FINAL

SEGMENTATION STUDY

June 1996

FINAL SEGMENTATION STUDY

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1. INTRODUCTION

1.1 Purpose

The purpose of this study is to classify the facilities of the FCRTS by the types of services they provide in order to derive the associated costs. The outcome of this study is the segmented FCRTS investment base and historical O&M expense for each segment. From these results, projected O&M, depreciation, and interest expenses and planned net revenues functionalized to transmission are associated with the segments to establish revenue requirements and the costs of the transmission services in BPA rate proposals.

This document is organized to facilitate the needs of readers interested in different degrees of detail. The text explains the theory and methodology used to segment the FCRTS and displays the results. The supporting data and analyses are documented in appendices.

This document contains two separate but related analyses. Appendix A segments the transmission facilities of BPA, the Corps, and the Bureau. Appendix B further divides the Network segment, developing the revenue requirements used to calculate the Formula Power Transmission rates. Within each appendix, historical plant-in-service is analyzed prior to data for future years (FYs 1997 through 2001).

The present final study follows the definitions and methodology used in the Segmentation Study of BPA's previous rate filings, in particular the segmentation study filed with BPA's supplemental proposal, WP-96-E-BPA-59, which incorporated BPA's supplemental proposal and reflected the elimination of the Fringe segment, slight changes to some segment definitions, and updated cost data. This Final study reflects changes that implement the "Transmission Rates and Terms and Conditions Settlement Agreement," WP-96-E-BPA-129, These changes are:

- Including the former Fringe facilities in the network;
- Combining Northern Intertie facilities costs in the Network;
- Including 34.5-kV utility delivery facilities in the Network.

In addition, investment costs have been updated to correspond with plant investment records as of September 30, 1995.

2. THE SEGMENTS

For rate-setting purposes, BPA allocates the rate period transmission revenue requirement to the various customer classes according to their projected use of the system. To ensure that the allocated costs correspond to the services provided, the facilities of the transmission system are divided among different categories of service (segments). Because the entire transmission system is not needed to provide each type of service, this method of cost allocation is more equitable than one that does not segment facilities and their associated costs.

The six FCRTS segments for this Study are defined below. This segmentation study covers only those facilities owned and operated by BPA and other Federal agencies.

2.1. Generation-Integration Segment

The Generation-Integration segment consists of all facilities that connect the Federal generating plants to the integrated BPA transmission network. The segment includes transmission lines and equipment between the generating plant step-up transformer (functionalized to generation) and the first BPA transmission system substation encountered by the generated power. Substation terminal equipment such as disconnect switches, circuit breakers, and lightning arresters is included in the segment.

2.2. Integrated Network Segment

The Integrated Network segment consists of the facilities that supply bulk power to the Delivery and Southern and Eastern Intertie segments and are 34.5 kV and above. In addition, consistent with the Settlement Agreements, the facilities formerly segmented to the Northern Intertie have been included in the Integrated Network segment. They are:

1. Two 500-kV lines between the Custer substation and the United States-Canadian border;
2. Fifty per cent of the cost of two 500-kV lines between Custer and Monroe substations; and
3. Two 230-kV lines from the Boundary Substation to the United States-Canadian border, including the associated substation facilities.

In its supplemental proposal BPA proposed to include costs of the Bellingham Reinforcement Project in the Northern Intertie segment. Consistent with the Settlement Agreement, those projected costs have been included in the Integrated Network.

These facilities integrate major system resources directly or in conjunction with either BPA's

Integrated Network facilities are allocated to all classes of service because they perform a transmission function for, and provide benefit to, all customer classes.

2.3. Intertie Segments

Two Intertie segments connect the U.S. Pacific Northwest power system to California and the Eastern Rocky Mountain areas. All BPA customers have access to transmission services on these segments.

2.4. Pacific Northwest-Southwest (Southern) Intertie Segment

This segment is a system of transmission lines which interconnect the PNW to California power systems at the Oregon border. The Southern Intertie consists of one 1000-kV direct-current line from the Celilo Converter Station at The Dalles, and a set of 500-kV alternating-current (A-C) lines originating in North Central Oregon. BPA owns most of the intertie facilities north of the California-Oregon and Nevada-Oregon borders except for:

1. One of the A-C lines (from Malin to Grizzly substation in central Oregon), and associated terminals owned by Portland General Electric Company; and
2. The Meridian-Captain Jack-Malin line and Summer Lake-Malin line owned by Pacific Power and Light Company. BPA has rights to use these facilities for intertie purposes.

The Southern Intertie segment includes the following major facilities:

1. The Celilo converter station;
2. The supply lines from John Day to Big Eddy to Celilo and associated substation facilities;
3. The two John Day-Grizzly lines and a Grizzly-Malin 500-kV line with associated terminal facilities;
4. Series compensation stations at Sycan, Fort Rock, and Sand Spring;
5. Fifty-seven percent of the Buckley-Summer Lake 500-kV line and associated substation facilities (the remaining 43 percent is allocated to Integrated Network. This allocation is based on past usage, which may change in future filings);
6. The braking resistor at Chief Joseph, used for Intertie stability control; and
7. The Third AC Intertie project facilities which consist of:
    a. Modifications to existing AC Intertie facilities;
    b. Existing facilities originally segmented to Network but currently dedicated to intertie use since commercial operation of the last 800 MW of the upgrade (One half of Marion-Alvey line and one quarter of Buckley-Marion line along with corresponding terminal facilities);
    c. Captain Jack Substation in Southern Oregon; and
    d. The one half of the new Alvey-Meridian 500-kV line and associated

For the most part, Intertie costs are recovered through application of the Southern Intertie transmission rate. BPA is being compensated for designated Third AC costs by non-Federal capacity owners in the form of an initial amount based on construction costs, followed by annual payments to cover operation and maintenance expenses as well as general plant and replacements costs.

2.5. Eastern Intertie Segment

The Eastern Intertie segment consists of the Garrison-Townsend 500 kV line and the associated substation facilities at Garrison. These facilities are used to integrate power generated at Colstrip and to transfer power to and from Montana. Most of the costs of this Intertie are recovered from the Montana Power Company and four Northwest IOUs which contracted for service on this line.

Delivery Segments

These consist primarily of substation facilities required to "step down" (reduce) from prevailing transmission voltages for delivery to customers at voltages below 34.5kV. They are near the points of delivery. They differ from Network in that they deliver power to a limited geographical area and serve one or two customers at the delivery point. Step-down transformers and associated switching and protection equipment constitute the primary facilities included in these segments.

These facilities are subdivided into three major groups: Utility Delivery, Industrial Delivery, and IOU Delivery. The facilities in each of these are substantially different in size and use. IOU facilities are combined with the Network segment. In addition to BPA owned facilities, the Delivery Segment includes costs incurred for leases and transfers to provide service equivalent to that provided by delivery service. However, these costs are not shown in the Segmentation Study.

2.6. Utility Delivery Segment

This segment consists of the facilities required to supply power at delivery voltages to BPA's public utility customers. These utilities have loads that vary during the year and have potential for growth. In addition to substation equipment, these facilities include a few short lines typically at 12.5 or 13.8-kV.

