EXHIBIT NO. _____ (CJB-1T)
DOCKET NO._____
2003 POWER COST ONLY RATE CASE
WITNESS: CHARLES J. BLACK

BEFORE THE

WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION

WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION, Complainant, v. PUGET SOUND ENERGY, INC., Respondent.	Docket No. _____

DIRECT TESTIMONY OF CHARLES J. BLACK ON BEHALF OF PUGET SOUND ENERGY, INC.

OCTOBER 24, 2003

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PUGET SOUND ENERGY, INC.

DIRECT TESTIMONY OF CHARLES J. BLACK

Q: Please state your name, business address and occupation.

A: My name is Charles J. Black. My business address is 10885 NE 4th Street, Bellevue, Washington, 98004. I am an energy economist, risk manager and resource planner.

Q: What were your responsibilities during development of PSE's Least Cost Plan?

A: I designed the overall process and coordinated many of the activities that resulted in completion of PSE's April 30, 2003 Least Cost Plan and the August 2003 Least Cost Plan Update. I performed a number of specific functions, including identification of resource planning issues, development of the analytical approach for the Least Cost Plan, preparation of the work plan and schedule, facilitation of Least Cost Plan Advisory Group meetings, and development of the outline and structure for the Least Cost Plan report documents.

Q: What is your professional and educational background?

A: My professional experience and education are described in **Ex. ____ (CJB-2)**.

I. PURPOSE AND CONCLUSIONS OF TESTIMONY

Q: What is the purpose of your testimony?

A: My testimony addresses PSE's determination of its need for new electric resources and its long-term resource strategy for meeting its need for new electric resources. PSE addressed these topics in depth as part of its most recent Least Cost Plan process. See PSE's Least Cost Plan, filed with the Commission on April 30, 2003 and PSE's Least Cost Plan Update, filed August 29, 2003 (collectively, the "2003 LCP"). See **Ex. ____ (CJB-3)** and **Ex. ____ (CJB-4)**, respectively.

Q: Please summarize your testimony.

A: My testimony covers the following topics:

1. Consistent with the requirements of the Washington Administrative Code (WAC 480-100-238), PSE developed its Least Cost Plan in consultation with WUTC Staff and with public involvement, including from a Least Cost Plan Advisory Group. In developing its resource strategy, PSE performed integrated portfolio analysis that incorporates explicit modeling of key uncertainty factors. The strategy also reflects judgment and policy direction regarding risk management and resource diversity, including recommendations from the 2003 Update to the Washington State Energy Strategy.
2. Two primary objectives that PSE considered in developing its Least Cost Plan are cost minimization and risk management.
3. In the April 30 Least Cost Plan, PSE evaluated a broad range of electric resource sufficiency standards, or portfolio planning levels. The Company used extensive analysis and its best judgment to adopt a portfolio planning level for energy and a portfolio planning level for capacity.
4. PSE has an existing need for new electric resources, largely as the result of expiration of long-term power supply contracts in the Company's electric resource portfolio.
5. PSE's need for new resources is projected to increase further during the next 20 years, partly due to further expiration of long-term power supply contracts and partly due to forecasted growth in retail electric customer loads.
6. PSE also evaluated various mixes of new resources to meet its existing need for new resources and to meet the projected growth in need over the long-term. The Company used extensive analysis and its best judgment to adopt a balanced resource strategy that includes a diversified mix of new electric resources to be acquired in stages throughout the 20-year planning period.

7. PSE's electric resource strategy includes aggressive goals to acquire new conservation resources and renewable resources. In order to meet the need for new resources, the resource strategy also includes goals for acquisition of a mix of new thermal resources.

8. PSE has developed a resource acquisition plan to implement its electric resource strategy.

9. PSE uses many of the same analytical approaches, modeling tools and assumptions that were used for the Least Cost Plan to evaluate specific resource acquisition opportunities.

10. PSE is continuing to update the analytical approaches, modeling tools and assumptions that it uses to support its resource planning and acquisition activities.

II. OVERVIEW OF PSE'S LEAST COST PLAN RESULTS

Q: What resource sufficiency standard did PSE use for its Least Cost Plan?

A: Based on extensive analysis and its best judgment, PSE adopted a resource sufficiency standard, or "portfolio planning level", as part of its April 30 Least Cost Plan. The portfolio planning level includes firm energy resources sufficient to serve the needs of PSE's retail electric customers during each month, assuming 40-year average hydroelectric generation. The portfolio planning level also includes capacity resources sufficient to serve the peak loads of PSE's retail electric customers on winter days that the minimum-hour temperature at Sea-Tac Airport drops to 16 degrees Fahrenheit.

