LOADS AND RESOURCES STUDY

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LOADS AND RESOURCES STUDY

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TABLES

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COMMONLY USED ACRONYMS

AC	Alternating Current
ACME	Accelerated California Market Estimator (computer program)
AFUDC	Allowance for Funds Used During Construction
aMW	Average Megawatt
APS	Ancillary Products and Services (rate)
ASC	Average System Cost
ASM	Aluminum Smelter Model
BASC	BPA Average System Cost
BTU	British Thermal Unit
CE	Emergency Capacity (rate)
CF	Firm Capacity (rate)
CO-OP	Co-operative Electric Utility
COB	California-Oregon Border
COE	United States Army Corps of Engineers
Con/Mod	Conservation Modernization Program
COSA	Cost of Service Analysis
CSPE	Columbia Storage Power Exchange
CT	Combustion Turbine
CWIP	Construction Work In Progress
CY	Calendar Year (Jan - Dec)
DC	Direct Current
DOE	Department of Energy
DSIs	Direct Service Industrial Customers
DSM	Demand-Side Management
EA	Environmental Assessment
ECC	Energy Content Curve
EIS	Environmental Impact Statement
ET	Energy Transmission (rate)
F & O	Financial and Operating Reports
FBS	Federal Base System
FCRPS	Federal Columbia River Power System
FCRTS	Federal Columbia River Transmission System
FELCC	Firm Energy Load Carrying Capability
FERC	Federal Energy Regulatory Commission
FPS	Firm Power Products and Services (rate)
FPT	Formula Power Transmission (rate)
FSEA	Federal Secondary Energy Analysis
FY	Fiscal Year (Oct - Sep)
GCPs	General Contract Provisions
GRSPs	General Rate Schedule Provisions
GTRSPs	General Transmission Rate Schedule Provisions
IDUEIS	Intertie Development and Use Environmental Impact Statement

IE	Eastern Intertie Transmission (rate)
IN	Northern Intertie Transmission (rate)
IOUs	Investor-Owned Utilities
IP	Industrial Firm Power (rate)
IR	Integration of Resources (rate)
IRE	Industrial Replacement Energy
IS	Southern Intertie Transmission (rate)
ISAAC	Integrated System for Analysis of Acquisitions (computer program)
ISC	Investment Service Coverage
KV	Kilovolt (1000 volts)
KW	Kilowatt (1000 watts)
kWh	Kilowatthour
LDD	Low Density Discount
LOLP	Loss of Load Probability
LTIAP	Long-Term Intertie Access Policy
M/kWh	Mills per kilowatthour
MC	Marginal Cost
MCA	Marginal Cost Analysis
MCS	Model Conservation Standards
MW	Megawatt (1 million watts)
MW-miles	Megawatt-miles
MWh	Megawatthour
MT	Market Transmission (rate)
NEPA	National Environmental Policy Act
NF	Nonfirm Energy (rate)
NFRAP	Nonfirm Revenue Analysis Program (computer program)
NOB	Nevada-Oregon Border
NR	New Resource Firm Power (rate)
NTSA	Non-Treaty Storage Agreement
NWPP	Northwest Power Pool
NWPPC	Northwest Power Planning Council
O&M	Operation and Maintenance
OMB	Office of Management and Budget
OY	Operating Year (Aug - Jul)
PA	Public Agency
PIP	Programs in Perspective
PF	Priority Firm Power (rate)
PMDAM	Power Market Decision Analysis Model
PNCA	Pacific Northwest Coordination Agreement
PNUCC	Pacific Northwest Utilities Conference Committee
PNW	Pacific Northwest
POD	Point of Delivery
PSW	Pacific Southwest
PURPA	Public Utilities Regulatory Policies Act
PUD	Public or Peoples' Utility District

RAM	Rate Analysis Model (computer model)
REVEST	Revenue Estimate (computer program)
ROD	Record of Decision
RP	Reserve Power (rate)
RPSA	Residential Purchase and Sale Agreement
SAM	System Analysis Model
SI	Special Industrial Power (rate)
SPM	Supply Pricing Model (computer program)
SPOM	Surplus Power-Open Market
SS	Share-the-Savings Energy (rate)
TGT	Townsend-Garrison Transmission (rate)
UFT	Use of Facilities Transmission (rate)
USBR	United States Bureau of Reclamation
VI	Variable Industrial Power (rate)
VOR	Value of Reserves
WNP	Washington Public Power Supply System (Nuclear) Project
WPPSS	Washington Public Power Supply System
WPRDS	Wholesale Power Rate Development Study
WSPP	Western Systems Power Pool
WSCC	Western Systems Coordinating Council

1. INTRODUCTION

The Loads and Resources Study (Study) represents the compilation of the load and resource data necessary for developing BPA's wholesale power rates. The results of the Study are used to: (1) determine resource costs for the Revenue Requirement Study, WP-96-FS-BPA-02; (2) derive billing determinants in the Wholesale Power Rate Development Study, WP-96-FS-BPA-05; and (3) derive load inputs for the 7(b)(2) Rate Test Study, WP-96-FS-BPA-07.

The Study provides a synopsis of BPA's loads and resources analyses. Specific components of the analyses are not addressed in detail in this Study. Instead, an overview is provided illustrating how each component is completed, how components relate to each other, and how each component fits into the rate development process. Methods, details, and results supporting the Study are contained in the Documentation for Loads and Resources Study, Volumes 1 and 2 (Documentation), WP-96-FS-01A and WP-96-FS-01B.

The Study and the supporting Documentation reflect all of the load and resource assumptions made for BPA's 1996 final wholesale power and transmission rate proposals.

2. METHODS

2.1 Overview.

This Study has three major interrelated components: (1) regional and Federal system load forecasts; (2) regional and Federal system resource forecasts; and (3) loads and resources studies. This Study provides projected firm loads and resources of the BPA system for the rate period.

A glossary of commonly used terms is provided on at the end of this study document.