2.7. Industrial Delivery Segment

This Delivery segment consists of facilities required to supply BPA's industrial customers. They consist mostly of substations that reduce transmission voltage to supply voltage below 34.5-kV. This type of customer has a high load factor contributing to a high usage of the equipment. Their loads are large but there is an upper limit on the load served.

3. METHODOLOGY

BPA facilities are segmented on the basis of voltage and function. The final determination of segmentation of the network for this proceeding incorporates the Settlement Agreement proposal. The segmentation study developed in prior rate proceedings is the starting point for this Final Study. In order to identify the facilities and the associated costs that provide a specific type of service, the segmentation process was originally based on:

- Power flow studies, one-line diagrams and other technical data that indicate the operating voltage of each facility and type of service.
- Contracts and rate structure.
- Work orders under which each of the facilities were constructed, standard costing procedures and accounting principles; and standard utility business practices.

In determining the cost of each segment, the following sources were used:

- The accounting records maintained by BPA's Plant Investment Section;
- The equipment catalog from BPA's Division of Materials and Procurement;
- The cost studies of the Division of Substation and Control Engineering. These studies provide the cost breakdown for major equipment installations and indicate the relationship of equipment cost to the total cost, including installation and costs associated with specific accessory equipment that form integral units such as line terminals;
- Standard costing procedures and accounting principles; and
- Actual and forecasted data from the Corps and the Bureau

In applying segmentation criteria, reference is made to some of the technical and legal sources listed above. While Delivery is characterized by voltage and function, Interties are identified by contracts and function. The investment cost of each segmented facility is determined from accounting records. Some substation facilities are common to more than one segment. Their costs are divided among the major segments served from the substation. Segmented projections for the period FYs 1995-2001 were provided by the BPA Budget Group which correlated plant-in-service with engineering estimates .

Some powerhouse switchyard facilities (Corps and Bureau) are functionalized as transmission Normally, the step-up transformer is the interface between the generating source and the transmission system, and is functionalized as generation. Remaining facilities connecting generation plants to BPA network are segmented as if they are owned by BPA.

4. APPLICATION OF THE SEGMENTATION STUDY

BPA computes revenue requirements for each of the segments using the results of the Segmentation Study. The components of BPA transmission revenue requirements are:

1. Operation and Maintenance expenses;
2. Depreciation;
3. Net Interest; and
4. Planned Net Revenues.

In these computations BPA uses plant investment as of the middle of the fiscal year rather than the year-end costs developed in the Segmentation Study. The mid-year costs are calculated as the average of costs at the beginning and at the end of the year.

Forecasted operation and maintenance expenses are obtained from budget documents, and are segmented pro rata on the basis of the 3-year averages of historical operation and maintenance expenses for each segment. The O&M expenses for each transmission line and substation are obtained from the plant records for the latest 3 years for which data is available and then averaged. For example, the FY 1996 study uses data for FYs 1992, 1993 and 1994. Use of these historical 3-year averages minimizes potential biases resulting from scheduling or weather anomalies in a particular year.

The straight-line depreciation is computed by dividing investment by the corresponding service life in years. BPA's Depreciation Study provides equipment service lives and net salvage factors. The calculation of weighted average service lives (including net salvage) for substations, lines, and each of the general plant FERC accounts is shown in Chapter 5 of Revenue Requirement Documentation, Volume 1, WP-96-FS-BPA-02A. These adjusted service lives are used to compute depreciation on the basis of total investment for each of the segments at mid-year. The transmission portion of general plant depreciation is prorated to the segments according to their direct depreciation expense. These calculations are also in Chapter 5 of Revenue Requirement Documentation, Volume 1.

Net revenues and interest expense are segmented prorata on the basis of the remaining undepreciated investment, i.e., net plant in the various segments. Planned net revenues make up the excess of amortization over depreciation, and include amounts required to achieve the Administrator's risk mitigation policy.

5. RESULTS

The results of the segmentation analysis are contained in Tables A through D that follow. The individual line and substation investments as of September 30, 1995, displayed in the analysis are summarized in Table A-2. These investments are used to distribute the actual FY 1996 substation spares and accumulated depreciation in Table A-1. In Table A the forecasted additions (from Chapter 7) are added to the investment base to determine the BPA segmented plant investment through FY 2001.

The results of the segmentation analysis for the Corps and Bureau are summarized in Tables B and C, respectively.

The 3-year average of O&M for each segment is listed in Table D; these are used to calculate percentages for projected transmission O&M.

TABLE A-2

SUMMARY OF SEGMENTED INVESTMENT

As of September 30, 1995

($)

Segment	Abbreviation	A Transmission Lines	B Substations
Direct Service Industries Delivery	D	14,407	78,855,359
Generation Integration	G	15,027,572	37,667,194
Eastern Intertie	IE	97,890,965	22,535,334
Southern AC Intertie	ISAC	168,168,068	147,692,218
Southern DC Intertie	ISDC	29,095,036	282,733,425
Network	N	1,588,800,039	1,129,401,990
Utility Delivery	P	140,191	104,184,007
Total		1,899,136,278	1,803,069,527

Note: This is the investment in facilities which are described in chapters 1 and 2 of Appendix A.

TABLE D

SUMMARY OF SEGMENTED THREE-YEAR AVERAGE O&M 1/

For The Period 1992-1994
($)

Segment	Abbreviation	A Transmission Lines	B Substations
Direct Service Industries Delivery	D	796	6,079,775
Generation Integration	G	358,285	2,895,728
Eastern Intertie	IE	517,657	941,665
Southern AC Intertie	ISAC	1,305,876	6,359,838
Southern DC Intertie	ISDC	404,605	13,277,597
	13-14		
Network	N	36,749,538	74,484,214
Utility Delivery	P	15,388	8,197,718
Total O&M		39,352,146	112,628,704

1/ Column A is a summary of Appendix A, Chapter 4 and Column B is a summary of Appendix A, Chapter 5.

APPENDIX A

DOCUMENTATION

OF

TRANSMISSION SEGMENTATION STUDY

INTRODUCTION

The FCRTS is segmented according to the types of services provided by the specific facilities. The plans for service and the existing contracts provide the basis for classification. Each facility, as represented on system one-line diagrams, is assigned to one of the segments. Only those services constituting the significant use of the facilities are considered in this analysis; incidental services are ignored, as are emergency uses of the facilities. The cost of each facility is determined from accounting records, and the total investment of the segment is determined from the facilities it contains.

Chapters 1 and 2 of Appendix A list the investment as of September 30, 1995, for each BPA transmission line and substation in each segment. Some substations are divided among more than one segment. These substations are referred to as multisegmented substations. Chapter 3 of Appendix A delineates the relevant data and computations used to make this allocation among appropriate segments. The historic O&M expenses of the facilities for the latest 3 years for which data is available, i.e., FYs 1992 through 1994, are shown with their averages in Chapters 4 (lines) and 5 (substations) of Appendix A. Chapter 6 of Appendix A lists the facilities of the Corps and of the Bureau that are functionalized as transmission, including the proposed additions, replacements and betterments for the period FYs 1996 through 2001. Chapter 7 of Appendix A displays the proposed segmented additions to BPA facilities for the FYs 1996 through 2001.