Q: Does PSE have an existing need for new electric resources at the portfolio planning level described above?

A: Yes, it does. For example, PSE's analysis for the April 30 Least Cost Plan identified a need for new energy resources, including conservation and generation, of 427 average

megawatts (aMW) in 2004. For the August Least Cost Plan Update, the 2004 need for new energy resources was revised to 436 aMW. **Ex. ____ (CJB-5).**

Q: What are some of the major causes for PSE's existing need for new resources?

A: The largest factor affecting the Company's existing need for new electric resources is the expiration during 2002 and 2003 of several long-term power supply contracts in PSE's electric resource portfolio. Two of these contracts alone provided a combined annual average of 195 megawatts of energy. **Ex. ____ (CJB-3)** at Ch. IX, p.2.

Q: Is PSE's existing need for new resources the same during all parts of the year?

A: No. The Company's existing and mid-term need for new energy resources has a seasonal profile or "shape". The need for new resources is largest during the winter months when PSE's retail electric loads are highest. The need for new resources is generally smaller during other months of the year. **Ex. ____ (CJB-3)** at Appendix F.

Q: Is PSE's need for new resources expected to change in the future?

A: Yes. The Company's need for new electric resources is expected to grow during the next 20 years. For example, the April 30 Least Cost Plan identified a need for new energy resources, including conservation and generation, of 1,729 aMW in 2013. **Ex. ____ (CJB-5).** For the August Least Cost Plan Update, the 2013 need for new energy resources was revised to 1,715 aMW. **Ex. ____ (CJB-5).**

Q: What factors will cause PSE's need for new resources to increase in the future?

A: Future increases in the need for new resources are expected to result from the expiration of additional long-term power supply contracts and the cumulative effects of forecasted growth in the loads of PSE's retail electric customers.

Q: Are there other factors that influence PSE's need for new electric resources?

A: Yes. I will address these factors in detail below. I will also provide specific results from the determination of PSE's need for new electric resources.

Q: What types of resources are included in PSE's long-term electric resource strategy?

A: PSE's resource strategy includes a diversified mix of new resources, including aggressive goals for conservation, a goal to meet 10 percent of PSE's retail electric customers' energy needs with renewable resources by 2013, and a mix of thermal generating resources. I will describe PSE's electric resource strategy in more detail below.

III. PROCESS AND OBJECTIVES FOR PSE'S LEAST COST PLAN

A. Least Cost Plan Involvement Process

Q: What involvement process did PSE follow to develop its Least Cost Plan and electric resource strategy?

A: The Company developed its Least Cost Plan in consultation with Commission Staff and through an extensive series of meetings with PSE's Least Cost Plan Advisory Group. PSE also issued draft Least Cost Plan reports for public review and comment on December 31, 2002, March 31, 2003, and July 31, 2003.

Q: Who were the participants in PSE's Least Cost Plan Advisory Group?

A: In addition to PSE and Commission Staff, the Least Cost Plan Advisory Group meetings during 2002 and 2003 included participation by representatives of various organizations, including the Northwest Energy Coalition; Renewable Northwest Project; Public Counsel, Washington Attorney General's Office; Washington Department of Community, Trade and Economic Development; Opportunity Council/Energy Project; Northwest Power and Conservation Council; PSE industrial

customers; PSE commercial customers, King County; wind power developers; and the Northwest Independent Power Producers Coalition.

Q: Did consultation with Commission Staff and meetings with the Least Cost Plan Advisory Group influence PSE's Least Cost Plan process and results?

A: Yes, in very favorable ways. Throughout development of the Least Cost Plan, Commission Staff and members of the Least Cost Plan Advisory Group helped PSE identify important issues. PSE addressed many of these issues in development of its Least Cost Plan. Commission Staff and members of the Least Cost Plan Advisory Group also made a number of practical suggestions for methods that PSE could use to address those issues. PSE implemented many of these suggestions. Overall, this process was very constructive and assisted PSE in developing a more complete and robust Least Cost Plan.

B. Objectives For Least Cost Plan

Q: What objectives did PSE consider in developing its Least Cost Plan?

A: The two major objectives that PSE considered were (1) minimization of long-term expected costs to PSE and its retail electric customers, and (2) management of risks.

Q: Do these objectives address requirements that the Commission has established for development of Least Cost Plans by PSE?

A: Yes. For example, Washington Administrative Code 480-100-238 requires PSE to biennially develop a Least Cost Plan "...describing the mix of generating resources and improvements in the efficient use of electricity that will meet current and future needs at the lowest cost to the utility and its ratepayers." Further, in a letter to PSE dated August 28, 2001, the Commission noted that "[i]n fulfilling this rule, PSE must balance price, supply, and weather risks against the directive to minimize costs."