2.1.1 Regional and Federal System Load Forecasts. BPA's load forecasts are analyses of the expected firm electric power requirements of the Pacific Northwest, grouped by customer class. To prepare its regional load forecasts, BPA applies concepts based on economic theory to construct models of electricity consumption. These models predict expected load trends and levels. The regional load projections in the Study reflect BPA's assumptions regarding current and projected regional, national, and international economic conditions.

BPA's major customer groups for which load forecasts are prepared, include: (1) the direct service industries (DSIs); (2) the non- and small generating public utilities (NSGPUs); (3) the generating public utilities (GPUs); (4) the investor-owned utilities (IOUs); (5) the contract Federal agencies; and (6) the United States Bureau of Reclamation (USBR).

BPA's forecasts of regional loads by customer group are used to derive a major portion of its forecast of total Federal system firm loads. The remaining portion of the projected total Federal system load is comprised of BPA's obligations to the public agencies under their power sales contracts, and other inter- and intra-regional contractual obligations.

2.1.2 Regional and Federal System Resource Forecasts. The Pacific Northwest regional resources are comprised of generating resources operated or being built by Federal entities, public agencies, IOUs, and independent power producers. This Study incorporates BPA's current projection of generation from these resources.

BPA markets power generated by Federally owned hydro resources and from several non-Federally owned resources, including Washington Public Power Supply System Nuclear Plant No. 2 (WNP-2), Packwood Lake, Idaho Falls and Cowlitz Falls.

BPA has new inter- and intra-regional contractual obligations which are reflected in the Study. These obligations include: capacity sales, capacity/energy exchange contracts, energy exchange contracts, and surplus power sales contracts. Additionally, option energy and supplemental energy from BPA's Pacific Southwest contracts which include these provisions are shown as firm Federal resources to provide consistency with the Federal Secondary Energy Analysis (FSEA) and the Nonfirm Revenue Analysis Program (NFRAP) analysis.

BPA estimates the regional and Federal system hydroelectric output derived from BPA's regional hydro regulation model, which shapes hydro resources to meet expected firm loads. The hydro studies consider regional contracts and the expected availability and operation of non-hydro resources. The combination of all Federal contracts and resources represents the Federal system's available firm resources.

2.1.3 Loads and Resources Studies. Projections of Federal system firm energy loads are compared with Federal system energy resources for each month of operating year (OY)1997 through OY 2001 (August 1996-July 2001) under 1930 water conditions. The results of this comparison yield the firm energy surplus or deficit of the Federal resources. Similarly, firm capacity surpluses or deficits are determined for OYs 1997 through OY 2001 using 1930 water

conditions. If BPA is firm energy deficit, the results are used to estimate the amount of purchases or resource acquisitions needed over the forecast period. The FSEA is developed using Federal loads and resources studies performed yearly for each of the 50-year historical water records over the study period.. The FSEA results are inputs to the NFRAP model for revenue and costing estimates.. Regional loads and resources studies are conducted in the same manner.

2.2 Regional Load Forecasts.

Load forecasts for all of BPA's major customer groups are prepared and compiled by BPA annually and revised during the year. BPA's regional load forecasts project future power needs for the Pacific Northwest regional planning area as defined by the Pacific Northwest Electric Power Planning and Conservation Act (Northwest Power Act). The region includes Oregon, Washington, Idaho, Montana west of the Continental Divide, and portions of Nevada, Utah, and Wyoming that lie within the Columbia River drainage basin. The Pacific Northwest region also includes any rural electric cooperative customers not in the geographic area described above that were served by BPA on the effective date of the Northwest Power Act.

These regional forecasts are used throughout BPA in its power planning activities and in rate development. The regional load forecasts for fiscal years (FY) 1997 through 2001 for all customer groups are provided in Tables 2 though 11, pages 30 through 39. Regional load forecasts for years beyond FY 2001 are provided in the Documentation, Volume 1, WP-96-FS-01A.

2.2.1 Direct Service Industry (DSI) Load Forecast. BPA's direct service industrial customers are 15 industrial firms, operating 19 plants in the Pacific Northwest, that purchase power directly from BPA. Approximately 90 percent of the DSI load is for production of primary aluminum at 10 regional smelters. The remainder of the DSIs use a variety of smaller electric-intensive

industrial processes. BPA's DSI customers are listed below. Details pertaining to the DSI load forecast are contained in the Documentation, Volume 1, Section 3, WP-96-FS-01A.

Industry	Companies
Primary Aluminum	Alcoa, Columbia Aluminum, Columbia Falls Aluminum, Northwest Aluminum, Intalco, Kaiser, Reynolds, Vanalco
Aluminum Fabrication	ACPC, Kaiser, Reynolds Vanexco 1/ 2/
Magnesium/Ferrosilicon	Northwest Alloys 1/
Titanium	Oremet
Nickel	Nickel Joint Venture
Pulp/Paper	Port Townsend Paper Co.
Chlor-Alkali	Georgia Pacific, Atochem
Steel Plate	Gilmore Steel 3/
Other 2/.....	Carborundum, Pacific Carbide

1/ Subsidiary of Alcoa
2/ Plants currently closed and dismantled
3/ No load placed on BPA at present time.

2.2.1.1 Aluminum DSI Load Forecast. The total aluminum DSI load forecast for the FY 1997 through 2001 rate period is based on an aluminum price forecast, estimated smelter production costs, and a simple economic decision rule. The forecasted price of aluminum was compared to the smelter production costs and if prices exceeded costs, the smelters were assumed to operate; if costs exceeded prices, the smelters were assumed to be at risk of closing potlines.

In addition to aluminum price and smelter production costs, other factors also were taken into consideration. These include information on the 1994 Brussels Agreement on world production levels, the competitive power market, BPA’s waiver and release of all or part of the DSI top quartile, the load amounts in the signed five-year block sales contracts, other anticipated five-year block sales contracts, the minimum load criterion (80 percent of firm load) set by the U.S. DOE for the DSIs to avoid incurring stranded investment charges, and BPA’s understanding of the

individual characteristics and business strategies of each company. The aluminum DSI load forecasts, energy and peak, for FYs 1997 - 2001 are provided in Tables 2 through 11.

