Exhibit ________
Docket No. UE-921262
Rate Design

Response of Public Counsel Witness Jim Lazar
Data Request of Puget Power

531. Please provide the cost estimates for interruptible water heater controllers referenced on page 53 line 29 of Mr. Lazar's testimony including all assumptions associated with those estimates.

RESPONSE: These estimates were included in WPAG-E-WA-02 in the 1987 BPA rate proceeding. Puget was a party to that proceeding, and presumably has the documents. If not, Mr. Saleba, the sponsor of those exhibits, is a witness for BOMA in this proceeding, and can probably locate a copy. Mr. Lazar has archived his copies and can provide them within 20 days if necessary.

Response of Public Counsel Witness Jim Lazar
Data Request of Puget Power

531. Please provide the cost estimates for interruptible water heater controllers referenced on page 53 line 29 of Mr. Lazar's testimony including all assumptions associated with those estimates.

SUPPLEMENTAL RESPONSE:

See attached report, Survey of Residential Water Heater Direct Load Control Programs, Program Research Unit, Washington State Energy Office, March, 1992

Survey of Residential Water Heater Direct Load Control Programs

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March, 1992

WSEO

Washington State Energy Office

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EXECUTIVE SUMMARY

The Washington State Energy Office has prepared this Survey of Residential Water Heater Direct Load Control Programs (hereafter Survey) to assist Puget Sound area utilities in developing water heater load control programs. The Survey presents information organized topically under the following six headings:

- Load Control Goals and Objectives
- Load Control Technologies
- Load Control Costs
- Load Reduction
- Customer Acceptance of Load Control
- Load Control Marketing Techniques

Information presented in the Summary is drawn mainly from a series of interviews WSEO conducted with utility load control managers around the nation. Survey contributors expressed a willingness to further discuss their load control activities with interested parties. Readers interested in further discussion will find these utility load control managers identified in Appendix A.

LOAD CONTROL GOALS AND OBJECTIVES

Direct load control allows electric utilities to remotely interrupt and restore home appliance electric loads during periods of heavy coincident peak demand. The objective of doing so is to shift appliance loads from periods of peak to off-peak demand and consequently, defer the need for adding generating and transmission capacity.

Water heaters are the most common type of controlled home appliance in America. The reason is two-fold. First, because of their thermal storage capacities, water heater loads can be interrupted for relatively long periods of time. Second, electric water heaters represent a relatively high load appliance that operates year-round. Taken together, these circumstances afford utilities controlling water heaters a significant degree of load relief without affecting customers.

LOAD CONTROL TECHNOLOGIES

VHF radio is the most common type of load control technology. VHF systems involve installing radio receivers at customers residences. The receivers are programmed to respond to tonal commands broadcast by radio transmitters located at utility central control facilities. Upon receiving a signal pitched at the preset tone, appliance circuits are either interrupted or restored.

