to be a drawback. Opportunity charging in the course of a trip was not possible. Also, the sheer size and weight of the van made it cumbersome for drivers who were used to driving compacts. Lack of visibility due to the van’s size was also mentioned by regular drivers.

   The G-Van was traded to York Technical College in Rock Hill, South Carolina for a 1985 Jet Industries Electric Ford Escort and other considerations.

2. **Jet Escort**

   This original Jet Industries conversion of the Ford Escort was further modified and updated by York Technical College. The Escort has a Curtis controller and operates at 108 volts D.C. The age of the vehicle and the eighteen 6 volt batteries make it a
heavy EV (3400 pounds). The battery pack was replaced once in the five year program. Maximum range attained was 47 miles. The gasoline fired Vesper heater provides satisfactory heat in cold months. The vehicle is left plugged in while parked, and the onboard “smart” charger cycles the pack as needed to keep it fully charged.

The car has a manual shift transmission and is adequate for the driving tasks expected of it in San Juan County.

3. **Solectria Force**

This AC drive vehicle is sold by Solectria of Arlington, Massachusetts. A GEO Metro glider is provided by General Motors to which Solectria adds the electric vehicle components. This vehicle is an automatic and is very friendly to drive. Drivers are unanimous in their choosing of the Solectria over the other available EVs when given a choice. Inadequate heat/defrost and regenerative braking on ice make it less desirable to drive in winter months. The light weight (2400 pounds) of the car makes it responsive and lively.

After two battery pack replacements, we have concluded that charging at every opportunity and keeping the pack “topped off” is best for the life of the lead acid batteries. Some equipment changes that have been made during the five year program include:

- Replacing motor mounts
- Replacing one battery charger
- Upgrading the controller
- Replacing battery pack twice

These changes and modifications were accomplished with excellent cooperation by Solectria.

On Island, an electric vehicle maintenance and repair company on Orcas Island is the area representative for Solectria. Maintenance and operations costs (excluding batteries) are approximately equal to comparable gasoline vehicles. Fuel cost per mile favors the EV in the Pacific Northwest. For example, the Solectria averages 1.8 cents per mile for electricity, the gasoline counterpart 4.0 cents.

Battery pack life ranged from 2500 to 7000 miles.
### Summary

#### Electric Vehicle Operation

September 1991 - September 1996

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**Operating Statistics**
**1991 - 1996**

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Total EV miles driven 10,534

Note: Miles per Day only includes the days the vehicle was driven.
Miles per month is total miles for the quarter divided by number of months.
CONCLUSIONS

Drivers in San Juan County, which, again, is comprised of islands making for short distances on rural (low speed limits) roads, found that present day electric vehicle technology can work in certain applications. An honest, accurate appraisal of the expectations of the vehicle is essential. When needs and capabilities are able to match up, then successful ownership and operation can occur. Also, if a driver is in a position to have "an island car" that is one that rarely or never goes to the mainland, many felt it could be an EV. Few people can bring themselves to spend $15,000 to $50,000 on a vehicle that will, "on paper," meet their driving needs on an island but also have some significant downsides. The experience of the OPALCO program suggests that the strength of the commitment to an "environmental contribution" provides the rationale for one to accent the cost difference between an EV and a comparable internal combustion vehicle.

Today’s EV technology can accomplish certain driving tasks. Careful, honest analysis of what is expected of the car can lead to a rewarding EV driving experience. Providing recharge locations in the community proved essential for the peace of mind of the EV driver. The importance is threefold. First, there is a security in knowing you can "plug in" when you get there. Second, "opportunity" charging is best for the lead acid battery pack. Third, recharging actually serves to extend the range on a given trip that includes stops along the way.

There is also value in the designated parking space itself. That is, a space reserved for EV charging also represents a benefit, especially in congested areas. Although not pursued in the OPALCO program, it seems reasonable to expect incentives for those opting to own an EV. The Internal Revenue Service provides a one time credit of up to
$4000 for a vehicle not previously operated as an internal combustion vehicle. State taxes, license fees, toll roads, high occupancy vehicle lanes, insurance, parking and ferry systems are other areas that should be explored for the purpose of encouraging electric transportation.

Today’s state of the art, dependable EV carries a price tag of nearly $30,000. There is no question that this is the single greatest deterrent to widespread EV ownership. Nevertheless, improvements in battery technology and economies of scale for EV companies will have a positive effect on the number of units sold in the future.

Since heating and air conditioning represent electric loads whose use reduces range, a moderate to warm year round climate is best for today’s EV. Also, even limited solar recharging has been determined to improve battery pack life.

Maintenance costs for EVs, excluding batteries, are approximately equal. Fuel costs favor the EV in the Pacific Northwest. In 1996, cost of fuel for a gas vehicle was over twice that of electricity on a per-mile basis. Limited though they may be, General Motor’s efforts with the EV1 sent a powerful message to the public. Also, states such as California and several in the Northeast are in a position to have major impacts on the growth or death of this present foray into electric transportation.