2.2.1.2 Aluminum Prices. The aluminum price forecast affects projections of both DSI smelter loads and BPA's associated revenues. A lower price of aluminum tends to reduce expected aluminum production, electric loads, and resulting power sales revenues. The projections of the U.S. transaction prices for aluminum are (expressed in current and average annual dollars) 83.5 cents/lb for FY 1997-1998, and 87.4 cents/lb. for FY 1997-2001. Details of the aluminum price forecast are included in the Documentation, Volume 1, Section 3, WP-96-FS-01A.

2.2.1.3 Non-aluminum DSI Load Forecast. The load forecast for the non-aluminum DSIs was prepared on a plant-by-plant basis. For each of the plants, load forecasts were based on information collected on historical, current, and future operating schedules, plant technology, and expected economic and market conditions, the load amounts in the signed five-year block sales contracts, other anticipated five-year block sale contracts, the minimum load criterion (80 percent of firm load) set by the U.S. DOE for the DSIs to avoid incurring stranded investment charges, and BPA’s understanding of the individual characteristics and business strategies of each company

The non-aluminum DSI peak and energy load forecasts for FYs 1997 through 2001 are provided in Tables 2 through 11. Details of the non-aluminum DSI load forecasts are included in the Documentation, Volume 1, Section 3, WP-96-FS-01A.

2.2.2 Non- and Small Generating Public Utility (NSGPU) Load Forecast. Standard econometric techniques are used to estimate a simple forecasting equation for regional NSGPU loads, expressed in monthly average megawatts. This technique is used to project NSGPU loads for the period October 1996 through September 2005. NSGPU loads are a function of average retail electricity prices, weather-related variables, and non-agricultural employment. Details describing

data, estimation techniques, and projections are presented in the Documentation, Volume 1, Section 3, WP-96-FS-01A. The NSGPU regional load forecasts, energy and peak, for FYs 1997 through 2001 are provided in Tables 2 through 11.

The projections of employment used as inputs to the NSGPU load forecasts are derived using BPA's Regional Economic Model (REM). REM contains state-level econometric models that project employment for the states of Washington, Oregon, and Idaho. Each model contains equations for major components of the state economies, including population, employment, and income. Details pertaining to the REM are contained in the Documentation, Volume 1, Section 2, WP-96-FS-01A.

Projected retail electricity rates used in the NSGPU load forecast are from BPA's Supply Pricing Model (SPM). The SPM simulates the region's wholesale and retail rate development process. Regional electricity generation, transmission, distribution, and other miscellaneous costs are allocated across regional loads disaggregated by utility type. Transactions at the wholesale level (i.e., purchases from BPA) also are addressed. The SPM uses this information to develop retail rate projections. Documentation for the SPM is provided in the 7(b)(2) Rate Test Study Documentation, WP-96-FS-BPA-07A.

Table 1 on page 29 shows estimates of conservation savings which are subtracted from the energy forecasts. Details pertaining to conservation assumptions are contained in the Documentation, Volume 1, Section 3, WP-96-FS-01A.

The forecast of monthly NSGPU peak loads is developed by applying monthly load factors to the monthly aggregate average energy forecast. The average monthly load factors are developed from historical billing records.

The NSGPU forecast is disaggregated to the individual utility level. The disaggregation uses a combination of historical information and forecasts contained in BPA's Sum of Utilities (SOU) database. The SOU database contains point-of-delivery forecasts for each regional NSGPU. These forecasts are revised periodically by BPA field economists.

2.2.3 Generating Public Utility (GPU) Load Forecast. The GPUs are Eugene Water and Electric Board (EWEB), Seattle City Light, Tacoma Public Utilities, Chelan County Public Utility District (PUD) #1, Douglas County PUD #1, Grant County PUD #2, Cowlitz County PUD #1, Pend Oreille County PUD #1, and Snohomish County PUD #1.

Standard econometric techniques similar to those used for the NSGPUs also are used to estimate a simple forecasting equation for regional GPU loads, expressed in monthly average megawatts. This technique is used to project loads for the period October 1996 through September 2005. GPU loads are a function of average retail electricity prices, weather-related variables, and non-agricultural employment for the state of Washington and Lane County, Oregon. Details describing the data, estimation techniques, and projections are presented in the Documentation, Volume 1, Section 3, WP-96-FS-01A. The GPU regional load forecasts, energy and peak, for FYs 1997 through 2001 are provided in Tables 2 through 11.

Projections of employment for Washington state are derived using BPA's Regional Economic Model (REM) (see Section 2.2.2 in this Study). Projections for Lane County, Oregon, are derived using BPA's county-level economic forecast.

Projected retail electricity rates used in the GPU load forecast are from BPA's Supply Pricing Model (SPM) (see Section 2.2.2 in this Study).

Table 1 shows estimates of conservation savings which are subtracted from the energy forecasts. Details pertaining to conservation assumptions are contained in the Documentation, Volume 1, Section 3, WP-96-FS-01A.

The forecast of monthly GPU peak loads is developed by applying monthly load factors to the monthly average energy forecast. The monthly load factors are developed from the GPU forecasts submitted to the Pacific Northwest Utilities Conference Committee (PNUCC) for the Northwest Regional Forecast of Power Loads and Resources, March 1994 (NRF).

The GPU forecast is disaggregated to the individual utility level using the utility-specific GPU forecasts submitted for the 1994 Northwest Regional Forecast (NRF) and BPA's analysis of current and expected load trends for each utility.

2.2.4 Forecasts of Unbundled Product Purchases. BPA prepared forecasts of unbundled product purchases by the public utilities, Federal agencies, and DSIs. The public utilities are assumed to purchase the load shaping, load regulation, and control area reserves for resources products. The Federal agencies are forecast to purchase the load shaping and load regulation products. The DSIs are assumed to purchase the load shaping, load regulation, and shaping services products. The forecast of purchases and the assumptions underlying the forecast is contained in the Documentation, Volume 1, WP-96-FS-01A.