IV. ANALYTICAL METHODS, INPUTS AND MODELS

A. Analytical Approach

Q: Please summarize the analytical approach that PSE used to develop its Least Cost Plan.

A: PSE followed an integrated resource planning approach to develop its Least Cost Plan. The approach that PSE used treats the electric resource portfolio as an integrated whole. This approach captures dynamic interactions between various parts of the portfolio, including PSE's retail electric loads, its existing electric resources and potential new resources. It also identifies net impacts on cost and risk for the overall portfolio. Further, for potential new resources, the approach focuses primarily on 'generic' electric resource technology alternatives (*e.g.*, conservation programs, wind power, combined-cycle gas turbines, single-cycle gas turbines, conventional coal-fired generation), rather than focusing on particular project-specific details of specific resource acquisition opportunities. This allowed PSE to develop a more comprehensive and integrated view of the effect of adding various resource types to its overall portfolio. PSE developed and used a computer-based portfolio simulation model to evaluate alternative resource strategies, with explicit assessment of key uncertainty factors. In addition, development of the Least Cost Plan incorporated policy and judgment decisions regarding resource diversity and risk management. I describe these in more detail in the following sections of my testimony.

Q: Please provide a pictorial representation of the analytical approach that PSE used to develop the Least Cost Plan.

A: A flowchart that summarizes the modeling analysis that PSE performed for its April 30 Least Cost Plan and August Least Cost Plan Update is provided as **Ex. ____ (CJB-6)**.

B. Forecasts And Assumptions

Q: What types of forecasts and assumptions did PSE use for its Least Cost Plan?

A: PSE collected and used extensive information to develop the Least Cost Plan, including various forecasts and other assumptions. Examples of these inputs include the following:

(1) forecasts of PSE's retail electric loads;

(2) information about existing resources in PSE's electric resource portfolio;

(3) information about potential new electric generating resources, including fixed and variable costs, generation profiles, etc.;

(4) economic and financial assumptions including inflation rates, interest rates, costs of equity and debt-equity ratios for investment in new generation resources by technology-type;

(5) information about conservation resource potential and costs;

(6) forecasts of market prices for natural gas;

(7) forecasts of market prices for power; and

(8) probability distributions and correlations for key uncertainty factors including natural gas prices, hydroelectric generation and power prices.

Q: How did PSE develop forecasts of its retail customers' electric loads?

A: PSE used econometric modeling techniques to develop forecasts for energy and winter peak loads of its retail electric customers. Annually, PSE develops a forecast of billed retail sales, which is converted into a monthly total Generated, Purchased and Interchanged amount (GPI) in order to be used in load/resource models. The forecast used for April 30 Least Cost Plan is shown in **Ex. ____ (CJB-7)**. The forecast used for the August Least Cost Plan Update is shown in **Ex. ____ (CJB-8)**.

Q: Please describe the assumptions that PSE made about its existing electric resources.

A: The LCP covers a twenty-year planning horizon, during which many resource contracts are scheduled to expire. PSE assumed that its Mid-Columbia hydroelectric contracts would be extended at their current prices, and that small QF contracts would also be extended at market price. An overview of the assumptions about the future availability and other characteristics of PSE's existing electric resources – including expiration of existing resources – that were used for the April 30 Least Cost Plan are provided in **Ex. ____ (CJB-9)**. Revisions to these assumptions for the August Least Cost Plan Update are provided in **Ex. ____ (CJB-10)**.

Q: What assumptions did PSE make about its existing long-term cogeneration contracts?

A: PSE assumed that the large QF contracts continue in effect through the remaining term of the agreements.

Q: Did PSE assume that the existing cogeneration contracts will be renewed or extended?

A: No. While it is possible that one or more of the contracts could be renewed or extended, such an outcome would be speculative.

Q: Please describe the assumptions that PSE used for potential new electric generating resource alternatives.

