Exhibit ____ (JL-3)
Transmission Costs

BEFORE THE

WASHINGTON UTILITIES AND

TRANSPORTATION COMMISSION

Cause No. UE-920499, UE-921262
Rate Design Phase

PUGET SOUND POWER AND LIGHT COMPANY

Exhibit of

JIM LAZAR
CONSULTING ECONOMIST

On Behalf of
Public Counsel Section
Office of the Attorney General

INTEGRATED RESOURCE PLAN

1992-1993

Planning and Innovating Together for Excellence

PUGET POWER

Transmission

Introduction

In the last decade, electrical transmission has assumed a vital role in providing energy to customers. With the population in the Puget Sound basin growing at a rate of 3% to 4% per year, it will be necessary for Puget Power to add transmission facilities, new distribution lines and substations in order to meet the increasing energy needs of the customers. These transmission lines will make it possible to meet the demand for reliable and cost-effective service for customers.

To meet these challenges, Puget Power has embarked on a corporate goal to build a backbone 230 kV transmission system. This transmission system, when expanded as planned, will provide Puget Power with a reliable, efficient and cost-effective system of new and rebuilt transmission facilities. This system will also allow Puget Power the flexibility to purchase the most economical energy resources and integrate current and future generation sources into the electrical system. Finally, this system will allow Puget Power to make a long-term commitment to plan and construct electrical facilities to meet the need for future growth.

The transmission system plays a key role in providing reliable electrical service. Large quantities of power are transmitted on the transmission system from the generator to the main load centers. Within the population centers, the power is redistributed on a network transmission system to the smaller load centers. Without an adequate system, the ability to deliver power during equipment failure or peak loads would be impaired.

Nationally, several issues have surfaced over the use of new and existing transmission facilities. One of these issues concerns a utility's access to other utilities' transmission systems. Also, electrical facilities themselves have become an issue from the standpoint of aesthetics, environmental effects and the health controversy of extremely low frequency electromagnetic fields (EMF). As a result, permits for construction of new transmission facilities are becoming increasingly more difficult to obtain.

A utility's investment in a transmission system is a long-term commitment for the future. These electrical facilities have at least a 40 to 50-year useful life. When constructing these facilities, the capacity of the system to meet new growth must be considered. The incremental cost of providing the additional capacity is a small percentage of the total project cost. One of a utility's most important roles is to plan and construct facilities for future growth.

Functions of Transmission

Transmission facilities have different functions that need to be addressed. They are to:

- Deliver bulk power (i.e. from Columbia River generation)
- Deliver power to load centers (within Puget Sound Basin)
- Provide reliable service (reduce outages)
- Provide an efficient operating system (quick restoration)

Each function has an important effect on whether the system provides cost-effective, reliable power to customers.

Utilities use high voltage transmission as the most economical means to transmit large quantities of electrical power. When the electrical system was initially built, the generation sources and the fuel to run them were located near the load centers. Later, to take advantage of the opportunity to use natural resources, such as hydro power from the Columbia River, 500 kV transmission was installed. This bulk power transmission system also allows power to be transferred between different regions such as from the Northwest to the Southwest, over the 500 kV Pacific Intertie.

The amount of power that can be transmitted on the electrical system at different voltage levels is shown in Table 1.

Table 1

Power Capacity of Typical Voltage Classes

Voltage kV	Capacity MW	Comments
12.5	12	Standard distribution voltage
34.5	34	Distribution voltage for rural and dense load areas
115.0	240	Subtransmission voltage to distribute power to local substations
230.0	500	Transmission voltage to distribute power to load centers and local substations
500.0	2000	Bulk power transmission from generation or between regions

The actual capacity ratings of the distribution or transmission lines are determined by voltage, conductor size, the number of conductors and operating temperature. The actual power that can be transmitted is also limited by distance. The longer lines have more losses, voltage drop, and chances of outages.

Caution should be exercised in assuming, for example, that two 115 kV lines are equivalent to one 230 kV line. The power grid is a network system of parallel 500 kV, 230 kV and 115 kV lines. In many cases, the lower voltage system cannot replace the need for higher voltage transmission lines.