2.2.5 Investor-Owned Utility (IOU) System Load Forecast. Forecasts of IOU system loads in the region are used for hydro regulation studies (as a component of regional loads). The IOUs are Portland General Electric Company (PGE), Puget Sound Power & Light Company (PSP&L), Washington Water Power Company (WWP), Idaho Power Company (IPC), Montana Power Company (MPC) (PNW regional load only), and PacifiCorp (PNW regional load only).

The IOU system load forecast was produced by BPA in 1993. This long-term forecast updated the economic assumptions from the 1991 joint BPA/Northwest Power Planning Council (NWPPC) forecast and also used a modified version of the residential sector model. Details pertaining to the IOU forecast are contained in the Documentation, Volume 1, Section 3, WP-96-FS-01A. Additional details describing the conversion of the long-term annual sales projections to monthly load projections are contained in the Documentation, Volume 1, Section 2, WP-96-FS-01A. The IOU system load forecasts, energy and peak, for FYs 1997 through 2001 are provided in Tables 2 through 11.

To produce utility-specific system forecasts, the IOU forecast was disaggregated by year and month based upon the utilities' forecast submittals to the PNUCC for use in the 1994 NRF.

The IOU residential exchange forecasts used in this rate proposal were submitted to BPA by the IOUs and are contained in the Documentation, Volume 1, Section 3, WP-96-FS-01A.

2.2.6 Contract Federal Agency Load Forecasts. The contract Federal agency energy and peak forecasts are developed by BPA field economists in cooperation with each Federal agency. These forecasts are reviewed periodically and updated as needed. The customers classified as contract Federal agencies are the Bureau of Mines at Albany, Oregon; Fairchild Air Force Base at Spokane, Washington; the Department of Energy at Richland, Washington; the Bureau of Indian Affairs at Polson, Montana, and Wapato, Washington; and the Department of the Navy at Bremerton, Bangor, and Arlington, Washington.

The forecasts of Federal agency loads, energy and peak, for FYs 1997 through 2001 are provided in Tables 2 through 11.

2.2.7 U.S. Bureau of Reclamation Reserved Energy Load Forecast. The United States Bureau of Reclamation (USBR) load forecast represents the "reserved energy" requirements for each USBR irrigation project in the Northwest. The peak and energy forecasts of each project's requirements are reviewed by BPA and updated periodically by the USBR.

The USBR load forecasts, energy and peak, for FYs 1997 through 2001 are provided in Tables 2 through 11.

2.3 Federal System Firm Load.

2.3.1 Summary. The Federal system firm loads include BPA's DSI load, sales to other Federal agencies, current obligations to regional public agencies and IOUs under their power sales contracts, and other inter- and intra-regional contractual obligations. The Federal system firm loads are based on BPA's regional firm load forecasts for each customer group. The Federal system firm loads used in BPA's final rate proposal are detailed in the Documentation, Volume 2, WP-96-FS-01B. Tables 12 through 23 of the Study, on pages 40 through 63, contain summaries of the Federal system loads and resources for OYs 1997 through 2002.

2.3.2 Contractual Obligations. BPA provides Federal power to customers under a variety of contractual arrangements that are not included in BPA's regional load forecasts. These contractually defined commitments are of five types: (1) adjustable rate contracts; (2) fixed rate contracts; (3) power or energy exchange contracts; (4) power payments for services; and (5) power commitments under international treaty. These arrangements are collectively referred to as contractual obligations. The energy and peak levels of each of these obligations are obtained from individual contracts. The contractual obligations are unaffected by weather, water conditions, or economic conditions. They are served by Federal firm resources, and service must be provided

under any water condition. The Federal system contractual obligations are included in the Documentation, Volume 2, WP-96-FS-01B.

2.3.3 Recent BPA Contracts. BPA has signed a number of inter- and intra-regional contracts since the 1996 initial rate analysis which are included in this final Study.

New inter-regional Federal contracts include a seasonal exchange with the City of Azusa through July 1998, a capacity/energy diversity exchange with Imperial Irrigation District through March 2014, a capacity sale and diversity exchange with the City of Palo Alto, a power sale and capacity/energy diversity exchange contract with the City of Pasadena through March 2015, a capacity/energy diversity exchange contract with the City of Riverside through April 2016, a storage agreement with Southern California Edison (SCE) through February 2005, and a seasonal exchange with the City of Vernon through July 1998. The Study also includes BPA's energy purchased from supplemental energy options exercised under contracts with the cities of Burbank, Glendale, and Pasadena through April 15, 2008, purchases of supplemental energy exercised under the SCE contract through April 15, 2006, and option energy purchases exercised under a SCE contract through July 2000. BPA also extended a power purchase contract with Basin Electric Cooperative through April 1999.

New intra-regional Federal contracts include a power sale to EWEB through July 2000, a surplus firm capacity sale with PGE through June 2000, a capacity/energy diversity exchange contract with WWP through June 2000, a power sale with WWP for Clark Public Utilities through March 1998, a power sale with WWP for the City of Riverside through July 2004, and a power sale with West Oregon Electric Cooperative through September 1998. This analysis also includes an estimate of potential surplus power sales to other unspecified entities through the study horizon.

Additionally, the Study includes the Southern Oregon exchange transfer contracts for Harney Electric Cooperative and Wells Rural Electric Company through IPC and Sierra Pacific Power Company through the study horizon.

2.3.4 Adjustments to Public Utility Purchases from BPA. Public utility purchases from BPA were reduced to account for those utilities who are actively seeking other suppliers to meet their loads. Firm Resource Exhibits (FRE) submitted to BPA before February 1, 1995 are the basis for the adjustments to NSGPU and GPU purchases from BPA. Additional adjustments beyond utilities' FRE submittals are made to the forecast of NSGPU and GPU purchases from BPA to reflect the desire of some utilities to diversify their resource bases beyond the pre-February 1, 1995, FRE submittals. BPA also assumes that GPU customers will purchase power under their existing 1981 Contracts. BPA believes that its adjustments to public utility purchases will adequately reflect the potential load reduction that could occur by the GPUs within their rights under the 1981 Contract, given current market information. In addition, BPA is currently engaged in load commitment negotiations with its public utility customers. Because the load commitment negotiations were not at a definitive stage when the load forecast for this study was completed, BPA is not basing its adjustments to public utility purchases on the outcome of those negotiations. The adjustments to public utility purchases are detailed in the Documentation, Volume 1, WP-96-FS-01A, Section 3 and Table 19.

