INDEX

TESTIMONY of

JON A. HIRSCH, TIMOTHY C. MISLEY, REED DAVIS,
KIM FODREA, and RANDY RUSSELL

Witnesses for Bonneville Power Administration

SUBJECT: LOADS AND RESOURCES

Page

Section 1: Introduction and Purpose of Testimony 1

Section 2: Public Agencies Total Retail Load Forecasts 2

Section 3: PF Sales Forecasting Process 4

Section 4: IOU and DSI Sales Forecasts 11

Section 5: Residential Exchange Forecasts 12

Section 6: Loads and Resources Study Process 13

Section 7: Hydro Regulation Studies 16

Section 8: Federal System Generating Resources 24

Section 9: Treatment of Federal System Contracts 27

Section 10: Federal System Transmission Losses 30

Section 11: PNW Total Regional Hydro Resources for the Market Price Forecast Study 31

TABLE

Table 9.1 Projected Federal System Augmentation Purchase 29

This Page Intentionally Left Blank

TESTIMONY of

JON A. HIRSCH, TIMOTHY C. MISLEY, REED DAVIS,
KIM FODREA, and RANDY RUSSELL

Witnesses for Bonneville Power Administration

SUBJECT: LOAD FORECASTS

Section 1: Introduction and Purpose of Testimony

Q. Please state your names and qualifications.

A. My name is Jon A. Hirsch and my qualifications are contained in WP-10-Q-BPA-25.

A. My name is Timothy C. Misley and my qualifications are contained in WP-10-Q-BPA-47.

A. My name is Reed Davis and my qualifications are contained in WP-10-Q-BPA-13.

A. My name is Kim Fodrea and my qualifications are contained in WP-10-Q-BPA-19.

A. My name is Randy Russell and my qualifications are contained in WP-10-Q-BPA-55.

Q. Please state the purpose of your testimony.

A. The purpose of this testimony is to describe and answer anticipated questions concerning the Loads and Resources Study (Study), WP-10-E-BPA-01. Additionally this testimony sponsors the Study, WP-10-E-BPA-01, of Bonneville Power Administration's (BPA) 2010 Wholesale Power Rate Case Initial Proposal, and the 2010 Wholesale Power Rate Case Initial Proposal Loads and Resources Study Documentation (Documentation), WP-10-E-BPA-01A.

Q. How is your testimony organized?

A. The Loads and Resources testimony contains 11 sections including this one. Section 2 discusses the process used to generate the total retail load forecasts for the public body and cooperative utilities and Federal agencies (together called "Public Agencies") served by BPA. Section 3 describes the Priority Firm (PF) sales forecasting process. Section 4

addresses the forecast of sales to the investor-owned utilities (IOU) and direct service industries (DSI). Section 5 discusses Residential Exchange forecasts. Section 6 describes the Loads and Resources Study process. Section 7 describes the hydro regulation studies. Section 8 describes BPA's Federal system generating resources. Section 9 addresses the treatment of Federal system contracts. Section 10 describes the treatment of Federal system transmission losses. Section 11 addresses PNW regional total hydro resources for the Market Price Forecast Study.

Section 2: Public Agencies Total Retail Load Forecasts

Q. Please describe the process used to produce the Public Agency Total Retail Load Forecasts.

A. BPA routinely produces or obtains from its customers, forecasts of its customers' total retail loads, which are used in BPA processes such as ratemaking. A description of the process or method used to produce the Public Agency total retail load forecasts is contained in the Loads and Resources Study, WP-10-E-BPA-01, Section 2.2.2. In general, the forecasting method uses a least squares regression approach on monthly historical energy values. The method uses a customer's monthly total retail load as the dependant variable and several independent variables in the regression equation. Independent variables can include indicator variables for months, a time trend variable, and heating and cooling degree days. This method produces monthly forecasts of total retail load for each customer.

Q. Is this process different than has been used in the past?

A. Yes. This is a change from the previous process of using a time series approach to project annual total retail loads based on annual historical values. The previous method shaped the annual projections to months and diurnal periods using recent historical data.

Q. Why did you change processes?

A. This new method allows us to explicitly model the effects of weather on the total retail load of each customer. In addition, because the new method is also applied in a forecasting tool created for BPA, a single consistent and uniform process can be applied by all forecasting analysts (analysts) agency-wide. Thus efficiencies are gained when one forecast can be used for both the Power and Transmission business units. Also, as more data are gathered, it can be used in the regression process to explicitly model the effects of other independent variables on total retail load.

Q, How is the customer involved in the process?

A. A BPA analyst will contact or meet with the customer to learn about potential new additional load or load loss in the customer's service territory. They will review the growth rate the analyst has developed and discuss new facilities that are being planned for in the customer's service territory. If the growth rate of the analyst's forecast does not reflect the new load additions or load loss, the analyst will add to the customer's forecast the new facility as a new project being developed, or will subtract the load loss. The facility will be modeled with the new information.

Q. Is this all to the process?

A. Not quite. The analyst will then review the forecast considering all of the information obtained from the customer. If the forecast as prepared does not quite reflect the growth as anticipated by the analyst, the analyst will adjust the forecast accordingly.

Section 3: PF Sales Forecasting Process

Q. Please generally describe the forecasting process for its power sales contract (PSC) obligations.

A. The forecast of Public Agency total retail loads described above is used as the basis for the PF sales obligation forecast. Customer-owned generation amounts and/or contract power purchase amounts are subtracted from their total retail load forecast to produce a sales obligation forecast for those customers for whom BPA follows the load. For the Slice/Block and Block customers, BPA's sales obligations are those designated by contract. Details pertaining to the Federal PSC obligation forecasting process are contained in the Study, WP-10-E-BPA-01, Section 2.2.2.