APPENDIX A
CHAPTER 1

LINE INVESTMENT
BY SEGMENT
As of September 30, 1995

The following table shows investment costs of each transmission line as of September 30, 1995. Costs are from the plant investment records. With the exception of five multisegmented lines, each transmission line falls within a single segment.

The costs of these multisegmented lines have been split into segments as described at the end of this Chapter. The costs of the Buckley-Summer Lake line are allocated 57 percent to Southern Intertie and 43 percent to Network, which has remained unchanged from the 1985 rate filing. This allocation is based on its past usage and may change in future rate filing. Network lines transferred to the Southern Intertie after commercial operation of the second 800 MW upgrade to the AC Intertie system are listed at the end of the investment for Network segment. The implementation of the Transmission Agreement is also delineated under the Network Segment.

All BPA lines in FCRTS are listed on the following pages along with their cost. In some instances cost of one line may be combined with the cost of another. This is likely to happen where two lines are on the same set of towers or where the line is sectionalized and renamed.

APPENDIX A
CHAPTER 2
SUBSTATION INVESTMENT
BY SEGMENT
As of September 30, 1995

The cost of each segmented substation is provided in this chapter. Since a large number of major substations are utilized by more than a single type of service, they have been multisegmented as described in Chapter 3.

The cost data, as of September 30, 1995, are from the Plant Investment Records. When a substation is multisegmented, each segment includes only the costs associated with the substation facilities that provide the specified service.

Network substations transferred to the Southern Intertie upon commercial operation of the second 800 MW upgrade to the AC Intertie system are listed at the end of the investment for Network segment. The implementation of the Transmission Agreement is also delineated under the Network Segment.

APPENDIX A
CHAPTER 3

MULTISEGMENTED SUBSTATION INVESTMENT

Although most substations are assigned entirely to a single segment, the costs of a substantial number of substations have to be divided among two or more segments because of the variety of transmission services that they provide. This segmentation is based on an analysis of these services and the costs of the major pieces of equipment at these substations.

Major substation equipment items are transformers, power circuit breakers (PCBs) and reactive blocks. These items are identified from the multi-page Dispatcher Jurisdiction Diagram (DJD) and other documents such as the System Engineering Data Book, Materials & Procurement records, and the construction one-line diagrams. A DJD is used to distinguish different segments and indicates the allocation of a particular substation bay or terminal. The functional segment of the facility is determined from the identity of the customers served from those facilities, the requirements of the customers, and BPA's contractual obligations. Within BPA, organizations such as the Area Offices and the Divisions of System Engineering, System Operations, and Power Sales, were consulted to confirm the function served by the facilities.

For multisegmented substations, major equipment is identified by its tag number as well as by the specific function served (Section 3.4). The actual cost of each item is taken from plant investment records and the records of the Materials and Procurement Division. Using the cost studies developed by the Cost Estimating Staff of the Division of Substation and Control Engineering and the itemized records of the Plant Investment Section, the cost of the major equipment is computed. This includes the purchase cost as well as the costs of installation and of the associated subsidiary items, such as control and protection equipment and supporting structures (Section 3.3).

The costs of the common facilities in a substation are prorated among the various segments in the same proportion as the costs of the major equipment. This is done by an analysis that takes into consideration the costs of the major equipment and the total substation cost. The analysis then provides the total cost of each segment for that substation.

The results of segmenting the cost of substations serving more than a single class of customers are shown in Section 3.2. The procedure is summarized in Section 3.3.

APPENDIX A
CHAPTER 3

MULTISEGMENTED SUBSTATION INVESTMENT

SECTION 3.1
Investment & Equipment Costs

TABLE 3.1.1 Investment & Average cost of Circuit Breakers
TABLE 3.1.2 Number of PCB and Cost of transformers & Reactive

SECTION 3.2

Investment in Multi-segmented Substations by Segment
TABLE 3.2.1 Segmented costs

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CHAPTER 3

MULTISEGMENTED SUBSTATION INVESTMENT
SECTION 3.3
Cost Detail of Segments

Although BPA Plant Investment records list the material and labor costs of the individual items of equipment as well as the total investment for each substation, the cost of the facilities associated with a specific segment cannot always be read directly. The cost accounting and work order systems were not specifically designed to segregate costs for segmentation purposes. The cost studies of the Division of Substation and Control Engineering indicate that ratios relating the purchase price of the major equipment to the total installed costs generally fall within a narrow range for equipment in each class. These ratios have been rounded off as follows:

Major Equipment		Cost Ratio
Power Circuit Breakers	500-kV	3.65
	230-kV	3.76
	115-kV	4.14
	69-kV and under	4.54
Transformers (depending on location)		1.5-2.5
Reactive blocks		2.11

The results of applying these ratios to the major equipment costs are included in this section. Where specific ratios are known for a substation they are preferred to the averages.

The derivation of these ratios is explained in Section 3.5. The use of these ratios is illustrated here for the computation of the costs for Ashe Substation.

Network

Average cost of 230-kV PCB	$59,851	Table 3.1.1	
No. of PCBs in segment	x 3	Table 3.1.2	
			$179,553
Cost ratio for 230-kV PCB	x 3.76	Section 3.5	
Component cost for Breaker			$675,119
Average cost of 500-kV PCB	$489,309	Table 3.1.1	
No. of PCBs in segment	x 5	Table 3.1.2	
			$2,446,545
Cost ratio for 500-kV PCB	x 3.65	Section 3.5	
Component cost for Breaker			$8,929,890

Generation Integration			
Average cost of 230-kV PCB	$59,851	Table 3.1.1	
No. of PCBs in segment	x 2	Table 3.1.2	
			$119,702
Cost ratio for 230-kV PCB	x 3.76	Section 3.5	
Component cost for Breaker			$450,080
Average cost of 500-kV PCB	$489,309	Table 3.1.1	
No. of 500-kV PCB in segment	x 2	Table 3.1.2	
Cost ratio for 500 kV PCB	x 3.65	Section 3.5	
Component cost for 500-kV PCB			$3,571,956
Major component cost (Gen Integration)		Table 3.2.1	$4,022,035
Major component cost for substation		Table 3.2.1	$18,368,214

The investment by segment (on page A44) is obtained by prorating the total investment at Ashe according to the major component costs shown above.

This method is not used to segment Buckley, Summer Lake, Malin, and Garrison Intertie Substations. When actual costs are available for segments, as for Garrison and Malin substations, they have been used directly from the plant investment records. The costs for Buckley and Summer Lake substations are allocated 57 per cent to the Southern Intertie and the rest to Network segment as indicated earlier in this document.

APPENDIX A
CHAPTER 3

MULTISEGMENTED SUBSTATION INVESTMENT

SECTION 3.4

List of Major Equipment
As of September 30, 1995

Major equipment at each substation is identified by tag number and segmented according to the transmission service provided. The actual cost of each item is taken from the records of BPA's Plant Investment Section and Materials and Procurement Division.