2.3.5 Sales to Public Agencies. Under current power sales contracts with BPA, customers identify their own generating and contractual resources which will be used to meet their system loads for the next seven years, starting with the next operating year. The designation of resources, commonly referred to as "dedicated resources," may be revised within the seven-year period under specific circumstances detailed in the power sales contracts. The total dedicated resources for each utility are shown in the Documentation, Volume 2, WP-96-FS-01B.

The Study assumes that BPA serves all of the public agencies' net firm load requirements not served by their dedicated resources plus other non-BPA purchases described in section 2.3.4 above, and in Section 3 of the Documentation, Volume 1, WP-96-FS-01A. This load requirement assumes the public agencies' hydro resource output based on 1930 water conditions. This level of hydro operation results in the maximum load requirement on the Federal system. BPA determined these obligations by performing individual utility GPU loads and resources balances and an aggregate loads and resources balance for the NSGPUs.

2.3.6 Sales to Investor-Owned Utilities (IOUs). The IOUs are served as contracted requirements customers under their power sales contracts, purchasing a given amount of energy and/or capacity in each OY. PGE was purchasing 150 MW of capacity through June 30, 1999, under its power sales contract. This contract has since been revised and the capacity now is purchased under a surplus peak contract through June 30, 2000. PSP&L was purchasing from BPA under its power sales contract; however, based on information contained in its Exhibit I submittal, this purchase was revised to zero for this Study.

2.4 Resource Forecasts.

2.4.1 Overview. BPA's resource forecasts depend on an analysis of the availability of all regional resources. This is necessary because the operation of nearly all regional resources is coordinated through the Pacific Northwest Coordination Agreement (Coordination Agreement or PNCA) operating provisions which BPA is a participant. In determining rate adjustments, BPA simulates regional and Federal resource operations according to the principles of the PNCA.

The Coordination Agreement defines the planning and operation of the regional hydro system. Unlike previous studies, the May Water Budget is not included in the hydro regulation study because it has been replaced by Columbia River flow augmentation targets from the 1995

National Marine Fisheries Services (NMFS) Biological Opinion dated March 2, 1995. The hydro regulation study incorporates the 1995 NMFS Biological Opinion which provides for Snake River flow augmentation April 1 through August 31 and provides storage of water January through mid-April for Columbia River flow augmentation April 16 through August 31.

Estimating the amount and timing of the region's resource operations and acquisitions necessary to meet loads requires examination and inclusion of expected operating schedules of coal, nuclear, hydropower, combustion turbine, and cogeneration resources, regional and interregional resource contracts, and expected generation resource acquisitions.

2.4.2 Federal System Resources. Federal firm resources from which BPA markets power currently consist of Federally owned hydro, non-Federally owned resources, exchange energy associated with BPA's existing capacity/energy exchanges, short-term power purchases, and other BPA hydro-related contracts.

The Federal system hydro resources are owned and operated by the United States Bureau of Reclamation (USBR) and the United States Army Corps of Engineers (COE). BPA also markets power purchased from hydro projects owned by the City of Idaho Falls, Lewis County PUD, and the Washington Public Power Supply System (Supply System). All of the above hydro resources are included in the Documentation, Volume 2, WP-96-FS-01B, Sections 3 and 6, Tables A-3 and A-4.

BPA's thermal resources in this Study include WNP-2, operated by the Supply System. WNP-2's capabilities have increased from 751 aMW to 842 aMW in OYs 1997 through 1999 to 878 aMW in OYs 2000 and beyond due to efficiency improvements. BPA's thermal resources are included in the Documentation, Volume 2, WP-96-FS-01B, Sections 2 and 5, Table A-10.

BPA's capacity/energy exchange contracts and additional power purchases provide firm energy to BPA in exchange for capacity BPA delivers. Details pertaining to BPA contracts are contained in the Documentation, Volume 2, WP-96-FS-01B, Section 3, Table A-2 (Exports), Table A-5 (Imports), and Table A-16 (Contracts Between Utilities).

The combination of these acquisitions and the resources discussed above represents BPA's available firm resources. Summaries of Federal system resources for OYs 1997 through 2002 are contained in Tables 12 through 23, on pages 40 through 63.

2.4.3 Hydro Regulation Study.

2.4.3.1 Energy. BPA generally plans to meet firm energy loads based on current hydro generation capability under critical streamflow conditions. The critical period is that period, using the historical streamflow data base, during which the hydro system can produce the least amount of power while drafting the reservoirs from full to empty. This period can vary depending upon the various assumptions which are used in a hydro study. In recent years, this period has been defined as the 42-month period of historical streamflows that occurred from September 1, 1928, through February 29, 1932. This year, however, due to changing constraints and project operations on the hydro system, the critical period has been found to be the 8-month period of historical streamflows that occurred from September 1, 1936, through April 30, 1937. Since the critical period is less than one year in duration, the hydro studies do not include the shifting of firm energy.

In past hydro regulation studies, first, the critical period portion of the streamflow record would be independently modeled with the hydro system maximizing the firm power generation over the length of this adverse water sequence. This establishes the system firm generating capability. Any generation occurring in other water conditions in excess of this firm amount is considered non-

firm. The monthly operation of the major federal reservoirs during this time period would define the critical rule curves (CRCs). Then, second, these CRCs would be introduced into a 50-year hydro regulation study and would guide the simulated operations of reservoirs by way of proportional drafting between these operational rule curves to meet system firm loads. The regulation of the hydro system during the 50-year streamflow record establishes the expected non-firm generation in the various 50 water conditions. With the introduction into firm planning of the National Marine Fisheries Service's (NMFS's) Biological Opinion (BO), dated March 2, 1995, drafting of federal projects is limited. In the hydro regulations prepared for the initial rates proposal, non-federal projects were adversely impacted, with deeper drafts being the result.