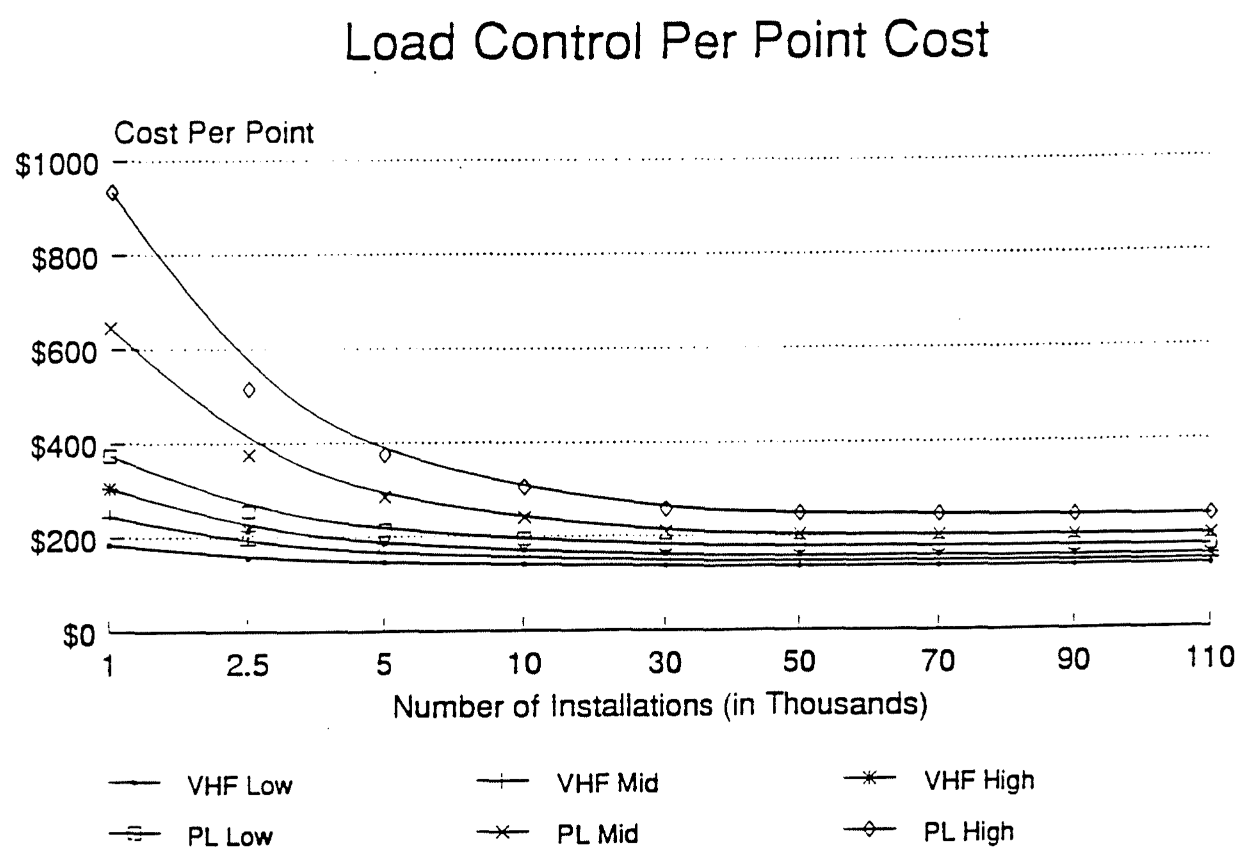
Power line carrier is the second most commonly employed type of load control technology. In a power line system, a utility's own power line distribution system serves as the medium for transmitting the signals that interrupt and restore home appliance loads. Power line carrier permits a number of applications unavailable with VHF radio. These include remotely connecting or disconnecting service, remote meter reading and mapping outages.

LOAD CONTROL COSTS

The Survey presents a range within which the per point cost a utility incurs in operating a load control program is likely to fall. These costs are summarized in the figure below. The table highlights a key feature of direct load control. Both VHF radio and power line systems are characterized by declining scale economies. As system size grows, all costs other than those directly related to acquisition and installation of switches and transponders diminish in significance to the point at which total system per point costs becomes insensitive to any but the acquisition and installations costs of the switch itself.

LOAD REDUCTION

Load reduction resulting from direct load control of water heaters varies widely with prevailing climate and weather conditions, the size of controlling equipment and control strategy. On average, controlling water heater loads during summer periods produces a coincident peak demand reduction of .592 kW. Controlling water heaters during winter peaking periods produces a higher average coincident peak demand reduction of .965 kW.



Source: Washington State Energy Office

CUSTOMER ACCEPTANCE OF LOAD CONTROL

Utilities report a high degree of customer satisfaction with their water heater load control programs. In consequence, utilities report attribution rates from their load control programs in the range of only 1 to 2 percent. Survey contributors credit the success they've enjoyed in ensuring customer satisfaction with load control to a number of factors:

- Avoid using the word "Control" in load control marketing activities. Customers have an strong aversion to seeing this word incorporated into the name of demand-side management programs.

- Offer a financial incentive to load control customers. Incentives as the most important • factor in ensuring customer satisfaction with load control.

- Avoid controlling water heaters on weekends and holidays. These are periods in which hot water use is likely to be heavier than usual and customers are therefore most likely to run out of hot water. Of course, these are also periods during which utilities are least likely to experience peaking periods.

- Ensure that utility-customer encounters pertaining to load control are of high quality. In particular, once a customer agrees to participate in a load control program, load control equipment should be installed as quickly as possible. Quality service delivery will not only enhance customer satisfaction with load control but increase the likelihood that customers will be willing to participate in other DSM programs as well.