Costs are further adjusted for substations where significant but partial replacements have taken place or special equipment such as PCBs with high amperage or high-speed closing are installed. These adjustments are based on the knowledge of BPA substations, equipment requirements, and engineering judgment, and are indicated where applicable. In some instances equipment costs are not available because items are too new, or have been reconditioned or purchased as part of a group. Some of these costs may be available in the future and therefore they are listed as unavailable or space is left blank.

The data is listed in two sets: the first one pertaining to multi-segmented Network substations and the second to Network substations which are not segmented.

APPENDIX A
CHAPTER 3

MULTISEGMENTED SUBSTATION INVESTMENT
SECTION 3.5
Cost Ratios for Segmenting Process

In the Segmentation Study the costs of facilities are obtained directly from the Plant Investment Records. Where a substation is used for more than one segment, the costs must be allocated to the different segments on the basis of the use of the major equipment such as power circuit-breakers, transformers, and reactive blocks. The total installed cost obtained from the accounting records is related to each of these components by multiplying the purchase price by an appropriate constant.

This constant includes costs of installation, protection, and a variety of accessories required for the functioning of a major power system component, such as a power circuit breaker. Because the accounting records do not aggregate the costs of these incidental items by major components, their costs must be allocated by means of ratios. These ratios represent the relationship of the total installed cost associated with a major component and its accessories, to the purchase price of the component itself.

The accumulated costs listed in the Plant Investment records do not directly address the segmentation criteria. For example, the installation of a 500-kV/230-kV transformer may require the replacement of most 230-kV power circuit breakers in a substation if the fault-current rating of the existing circuit breakers is exceeded. Although the addition of the transformer might result from an increase in the load of a specific service, it would not be equitable to assign all the costs to the service that triggered the change because all services utilizing the transformer and the new switchgear would benefit from the addition. The employed procedure assigns the cost of terminals on the basis of the costs of the switchgear.

Bulk purchase of items, as well as the common use of some of the facilities, complicates the distribution of recorded costs. Some materials, such as insulators, are purchased in bulk and then used in more than a single substation. Since some of the substation facilities are used in common by more than one type of customer, their costs have to be prorated.

The constants (ratios) representing the normal cost of installing a major component and rendering it operational, as compared to its purchase price, are obtained from a study of the cost estimates prepared by the Division of Substation and Control Engineering. All the cost estimates available in the files of that Division were analyzed and the ratios of the total installed cost of the functional unit to the purchase price of the principal components were computed and averaged. These results

The transmission facilities of BPA have been installed over a period of time starting from about 1940. Available data for this interval has been used in computing the averages.

In our allocation of the substation costs, these cost ratios have been rounded off as follows:

500-kV terminals w/power circuit breakers 3.65
230-kV terminals w/power circuit breakers 3.76
115-kV terminals w/power circuit breakers 4.14
69 kV or lower voltage terminals w/ power circuit breakers 4.54
Transformers (depending on location) 1.5-2.5
Reactive blocks (capacitive or inductive) 2.11

In many instances circuit breakers have been replaced to obtain higher interrupting capacity or significantly higher current capacity. Knowledge of BPA's system is required for proper use of these factors. If most of the switchgear and buswork remains substantially unchanged then the factor should be altered to reflect the real situation. For terminals that do not include circuit breakers, cost is half of what it would be if a circuit breaker were present.

There is a wide variation in the sizes, purchase prices, voltage ranges and installation conditions for transformers at different substations. Based on the professional judgment of Substation and Control Engineers, a range of cost ratios varying between 1.5 and 2.5 is used depending on specific conditions at individual locations. The higher ratio is suitable for installations with a single transformer whereas those with a series of banks of uniform size indicate lower ratios.

APPENDIX A
CHAPTER 4

LINE O&M BY SEGMENT
FYs 1992 Through 1994 and 3-Year Average

The O&M costs for the FYs 1992 through 1994 are listed for each transmission line. The average of the 3 years is also computed for each of the lines. If a line did not exist for all 3 years, the average is computed on the basis of the years during which the substation existed.

For lines falling in more than a single segment, the 3-year average is calculated prior to segmenting. The lines in this class are listed at the end of the chapter.

O&M costs for Northern Intertie and 34.5-kV Utility Delivery facilities transferred to Network for this rate case are shown under Network, as are the costs of Network facilities now associated with the Southern AC Intertie.

APPENDIX A
CHAPTER 5

SUBSTATION O&M BY SEGMENT
FYs 1992 Through 1994 and 3-Year Average

The O&M costs of the substations for 1992, 1993, and 1994 are listed in this section. The 3-year average is also listed for each substation. If a substation did not exist for all 3 years, the average is computed on the basis of the years during which it existed.

Several major substations serve more than a single class of customers. For these stations, the 3 year average is computed prior to segmentation. The O&M costs are segmented on the same basis as the investment in Chapter 3. The multisegmented substations are listed in Section B of this chapter.

These costs are not used directly in the computation of revenue requirements. They provide a basis for segmenting the O&M for the rate test period as described in Chapter 2 of the Documentation of the Revenue Requirement Study, Volume 1, WP-96-FS-BPA-02A.

O&M costs for Northern Intertie, IOU delivery facilities and 34.5-kV Utility Delivery facilities transferred to Network for this rate case are shown under Network, as are the costs of Network facilities now associated with the Southern AC Intertie.

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CHAPTER 5

SUBSTATION O&M BY SEGMENT
SECTION 5.1
FYs 1992 Through 1994 and 3-Year Average O & M

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SUBSTATION O&M BY SEGMENT
SECTION 5.2
FYs 1992 Through 1994 O&M for Multisegmented Substations

APPENDIX A
CHAPTER 6

CORPS AND BUREAU TRANSMISSION ADDITIONS

Some powerhouse switchyard facilities (Corps and Bureau) are functionalized as transmission. Normally, the step-up transformer is the interface between the generating source and the transmission system and is functionalized as generation. If the switchyard has a significant amount of high-voltage switching equipment on the high side of the transformer and there are lines going directly to a load center rather than to a BPA Generation-Integration substation, the pertinent facilities are functionalized to transmission and subsequently segmented.

The Corps and the Bureau supply the information on the transmission facilities in their switchyards. These facilities are segmented on the basis of their use as in the Segmentation Study for the previous rate filings.

This chapter contains the latest cost information received from the Corps and Bureau.

CORPS OF ENGINEERS
ADDITIONS TO TRANSMISSION FACILITIES
FYs 1996-2001
($000)

No additions to transmission facilities have been projected for this period.

BUREAU OF RECLAMATION
ADDITIONS TO TRANSMISSION FACILITIES
FYs 1996-2001
($000)

No additions to transmission facilities have been projected for this period.

APPENDIX A
CHAPTER 7
PROPOSED FYs 1996 THROUGH 2002 SYSTEM ADDITIONS

Plant-in-service additions for FYs 1996 through 2001 are shown in the following Tables. These forecasts are provided by BPA program offices, consistent with the capital obligations in BPA's Draft Business Plan. The program offices indicate the energization dates and segmentation of proposed plant additions. The forecasted additions receive loadings and AFUDC. Final plant-in-service is shown in the following table. Segmented figures are in the subsequent table.