To avoid these adverse effects, BPA modeled the hydro system in a manner similar to those regulations modeled for the Pacific Northwest Coordination Agreement (PNCA). First, an Actual Energy Regulation (AER) type study was run to determine the 50-year operation of the non-federal projects when trying to meet the coordinated system's Firm Energy Load Carrying Capability (FELCC) and an unlimited secondary-energy load. Second, an Operational type 50-year study was run with estimated regional firm loads and a limited, realistic secondary-energy load. The operation of the non-federal projects was limited in the 50-year Operational study to the proportional draft points (PDP's) developed in the 50-year AER type study.

In these current hydro regulation studies, the critical period portion of the streamflow record was not independently modeled. CRCs developed in PNCA 1995-96 final regulation are used to guide proportional drafting of the coordinated system's projects during both the AER and the Operational hydro studies. The AER studies developed the proportional draft points (PDPs) which the hydro system would operate to in its Operational hydro studies.

The Northwest regional hydro system operation is simulated for water years 1929 through 1978, during each of the operating years (OY) in the planning period of August 1996 through July 2001

(OY 1997 through OY 2001). The OY 1997 level hydro study was run in a refill mode, with the system reinitialized each August 1st in the 50 year sequence to BPA's best estimate of the OY 1996 final storage level contents. This refill study more accurately reflects expected energy generation values for the OY 1997 level due to our current knowledge of the 1996 runoff to date. The OY 1998 through OY 2001 level studies were run in a continuous mode with each water-year starting where the previous water-year ended in the 50-year sequence. These continuous studies accurately reflect the expected energy generation values for OY 1998 through OY 2001 when nothing is known of the 1997 through 2000 level refill events.

With the introduction of the March 2, 1995 NMFS' BO as a firm planning constraint, the major federal hydro projects (Grand Coulee, Libby, Hungry Horse, Albeni Falls and Dworshak) are constrained so that minimal proportional drafting will occur.

In the AER studies, the Canadian projects are modeled as duplicating their final Assured Operating Plan (AOP) operations from the 1997 through 2001 AOPs for the 1997 through 2001 levels of the hydro studies, respectively. The AOP operations were developed through joint studies between the U.S. and Canada in determining the benefits of the development of the Canadian portion of the Columbia River. The AOP studies are run yearly to show the downstream benefits and to coordinate operation of Canadian dams as required in the Columbia River Treaty. These operations of the Canadian projects allow them to be free of impacts due to fish operations on the United States' side of the border. In the Operational studies, an additional one million acre-feet (1.0 MAF) of flow augmentation storage is modeled for Arrow during years when the January through July runoff at The Dalles is estimated to be below 90 MAF. Storage occurs at Arrow between January and mid-April with release occurring between mid-April and June.

In the AER studies, non-federal hydro projects proportionally draft to meet the coordinated system's FELCC. This FELCC was taken from the 1995-96 PNCA Final Regulation. In the Operational studies, non-federal hydro projects have their drafting limited to the proportional draft points established in the AER studies, as the projects operate to a regional system load.

Both the AER and the Operational hydro studies use Columbia River and Snake River flow augmentation as set forth in the March 2, 1995 NMFS' BO and the CCOE's and the USBR's PNCA data submittals.

The hydro studies replace the Water Budget, developed under the Northwest Power Planning Council's (NPPC's) Columbia River Basin Fish and Wildlife Program, with Columbia River flow augmentation, as described in the March 2, 1995 NMFS' BO. Columbia River flow augmentation, modeled in both the AER and the Operational studies, includes storing water at Arrow, Libby, Hungry Horse and Grand Coulee for later release during the springtime in order to enhance fish passage at the dams. Arrow storage of up to 1.0 MAF whenever the hedged January through July runoff forecast at The Dalles is below 90 MAF, occurs only in the Operational study. The hydro studies are discussed in greater detail in the Documentation, Volume 2 (WP-96-FS-BPA-01B).

Snake River flow augmentation includes releases of water from Dworshak and Brownlee to try to meet Lower Granite flow targets April through August. Other constraints related to Snake River flow augmentation include the drawdown of the four Lower Snake projects (Lower Granite, Little Goose, Lower Monumental and Ice Harbor) to facilitate fish bypass.

Other fish measures on the system to complement flow augmentation include: 1) the drawdown of John Day Dam, 2) spring-time fish spills at Lower Granite, Little Goose, Lower Monumental,

Ice Harbor, McNary, John Day, The Dalles and Bonneville Dams, and 3) summer-time fish spills at Ice Harbor, John Day, The Dalles and Bonneville Dams.

This process shapes generation, with less firm energy available to meet firm loads when the hydro system is storing water (January through mid-April), and with more firm energy available to meet firm loads when the hydro system is releasing stored water during flow augmentation periods (mid-April through August).

BPA's Loads and Resources Study uses the 1930 water conditions from the Operational hydro studies to estimate the firm energy available on the system during the critical period. The 1930 water conditions are used for the analysis because of the similarity to the critical period conditions and to simplify the rate analysis process.

The Operational hydro studies determine the amount of nonfirm energy that is available from the system, as well as system deficits, for which spot market purchases are made in each of the 50 water conditions. This portion of each study was input into the Federal Secondary Energy Analysis (FSEA), which determines by month the secondary energy, adjusted for interchange between the Federal system and other non-federal utilities, that will be available from Federal system hydro projects. The FSEA results were then used in the Nonfirm Revenue Analysis Program (NFRAP) to determine nonfirm energy sales and revenues.