LOAD CONTROL MARKETING TECHNIQUES

Direct mail advertising is the medium used most commonly by utilities to market direct load programs. Bill inserts, newspaper, radio and television advertising are also commonly used direct load control marketing techniques. Telemarketing is less commonly used for marketing load control, although there is evidence that it might be an effective tool for increasing load control program participation rates.

In their load control marketing activities, utilities typically emphasize the value of incentives and the promise of lower longtime levelized costs resulting from deferring capacity additions. Utility marketing materials also often emphasize the environmental benefits to be derived from participating in a load control program. Several Survey contributors expressed the view that appealing to environmental sensitivities would be an especially valuable tool in marketing load control to in the Pacific Northwest, an area in which they believe energy consumers are likely to be especially environmentally aware.

IV. LOAD CONTROL COSTS

Some 361 utilities operated load control programs in 1988 (EPRI 1989). That such a large number of utilities have elected to operate load control programs is testimony to the fact that in many cases, load control is a cost effective utility demand side strategy. Still, it is difficult to derive generalized load control cost effectiveness estimates. In part, this is because the costs a utility incurs in operating a load control program are highly variable. Load control costs are contingent upon number of variables including system size and the level of market saturation attained, the sophistication of central controlling equipment, type of receivers or transponders used, local labor rates and incentive levels. The variability intrinsic to utility avoided cost calculation also makes the derivation of generalized load control cost effectiveness difficult. Given these complexities, it is not possible to assess cost effectiveness projections for direct load control that would be applicable to any utility of any size. It is however possible to outline a general methodology for calculating the costs a utility is likely to incur when installing and operating a direct load control program. In evaluating load control system costs, it is the total installed cost per point cost that must be considered (EPRI 1980). Deriving per point costs allows different load control technologies and configurations to be compared. This is the approach taken here.

Information collected by WSEO indicates that the cost of acquiring and installing the central control equipment necessary for operation of a VHF radio load control system commonly ranges from between $50,000 and $150,000. Included in this total is acquisition and installation of computer equipment and software and signal transmitting devices. The cost incurred in acquiring VHF radio load control receiver equipment varies based upon how many switch relays (for controlling different appliances) are involved, whether analog or digital technology is employed and purchase volumes. Depending upon these variables, receiver prices range between $75.00 and $95.00. Current labor rates in the Puget Sound area suggest a per unit cost of about $60.00 to have VHF radio receivers installed by at customers homes by private contractors.

The costs involved in installing and operating a power line system are more highly variable. The cost of acquiring and installing central control equipment and making necessary substation upgrades can range anywhere from $100,000 for a small one way system to upward of $1 million for a large bi-directional system. Similarly, the per unit cost of acquiring power line switches can range from between $115.00 for unidirectional devices to $175.00 for transponders configured for advanced applications such as remote meter reading and connection and disconnection.

WSEO has used this information to derive estimated high, mid, and low range per point cost scenarios for VHF radio and power line direct load control systems. These estimates are based upon the following assumptions:

- VHF Radio System: High range scenario assumes utility expenditure of $300,000 for central control equipment and $95.00 per receiver. Mid range scenario assumes expenditure of $150,000 for central control equipment and $85 per receiver. Low range scenario assumes an expenditure of $100,000 for central control and $75.00 per receivers. Per unit expenditures for receiver installation assumed constant at $60.00 through all scenarios.

- Power Line System: High range scenario assumes a bi-directionally operated system possessing remote meter reading and other reciprocal capabilities involving expenditures of $700,000 for central control equipment and substation upgrades and $175.00 per transponder. Mid-range costs assumes limited bidirectional capability involving expenditures of $450,000 for central control equipment and substation upgrades and $135.00 for transponders. Low-range scenario assumes $200,000 for central control equipment and upgrades and $115.00 each for power line switches. Utility expenditures for transponder or switch installation assumed constant at $60.00 through all scenarios.

The following equation has been used to derive per-point costs for each of these scenarios:

$$PP = \frac{(N^{*}\{RA+RI\})+CC}{N}$$

Where:

PP = Per point load control cost
N = Number of points installed
RA = Per unit cost of receiver acquisition
RI = Per unit cost of receiver installation
CC = Cost for acquiring and installing central control equipment

Table 2 summarizes the per point costs for each of the six scenarios at different levels of market penetration. The same information is also depicted graphically in Figure 5. The figure highlights a key feature of load control operations. Both VHF radio and power line load control systems are characterized by declining scale economies. As system size grows, all costs other than those directly related to acquisition and installation of switches and transponders diminish in significance to the point at which total system per point costs becomes insensitive to any but the acquisition and installations costs of the switch itself.