APPENDIX B

SUBSEGMENTATION OF THE INTEGRATED NETWORK

Purpose

For general ratemaking purposes the FCRTS is divided into segments. To develop the FPT rates, which are charges for transmission services over specified paths of integrated network, the Network segment is further divided into subsegments. The types of equipment that perform these transmission services constitute the subsegments. From the associated costs of the major equipment, the components of the Network revenue requirement in the rate period are subsegmented providing the cost base for transmission rate design.

Methodology

The subsegments are composed of the major equipment that perform the specific transmission functions. These services are classified in terms of the voltage range of the facilities: the Main Grid, which includes all facilities in the 500 kV and 230 kV voltage classes, and the Secondary System, composed of facilities below 230-kV and above 34.5-kV. This methodology has not changed from earlier filings going back to 1985.

The cost of each subsegment is identified from the major equipment and associated facilities included therein. The subsegments are identified as follows:

A. Main Grid

1. 500 kV lines.
2. 500 kV reactive, including shunt reactors, series and shunt capacitors.
3. 500/230 kV transformation.
4. 500 kV line terminals, which are located at the generation and load ends. Power is assumed to enter or leave the 500 kV system at these terminals.
5. 500 kV switching terminals for lines that merely connect two 500 kV substations. These terminals divide long lines into sections to improve reliability and operating characteristics.
6. Transmission lines operating at 230, 287, or 345 kV.
7. Reactive operating at voltages between 230 kV and 345 kV, including all series and shunt components. Since the 345 kV lines are switched at 230 kV, the 230/345 kV transformers are in this category.
8. 230 kV line terminals, where power enters or leaves the 230 kV system.
9. 230 kV switching terminals, which sectionalize long lines that connect 230 kV substations. The lines emanating from these terminals are not connected to loads nor are they entry points for generation.
10. 230 kV inter-connection terminals are BPA terminals on lines owned totally or partially by customers.

B. Secondary System

1. Secondary system lines are primarily115 kV and 69 kV;

For the FPT rates the line terminal function at a substation must be differentiated from the switching function. This requires a careful analysis of line diagrams as well as engineering judgment where both kinds of terminals are found. Where power enters or leaves the system, the terminals are classified as line terminals. The terminals that sectionalize a line by looping it through a substation along its path for improved reliability are classified as switching terminals. At the substations, terminals with loads are classified as line terminals while those without loads are classified as switching ones. At substations without loads or generation, all terminals are classified as switching.

Northern Intertie facilities have been included in the subsegmentation, but not the IOU facilities or 34.5-kV ones because the latter are not covered by FPT rates.

Application of Methodology

Subsegmentation essentially utilizes the procedures for segmentation described in the body of this Study. In order to identify the specific facilities involved in the relevant transmission services on the Network segment and determine the associated costs, subsegmentation is based on:

A. power flow studies and one-line diagrams that indicate the power flowing through each facility and its "causation" (destination);
B. contracts and rate structures;
C. work orders under which each of the facilities were constructed;
D. standard costing procedures and accounting principles; and
E. utility business practices.

In determining the investment cost of each subsegment, the following sources were used:

A. The accounting records maintained by the Plant Investment Section;
B. The equipment catalog from the Division of Materials and Procurement;
C. The cost studies of the Division of Substation and Control Engineering. These studies provide the cost breakdown for major equipment installations and indicate the relationship of equipment cost to the total cost, including installation and costs associated with specific accessory equipment that forms such integral units as line terminals.

In order to subsegment the integrated Network, the plans of service and existing contracts are examined to determine the types of services provided by specific facilities. Each facility is analyzed using the system one-line diagrams in conjunction with the power flow studies to assign it to the proper voltage class and subsegment. Only those services constituting the significant uses of the facilities are considered; incidental services are ignored, as are any emergency uses of the facilities. The investment in each subsegment is then determined from the accounting records and the application of cost factors.

LINES 1-17: Identify the costs of the Main Grid.

LINES 18-24: Identify the costs of the Secondary System.

LINES 3, 11, and 20: Reactive facilities compensate for the line reactances and are therefore combined with the line when the line costs are calculated.

COLUMN A: The average net plant investment.

COLUMN B: The allocated average net transmission general plant, based on net plant.

COLUMN C: COLUMN A + COLUMN B.

COLUMN D: The annual costs (operation, maintenance, and depreciation expenses) for BPA, Corps, and Bureau.

COLUMN E: The allocation of the Net Operating Revenues (net interest expense and planned net revenues), which is based on the total net transmission plant (COLUMN C).

COLUMN F: The Revenue Credits are from The Wholesale Power Rate Development Study, WP-96-FS-BPA-05.

COLUMN G: The Total Network Revenue Requirement is composed of Annual Costs (COLUMN D) + Net Operating Revenues (NOR) (COLUMN E) + Revenue Credits (COLUMN F).

CHAPTER 8

Lines and Substation Investment

Table 1

Table 1 lists the Network lines and substation investments as of September 30, 1995, which are taken from Chapters 1 and 2 of the Segmentation Study. Sections A and B list the lines investment for the Main Grid, and Section C lists the lines investment for the Secondary System. Line investments are subsegmented by voltage. Substation investments are displayed in Section D and are subsegmented in Chapter 9 of this appendix.

CHAPTER 9

Subsegmented Substation Costs

Table 2 Lists the major equipment categories and the direct costs of the major equipment in each substation.

Table 3 Identifies the number of circuit terminals in each substation for the three voltage classes, classified by their function in the transmission of power.

Table 4 Lists the total cost of each substation in each subsegment by voltage class. Page 3 of each section contains the grand totals of subsegmented costs for that voltage class.

Also contained in this section is an example for using Tables 2 through 4.

Table 2

Major Equipment and Direct Costs

This table apportions all substation investments in the Network Segment among the following major equipment categories

1. Reactive Blocks
2. Transformers
3. Power Circuit Breakers (PCB)

Sections A through C of this table show the component cost data and factors and the calculated major equipment costs in the 500 kV (Section A), 230 kV (Section B), and 115 kV (Section C) voltage classes.

Although BPA's accounting records list the material and labor costs of individual items and the total investment of each substation, the current cost accounting system was not designed to associate costs for segmentation or subsegmentation purposes. Consequently, the costs of associated facilities such as structures, switches and protective equipment, which are necessary for the major equipment to operate as designed, are not designated in a manner that allows direct identification for these purposes. Some procedure is necessary, therefore, to factor these costs into the major equipment costs. Analysis of the cost studies of the Division of Substation and Control Engineering indicate that the ratios relating the purchase price of the major equipment to the total installed costs generally fall within a narrow range for equipment in each class. These ratios are the cost factors shown on page 55 of Appendix A. They are used to derive installed costs of the components whose purchase costs are listed in Columns A, C, and D in Sections A and B, and in Columns A, C, D, E1, E2, and E3 in Section C.

The reactive and transformer costs listed there represent the purchased cost of equipment, while the PCB costs are averages for the voltage class at the particular substation. (This is documented in the Segmentation Study, Section 3.3. Data is extracted from Section 3.4 for multisegmented substations.)