Q. Please summarize the growth exhibited in the Public Agency sales obligation forecast.

A. Full Service customer PSC obligations are projected to grow at an average annual rate of approximately 2.2 percent from FY 2010 to FY 2011. Partial Service customer PSC obligations are projected to grow at an average annual rate of about 2.9 percent from FY 2010 to FY 2011. Overall, PSC obligations for which BPA follows the load obligation are projected to grow at an average annual rate of about 2.5 percent from FY 2010 to FY 2011. Block sales and Slice Block sales are fixed by contract and are projected to remain constant over the same period. BPA's total non-Slice Public Agency PSC obligations served at PF rates are projected to grow by 1.7 percent from FY 2010 to FY 2011.

Q. The growth rate for the Load Following customers of 2.5 percent seems rather high. Please explain what is causing this amount of growth?

A. The forecast was completed in the summer of 2008 with the information available at that time. It included anticipated growth assuming that there would be some economic slowing associated with the then impacts of the housing situation. We did not expect the financial collapse experienced in October or the depth of recession that we are now

experiencing. We are completing a customer by customer review of the recession impacts and will include that forecast in the Final Proposal.

Q. Please state what billing determinants are used for each product purchased.

A. PSC obligation forecasts are needed for both the Full and Partial Service product customers. These obligation forecasts include the four billing determinants used in the PF rate schedule. These billing determinants are heavy load hour (HLH) energy, light load hour (LLH) energy, generation system peak, and load variance. Billing determinants for Block products, whether or not in conjunction with the Slice product, are specified by contract and no forecasts are required.

Q. How did you forecast Public Agency Full Service customer energy sales?

A. A description of how we forecast Public Agency Full Service customer PSC obligation is contained in the Study, WP-10-E-BPA-01, Section 2.2.2. In general, the forecasting method uses the least squares regression approach described earlier in testimony.

Q. Please describe how the HLH and LLH sales were developed for BPA's PSC obligation forecast.

A. We developed the HLH and LLH ratio based on historic relationships of HLH and LLH sales for each customer. These customer-by-customer relationships were used to divide the total monthly PSC obligations into heavy and light load hours. Then any sales made under the Firm Power Product and Services (FPS) rate schedule, such as Pre-Subscription or the Irrigation Rate Mitigation Product were subtracted to derive sales at the PF rates.

Q. How did you forecast the PSC demand obligations for the Public Agency Full Service customers?

A. A description of our process for forecasting Full Service demand PSC obligations is contained in the Study, WP-10-E-BPA-01, Section 2.2.2. The process allows an analyst to use one of two approaches to forecast the PSC demand obligations. The first approach

uses a least squares regression technique, which is similar to that used to forecast energy but using historical demand data as the dependent variable. In this approach, the independent variables change slightly from those used in the energy models. In the second approach, the analyst can select a process that uses the monthly load factors from historical data to forecast the demand. This process will apply an average load factor obtained from historical data and apply that value to the monthly energy sales forecasts to project the PSC demand obligation.

Q. What determines which approach of forecasting demand the analyst will select?

A. To determine which approach to select, the analyst considers if the load factor is showing a trend of changing over time. If that is the case, then the analyst considers using the regression technique to capture the continuation of that trend. Also, if data indicate that the types of appliances in a customer's consumers' households are changing and will impact the load factor, then the analyst will model that changing relationship using the regression model.

Q. How do you use forecast demand to determine the demand billing determinant, BPA's Generation System Peak (GSP), or the load at the time of the BPA system peak?

A. In the BPA forecasting tool, an analyst calculates the historical relationship between GSP and the customer's demand. This relationship determines the GSP coincidental factor. This factor is then applied to the forecast demand produced earlier, providing the basic demand billing determinant (GSP) for use in the remainder of the ratemaking processes.

Q. Why have you created a GSP coincident factor that measures the relationship between a customer's demand and its load at the time of BPA's system peak?

A. To project revenues, a forecast of all elements which contribute to a customer's bill is required. In this case, the traditional demand forecast does not provide a forecast of the billing determinant (GSP) that BPA needs to calculate a customer's bill. In the

forecasting process it is therefore necessary to create and use a coincident factor that represents the GSP billing factor. The calculation of a coincident factor is performed by comparing a customer's load at the time of BPA's system peak with the customer's total demand.

Q. How did you forecast PSC energy obligations to Public Agency Partial Service customers?

A. A description of our process for forecasting Public Agency Partial Service customer PSC obligations is contained in the Study, WP-10-E-BPA-01, Section 2.2.2. The Partial Service customers' energy resources are subtracted from the total retail load energy forecast to derive BPA's energy PSC obligations. The energy sales projections are then split into HLH and LLH forecasts using the process described above for the Full Service customers. Sales made under the Firm Power Sale (FPS) rate schedule, such as Hungry Horse Reservation Pre-Subscription sales or the Irrigation Rate Mitigation Product are subtracted to derive PSC obligations sold at the PF rates.

Q. How did you forecast the demand PSC obligations for the Public Agency Partial Service customers?

A. A description of our process for forecasting Partial Service customer demand PSC obligations is contained in the Study, WP-10-E-BPA-01, Section 2.2.2. Monthly load factors are applied to the energy PSC obligation forecasts to derive demand PSC obligation forecasts by month. The Partial Service customers' monthly estimated resource demands are then subtracted to derive the demand PSC obligation forecast.

Q. How was the billing determinant for the Load Variance charge estimated?

A. The Load Variance rate is charged against a utility's total retail load for those utilities purchasing the Full and Partial Service products. The total retail load forecasts for

customers with products subject to the Load Variance charge were summed by product creating the Load Variance billing determinant.

Q. What historical time period did you use in the estimation of its loads and sales obligation forecast models?

A. The time period for the historical series of data on which BPA's loads and sales obligation forecasts is based varies by customer. In general, we used the historical data for FY 1998 through 2007, when possible, in total retail load and sales contract obligation forecasts. However, if discrete changes in a customer's historic loads or sales obligations occurred, changes in the length of the historical data streams may be incorporated to reflect the current conditions in the customer forecast.

Q. Why would the historical time period used in the estimation of BPA's loads and sales obligation forecast models vary?

A. For some customers, the historical data reflect long or near term changes that could possibly skew load growth trends. For example, BPA customers may have large (relative to their system) discrete consumer loads that started or ended during the historical period. The historic data provided to the loads and sales obligation forecast models in such instances, would take into account the most recent stable data.