In addition to the costs specific above, utilities incur other costs in operating load control programs. Marketing expenditures, the value of incentives offered to induce program participation by customers and expenditures for load control staff and equipment maintenance are costs common to both VHF and power line systems. Acquiring radio signal rights is an additional cost peculiar to VHF radio systems. Not only are these costs highly variable between utilities and over time. Utilities often do not break out these costs from other costs they incur in operating and marketing their load control programs. These costs are therefore difficult to tangibly quantify. For this reason, they are not included in the calculations presented in this survey.

Table 2. Range of Per Point Load Control Costs

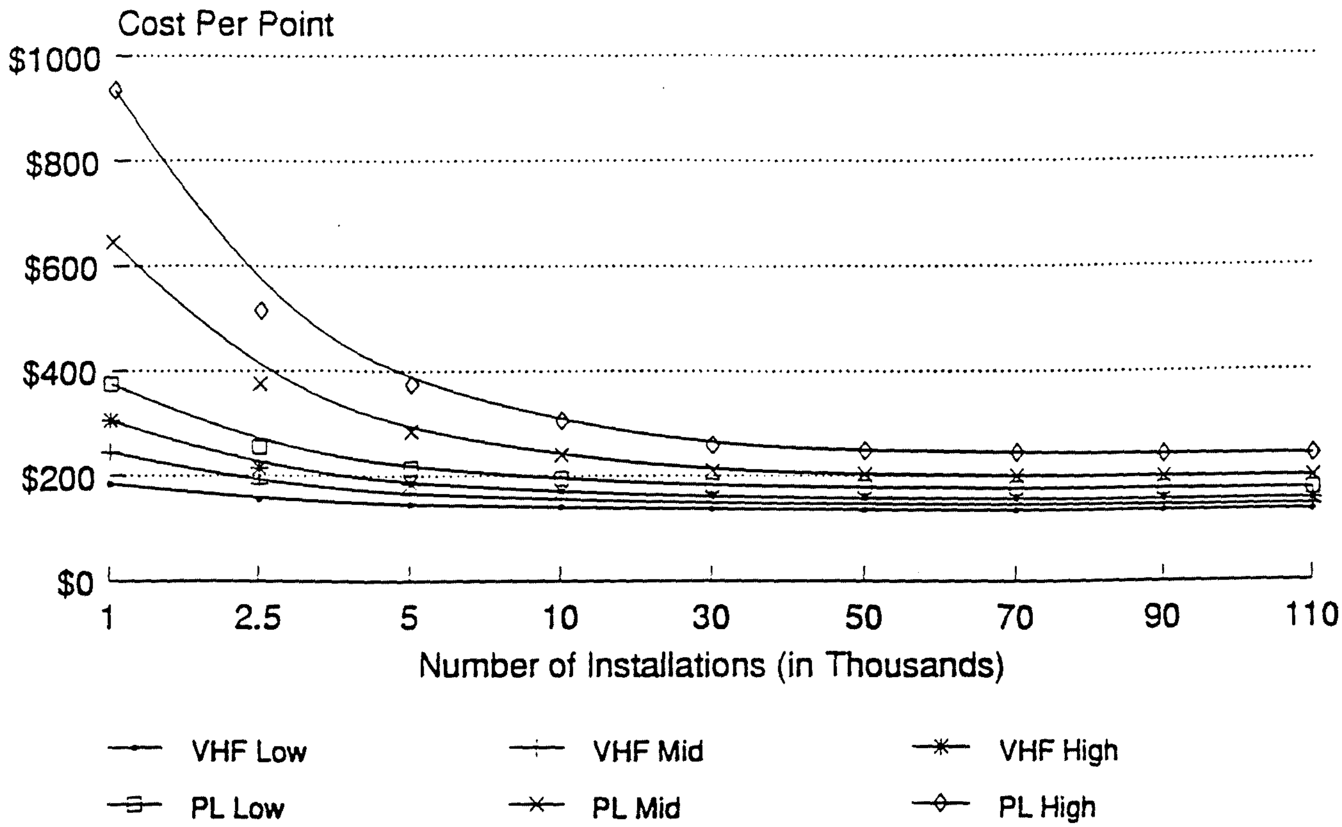
VHF Radio

System Level	Low Range CC Cost	Low Range Receiver Cost	Low Range Per Point Cost	Mid Range CC Cost	Mid Range Receiver Cost	Mid Range Per Point Cost	High Range CC Cost	High Range Receiver Cost	High Range Per Point Cost
1,000	$50,000	$135,000	$185.00	$100,000	$145,000	$245.00	$150,000	$155,000	$305.00
2,500	$50,000	$337,500	$155.00	$100,000	$362,500	$185.00	$150,000	$387,500	$215.00
5,000	$50,000	$675,000	$145.00	$100,000	$725,000	$165.00	$150,000	$775,000	$185.00
10,000	$50,000	$1,350,000	$140.00	$100,000	$1,450,000	$155.00	$150,000	$1,550,000	$170.00
20,000	$50,000	$2,700,000	$137.50	$100,000	$2,900,000	$150.00	$150,000	$3,100,000	$162.50
30,000	$50,000	$4,050,000	$136.67	$100,000	$4,350,000	$148.33	$150,000	$4,650,000	$160.00
40,000	$50,000	$5,400,000	$136.25	$100,000	$5,800,000	$147.50	$150,000	$6,200,000	$158.75
50,000	$50,000	$6,750,000	$136.00	$100,000	$7,250,000	$147.00	$150,000	$7,750,000	$158.00
70,000	$50,000	$9,450,000	$135.71	$100,000	$10,150,000	$146.43	$150,000	$10,850,000	$157.14