Columns F through H (as well as Columns H1 and H2 in Section C) are the costs computed by multiplying the unit cost by the cost factor (for PCBs the additional multiplier accounts for the number of PCBs as well). These computed costs on Table 2 are referred to as direct costs. In the few substations where terminals exist without circuit breakers, the computational procedure requires the assumption of an appropriate circuit breaker cost. The difference between the total Network costs in the particular voltage class, listed in Column I and the total of the direct costs is

Table 3

Circuit Terminals and Unit Costs

In this table the substation circuit terminals are listed by voltage class (Sections A through C) where they are classified according to their function in the transmission of power (reactive, line, switching, inter-connection or transformer).

The unit cost of circuit terminals is computed by dividing the total direct costs of the PCBs (from last column of Table 2) by the total number of terminals in Table 3.

The costs of transformation and reactive support include those of the connected terminals. Transformation may be accompanied by circuit terminals in two voltage classes.

Table 4

Cost by Subsegment

The total costs of each substation for each subsegment are displayed by voltage class in Sections A through C of this table.

For line, switching and delivery terminals, the total cost is found by multiplying the unit cost by the number of terminals performing that function (from Table 3).

Since the costs of transformation and reactive support include the connected terminals, the total costs for these items are found by multiplying the unit cost by the number of terminals performing that function (as above) and adding the result to the total direct costs for these items (Table 2). In addition, transformation includes the cost of associated terminals from the next lower voltage class.

The grand totals on page 3 of each section are the historical subsegment investments in each voltage class used in the remainder of this study.

Example For Using Tables 2 through 4

Tables 2 through 4 can be illustrated using Hot Springs substation and the 500 kV system (Section A of each table), although the process is similar for all substations and the 230 kV (Section B) and 115 kV (Section C) systems. The letters in the following example refer to the columns.

Table 2A:

F = A x B = Direct cost associated with transformer and its accessory equipment in this voltage range: Section A for 500 kV, Section B for 230-345 kV and Section C for the secondary part (115 & 69 kV).

G = C x 2.11(factor for reactive, page A55) = Direct cost associated with reactive and its accessory equipment in this voltage range.

H = D x E x (Factor for 500-kV PCB on page A55) = Direct cost associated with circuit breaker and its accessory equipment in this voltage range.

K = ((F + G + H)/(F + G + H + Section B: F + G + H + Section C: F + G + H)) x Hot Springs investment in Table 1, Section D.

For Hot Springs the only direct costs outside Section A are in Section B, Column J. The total cost of the network portion of Hot Springs is prorated between each of the voltage ranges on the basis of costs associated with transformers, reactive and power circuit breakers in each voltage range.

J = F + (F/(F + G + H) x K) = Cost prorated to transformers in this voltage range.

K = G + (G/(F + G + H) x K) = Cost prorated to reactive in this voltage range.

L = H + (h/(F + G + H) x K) = Cost prorated to power circuit breakers in this voltage range

Table 3:

Q = M + N + O+P= Total number of terminals in this voltage range.

R = L / Q = Average cost per terminal in this voltage range.

Table 4

AA = O x R = Cost of switching terminals in this voltage range.

AB = P x R = Cost of line terminals in this voltage range

AC of Section A = J of Section A + (M x R) of Section A + [M x R] of Section B = Cost of 500 kV transformer and its terminals on the high and low sides.

AD = K + (N x R) = Cost of 500 kV reactive and its terminal.

CHAPTER 10

Forecasted Network Plant Investment by Voltage Class

Table 5 Displays Subsegmented Network additions for lines and substations.

Table 6 Summarizes the investment data developed in Tables 1 through 5.

Table 5

Subsegmented Network Line and Substation Additions

Table 5 lists the subsegmented substation additions in the Network for FYs 1997 through 2001.

Table 6

Subsegmented Network Investment Summary

Table 6 summarizes the investment data developed in Tables 1 through 5. The projected additions are added to the historical investment base to obtain the cumulative investments for FYs 1996 through 2001.

Line investments in Column A, lines 2, 10, and 19 of this table, are from the September 30, 1995 totals in Table 1, Sections A through C. The projected lines additions are from Table 5.

The historical investments for the substation subsegments are from the total line in each section of Table 4. The additions for these subsegments are from Table 5. Transformation investments (lines 8 and 17) are adjusted to include the cost of emergency spares and portable substations allocated to Network, as identified in Table A-1 of the Segmentation Study.

The Corps and Bureau historical investments (from Segmentation Study, Tables B and C) are directly assigned to the voltage classes. The additions are allocated from these investments. Corps and Bureau data are found in this table on lines 6, 14, and 23.

CHAPTER 11

Subsegmented Annual Expenses and Obligations

Tables 7 through 11 incorporate the data from Tables 1 through 6 to develop the subsegmented rate proposal costs for test years FYs 1997 and 2001

Table 7 Calculates average net plant and subsegments the general plant.

Table 8 Lists the 3 year average of O&M for lines and substations.

Table 9 Lists the percent of each substation's total Network investment that is found in each subsegment.

Table 10 Allocates each substation's average O&M to the subsegments by the percentages in Table 9, then calculates the ratios for the subsegments in each voltage class from the grand totals.

Table 11 Allocates the test years' annual costs by subsegment.

Table 12 The subsegmented Network revenue requirements, includes a summarization of Tables 8 and 11 with the allocation of the Network Net Operating Revenues to the subsegments and the distribution of the Network Revenue Credits. The results for FYs 1997 and 2001 were averaged for use in TRDS Table 2.

Table 7

Subsegmented Network Investment Base And General Plant Allocation

Column C of Table 7 is the average of the cumulative gross investments (from Table 6, Columns E and G) in Column A and Column B.

Column F is the average of the accumulated depreciation in Column D and E. The accumulated depreciation (from Chapter 5 of Documentation For Revenue Requirement Study, Volume 1, WP-96-FS-BPA-02A, is prorated to the subsegments based on their average gross investment for the particular year.

Column G is the Average Net Plant, the difference between Columns C and F. It comprises Column A of Table 12.

Column H is the subsegmented Network General Plant (from Chapter 2 of Volume 1 of Documentation For Revenue Requirement Study, WP-96-FS-BPA-02A, allocated on the basis of the corresponding Net Plant in Column G.

Table 8

3-Year Average of Network O & M

This table consists of the 3-year averages of historical O&M. Sections A-C list data for lines by voltage class, and Section D lists the data for substations. These figures are taken from the Segmentation Study, Chapters 4 and 5.

Table 9

Ratios Of Subsegmented Network Substation Investment

This table calculates the percent of each substation's total Network investment that is found in each subsegment of each voltage class. The total Network investments are from Table 1, Section D; subsegmented investments are from Table 4.

Table 10

Subsegmented Network Substation O & M

In Table 10 the percentages from Table 9 are used to allocate each substation's 3-year average O&M (from Section D of Table 8) to the subsegments. From the total O&M in each subsegment, the percent in relation to the total Network O&M is found.

Table 11
Subsegmentation of Network Annual Costs
From Documentation for Revenue Requirement Study, Volume 1, chapter 2,WP-96-FS-BPA-02A.