Q. Are the historical data used in the forecast period adjusted for weather?

A. No, we do not weather adjust the historical data. We believe that the regression approach models the impact of weather on the load. The models then use temperatures averaged over the last 30 years as the expected temperature in the future. Temperature is the only weather variable we use in the modeling process. We believe that the monthly temperature reflects effects of other variables on a monthly basis to capture the effects of most weather conditions on loads.

Q. Do your models reflect price elasticities?

A. No, we do not reflect the effects of price elasticities in the Loads and Resources models. There are several reasons for not doing so. First, if we were to incorporate price elasticities in the models, we would need to be certain that, and the extent to which, the wholesale rate changes are being incorporated into retail rates. That is, consumers will only respond to changes in BPA's rates to the extent utilities reflect those changes in their retail rates. Second, it is problematic to develop an overall price elasticity since different consuming sectors (residential, commercial, industrial, etc.) presumably have different retail rate structures and perhaps different elasticities. Third, since wholesale power costs are only a portion of a utility's total retail rates, wholesale price changes are muted to a certain extent. Finally, some customers may supply part of their retail load from sources other than BPA. The costs of these resources, to which we are not privy, would go into their retail rate calculations as well.

In addition, when considering elasticities for other analyses in the past, we concluded there are rather small price elasticity effects. Incorporating a rather complex adjustment for an insignificant effect was deemed inefficient and impractical. Given that we are proposing fairly small changes to its wholesale power rates design, any expected elasticity effects would be insignificant. Finally, the sales to which price elasticities would apply (those for whom BPA follows their load) is about 3,700 aMW, while the sales that would not be influenced by price elasticities accounts for about 3,400 aMW. This, too, makes the impact of including a price elasticity adjustment relatively insignificant.

Q. Are any adjustments made to the aggregate PSC obligation forecast?

A. Yes, the aggregate sum of the individual utility forecast of PSC obligations is adjusted by an incremental reduction of 21 aMW per year beginning in FY 2007 for the rate period to

reflect projected savings from bilateral conservation acquisition agreements. The reductions from these bilateral conservation acquisition agreements are estimated at 84 aMW for FY 2010 and 105 aMW for FY 2011.

Q. Are individual customer sales data adjusted by accounting for historical conservation before producing your forecasts?

A. No, individual customer sales data are not adjusted to account for the effects of historical conservation savings.

Q. Does reducing the aggregate forecast by 21 aMW per year produce a forecast that is too low?

A. We do not believe so. Conservation and energy efficiency measures such as building codes will continue to save an increasing amount of energy over time as houses built to those codes become an ever-increasing share of the housing stock. Items like compact fluorescent lights and more efficient appliances will continue and perhaps increase in use as technology improves and costs come down. Where such conservation measures have already occurred in a customer's energy consumption, we believe a lower growth rate is a reasonable outcome. However, when bilateral agreements are negotiated to provide conservation savings it is reasonable and appropriate to reflect those savings in the PSC obligation forecast.

Q. Are the PSC obligation forecasts reduced for savings achieved through BPA's conservation rate credit programs?

A. Not explicitly. The PSC obligation forecasts are produced using historic consumption. These forecasts reflect the savings impact from customer activities taken pursuant to BPA rate credit programs. However, because the rate credit programs are not directed at specifically acquiring conservation savings, we are not forecasting conservation savings that may be achieved through such programs. To the extent a customer has used

conservation rate credit funds to achieve conservation savings those savings will be reflected in the historical loads and a lower growth rate than would have been the case absent the conservation rate credit.

Section 4: IOU and DSI Sales Forecasts

Q. What do you forecast for IOU PSC obligations during the rate period?

A. We forecast no PSC obligations to the IOUs at the New Resources rate. IOUs may receive benefits under the Residential Exchange Program but these benefits are not forecast to be in the form of actual power deliveries. *See* Study, WP-10-E-BPA-01, Section 2.2.3.

Q. What is your forecast for DSI sales during the rate period?

A. Our forecast was complete prior to the opinion of the U.S. Court of Appeals for the Ninth Circuit in *Pacific Northwest Generating Cooperative, et al., v. Bonneville Power Administration*, No. 05–75638, slip op. at 16513 (9th Cir. Dec. 17, 2008) (*PNGC*). The *PNGC* opinion, if finalized by the Court, would change our forecast of DSI sales, depending on BPA's decisions made outside of this proceeding on how to serve the DSIs. *See* the testimony of Bliven and Lefler, WP-10-E-BPA-10. Therefore, our answer reflects our forecast completed prior to the PNGC opinion.

We forecast actual physical sales of power to the DSIs will be 17 aMW per year over the FY 2010 through 2011 period. This will be a sale of surplus power for each year of the rate period to a local preference customer for delivery to Port Townsend Paper. *See* Study, WP-10-E-BPA-01, Section 2.2.4.

Section 5: Residential Exchange Forecasts

Q. Your study states that the residential exchange forecasts were reviewed by BPA and found reasonable and so were used as submitted. Were the COUs' and IOUs' total load forecasts found reasonable in your view?

A. Yes. Historical data on each IOU were obtained from the customers' financial reports. The forecast loads were then compared to the historical data and two reviews were made. The first review was a comparison to make sure that the starting year of the forecast was similar to the ending year of the actual data. We made sure that the load levels in the forecasts by each customer were similar to historical levels. The second review was to compare the forecast average annual growth rate to the historical average annual growth rate. We reviewed the cause of any load changes whenever a customer indicated that growth rates would be changing dramatically from historical levels. We determined through both checks that the forecasts produce reasonable results.

Q. Were the COUs' and IOUs' residential and small farm exchange load forecasts found reasonable in your view?

A. Yes. We reviewed the ratio of the forecast exchange loads to the total forecast loads and determined they were reasonable when compared to the ratio of the residential loads to the total loads. Additionally, we compared the forecast average annual growth rate of the residential and small farm exchange loads to the average annual growth rate of the total forecast load to make sure that growth rates were consistent. We determined both forecasts were reasonable.