The 500 kV transmission system in the Northwest is primarily owned and operated by The Bonneville Power Administration (BPA). Puget Power is a co-owner of 500 kV transmission in Montana and is negotiating ownership rights on the 500 kV Third AC Intertie to California. The primary bulk power transmission voltage used by Puget Power is 230 kV. The 230 kV transmission system is utilized primarily to distribute the power from the 500 kV transmission system to the load centers. Some generation facilities are integrated into the system at 230 kV. The 230 kV system is also used to back up the 500 kV system during maintenance or forced outage conditions. The 230 kV transmission substations, located in the load centers, are used to distribute the power to the 115 kV subtransmission system that supplies local neighborhood substations.

An adequate 230 kV transmission system is needed in order to provide reliable service. Because the 230 kV system supplies significant quantities of power, its design is such that during an outage for maintenance or the forced outage of a facility, no customer should be out of service.

A 230 kV system can also provide greater efficiencies in operation. In many cases, power could be distributed at 115 kV, but the overall system losses would be much higher, requiring additional generating facilities to deliver the same amount of power. Using 230 kV for both transmission and subtransmission, fewer lines would be needed, but the cost of a 230 kV line is not twice the cost of a 115 kV line. Thus the net result of using a higher voltage system is reduced construction costs, reduced losses and fewer facilities.

In the 1920's, when Puget Power moved from local generation to remote generation, the losses in the system were 23 percent of generation. Today, with six times the peak, hundreds of thousands of additional customers, many more uses of electricity, and hundreds of miles of additional transmission, the system losses have been reduced to 7 percent of generation. This is due to higher voltages, the use of larger conductors, technology of interconnections and the networking of transmission systems.

Transmission Initiative

Puget Power has established a corporate goal to obtain long-term transmission access to existing and new power markets, and other utility systems. This goal recognizes the importance of transmission in the energy marketplace. Puget Power can take advantage of this market and other utility transmission systems by interconnecting with its neighbors' systems and expanding its own system.

In order to accomplish this goal, a 230 kV system will have to be built from the Canadian border to the southern part of Thurston County and from the Columbia River to Kitsap County. This future system is illustrated in Figure 1. The new transmission system will consist of at least two circuits in most areas in order to provide the necessary reliability and transfer capability. Figure 2 shows the number of miles of new and rebuilt 230 kV lines that are planned for the next 10 to 15 years. If Puget Power builds as planned, it will double the miles of 230 kV transmission. Because much of this is rebuild, the total mileage of 115 kV transmission will be reduced.

Puget Power has recently negotiated power contracts with other utilities. When the resource is outside the area served by Puget Power, it is necessary to negotiate access to other utilities' transmission systems. This is the situation with the 300 MW exchange contract with Pacific Gas & Electric (PG&E), a California utility. Puget Power has been negotiating with BPA to gain access to the 3rd 500 kV AC Pacific Intertie for the seasonal transfer of power between Puget Power and PG&E.

BPA is proposing to rebuild its existing single-circuit 230 kV line between Custer Substation and Sedro Woolley to double-circuit on the existing right-of-way. To allow for future long-term transmission needs and to optimize the use of the existing corridor, consideration may be given to constructing the 230 kV double-circuit line to 500 kV standards instead, and operating it at 230 kV. Puget Power proposes to install a 230-115 kV transformer at BPA's Bellingham Substation and rebuild two 115 kV lines from its Bellingham Substation to BPA's Bellingham Substation.

The water line will be constructed in the best location to serve both the existing and future customers. The facilities being installed have a 40-to 50-year useful life. Because these facilities will be used for such a significant period of time, it is even more important that the future be considered. The incremental cost to provide adequate capacity at the optimum location is relatively small compared to the total cost of the project. This will usually result in minimizing the environmental, social and cost effects.

Constructing a facility large enough to take care of future customers results in lowering the cost per customer. Although the initial cost will be high, the total future cost will be relatively low, minimizing the cost of service to all customers. In addition, good planning provides for the flexibility needed to deal with future uncertainties, such as environmental concerns which have surfaced in recent years.

Planning the Electrical System

The construction of new facilities to serve load is based on needs. When the existing facilities are old and not adequate to provide the planned level of service to customers, they must be replaced. Otherwise, some customers cannot be served during certain conditions when equipment is out of service. All utilities adopt standards for level of service and refer to them as "Reliability Guidelines". New facilities are justified based on:

- Maintenance
- Equipment failures
- Reliability of service
- Overloaded facilities

Before new facilities are constructed, their location and additional capability must be considered to provide for future growth.