O&M

In Columns C and D of Table 11 (page 2) the Network lines O&M is allocated to lines by the percentages (Column B) of 3-year average historical O&M for voltage class (Column A) from the lines Summary from Table 9.

In Columns F and G the total BPA Network substation O&M is allocated to the subsegments by the percentages in Column E (from Table 9). Corps/Bureau O&M is prorated by the ratio of average gross investment for Corps/Bureau facilities (Table 6, C-6, 14, and 23).

Depreciation

In Columns B and E of page 1 the Network lines depreciation is prorated on the basis of average gross investment from lines (Table 6, C-2, 10, and 19).

The depreciation for Corps and Bureau Network substations is prorated on the basis of the average gross investment for Corps and Bureau facilities (Table 6). BPA Network substation depreciation is prorated on the basis of the average gross investment of the remaining substations in Table 6.

In Columns A and D the total annual costs (sum of Columns B-E) comprise Column D.

Table 12

Subsegmented Network Revenue Requirement

In Table 12 net plant (Column A) and the allocated General Plant (Column B) are combined in Column C as the basis for allocating Net Operating Revenues (NOR) for Network. The NOR consists of the net interest expense and the planned net revenues from the transmission revenue requirements that have been segmented to Network. The annual costs (Column D) are from Table 11. The Network Revenue Credits are allocated to the relevant subsegments in Column F. The Total (Column G) is the sum of the annual costs and the net operating revenues less the Revenue Credits. An average of pages 1 through 5 is incorporated into the TRDS, WP-96-FS-BPA-06, as Table 2.

The purpose of this study is to classify the facilities of the FCRTS by the types of services they provide in order to derive the associated costs. The outcome of this study is the segmented FCRTS investment base and historical O&M expense for each segment. From these results, projected O&M, depreciation, and interest expenses and planned net revenues functionalized to transmission are associated with the segments to establish revenue requirements and the costs of the transmission services in BPA rate proposals.

This document is organized to facilitate the needs of readers interested in different degrees of detail. The text explains the theory and methodology used to segment the FCRTS and displays the results. The supporting data and analyses are documented in appendices.

This document contains two separate but related analyses. Appendix A segments the transmission facilities of BPA, the Corps, and the Bureau. Appendix B further divides the Network segment, developing the revenue requirements used to calculate the Formula Power Transmission rates. Within each appendix, historical plant-in-service is analyzed prior to data for future years (FYs 1997 through 2001).

The present supplemental study follows the definitions and methodology used in the Segmentation Study of BPA's previous rate filings, in particular the segmentation study filed with BPA's supplemental proposal, WP-96-E-BPA-59. That supplemental segmentation study included changes described in BPA's testimony, WP-96-E-BPA-28, such as elimination of the Fringe segment, slight changes to some segment definitions, and updated cost data.. This study incorporates changes required to be compatible with "Transmission Rates and Terms and Conditions Settlement agreement." These changes are:

1. Combining Northern Intertie Segment costs with those of Network;
2. Inclusion of 34.5-kV utility delivery facilities in the Network cluster; and

In addition,

3. Investment costs have been updated to correspond with plant investment records as of September 30, 1995;
4. Projected plant additions cover the period FYs1996-2001; and
5. This study corresponds to Revenue Requirement Study and other documents related to the Final Proposal.

2. THE EIGHT SEGMENTS

For rate-setting purposes, BPA allocates the rate period transmission revenue requirement to the various customer classes according to their projected use of the system. To ensure that the allocated costs correspond to the services provided, the facilities of the transmission system are divided among eight categories of service (segments). Because the entire transmission system is not needed to provide each type of service, this method of cost allocation is more equitable than one that does not segment facilities and their associated costs.

The eight FCRTS segments are defined below. This revised segmentation study continues to use the same methodology as in previous studies. As before, it covers only those facilities owned and operated by the Federal Columbia River Transmission System.

This Supplemental Study updates the Revised Segmentation Study WP-96-E-BPA-40 by reflecting reduced program levels. Corrections consistent with errata have been made except for Dworshak and Minidoka in Tables B and C. These latter two will be corrected in the Final Proposal as it was too late for inclusion in the Supplemental.

The Revised Study incorporated the following changes to the initial proposal Segmentation Study, WP-96-E-BPA-03, presented in June 1995:

1. Redefinition of network and delivery segments and elimination of Fringe segment.

2. Update of cost figures for transmission plant to reflect the status as of September 30, 1994.

3. Correction of substation lists to eliminate facilities that are no longer part of the Transmission plant.

4. Revision of the definition of the Northern intertie segment.

2.1. Generation-Integration

The Generation-Integration segment consists of all facilities that connect the Federal generating plants to the integrated BPA transmission network. The segment includes transmission lines and equipment between the generating plant step-up transformer (functionalized to generation) and the first BPA transmission system substation encountered by the generated power. Substation terminal equipment such as disconnect switches, circuit breakers, and lightning arresters is included in the segment.

These facilities consist almost entirely of lines and equipment at voltages from 34.5-kV to 500-kV owned and operated by BPA. A few facilities owned by the Corps of Engineers and the Bureau of Reclamation are also included. Costs incurred by BPA to deliver power to its customers who are not directly connected to BPA system fall into this segment, but are not covered in the Segmentation Study. BPA does not own these facilities, but pays through leases and transfer agreements.

Integrated Network facilities are allocated to all classes of service because they perform a transmission function for, and provide benefit to, all customer classes.

2.3. Intertie Segments

Three Intertie segments connect the U.S. Pacific Northwest power system to California, Canada, and Eastern Rocky Mountain areas: All BPA customers have access to transmission services on these segments.

2.4. Pacific Northwest-Southwest (Southern) Intertie

This segment is a system of transmission lines which interconnect the PNW to California power systems at the Oregon border. The Southern intertie consists of one 1000-kV direct-current line from the Celilo Converter Station at The Dalles, and a set of 500-kV alternating-current (A-C) lines originating in North Central Oregon. BPA owns most of the intertie facilities north of the California-Oregon and Nevada-Oregon borders except for:

1. One of the A-C lines (from Malin to Grizzly substation in central Oregon), and associated terminals owned by Portland General Electric Company; and
2. The Meridian-Captain Jack-Malin line and Summer Lake-Malin line owned by Pacific Power and Light Company. BPA has rights to use these facilities for intertie purposes.

The Southern Intertie segment includes the following major facilities:

1. The Celilo converter station;
2. The supply lines from John Day to Big Eddy to Celilo and associated substation facilities;
3. The two John Day-Grizzly lines and a Grizzly-Malin 500-kV line with associated terminal facilities;
4. Series compensation stations at Sycan, Fort Rock, and Sand Spring;
5. Fifty-seven percent of the Buckley-Summer Lake 500-kV line and associated substation facilities (the remaining 43 percent is allocated to Integrated Network. This allocation is based on past usage, which may change in future filings);
6. The braking resistor at Chief Joseph, used for Intertie stability control; and
7. The Third AC Intertie project facilities which consist of:

The Southern Intertie is used by BPA, the Bureau, and private and public utilities in the PNW and PSW to realize benefits from regional diversity and for flexibility to mitigate damage to fish runs. These uses include:

1. Sales of surplus power and surplus firm capacity for use in the Southwest;
2. Exchange of power and energy; and
3. Power transfers to benefit scheduled maintenance and emergency outage service.