2.4.3.2 Nonfirm Energy Analysis. BPA resource planning uses critical water flows to compute the region’s firm hydro energy. In most years, however, the Columbia River Basin collects enough water from rain and snow melt to surpass the region’s critical water flows. The amount of hydro generation that can be produced in excess of critical water levels is called nonfirm energy. The availability of nonfirm energy described in this analysis has changed dramatically compared to the last rate filing. The NMFS Biological Opinion dated March 2, 1995, created

significant impacts on the ability of the system to shape energy generation to follow monthly loads. The Biological Opinion included flow augmentation on the Snake and Columbia Rivers and their tributaries to aid fish and wildlife. These impacts are included in the hydro regulation studies used in the nonfirm energy analysis. The changes also have made it necessary to revise the analysis of the availability of regional surplus energy in excess of firm load.

The NMFS Biological Opinion changed the annual shape and amount of regional surplus energy available in excess of firm load. In September through December, there was little nonfirm energy available. In January through mid-April, there were deficits due to Columbia River augmentation storage. Furthermore, in the second part of April through June, the release for the additional stored water created overgenerations, causing these three periods to report the highest three values of 50-year average overgeneration of any of the 14 periods. These occurrences demonstrate that an annual average of nonfirm energy supply does not adequately represent the available nonfirm energy in any water year, given the limited flexibility of the hydro system. The FSEA used in the ratemaking process appropriately analyzes the Federal nonfirm energy on a month by month basis over the 50-historical water years of record.. The seasonality of the surplus energy in excess of firm load from the hydroregulation study is described as follows.

2.4.3.2.1 <u>September through December</u>. Numerous deficits occur during this time period as Grand Coulee, Dworshak, Hungry Horse and Libby are all either on minimum flow or low flow operations, recovering from fish operations which caused the drafting of these projects through the end of August. The following table shows the project operations at the end of August from which the system had to recover.

End of August Storage Values

Project Draft from Full	Grand Coulee at least 10 feet	Dworshak at least 80 feet	Hungry Horse at least 20 feet	Libby at least 20 feet
1997 Level	49 out of 50	0 out of 50	49 out of 50	33 out of 50
1998 Level	47 out of 50	33 out of 50	40 out of 50	37 out of 50
1999 Level	47 out of 50	33 out of 50	40 out of 50	37 out of 50
2000 Level	47 out of 50	33 out of 50	40 out of 50	37 out of 50
2001 Level	47 out of 50	33 out of 50	40 out of 50	35 out of 50

Of the 200 periods represented by September through December in all 50 water conditions, surplus energy was generated as the following table shows.

Surplus Energy Generation for September through December

	Surplus	L/R Balance	Deficit	50-year Avg
1997 Level	150 out of 200	0 out of 200	50 out of 200	1654.6 aMW
1998 Level	112 out of 200	22 out of 200	66 out of 200	1014.1 aMW
1999 Level	88 out of 200	5 out of 200	107 out of 200	553.5 aMW
2000 Level	95 out of 200	5 out of 200	100 out of 200	565.8 a MW
2001 Level	97 out of 200	4 out of 200	99 out of 200	547.9 aMW

2.4.3.2.2 January through mid-April. The federal system operates to store water for flow augmentation during the period of January through mid-April of every year; a result of the March 2, 1995 NMFS' BO being modeled in firm planning. Energy that would otherwise be generated from this stored water is not available for sale as either firm or nonfirm energy. The regional nonfirm energy analysis incorporating the NMFS Biological Opinion is presented in the "Regional Surplus Energy" tables found in the Documentation, Volume 2 (WP-96-FS-BPA-01B). Negative

quantities in the tables represent the amount of energy that must be purchased in years of low runoff.

Of the 200 periods represented by January through mid-April in all 50 water conditions, surplus energy was generated as the following table shows.

Surplus Energy Generation for January through Mid-April

	Surplus	**L/R Balance**	**Deficit**	**50-year Avg**
1997 Level	160 out of 200	4 out of 200	36 out of 200	4004 aMW
1998 Level	162 out of 200	6 out of 200	32 out of 200	4282 aMW
1999 Level	164 out of 200	3 out of 200	33 out of 200	4216 aMW
2000 Level	154 out of 200	2 out of 200	44 out of 200	3293 a MW
2001 Level	156 out of 200	1 out of 200	43 out of 200	2811 aMW

The large amount of surplus energy generated on the system reflects the good streamflows that naturally occur on the system during the springtime and occurred even though the federal hydro system took such large measures to provide for flow augmentation.

2.4.3.2.3 Mid-April through July. Flow targets at McNary and Lower Granite Dams are used for modeling the Columbia River and Snake River flow augmentation operations. For specific flow targets, please refer to Section 2.2.9 (Columbia River Flow Augmentation) and Section 2.2.18 (Snake River Flow Augmentation) of the Documentation, Volume 2 (WP-96-FS-BPA-01B).

Flow targets occur for all water conditions in the 50 water years. Therefore, nonfirm energy is abundant during the mid-April through July period. Of the 200 periods represented by mid-April through July in all 50 water conditions, surplus energy was generated as the following table shows.

Surplus Energy Generation for Mid-April through July

	Surplus	L/R Balance	Deficit	50-year Avg
1997 Level	194 out of 200	3 out of 200	3 out of 200	7287 aMW
1998 Level	190 out of 200	6 out of 200	4 out of 200	7471 aMW
1999 Level	189 out of 200	4 out of 200	7 out of 200	7267 aMW
2000 Level	189 out of 200	2 out of 200	9 out of 200	7318 aMW
2001 Level	192 out of 200	5 out of 200	3 out of 200	7190 aMW

2.4.3.2.4 August. August is a nondescript transitional period. Although flow targets for McNary and Lower Granite are in place, project constraints limit the water available on the system to meet the targets.

Of the 100 periods represented by both halves of August in all 50 water conditions, surplus energy was generated as the following table shows.