The system planner will consider:

- Potential location of growth
- Current and future load densities
- Growth rates
- Technological advances
- Zoning
- Environmental effects

Also, the incremental cost of providing for future customers will be evaluated. There is a need for new facilities to maintain reliable service to existing customers as well as to provide capacity for future customers.

A number of factors must be considered in assessing the potential benefits by planning and building for tomorrow. The proposed transmission system should:

- Reduce environmental effects
- Reduce long-term costs
- Provide reliable service
- Increase system efficiency
- Avoid lost opportunities

The following is a review of the issues associated with serving future customers.

Reduce Environmental Effects

By constructing facilities for the future, environmental effects can be reduced. If facilities are built before the area is densely urbanized, more options will be available to locate the facilities in less environmentally sensitive areas. Also, if facilities are built in the current and future load centers, it will not be necessary to later add facilities; thus decreasing the total number of facilities needed. In addition, by having the optimal transmission facilities in place, the counties, cities and developers can site new development so that the effects of the facilities can be minimized.

Reduce Long-Term Costs

Costs can be minimized by constructing facilities prior to significant growth in a given area. First, the cost of the easements and right-of-ways will be less because land values will be lower in less densely populated areas. Second, when more options exist to site the facilities as close as possible to the future load centers, fewer facilities are needed. Third, fewer environmental and social effects will reduce permitting time and costs.

Provide Reliable Service

One of the key factors in assuring reliability of service is to provide alternate electrical sources, such as transmission substations which consist of several transmission line terminals. When urbanization occurs, it becomes more difficult to site additional transmission facilities and therefore provide the alternate sources. When these electrical sources are far apart, or distance increases between the load and the electrical source, more outages will occur, causing a reduction in the level of service. In extreme cases, where additional electrical facilities cannot be constructed, increased numbers and length of outages result.

Increase System Efficiency

In planning the electrical system, every attempt is made to reduce system losses. If the optimal facilities cannot be constructed, less efficient facilities will take their place, resulting in greater system losses, earlier replacement, and higher cost. Additional generating facilities are required to meet the system losses.

Avoid Lost Opportunities

When urbanization occurs, it becomes more difficult to construct new electrical facilities. Fewer alternate sites and routes are available. In some cases, the environmental and social effects preclude construction of electrical facilities. In other situations, the costs of the various options become prohibitive. These factors result in lost opportunities to provide a reliable, low-cost transmission system. It is in the best interest of Puget Power's customers to construct facilities with the capacity to meet tomorrow's load growth, using the most effective technology available for the highest system efficiency.

Transmission & Distribution (T&D) Reliability

The term "reliability" has been used to describe the ability of utility systems to provide service with minimum interruptions. Puget Power customers' definition of reliability varies based on their requirements for power. Customer needs and expectations are changing and are significantly different from those of customers 25 years ago. During this period, electronics equipment has become commonplace in homes and businesses. This equipment is susceptible to quality of power.

Power Quality

Many customers are now interested in power quality. This includes interruptions and other power variations that affect electronic equipment. The factors affecting power quality are:

- Long-term interruptions
- Momentary interruptions
- Voltage transients
- Stray voltages
- Harmonics

Long-term power outages have always created problems. Momentary outages 25 years ago were more of an annoyance than a problem; but today, computer systems stop working, VCR's will not record favorite programs and electronic clocks must be reset. Lifestyles are now suddenly affected.

Voltage transients have always existed on the power system. Transients can cause computer operating systems to malfunction, motors to drop out of service and other electronic equipment to malfunction. These transients can be created by normal switching of the power system, an outage on another part of the electrical system or a neighboring customer's equipment.

Stray voltages can cause similar operating problems for electronic equipment. Stray voltage is usually the result of improper grounding of the utility's or customer's electrical system. A classic example occurred with the company's dairy farm customers. With an improperly grounded system, the cows would receive an electrical shock when they were connected to the milking machines. This would cause milking problems and reduce overall milk production. This problem can be solved by balancing the power on the distribution system or by installing new equipment (neutral isolators) to provide proper grounding.

Harmonics is another problem that a few customers have experienced. Harmonics result when the level of frequency in which the company generates power is disturbed by the alternating currents of certain electronic equipment used by Puget Power customers. Special filters can be added to the customer's system to minimize harmonics problems.

At a customer's request, Puget Power will work with the customer to solve power quality problems. Customer service engineers have been trained and have test equipment to monitor the customer's power quality.