For the most part, Intertie costs are recovered as through application of the Southern Intertie transmission rate. BPA is being compensated for designated Third AC costs by non-Federal capacity owners in the form of an initial amount based on construction costs, followed by annual payments to cover operation and maintenance expenses as well as general plant and replacements costs.

2.5. Northern Intertie

The Northern Intertie segment consists of:

1. Two 500-kV lines between the Custer substation and the United States-Canadian border;
2. Fifty per cent of the cost of two 500-kV lines between Custer and Monroe substations; and
3. Two 230-kV lines from the Boundary Substation to the United States-Canadian border, including the associated substation facilities.

In prior Segmentation Studies, only one of the two 500-kV lines between Monroe and Custer substation was included in the Northern Intertie. This revised segmentation study reflects BPA's proposal to include 50 percent of the cost of both lines in the Northern Intertie, leaving the remaining cost in Network.

The Northern Intertie provides for better coordination between the systems of the PNW and Canada. Its uses include sales and exchanges of power and power transfers during scheduled maintenance and emergency outages. Northern intertie costs are recovered from users of the intertie, including Northwest and Canadian utilities.

2.6. Eastern Intertie

The Eastern Intertie segment consists of the Garrison-Townsend 500 kV line and the associated substation facilities at Garrison. These facilities are used to integrate power generated at Colstrip and to transfer power to and from Montana. Most of the costs of this Intertie are recovered from the Montana Power Company and four Northwest IOUs which contracted for service on this line.

Delivery Segments

These consist primarily of substation facilities required to "step down" (reduce) from prevailing transmission voltages for delivery to customers at 34.5-kV or lower voltages. They are near the points of delivery. They differ from Network in that they deliver power to a limited geographical area and serve one or two customers at the delivery point. . Step-down transformers and associated switching and protection equipment constitute the primary facilities included in these segments. In the definition of delivery segments the sole criterion is the voltage level, the rest of the explanation is merely elaboration of some of the descriptive features of these facilities.
These facilities are subdivided into three major segments: Utility Delivery, Industrial Delivery, and IOU Delivery. The facilities in each of these are substantially different in size and use. In addition to BPA owned facilities, the Delivery Segment includes costs incurred for leases and transfers to provide service equivalent to that provided by delivery service. However, these costs are not shown in the Segmentation Study.

2.7. Utility Delivery

This segment consists of the facilities required to supply power at delivery voltages to BPA's public utility customers. These utilities have loads that vary during the year and have potential for growth.. In addition to substation equipment, these facilities include a few short lines typically at 12.5 or 13.8-kV.

2.8. Industrial Delivery

This Delivery segment consists of facilities required to supply BPA's industrial customers. They consist mostly of substations that reduce transmission voltage to supply voltage at 34.5-kV or at lower voltages. This type of customer has a high load factor contributing to a high usage of the equipment. Their loads are large but there is an upper limit on the load served.

2.9. Investor-Owned Utility (IOU) Delivery

The IOU Delivery segment consists of facilities that supply power at delivery voltages to BPA's IOU customers. These facilities consist almost exclusively of substation equipment. Very few substations are in this segment. These costs are later merged with Network.

3. METHODOLOGY

BPA facilities are segmented on the basis of voltage and function. Where in previous rate cases, BPA had identified and segmented costs based on the primary use of the facilities, using information described below, the determination of segmentation of network for this proceeding is governed by the fact that under the comparability principles, all of BPA's network will be available for wheeling, except those portions that continue to be identified as delivery facilities. BPA has proposed to define delivery facilities as facilities that deliver power at or below 34.5 kV. BPA resegmented fringe and delivery facilities using the segmentation study as it has been developed in prior rate proceedings as the starting point. In order to identify the facilities and the associated costs that provide a specific type of service, the segmentation process was originally based on:

- Power flow studies, one-line diagrams and other technical data that indicate the operating voltage of each facility and type of service.
- Contracts and rate structure.
- Work orders under which each of the facilities were constructed, standard costing procedures and accounting principles; and standard utility business practices.

In determining the cost of each segment, the following sources were used:

- The accounting records maintained by BPA's Plant Investment Section;
- The equipment catalog from BPA's Division of Materials and Procurement;
- The cost studies of the Division of Substation and Control Engineering. These studies provide the cost breakdown for major equipment installations and indicate the relationship of equipment cost to the total cost, including installation and costs associated with specific accessory equipment that form integral units such as line terminals;
- Standard costing procedures and accounting principles; and
- Actual and forecasted data from the Corps and the Bureau

In applying segmentation criteria, reference is made to some of the technical and legal sources listed above. While Delivery is characterized by voltage and function, Interties are identified by contracts and function. The investment cost of each segmented facility is determined from accounting records. Some substation facilities are common to more than one segment. Their costs are divided among the major segments served from the substation. Segmented projections for the period FYs 1995-2001 were provided by the BPA Budget Group which correlated plant-in-service with engineering estimates .

Some powerhouse switchyard facilities (Corps and Bureau) are functionalized as transmission (ref. Appendix A, Chapter 6). Normally, the step-up transformer is the interface between the generating source and the transmission system, and is functionalized as generation. Remaining facilities connecting generation plants to BPA network are segmented as if they are owned by BPA

4. APPLICATION OF THE SEGMENTATION STUDY

BPA computes revenue requirements for each of the segments using the results of the Segmentation Study. The components of BPA transmission revenue requirements are:

1. Operation and Maintenance expenses;
2. Depreciation;
3. Net Interest; and
4. Planned Net Revenues.

In these computations BPA uses plant investment as of the middle of the fiscal year rather than the year-end costs developed in the Segmentation Study. The mid-year costs are calculated as the average of costs at the beginning and at the end of the year.

Forecasted operation and maintenance expenses are obtained from budget documents, and are segmented pro rata on the basis of the 3-year averages of historical operation and maintenance expenses for each segment. The O&M expenses for each transmission line and substation are obtained from the plant records for the latest 3 years for which data is available and then averaged. For example, the FY 1996 study uses data for FYs 1992, 1993 and 1994. Use of these historical 3-year averages minimizes potential biases resulting from scheduling or weather anomalies in a particular year.

The straight-line depreciation is computed by dividing investment by the corresponding service life in years. BPA's Depreciation Study provides equipment service lives and net salvage factors. The calculation of weighted average service lives (including net salvage) for substations, lines, and each of the general plant FERC accounts is shown in Chapter 5 of Revenue Requirement Documentation, Volume 1, (WP-96-FSBPA-02A). These adjusted service lives are used to compute depreciation on the basis of total investment for each of the segments at mid-year . The transmission portion of general plant depreciation is prorated to the segments according to their direct depreciation expense. These calculations are also in Chapter 5 of Revenue Requirement Documentation, Volume 1.

Net revenues and interest expense are segmented prorata on the basis of the remaining undepreciated investment, i.e., net plant in the various segments. Planned net revenues make up the excess of amortization over depreciation, and include amounts required to achieve the Administrator's risk mitigation policy.