Q. Did you review the reasonableness of the distribution loss factors or the NLSL assumptions in either the total retail load or residential and small farm exchange load forecasts?

A. No. BPA is determining the reasonableness of the utility's distribution loss factors and NLSL assumptions in the ASC Review Process. If either of these items is changed as a

result of the ASC Review Process, BPA will update the total retail load and residential and small farm exchange load forecast to reflect the final determinations made in the ASC Review Process.

Section 6: Loads and Resources Study Process

Q. What is the process entailed to produce the loads and resources for this Study?

A. The loads and resources study process is used to compute the Federal system loads and resources balance for the Study. We compile supporting data from forecasts, contracts, and computer models to estimate the Federal system loads and resources balance. The loads and resources balance compiles the monthly energy amounts of BPA's resources, which include hydro, non-hydro, and contract purchases; less BPA's load obligations, which are comprised of BPA's PSC obligations and other contract obligations. This determines BPA's monthly and annual energy loads and resources balance. BPA determines the amount of its annual forecasted firm energy resources under 1937 critical water conditions. If BPA's expected firm energy resources under critical water conditions are sufficient to serve BPA's expected load obligations, then BPA is considered to be in load/resource balance. If BPA's resources are less than its load obligations, BPA can purchase power or otherwise secure resources to meet Federal system annual energy deficits. Data contained in the loads and resources balance are used as input to the Market Price Forecast Study, WP-10-E-BPA-03, the Risk Analysis and Mitigation Study, WP-10-E-BPA-04, and the Wholesale Power Rate Development Study (WPRDS), WP-10-E-BPA-05.

Q. Why does the Study use 1937 water conditions to represent the critical period?

A. The critical period or critical water condition means the time period when the hydro system produces the least amount of power while taking into account the historical

streamflow record, power and non-power operating constraints, the planned operation of non-hydro resources, and system load requirements. For operational purposes, the critical period adopted by BPA is September 1936 through April 1937 water conditions. However, to align with fiscal years used in this Study, BPA uses the historical streamflows from October 1936 through September 1937 water conditions as the critical period. This is termed "1937 critical water conditions." The hydro generation estimates under 1937 critical water conditions determine the critical period firm energy for the regulated and independent hydro projects. This is called the Firm Energy Load Carrying Capability (FELCC).

Q. How are the Federal system loads, sales, and contract obligations treated in the Study?

A. The Study treats all Federal system loads, sales, and contract obligations as firm obligations that are served regardless of weather, water, or economic conditions. The forecast of Federal system sales and contract obligations are summarized monthly, for energy in aMW, in the Documentation, WP-10-E-BPA-01A, Section 2.3, Tables 2.3.1 through 2.3.3, *Loads and Resources-Federal System, (2002 PSC Sales), (Slice Sales), (Exports)* and *(Intra-Regional Transfers (Out))*. These obligations are detailed monthly, for energy in aMW, HLH MWh, and LLH MWh in the Documentation, WP-10-E-BPA-01A, Sections 2.4 through 2.6, Table A-2, *Exports*, Table A-16, *Intra-Regional Transfers*, and Table A-22, *BPA PSCs*. These obligations are used as input to the Risk Analysis and Mitigation Study, WP-10-E-BPA-04, and the WPRDS, WP-10-E-BPA-05.

Q. How are the Federal system resources and contract purchases treated in the Study?

A. Federal system resources are grouped in the following manner: hydro resources, non-hydro resources, and contract purchases.

Federal system hydro resources include regulated and independent hydro projects. The generation forecasts for regulated hydro resources are produced using BPA's hydro

regulation simulation model, HYDSIM. Federal system independent hydro project generation estimates are not provided by HYDSIM; rather, they are provided by each project's owner for the same 70 water years. The energy, in aMW, of the total Federal system hydro resources using 1937 critical water conditions is summarized in the Documentation, WP-10-E-BPA-01A, Section 2.3, Tables 2.3.1 through 2.3.3, *Loads and Resources-Federal System*, *(Regulated Hydro)* and *(Independent Hydro)*. The hydro energy is detailed in the Documentation, WP-10-E-BPA-01A, Section 2.4, Table A-3, *Federal Regulated Hydro Projects* and Table A-4, *Federal Independent Hydro Projects*.

The monthly output of the hydro system varies greatly, depending on the season and water conditions. The hydro regulation study provides 70 water year Federal hydro generation estimates for FY 2010 through 2011. The 70 water year data are used in the Risk Analysis and Mitigation Study, WP-10-E-BPA-04, and presented in the Risk Analysis and Mitigation Study Documentation, WP-10-E-BPA-04A, Tables 3 and 4.

The Study assumes that all Federal system non-hydro resources and contract purchases are firm resources available to meet Federal obligations, regardless of weather, water, or economic conditions. The expected generation from non-hydro resources and contract purchases are summarized monthly, for energy in aMW, in the Documentation, WP-10-E-BPA-01A, Section 2.3, Tables 2.3.1 through 2.3.3, *Loads and Resources-Federal System*, *(Imports)*, *(Renewables*), *(Large Thermal)*, *(Non-Federal Canadian Entitlement Return for Canada)*, *(Intra-Regional Transfers (In))*, and *(Non-Utility Generation)*. These data are detailed monthly for energy in aMW, HLH MWh and LLH MWh in the Documentation, WP-10-E-BPA-01A, Sections 2.4 through 2.6, Table A-5, *Federal Imports*, Table A-8, *Federal Renewable Resources*, Table A-10, *Federal Large Thermal*, Table A-15, *Canadian Entitlement Return for Canada*, Table A-16, *Intra-Regional Transfers (In)*, and Table A-24, *Federal Non-Utility Generating Resources by*

Project. These data are provided for the Risk Analysis and Mitigation Study, WP-10-E-BPA-04, and the WPRDS, WP-10-E-BPA-05.