Reliability Planning Guidelines

Each utility has adopted reliability planning guidelines to assure an adequate level of service. These guidelines are tailored to minimize the number of interruptions a customer would experience. The Western Systems Coordinating Council (WSCC) has adopted reliability guidelines for generation and the bulk power transmission system. The WSCC is a cooperative group of utilities in the Western United States and a member of the North American Electric Reliability Council (NERC). Puget Power has developed additional guidelines which are consistent with the WSCC guidelines. These guidelines are used as evaluation criteria to determine when the electric system should be reinforced.

Puget Power's guidelines are published and updated on a regular basis. The guidelines establish:

- Allowable equipment loading
- System design requirements
- System operating voltages
- System protection requirements

Examples of the reliability guidelines are:

Transmission

- Loss of one 230 kV transmission line should not cause loss of service to customers.

- Loss of one transmission substation transformer, 230-115 kV, 115-66 kV, or 115-55 kV should not cause loss of service to customers.

- Outage of one 115 kV transmission line with two or more substations should interrupt service to customers only until transfer to an alternate source is accomplished.

Distribution

- In urban areas, loss of a distribution substation transformer serving essentially residential, small commercial and small load should cause an interruption only until load is transferred to adjacent substations.

- Loss of a distribution feeder will cause interruption of service until the load is transferred, the faulted section is isolated, or the feeder is repaired.

The planning guidelines are used to evaluate the performance of the existing and planned electrical system. The goal is to achieve the desired level of system reliability. The proposed Transmission & Distribution long-range construction plan is based on maintaining these levels of service.

Reliability Indices

The majority of the interruptions that affect utility customers are caused by outages on the distribution system. The following national statistics indicate the percentage of failures for different systems:

Distribution system	85%
Substations	9%
Transmission	4%
Generation	2%

The three leading causes of distribution system outages on the Puget Power system are trees and limbs (by far the leading cause), equipment failure and third-party contacts. Third-party contacts are situations such as underground cable digups and car/pole accidents.

Puget Power monitors and maintains records of interruption incidents and logs information such as location, timing, probable cause and duration. A number of reliability indices have been used to track reliability. Puget Power uses System Average Interruption Duration Index (SAIDI). This is the average number of outage minutes that the average customer will experience during the year. The index is calculated by dividing the total number of customer outage minutes by the total number of customers on the electrical system.

By monitoring the reliability indices on individual circuits, poorly performing circuits can be identified and component upgrades and design changes can be evaluated.

Improving Reliability

The reliability monitoring information is used to design programs to reduce customer outages. The three main areas monitored are outages caused by:

- Trees
- Storms
- Equipment failure

A number of programs have been initiated to reduce customer outages. The following is a brief description of some of the programs.

Vegetation Control

Vegetation control has a significant affect on the level of reliability. Puget Power is in the fifth year of a six-year program to control vegetation. The future plans are to trim the trees on a six-year cycle to reduce tree and limb caused outages.

Maintenance

Poles and underground cables are given special maintenance attention in the distribution system. A pole inspection program determines whether poles need replacement, stubbing or treatment. Underground equipment is inspected with infrared (IR) devices to detect equipment hot spots which would indicate equipment in the failure mode. This information is used to identify and replace the defective equipment.

Underground Cable

Puget Power, like all utilities with high molecular weight (HMW) cable, is experiencing increasing cable failures, resulting in customer outages. In 1990, approximately 1000 HMW cable failures occurred. Studies indicate that the failure rate will increase, causing additional customer outages. Figure 5 shows the increase in cable failures from 1989 to 1990. This trend is expected to continue. A program has been initiated to extend the cable life: 1) replace HMW cable, 2) inject silicon into HMW cable to extend the cable life, and 3) install surge arresters.

The company's focus is to increase reliability at the lowest cost. As a result, Puget Power is also looking at new methods of cable replacement such as wheel trenching and guided boring techniques.

Service Restoration

An important aspect of customer service is how quickly service can be restored following an outage. Puget Power is developing a "Service Order Tracking System" which will aid the service centers in identifying the location and probable cause of an outage.

Future Transmission Issues

The construction of new transmission facilities and the use of the existing transmission network have become national issues. It is increasingly more difficult to build new or rebuild existing transmission lines. Utility and non-utility parties are trying to gain access to the existing transmission network. The transmission system is not keeping pace with the demand for electrical energy. These and other issues, are in dispute and must be dealt with in the 1990s.