A: An overview of the assumptions about costs and other characteristics of generic types of new generating resources that PSE used for the April 30 Least Cost Plan is provided in **Ex. ____ (CJB-11)**. Revisions to these assumptions for the Least Cost Plan Update are provided in **Ex. ____ (CJB-12)**. Five different electric generating technologies were considered:

(1) Combined-Cycle Gas Turbine: two-by-one configuration of two turbines and one heat recovery system, for a total capacity of 516 MW at a heat rate of 6,900 Btu/kWh;

(2) Single Cycle Gas Turbine: Capacity of 168 MW at a heat rate of 11,700 Btu/kWh. This technology represents a traditional peaking resource with a lower capital cost but lower fuel-to-electric conversion efficiency than combined-cycle gas turbine technology;

(3) Duct-firing: An additional 70 MW at a heat rate of 9100 Btu/kWh could be added to the combined cycle gas turbine (used in the Portfolio Screening Model, but not the AURORA Optimizing model);

(4) Coal: represented by a 900 MW plant at a heat rate of 9,425 Btu/kWh with costs based on a new supercritical boiler design; and

(5) Wind: represented by a 100 MW capacity plant, which reflects economies of scale.

The information for the three thermal technologies was provided by Tenaska, Inc., a consulting firm that performed an assessment of self-build generation opportunities for PSE. This assessment was provided as an appendix to the April 2003 LCP. **Ex. ____ (CJB-3)** at Appendix H. The information for wind power technology came from the U.S. Energy Information Agency (EIA) Annual Energy Outlook dated 2003. Solar power was not considered in depth because its very high capital costs make it currently uneconomic for utility-scale resource development.

Q: Please describe the economic and financial assumptions that PSE made about new electric generating resources.

A: An overview of the economic and financial assumptions for new electric generating resources that PSE used for the April 30 Least Cost Plan is provided in **Ex. ____(CJB-13)**. Revisions to these economic assumptions for new electric generating resources

for the August Least Cost Plan Update are provided in **Ex. ____ (CJB-14)**. One set of assumptions addressed development of new generating resources by three types of market participants: public-owned utilities (POUs), investor owned utilities (IOUs), and independent power producers (IPPs). For each of these entities, PSE made assumptions about their financing costs and their level of participation in the development of new resources. For example, the average cost of capital assumed in the modeling analysis was 6.5% for POUs, 9.3% for IOUs, and 14% for IPPs, based on their debt/equity ratios and expected rates respectively. The cost of capital, together with assumptions about development participation and the cost of each technology (see **Exs. ____ (CJB-11)** and **____ (CJB-12)**) determine the overall cost of new generic resources, which were used in the models.

Q: Please describe the assumptions that PSE used for new conservation resource potential and costs.

A: For the April 30 Least Cost Plan, PSE assumed that it would acquire 15 average megawatts per year of new conservation during 2004-2013. This amount was consistent with the settlement reached during 2002 in PSE's General Rate Case. However, a more fully integrated approach for incorporating conservation into the analysis was used for the August Least Cost Plan Update. An overview of the assumptions about conservation resource potential and costs used for the August Least Cost Plan Update are provided in *Achievable Electricity Conservation Potentials by Resource Bundle and Segment,* **Ex. ____ (CJB-15)**.

Q: Where did PSE obtain its base case forecasts of market prices for natural gas?

A: For the years 2004-2005, PSE used forward market prices for natural gas that were provided by PSE's Portfolio Management Group. For the years 2006-2023, PSE used long-term natural gas price forecasts developed by independent third-party sources. The gas price forecast used for April 30 Least Cost Plan was provided by PIRA Energy

Group and is shown in **Ex. ____ (CJB-16)**. The forecast used for the August Least Cost Plan Update is an average of four forecasts, including one provided by PIRA Energy Group, two provided by Cambridge Energy Research Associates and one provided by the Northwest Power and Conservation Council. The gas price forecast used for the August Least Cost Plan Update is shown in **Ex. ____ (CJB-17)**.

Q: Where did PSE obtain its base case forecasts of market prices for power?

A: PSE used the AURORA model to develop the long-term forecasts of market prices for power that it used for the Least Cost Plan. The AURORA electric price forecasts used for the April 30 Least Cost Plan are shown in **Ex. ____ (CJB-18)**. The AURORA electric price forecast used for the Least Cost Plan Update is shown in **Ex. ____ (CJB-19)**.

C. Aurora Model

Q: Please describe the AURORA model.

A: The AURORA model simulates the functioning of wholesale power markets throughout the Western Interconnection. The model focuses on the market fundamentals of supply and demand. It simulates, on an hourly basis, economic dispatch of the regional fleet of generating resources to meet regional electric loads, based on fuel prices and other variable operating costs, inter-regional transmission limitations and other factors. A primary result that AURORA produces is a long-term forecast of wholesale market prices for power. In this "optimization mode", AURORA simulates the addition of new generating resources as needed to maintain long-run market equilibrium.

Q: Can AURORA be used to model operation of a utility's resource portfolio?