Section 7: Hydro Regulation Studies

Q. Please describe how you estimate the generation from Columbia River Basin hydro projects for the Study.

A. We use the hydro regulation simulator model, HYDSIM, to produce hydro regulation studies that estimate the Federal system energy production that can be expected from specific hydroelectric power projects in the PNW Columbia River Basin when operating in a coordinated fashion and meeting power and non-power requirements for the 70 water years of record (October 1928 through September 1998). The hydro regulation study uses plant operating characteristics and conditions to determine energy production expected from each specific project. Plant operating characteristics of each project are provided by annual Pacific Northwest Coordination Agreement (PNCA) data submittals. We compile these data submittals for PNCA members involved in the coordination and operation of regional hydro projects. The HYDSIM model incorporates the plant operating characteristics along with power and non-power requirements to provide project-by-project monthly energy generation estimates for the Federal system regulated hydro projects that vary by water year for FY 2010-2011.

BPA hydro generation estimates also incorporate expected hydro improvement generation increases due to: 1) hydro improvements from hydro optimization; 2) turbine runner replacement; and 3) reliability increases through BPA's capital improvement programs at specific Federal regulated hydro projects. These generation increases are not calculated in the hydro regulation studies. Instead, the increased generation associated with these hydro improvements is calculated by multiplying a project's specific hydro

improvement generation factor by that project's generation projection. The Federal system hydro improvement forecast varies by fiscal year and water year.

Q. Please describe the primary drivers of reservoir operations in the hydro regulation studies.

A. The HYDSIM studies incorporate the power and non-power operating requirements expected to be in effect during the rate period, including those described in the National Oceanographic and Atmospheric Administration Fisheries (NOAA Fisheries) FCRPS Biological Opinion (BiOp) regarding salmon and steelhead, published May 5, 2008; the United States Fish and Wildlife Service (USFWS) FCRPS BiOp regarding bull trout and sturgeon, published December 20, 2000; the USFWS Libby BiOp regarding sturgeon and bull trout, published February 18, 2006; relevant operations described in the Northwest Power and Conservation Council's Fish and Wildlife Program; and other fish mitigation measures. Each hydro regulation study specifies particular hydroelectric project operations for fish, such as seasonal flow objectives, minimum flow levels for fish, spill for juvenile fish passage, reservoir target elevations and drawdown limitations, and turbine operation efficiency requirements.

Additionally, HYDSIM uses hydro plant operating characteristics in combination with the power and non-power requirements to simulate the coordinated operation of the hydro system. These operating requirements include, but are not limited to, storage content limits determined by rule curves, maximum project draft rates determined by each project, and flow and spill objectives determined by the BiOps as provided by the 2008 PNCA data submittals. Deviations from the PNCA data submittals occur when specific operating decisions are made subsequent to the date of submission in order to implement the BiOps.

Q. Does this Study reflect the current method of reservoir operation in the PNCA planning process?

A. Yes, however, some deviations from the 2008 PNCA data submittals occurred when specific operating decisions were made subsequent to the time of submission in order to more accurately model anticipated operations for the rate period.

Q. Please describe the steps in the hydro regulation study.

A. There are two main steps that we incorporate to produce hydro regulation studies that estimate hydro generation production.

First, an Actual Energy Regulation study (AER step) is run in HYDSIM to determine the operation of the U.S. Federal hydro projects under each of the 70 historic water conditions while meeting the Firm Energy Load Carrying Capability (FELCC) produced in the PNCA final hydro regulation. In this step, the Canadian operation is fixed to that specified in the assured operating plan (AOP) and updated for changes specified in the detailed operating plan (DOP) for each year of the Study. The U.S. Federal, U.S. non-Federal, and Canadian reservoirs draft water to meet the Coordinated System FELCC, while continuing to meet individual reservoir non-power operating requirements. If possible, all projects draft to their Energy Content Curve (ECC) to produce secondary energy. The operation from the AER step determines the drafting rights of each of the projects for use in the operational study.

Second, a 70 year operational study (OPER step) is run in HYDSIM to meet the estimated regional firm loads developed for each year of the Study with any necessary deviations from the PNCA data submittals. The operation of the non-Federal projects is limited by the proportional draft points (PDP) developed in the AER step.

In summary the AER step is run to meet FELCC under PNCA planning assumptions, and the OPER step is run to meet estimated regional firm loads for each

study year with operating assumptions specific to each study year. The end result of these two steps is generally referred to as the hydro regulation study.

Q. Why did you move from a 50 year study to a 70 year study?

A. About two years ago BPA expanded the Loads and Resources Study from 50 historical water years (1929 through 1978) to 70 historical water years (1929 through 1998). This change provides a wider range of hydrologic conditions for assessing hydro power generation and the load-resource balance. The 70 water years are more likely to encompass the hydrologic conditions that actually occur during the 2010-2011 rate period. Prior to this Study, however, other data necessary for the Loads and Resources Study were only available for the 50 water years of record. We propose to adopt the 70-year study for use in the Study.

Q. What are the differences between the FY 2010 and 2011 hydro regulation studies?

A. The main differences in the hydro regulation studies for FY 2010 and 2011 are as follows:

1) The hydro availability factors used to model anticipated unit outages and the standard reserve requirements estimated for each study year. The 2010 hydro regulation study availability factors reflect outages associated with anticipated maintenance specific to that year, including Chief Joseph unit outages beginning in April 2010. The 2011 hydro regulation study availability factors reflect outages associated with anticipated maintenance specific to that year, including Grand Coulee Third Powerhouse unit outages beginning in April 2011. The availability factors are also adjusted to reflect the amount of reserve requirements estimated for each year, including the forecast wind reserve requirements (contingency reserves and increases and decreases in balancing reserves (INCs

and DECs)). *See* Generation Inputs Study, WP-10-E-BPA-08, for details on wind assumptions.

2) The loads assumed in HYDSIM are different in the two hydro regulation studies. The loads forecast incorporated in the 2011 hydro regulation study are slightly higher than the loads projected for the 2010 hydro regulation study mainly due to load growth.