Following are four major issues which Puget Power must currently address:

- Access to other utility systems
- Aesthetics and environmental concerns
- EMF health concerns
- Keeping pace with growth

Access To Other Utility Systems

Puget Power has purchased power from other parties outside the area it serves and needs the flexibility to do this in the future. In order for power to be delivered to Puget Power's system, other utility transmission systems must be utilized and a contract must be negotiated for those services. In other states, cogenerators and independent power producers are trying to gain access to utility transmission systems to deliver power to prospective customers. These parties could also request the use of Puget Power's transmission system.

Aesthetics & Environmental Concerns

The continuous growth in the Puget Sound basin requires the continuous expansion of the transmission system. The aesthetics and environmental effects of transmission expansion are being scrutinized. Concern has been raised over the impact on forest and wetland areas. In some cases, people feel that by stalling or stopping the construction of roads, utilities, schools, etc., growth can be slowed or stopped. Before obtaining permits for a transmission project, these concerns must be addressed.

Electromagnetic Fields Health Concerns

Much controversy and publicity surrounds the potential health effects of extremely low frequency electromagnetic fields (EMF). Even though most experts feel that studies have not proven EMF causes cancer, many people are concerned. The researchers, equipment and appliance manufacturers, utilities and the public agree that the studies should be continued. Puget Power is supporting research through its membership in the Electric Power Research Institute. The EMF issue continues to be raised during the permitting period for transmission projects and has become a delaying factor.

Keeping Pace With Growth

If power demand continues to grow, the existing system will soon be inadequate. Puget Power's aggressive conservation programs have reduced and will continue to reduce energy needs. Even with these programs, peak growth has been approximately 100 MW per year over the last decade. Additional facilities and improvements will need to be constructed to continue to provide reliable service to customers.

At some peak winter load levels, it will be difficult to maintain service to customers. Extremely heavy winter loading can result in voltage instability. The voltage stability problem continues to be studied by Puget Power, Snohomish PUD, Seattle City Light, Tacoma City Light and BPA. A region-wide voltage instability study resulted in the Puget Sound Electric Reliability Plan (see Appendix B for details). This plan provides alternative strategies for meeting peak loads, as well as restoring voltage stability to the Puget Sound area transmission system.

The preferred strategy developed in this plan recommends the use of conservation and voltage support to meet extreme peak loads through the year 2003. Under extremely heavy winter load conditions and with the loss of a cross-Cascade 500 kV transmission line, customer loads would likely be interrupted in the Puget Sound Basin. Other areas of the country, notably Washington D.C., Texas, and Florida, experienced rolling blackouts in 1990 due to similar problems.

The utilities mentioned above have implemented remedial plans to avoid or minimize such an occurrence in the Puget Sound basin. The results of their studies will provide both near-term and long-range solutions to this problem. The issues addressed above increase the difficulty of maintaining adequate reliability and providing for future growth. The challenge of the 1990's will be to work with customers, interest groups and governmental bodies to achieve approval to build new and rebuild existing transmission lines.

helicopter. All double-circuit 345-kV lines have been built on self-supporting steel to····· ···th the phases of each circuit arranged verticall} width or, in the southwestern towers with each circuit in a 1

Self-supporting steel towers monly used on 500-kV lines. T E has used guyed portal-steel towers; VEPCO has used guyed-V towers of alloy steel; and Ontario Hydro has used guyed-V towers—some steel, others aluminum. Subsequent to the guyed-V tower design, a guyed-Y still less material. Wood for 500-kV lines, although n experimental lines. It is 500-kV lines may be built nes of the Hydro-Quebec Power Commission are built on self-supporting steel towers.

TABLE 1.2—COORDINATED NATIONAL POWER SURVEY TRANSMISSION AND INTERCONNECTION SPECIAL TECHNICAL COMMITTEE ESTIMATED COSTS OF EHV OVERHEAD LINES A-C