80,000	$50,000	$10,800,000	$135.63	$100,000	$11,600,000	$146.25	$150,000	$12,400,000	$156.88
90,000	$50,000	$12,150,000	$135.56	$100,000	$13,050,000	$146.11	$150,000	$13,950,000	$156.67
100,000	$50,000	$13,500,000	$135.50	$100,000	$14,500,000	$146.00	$150,000	$15,500,000	$156.50
110,000	$50,000	$14,850,000	$135.45	$100,000	$15,950,000	$145.91	$150,000	$17,050,000	$156.36

Power Line

System Level	Low Range CC Cost	Low Range Receiver Cost	Low Range Per Point Cost	Mid Range CC Cost	Mid Range Receiver Cost	Mid Range Per Point Cost	High Range CC Cost	High Range Receiver Cost	High Range Per Poin Cost
1,000	$200,000	$175,000	$375.00	$450,000	$195,000	$645.00	$700,000	$235,000	$935.0
2,500	$200,000	$437,500	$255.00	$450,000	$487,500	$375.00	$700,000	$587,500	$515.0
5,000	$200,000	$875,000	$215.00	$450,000	$975,000	$285.00	$700,000	$1,175,000	$375.0
10,000	$200,000	$1,750,000	$195.00	$450,000	$1,950,000	$240.00	$700,000	$2,350,000	$305.0
20,000	$200,000	$3,500,000	$185.00	$450,000	$3,900,000	$217.50	$700,000	$4,700,000	$270.0
30,000	$200,000	$5,250,000	$181.67	$450,000	$5,850,000	$210.00	$700,000	$7,050,000	$258.
40,000	$200,000	$7,000,000	$180.00	$450,000	$7,800,000	$206.25	$700,000	$9,400,000	$252.
50,000	$200,000	$8,750,000	$179.00	$450,000	$9,750,000	$204.00	$700,000	$11,750,000	$249.
70,000	$200,000	$12,250,000	$177.86	$450,000	$13,650,000	$201.43	$700,000	$16,450,000	$245.
80,000	$200,000	$14,000,000	$177.50	$450,000	$15,600,000	$200.63	$700,000	$18,800,000	$243.
90,000	$200,000	$15,750,000	$177.22	$450,000	$17,550,000	$200.00	$700,000	$21,150,000	$242.
100,000	$200,000	$17,500,000	$177.00	$450,000	$19,500,000	$199.50	$700,000	$23,500,000	$242.
110,000	$200,000	$19,250,000	$176.82	$450,000	$21,450,000	$199.09	$700,000	$25,850,000	$241.

Figure 5. Load Control Per Point Cost



Source: Washington State Energy Office