Surplus Energy Generation for August

	Surplus	L/R Balance	Deficit	50-year Avg
1997 Level	87 out of 100	0 out of 100	13 out of 100	2629 aMW
1998 Level	47 out of 100	6 out of 100	47 out of 100	1228 aMW
1999 Level	50 out of 100	3 out of 100	47 out of 100	1102 aMW
2000 Level	48 out of 100	3 out of 100	49 out of 100	928 aMW
2001 Level	51 out of 100	3 out of 100	46 out of 100	1107 aMW

The hydro studies determine the amount of nonfirm energy that is available on the system, as well as system deficits, for which spot market purchases are made. In the past, this portion of the studies was input into the Federal Secondary Energy Analysis (FSEA), which determines by

month the secondary energy, adjusted for interchange between the Federal system and other non-Federal utilities, that will be available from Federal system hydro projects. The FSEA results were then used in the Nonfirm Revenue Analysis Program (NFRAP) to determine nonfirm energy availability for sales and revenues.

2.4.3.3 Capacity. Hydro peaking capacity is based on the historical water year 1930. Hydro peaking capability, based on a 1-hour capability, is reduced by a sustained peaking adjustment to reflect the daily duration characteristics of peak loads and the shaping limitations of the hydro resources used to meet those loads. The sustained peaking adjustment is calculated assuming that any capacity sales in addition to existing commitments will be for 50 hours per week every week of the year. These BPA sales are for contractual firm peaking capacity with the associated energy being returned to BPA. The planned hydro maintenance adjustment is for generating units taken out of service for maintenance.

Total peaking capacity is determined for hydro peaking capability, regional and interregional resource contracts, peaking capability of thermal and cogeneration resources, and expected generating resource acquisitions. Total peaking capacity is reduced by reserves for forced outages. Forced outage reserves are calculated as 15 percent of large thermal project output and 5 percent of the output of all other resources. Unlike the capacity credit in prior studies, the capacity credit given to the DSIs for DSI reserves was removed from the Federal system and regional capacity loads and resources analysis for this planning document. Since the 1996 initial rate study, the DSIs have signed new contracts containing different contract provisions under which the DSIs provide real-time operating reserves. The DSI real-time operating reserve criterion is shorter in duration than the DSI planning modeled in the 1996 initial rate study. Since the duration of the DSI real-time operating reserves is much less than the 50-hour per week used in capacity loads and resources planning, the reserves were removed from the Study.

Additionally, the capacity surplus values do not contain the full potential impacts of nighttime return problems on the Federal system due to increased capacity sales.

2.4.4 Conservation and Resource Acquisitions

2.4.4.1 Conservation and Conservation Reinvention Acquisitions. Beginning in 1996, BPA will be transferring some conservation funding responsibilities to its customers. BPA remains committed to the acquisition of all regionally cost-effective conservation as established in the NPPC's Power Plan. All conservation savings are treated as reductions to the public utility load forecast during the load forecasting process and are shown in Table 1.

2.4.4.2 Generation. Specific planned generation resource actions consist of the following components.

2.4.4.2.1 Hydro, Thermal, and Transmission Efficiency Improvements. Efficiency improvements consist of control system improvements at several major Federal hydro projects as well as improvement projects at the Supply System's WNP-2 facility. This Study includes 44 aMW of hydro efficiency improvements. The efficiency improvements at WNP-2 are as follows:

1) OYs 1997 through 1999: 72 percent capacity factor increases energy from 751 aMW to 842 aMW;
2) OYs 2000 and beyond: 75 percent capacity factor increases energy from 751 aMW to 878 aMW.

2.4.4.2.2 Other Federal Generation. BPA has contracted or is negotiating for the output of several generation projects. These projects include hydro (Clearwater) and wind (90 percent of Columbia Hills Wind and Wyoming Wind). These resources are included in the Federal System

Loads and Resources Table 2 (see Documentation, Volume 2, WP-96-FS-01B). Environmental reviews for these resources have not been completed and BPA has not made final decisions regarding the acquisition of the wind resources. However, they are included in this study because of the possibility of successful completion of the decision process, including completion of environmental reviews. BPA has also contracted for the output of the gas-fired James River Wauna project. In the 1996 initial rate proposal analysis, BPA included the Tenaska and SDS Lumber gas-fired projects; however, since that analysis, BPA determined that it is excused from any further obligations under the Tenaska and SDS Lumber agreements and these projects are not included in the final Study. The 1996 initial rate proposal analysis also included the Newberry and Glass Mountain geothermal projects; however, due to cost effectiveness and performance issues, and the fact that environmental review of the Glass Mountain project has not been completed, these projects are not included in the final Study.

Information on BPA's expenditures for resource acquisitions is used for budgets and revenue requirements. All expenditure data are included in the Revenue Requirement Study, WP-96-FS-BPA-02.

2.5 Loads and Resources Balances.

2.5.1 Overview. BPA prepares monthly loads and resources balances for each of the major utilities, for the Federal system, and for the region. These balances evaluate all firm loads (system firm loads and contractual loads) and firm resources (hydro resources, thermal resources, resource acquisitions, miscellaneous resources, and contractual resources) in the region. BPA's loads and resources balances exclude residential exchange and Exchange Transmission Credit Agreement (ETCA) loads.

2.5.2 Firm Energy and Capacity Analyses. The Federal system firm energy loads and resources balances under 1930 water conditions were determined by month for each operating year over the study period. As previously discussed in section 2.4.3.2 of this Study, the 1995 NMFS Biological Opinion dramatically changed the ability of the hydro system to shape monthly energy. This demonstrated a need to analyze the supply of hydro energy on a monthly rather than a 12-month annual average. Therefore, in order to accurately analyze the power needs and revenue impacts of any utility's loads and resources balances, surpluses in any given month must be treated the same as deficits in other months. In the 1996 initial rate proposal study, the Federal system loads and resources analysis did not treat the months of May and June the same as other months in the operating year. The Federal system resources were reduced in those months (called May Flow Augmentation and June Flow Augmentation reductions) to avoid overstating the 12-month annual average of the hydro system. All other utility loads and resources balances, except the regional analysis which included the Federal system, did not include these reductions. To analyze the purchases, sales, and revenue impacts of the Federal system loads and resources analysis, the May and June Flow Augmentation reductions were removed from the current Study. This provides revenue and risk consistency with the FSEA and NFRAP analysis.

Similarly, the Federal system firm capacity loads and resources balances under 1930 water conditions were determined by month for each operating year over the study period.