kV	Structure	No. Circuit	Conductors MCM-ACSR[2]	Costs per Mile: R/W and Clearing[1]	Costs per Mile: Labor and Material	Costs per Mile: Total Cost[5]
230	Wood	1	1-954	$10,000	$35,000	$45,000
230	Steel	1	1-954	10,000	45,000	55,000
230	Steel	1	1-1431	10,000	50,000	60,000
230	Steel	2	1-954	10,000	60,000	70,000
345	Wood	1	1-1414	12,000	48,000	60,000
345	Steel	1	1-1414	12,000	55,000	67,000
345	Steel	1	2-795	12,000	60,000	72,000
[6] 345	Steel	1	2-954	12,000	65,000	77,000
345	Steel	2	1-1414	12,000	80,000	92,000
345	Steel	2	2-795	12,000	86,000	98,000
345	Steel	2	2-954	12,000	93,000	105,000
[6] 500	Steel	1	2-1780	14,000	85,000	99,000
[6] 700	Steel	1	4-954	18,000	125,000	143,000
700	Steel	1	4-1272	18,000	142,000	160,000

ESTIMATED COSTS OF EHV OVERHEAD LINES D-C

kV	Structure	No. Circuit Bipolar	MW Capability[3]	Conductors MCM-ACSR[4]	Costs per Mile: R/W and Clearing[1]	Costs per Mile: Labor and Material	Costs per Mile: Total Cost[5]
[6] ±250	Steel	1	600	1-3000	$10,000	$56,000	$66,000
[6] ±375	Steel	1	900	1-4000	12,000	68,000	80,000
[6] ±500	Steel	1	1200	1-4000	14,000	78,000	92,000

Configuration and Right of Way:

230—18-ft phase spacing; 125 ft right-of-way.
345 and 32-ft phase spacing; 150 ft right-of-way.
500—38-ft phase spacing; 175 ft right-of-way.
700—45-ft phase spacing; 225 ft right-of-way.
±250—125-ft right-of-way.
±375—150-ft right-of-way.
±500—175-ft right-of-way.

[1] Assume 60 percent of right-of-way to require clearing.
[2] Since capability of a-c overhead lines varies with distance and degree of compensation, refer to "Report on Criteria for Transmission Studies."
[3] The capability of d-c overhead lines is determined by the current rating of terminal equipment and the conductor is chosen for economic sizes.
[4] Assuming 10 percent voltage drop, the 3000 MCM ACSR conductor for ±250 kV will carry 600 MW 600 miles; the 4000 MCM ACSR conductor for ±375 kV will carry 900 MW 1200 miles; and the 4000 MCM ACSR conductor for ±500 kV will carry 1200 MW 1600 miles.
[5] All costs have been adjusted to 1962 costs based on use of "Handy-Whitman Index of Public Utility Construction Costs," Bulletin No. 75.
[6] Preferred construction to be used in the study.
The above costs are average based on reports received from all sections of the country and any specific application should be studied in detail, adjusting them as necessary. These adjustments should consider the labor area, right-of-way acquisition costs, and the length of line involved. These costs are typical for making comparisons in this study only.
13.5 percent included in cost of line for engineering and general overhead.

Puget Sound Power & Light Company
Docket No. UE-920499
Response to NCAC Number 810

Request:

Does the Company have cost estimates for the incremental cost and incremental capacity provided by transmission size upgrades, for example, constructing 230 kV transmission instead of 115 kV transmission, or dual circuit 230 kV transmission in lieu of single circuit transmission? If so, please provide.

Response by Ms. Lynch:

Please see Attachment I, pages 1 and 2.

INTEROFFICE MEMORANDUM

Date: 03-Mar-1992 04:
From: DALE EASLEY
EASLEY
Dept: T & D ENGINEERI
Tel No: 3331

TO: See Below

Subject: 1992 T-LINE COSTS PER MILE

Attached is a tabulation of transmission line costs per mile for 1992 construction. These costs can be used for planning studies, comparative cost estimates and budget estimates. A +/- 50% accuracy should be assumed.

Again this year the format is in BASE COSTS + ADDERS. The adders include environmental, right of way, and roadwork costs which make the estimates more site-specific.

The overall costs have gone DOWN slightly over last year's costs per mile, primarily due to overhead changes. We've also added costs for lines using 1-1590 kcmil ACSR "Lapwing" conductor.

Please call me if you have any questions.