3) The amount of anticipated hydro improvement varies with each year of the hydro regulation study. Hydro improvements are part of BPA's capital improvements programs.

Q. Please explain the difference between two modes of hydro regulation studies: refill and continuous.

A. There are two modes for hydro-regulation studies: refill and continuous. Both are used to estimate the energy production of the hydro system. However, each mode is different in how it treats initial reservoir conditions. Continuous hydro regulation studies operate from one water year to another, using the previous water year's final reservoir elevations as the initial reservoir elevations for the following water year. Refill hydro regulation studies operate each water year independent of all other water years, using the same initial reservoir elevation for each water year. For ratemaking, continuous hydro regulation studies are typically used because there is little or no information on initial reservoir elevations when considering operations for a future year. The FY 2010 and 2011 hydro regulation studies were run in the continuous mode.

Q. In the Loads and Resources Study, why is the hydro regulation study called a "70 year study?"

A. The hydro system operation under current operating requirements is simulated over the 70 historic water conditions from October 1928 through September 1998 (fiscal year

1929 through 1998) using BPA's hydro regulation simulation model HYDSIM. HYDSIM produces a monthly estimate of hydro energy production that could reasonably be expected from the hydropower system over a wide range of runoff conditions. The Federal hydro generation estimates under 70 water conditions are used as inputs to the Risk Analysis and Mitigation Study, WP-10-E-BPA-04, which estimates revenues and risks associated with various load, resources, and rate scenarios. The Federal hydro generation estimates under 70 water conditions are presented in the Risk Analysis and Mitigation Study Documentation, Tables 3 and 4, WP-10-E-BPA-04A.

Q. Please explain why BPA uses a 70 year hydro regulation study in the Study.

A. BPA uses the 70 year hydro regulation study because it is a historically prudent and reasonable way to forecast the expected operations of the regulated hydro projects for varying hydro conditions. Approximately 80 percent of BPA's Federal system resource stack is comprised of hydro generation that can vary annually by up to 4,825 aMW. Depending on water conditions, Federal hydro generation estimates for FY 2010 range from 6,735 aMW to 11,560 aMW. BPA uses the hydro regulation simulation model HYDSIM to estimate regulated hydro project generation for varying water conditions, which takes into account specific flows, volumes of water, elevations at dams, biological opinions, and many other aspects of the hydro system.

Additionally, BPA has generation estimates for other hydro projects that are based on 70 historical water conditions, 1929 through 1998. These projects are called "independent hydro" projects because their operations are not regulated in the HYDSIM model and they have much less storage capability than those hydro projects in the Columbia River Basin. The independent hydro projects usually have generation estimates for each of the 70 water years of record. Most of these hydro projects are not Federally-owned and must be updated with the cooperation of each project owner. For

those independent hydro projects that did not have data for 70 water years, generation estimates for those projects were expanded using the project's median generation to estimate generation for the additional water years.

Q. What has changed in the hydro modeling since the WP-07 Supplemental Final Proposal?

A. Several changes were made, including:

1) A minimum powerhouse flow requirement of 50,000 cubic feet per second (cfs) was added at Chief Joseph, because a few periods (June 1970, June 1971, and June 1984) had zero generation at the project in the 2009 rate case study. This is an unlikely operation, and a minimum powerhouse flow of 50,000 cfs is more realistic.

2) Availability factors were updated to include increased reserve requirements associated with new wind generating plants. These availability factors reduce the powerhouse capacity available for generation in HYDSIM. The wind assumptions are described in the Generation Inputs Study, WP-10-E-BPA-08.

3) The secondary market limit was increased from 9,000 MW to 10,000 MW based on observations of the market in the recent past.

4) The Mid-Columbia projects were included in the spill priority list based on observations of recent past operations. This priority list is used to allocate spill when the secondary market limit is reached in HYDSIM.

5) Vernita Bar, Chum, and McNary flow requirements were updated and given a higher priority than previous studies, which had been primarily driven by high priority reservoir elevation targets rather than flow targets.

6) Grand Coulee target elevations were updated in September, October, November, and December to better reflect actual operations.

7) Canadian Operations were updated to reflect recent past operations that had not previously been modeled, such as the Canadian trout spawning operation.

8) Voluntary spill for fish passage was updated to reflect the expected spill operations as of October 2008.

Q. Why were these changes made?

A. These changes were made as part of BPA's continual efforts to improve hydro regulation modeling and better reflect operations as guided by in-season management decisions under the 2008 BiOp.

Q. What was the effect of these changes?

A. These combined changes generally decreased annual average federal generation about 100 aMW under 1937 critical water conditions, while the 70 year average increased about 100 aMW.

Q. Was most of that change due to the wind-related assumptions?

A. While we have not analyzed the separate effects of each modeling change, we believe the most significant modeling change is not due to the wind-related assumptions, but is due to the change in modeling spring flow targets as a priority rather than operating to reservoir elevation targets.

Q. Will there be more changes in the hydro regulation studies for the Final Proposal?

A. Yes. In reviewing the hydro regulation studies for the WP-10 Initial Proposal we have found more improvements that we believe should be reflected in the WP-10 Final Proposal. These include:

1) Grand Coulee flood control requirements and associated draft limits will be updated to correct an error in the last twenty years of the study. When the HYDSIM rate case studies were expanded from 50 to 70 years, an error was made in the upstream storage adjustment of Grand Coulee's flood control requirements.

2) Spill assumptions will be updated to reflect the most current information on expected spill operations.

3) Grand Coulee's storage table will be updated to reflect the most recent information from Reclamation.

4) Additional minimum powerhouse flow requirements will be included to adequately cover wind DEC reserve requirements.

We also may find additional improvements as we continue working on and reviewing the rate case studies. Any such improvements will be included in the WP-10 Final Proposal.

Q. Do you expect these four changes listed above to make a significant difference to the regulated hydro generation?

A. No. The effects on generation estimates under the 70 year average and 1937 critical water conditions will likely be insignificant.