Distribution:

TO: RICH BARRUTIA (BARRUTIARB)
TO: DOUG CORBIN (CORBINDL)
TO: Steve Gates (GATESSF)
TO: John M. Gower (GOWERJM)
TO: RAY A. HISAYASU (HISAYASURA)
TO: KEN HOULDER (HOULDERKH)
TO: Charles L. Morton (MORTONCL)
TO: Jeff Potter (POTTERJ)
TO: Gary S Takeuchi (TAKEUCHIGS)
TO: DON YUEN (YUEN)
TO: Greg Zeller (ZELLERGJ)
TO: C. V. Chung (CHUNG)
TO: Max Emrick (EMRICKM)
TO: Ron S. Forster (FORSTER)
TO: Steven F. Hummer (HUMMERSH)
TO: Joe W. Seabrook (SEABROOK)
TO: Gary R. Shumate (SHUMATE)
TO: David W. Townsend (TOWNSENDDW)
TO: Franklin L. Wilton OBC-14N (WILTON)
TO: Gerald G. Baker (BAKERGG)
TO: Kelly J. Foster (FOSTERKJ)
TO: GERRY J. HAGEN (HAGENGJ)
TO: TIM D. LOW (LOWTD)
TO: GARY T. MUELLER (MUELLERGT)

1992 PER MILE LINE COSTS W/OH

The following is a summary of 1992 line construction costs including administrative overhead. Abbreviation conventions are:

- NC = New Construction
- RC = Reconductor only
- RIRC = Reinsulate and ReConductor
- RIRC25% = Reinsulate, ReConductor, replace 25% of the structures
- RIRC50% = Reinsulate, ReConductor, replace 50% of the structures
- SWP = Single Wood Pole
- HF = H-Frame
- HPA = Horizontal post insulators, standard phase spacing
- RHF = H-frame structure for use on restricted R/W
- UHF = H-frame structure for use on unrestricted R/W
- NAR = 1272 kCM Narcissus AAC conductor
- BIT = 1272 kCM Bittern ACSR conductor
- TRN = 795 kCM Tern ACSR conductor
- CHK = 397.5 kCM Chickadee ACSR conductor
- LAP = 1590 kCM Lapwing ACSR conductor

The costs include nominal amounts for clearing, surveying, and engineering, but exclude R/W, road work, and environmental costs. The structure "designation" noted below represents the structure type/structure configuration/conductor system. Level/rolling terrain, and normal (conventional) construction equipment and methods have been assumed.

DESIGNATION	VOLTAGE	NC	RC	RIRC	RIRC25%	RIRC50%
SWP/HPA/1TRN	115 kV	$173,600	$71,000	$87,600	$106,700	$125,800
SWP/HPA/1NAR	115 kV	$186,800	$85,100	$101,700	$120,800	$139,900
SWP/HPA/1NAR	230 kV	$202,800	$85,100	$117,700	$136,800	$155,900
SWP/HPA/1LAP	230 kV	$227,300	$105,500	$140,200	$160,100	$180,000
SWP/HPA/2CHK	230 kV	$206,300	$89,700	$122,300	$141,700	$161,100
SWP/HPA/2TRN	230 kV	$245,900	$119,200	$155,900	$176,900	$198,000
SWP/HPA/2NAR	230 kV	$279,500	$143,400	$184,200	$206,900	$229,500
HF/RHF/1BIT	230 kV	$202,000	$91,700	$112,100	$132,400	$152,700
HF/RHF/1LAP	230 kV	$226,400	$105,500	$129,300	$151,600	$174,000
HF/RHF/2CHK	230 kV	$197,300	$89,700	$110,100	$130,400	$150,700
HF/RHF/2TRN	230 kV	$249,200	$119,200	$146,400	$170,300	$195,200
HF/RHF/2BIT	230 kV	$308,000	$156,700	$190,700	$219,200	$247,700
HF/UHF/1BIT	230 kV	$192,000	$91,700	$98,000	$119,000	$140,000
HF/UHF/1LAP	230 kV	$214,800	$105,500	$112,900	$136,000	$159,200
HF/UHF/2CHK	230 kV	$187,300	$89,700	$96,000	$117,000	$138,000
HF/UHF/2TRN	230 kV	$235,900	$119,200	$127,600	$153,000	$178,300
HF/UHF/2BIT	230 kV	$291,400	$156,700	$167,200	$196,900	$226,600

Typical Adder Costs:

Environmental, $:	
minor impact	1,000 - 10,000
EAR	10,000 - 100,000
EIS	100,000 - 750,000
Right-of-Way, $/mi:	
20' overhang	10,000 - 40,000
100' urban	100,000 - 300,000
100' suburban	25,000 - 150,000
Road work, $/mi:	1,000 - 30,000

Rev. 3