Section 8: Federal System Generating Resources

Q. How is the Federal system regulated hydro generation forecast in the Study?

A. The generation forecast for the Federal system regulated hydro projects is set by the hydro regulation study using the HYDSIM hydro regulation model. HYDSIM produces monthly energy generation estimates by project incorporating 70 historical water years (October 1928 through September 1998). The Federal system regulated hydro generation includes estimated generation increases due to capital improvements at specific Federal system projects. The detailed monthly energy, in aMW for each hydro project, is shown in the Documentation, WP-10-E-BPA-01A, Section 2.4, Table A-3, *Federal Regulated Hydro Projects*. The summarized HLH/LLH split of the regulated hydro is presented in the Risk Analysis and Mitigation Study, WP-10-E-BPA-04.

Q. How is the Federal system independent hydro generation forecast in the Study?

A. The generation forecast for Federal system independent hydro projects are not regulated by BPA in the HYDSIM model. Monthly average energy production estimates for the Federal system independent hydro projects are set by the project owners for the 70 historical water years (October 1928 through September 1998). Most of the hydro projects are not Federally-owned and must be updated with the cooperation of each project owner. For those independent hydro projects that did not have data for 70 water years, generation estimates for those projects were expanded using the project's median generation to estimate generation for the additional water years. The detailed monthly energy, in aMW for each hydro project, is shown in the Documentation, WP-10-E-BPA-01A, Section 2.4, Table A-4, *Federal Independent Hydro Projects.* The summarized HLH/LLH split of the independent hydro is presented in the Risk Analysis and Mitigation Study, WP-10-E-BPA-04.

Q. How are improvements to the Federal system hydro resource generation treated in the Study?

A. The Study includes expected increases in hydro generation for specific Federal regulated hydro projects resulting from BPA's capital improvements programs. These improvements are expected to increase and preserve Federal hydro generation by: (1) replacing turbine runners to preserve and increase hydro generation and to make the turbine operation more fish friendly; (2) providing increased reliability by decreasing forced and planned outages; and (3) implementing hydro system optimization and operational planning tools to increase generation efficiency. These improvements are estimated by regulated hydro project and vary by FY and water conditions and are included in that project's generation estimate. Using 1937 critical water conditions, generation increases are expected to yield as much as 122 aMW in FY 2010, increasing

to 128 aMW by FY 2011. *See* Documentation, WP-10-E-BPA-01A, Section 2.3, Table A-3, *Federal Regulated Hydro Projects*.

Q. What other Federal generation besides regulated and independent hydro are included in the Study?

A. In addition to the generation from the Federal system regulated and independent hydro projects, this Study includes the output of several generation projects contracted for or assigned to BPA. These resources are inputs to the Risk Analysis and Mitigation Study, WP-10-E-BPA-04, and the WPRDS, WP-10-E-BPA-05, and are presented as monthly energy in aMW as well as HLH MWh and LLH MWh. These projects include the following resources:

1) Renewable resources, which include cogeneration (Georgia Pacific (Wauna)) and wind (Federal purchases of shares of the Condon Wind Project, Foote Creek 1, 2, and 4 Wind Projects, Klondike Phase I Wind Project, Klondike III Wind Project, and Stateline Wind Project). These projects are detailed in the Documentation, WP-10-E-BPA-01A, Sections 2.4 through 2.6, Table A-8, *Federal Renewable Resources*;

2) CGS, which incorporates facility improvements and a two-year refueling cycle. CGS details are shown in the Documentation, WP-10-E-BPA-01A, Sections 2.4 through 2.6, Table A-10, *Federal Large Thermal*; and

3) Other projects that BPA has acquired the output from include small hydro (Elwha and Glines Hydro through September 30, 2011, and Dworshak/Clearwater Small Hydropower) and a small amount of solar resources (Ashland Solar Project and White Bluffs Solar). These projects are detailed in the Documentation, WP-10-E-BPA-01A, Sections 2.4 through 2.6, Table A-24, *Federal Non-Utility Generating Resources by Project*.

The Non-Utility Generation and Renewable Resources generation estimates are provided by BPA, using actual project output data or estimates provided by the project owner. The generation estimates for the Columbia Generating Station nuclear power plant are provided by Energy Northwest, Inc. The other Federal system generation estimates are summarized for monthly energy in aMW in the Documentation, WP-10-E-BPA-01A, Tables 2.3.1 and 2.3.2, *Loads and Resources-Federal System, (Renewables), (Large Thermal),* and *(Non-Utility Generation).*

Section 9: Treatment of Federal System Contracts

Q. Please describe how you treat Federal system contract obligations in the Study.

A. BPA's PSC obligations and other signed contract obligations are considered firm Federal system obligations. These contracts are assumed to be delivered by the Federal system regardless of weather, water, or economic conditions. These contracts are categorized as: (1) PSC obligations; (2) power or exchange contracts; (3) capacity or capacity-for-energy exchange contracts; (4) power payments for services; and (5) power commitments under international treaty.

These load obligations are summarized monthly, for energy in aMW in the Documentation, WP-10-E-BPA-01A, Section 2.3, Tables 2.3.1 through 2.3.2, *Loads and Resources-Federal System, (2002 PSC Sales), (Slice Sales), (Exports),* and *(Intra-Regional Transfers (Out)).* These contracts are detailed monthly, for energy in aMW, HLH MWh, and LLH MWh in the Documentation, WP-10-E-BPA-01A, Sections 2.4 through 2.6, Table A-2, *Exports*, Table A-16, *Intra-Regional Transfers (Out),* and Table A-22, *BPA PSCs* for the rate period. The PSC obligations and other signed contract obligations data are provided to the Risk Analysis and Mitigation Study, WP-10-E-BPA-04, and the WPRDS, WP-10-E-BPA-05.

Q. Please describe how BPA treats Federal system contract purchases in the Study.

A. BPA's PSC contract purchases are considered firm Federal system resources. These contract purchases are assumed to be received by the Federal system regardless of weather, water, or economic conditions. These contracts are categorized as: (1) power or exchange contracts; (2) capacity or capacity-for-energy exchange contracts; (3) power received for services; and (4) power received under international treaty.

BPA's expected contract purchases are summarized monthly, for energy in aMW, in the Documentation, WP-10-E-BPA-01A, Section 2.3, Tables 2.3.1 through 2.3.2, *Loads and Resources-Federal System*., *(Imports)*, *(Non-Federal Canadian Entitlement Return for Canada)*, and *(Intra-Regional Transfers (In))*. The monthly energy in aMW, HLH MWh, and LLH MWh is detailed in the Documentation, WP-10-E-BPA-01A, Sections 2.4 through 2.6, Table A-5, *Imports*, Table A-15, *Canadian Entitlement for Canada*, and Table A-16, *Intra-Regional Transfers (In)*. The contract purchases data are provided to the Risk Analysis and Mitigation Study, WP-10-E-BPA-04, and the WPRDS, WP-10-E-BPA-05.

Q. Please describe how BPA's surplus firm power contracts with Pacific Southwest (PSW) utilities were treated in the Study.

A. This analysis includes several contracts with the PSW utilities that contain power sales and capacity-for-energy exchange agreements. This Study assumes the contracts with the cities of Pasadena and Riverside are capacity-for-energy exchange agreements throughout the study period. *See* Documentation, WP-10-E-BPA-01A, Sections 2.4 through 2.6, Table A-2, *Exports*.

Q. Please describe how you treat FY 2010-2011 augmentation purchase contracts in the Study.

A. This analysis includes both signed and projected augmentation purchases to meet annual firm Federal system energy needs.

First, BPA retained Excess Requirements Energy (ERE) from some Slice customers. While this is not an acquisition of power, BPA nonetheless considers the Slice ERE energy as part of its firm augmentation for the rate period. The availability of Slice ERE for FY 2010 is 10.3 aMW and for FY 2011 is 7.6 aMW. Slice ERE is a result of a Letter Agreement that settled the implementation of Exhibit N of the Block and Slice Power Sales Agreement for FYs 2008-2011.

We also project system augmentation purchases to maintain annual Federal system firm energy loads and resources balance under 1937 critical water conditions. These system augmentation purchase estimates are assumed to be firm Federal system resources, purchased annually as flat energy. For FY 2010, the annual augmentation purchase is estimated to be 372 aMW and 599 aMW for FY 2011 and is summarized below in Table 9.1.

The augmentation purchases are shown monthly, for energy in aMW in the Documentation, WP-10-E-BPA-01A, Section 2.3, Tables 2.3.1 through 2.3.2, *Loads and Resources-Federal System, (Augmentation Purchases).*

Table 9.1
Projected Federal System Augmentation Purchase
Energy in Average Megawatts

	A	B
Fiscal Year	2010	2011
Augmentation Purchase	372	599

The monthly energy of these contracts for energy in aMW, HLH MWh, and LLH MWh, are inputs to the Risk Analysis and Mitigation Study, WP-10-E-BPA-04, and the WPRDS, WP-10-E-BPA-05.

Section 10: Federal System Transmission Losses

Q. Please describe your treatment of Federal system transmission losses in the Study.

A. Federal system transmission loss estimates are treated as generation reductions in the Study. The transmission losses are calculated as 2.82 percent of the energy output of all Federal system hydro, small and large thermal, renewable, non-utility generation resources, and contract purchases. This reduction allows transmission losses to be calculated monthly and to vary by water conditions. BPA's Transmission business unit provided the analysis of expected Federal system transmission loss factors for energy and demand load conditions. The Federal system transmission loss factors used in this Study were developed in 1992 and reaffirmed by BPA's Transmission business unit in 1994. These studies concluded the Federal system loss factors for BPA's transmission system are 2.82 percent for energy and 3.35 percent demand when averaged over the year.

The loss factors have several components that combine to give the estimate of losses typically associated with Federal system generation: (1) step-up transformers to the high voltage transmission network; (2) high voltage network distribution; (3) transfers through adjacent networks; and (4) step-down transformers to BPA customer meters. The estimated magnitude of those loss factor components for energy is as follows:

1) Step-up transformers between the Federal generation and the transmission network of 0.31 percent;

2) Network loss factor of 1.90 percent;

3) Some loads are transfer customers, which have additional losses crossing other transmission networks averaging 0.34 percent; and

4) Some loads have step-down transformer losses of 0.27 percent.

These assumed loss factors for load delivery to BPA customers have not changed since 1992.

The Federal system surplus energy availability reflects Federal system transmission losses that vary by water-year and is consistent with the Risk Analysis and Mitigation Study, WP-10-E-BPA-04. *See* Documentation, WP-10-E-BPA-01A, Section 2.3, Tables 2.3.1 through 2.3.2, *Loads and Resources-Federal System, (Federal Transmission Losses).*

Section 11: PNW Total Regional Hydro Resources for the Market Price Forecast Study

Q. Please describe the treatment of the regional hydro resources used in the Study.

A. To provide an additional input for the secondary revenue analysis used in the Market Price Forecast Study, WP-10-E-BPA-03, the Study develops a PNW total regional hydro resource stack for FY 2010 through 2011. The regional hydro resources include all regional regulated and independent hydro projects, plus regional non-utility generation (NUG) hydro projects. We estimate the monthly regional regulated hydro generation energy by project, for each of the 70 water years of record (October 1929 through September 1998) using HYDSIM. We forecast the monthly regional independent hydro generation energy by project, for each of the 70 water years of record by incorporating data provided by project owners. The generation estimates for the set of NUG hydro projects are not produced in the hydro regulation study; the individual NUG project owners provide these estimates. The total regulated, independent, and NUG regional hydro projections are summarized for 70 water years for FY 2010 through 2011 in the

Documentation, WP-10-E-BPA-01A, Section 2.7, Tables 2.7.1 through 2.7.2, *Pacific Northwest Regional Hydro Resources*. These estimates are presented in the Risk Analysis and Mitigation Study, WP-10-E-BPA-04, Tables 1 and 2 and are provided to the Market Price Forecast Study, WP-10-E-BPA-03.

Q. Does this conclude your testimony?

A. Yes.