A: Yes. In addition to market-wide analysis, AURORA also has the capability to simulate hourly economic dispatch of a utility's generation resource portfolio. When used in

this mode, AURORA produces forecasts of variable operating costs for the utility's generating resources, but does not include fixed costs for existing or new resources. *See* **Ex. ____ (WAG-14)** (description of AURORA Dispatch Model).

Q: Please describe some of the strengths of the AURORA model.

A: Strengths of the AURORA model include the following:

(1) it is a comprehensive, integrated model of electric loads and generating resources in the entire Western Interconnection;

(2) it accounts for many of the fundamental supply and demand factors that determine prices in thirteen subregions throughout Western North America;

(3) it addresses price effects and other interactions between subregions (e.g., between California and the Northwest);

(4) it is a standardized model that is widely used and understood by utilities, the Northwest Power and Conservation Council and others;

(5) it simulates economic dispatch of each generating resource on an hour-by-hour basis.

Q: Please describe some of the limitations of the AURORA model as a tool for simulating supply, demand and prices in regional power markets.

A: AURORA also has certain limitations, including:

(1) it is a long-run market equilibrium model that assumes market participants have perfect information, clear foresight, and act in an economically rational manner (i.e., it does not predict market boom/bust cycles or the associated effects on power prices);

(2) it does not reflect transmission constraints within subregions (e.g., cross-Cascades) or impacts of such constraints on generation patterns and market prices;

(3) conservation resources are not addressed within the model;

(4) it allows only one correlation to be specified between uncertainty factors; and

(5) it requires large amounts of input data that must be checked and updated.

Q: Does AURORA have other characteristics that affect its usefulness to analyze a specific utility's electric resource portfolio?

A: Yes. First, AURORA produces large output data sets that can make it time-consuming to evaluate a large number of cases and alternatives. Second, AURORA does not have sophisticated capabilities to model fixed-costs for addition of potential new resources to a utility's portfolio, including reflection of the utility's specific financial and regulatory circumstances. This makes it more difficult to compare total (fixed and variable) costs for different resource portfolio strategies.

Q: Did PSE use AURORA to model its own electric resource portfolio?

A: PSE used AURORA to identify the amount of new resources that would be needed at various levels of resource sufficiency, or "portfolio planning levels". I will describe this further in Section V of my testimony.

D. Portfolio Screening Model

Q: Did PSE use other models to perform analyses for its Least Cost Plan?

A: Yes. PSE developed and used a dedicated, PSE-specific model to analyze cost and risk for the various portfolio planning levels. This model is called the "Portfolio Screening Model". PSE also used the Portfolio Screening Model to evaluate resource strategy alternatives for its own electric resource portfolio. *See* **Ex. ____ (CJB-3)** (Appendix J).

Q: Why did PSE decide to develop and use the Portfolio Screening Model?

A: First, PSE was seeking a modeling tool that could be used to quickly evaluate and compare results for a wide range and large number of alternative resource strategies. Second, PSE was seeking a model that could be used to calculate variable costs for all

resources, including existing and new resources, as well as fixed costs for new resources. As noted above, AURORA does not address fixed costs for new resources added to a utility's portfolio. Third, PSE was seeking a model that could be used to perform probabilistic analysis of several key uncertainty factors, including multiple correlations among the uncertainty factors. Fourth, PSE was seeking a model that could be used to address other topics such as end effects for resource alternatives that have varying lives. Based on these specialized needs, PSE determined that a dedicated computer model would provide the most effective solution.

Q: Why was the capability to address correlations among multiple key uncertainty factors important?

A: Empirical historical data indicates the existence of statistical relationships between regional hydroelectric generation, market prices for power and market prices for natural gas. For example, during periods of below-normal hydroelectric generation, market prices for power and natural gas tend to increase. Commission Staff and others strongly suggested that these statistical relationships, or correlations between key uncertainty factors, be included as an integral part of the modeling and analysis. PSE agreed with this recommendation and incorporated it in the Portfolio Screening Model.

Q: How did PSE develop the model?

A: PSE developed the model in late 2002 and during 2003. Several versions of the model were developed and used as various enhancements were added. The model is built in Microsoft Excel and uses an Excel add-in, Crystal Ball, to perform Monte Carlo simulation of key uncertainty factors. The model includes a component that simulates hourly dispatch of PSE's existing resources and potential new resources. The model also includes other components that compute fixed costs.

Q: What types of resource planning issues did PSE address with the Portfolio Screening Model?

A: PSE used the model to perform a number of analyses during development of the Least Cost Plan. One major use of the model was for the analysis of portfolio costs and risks at different levels of resource sufficiency. As described in more detail below, this analysis was used to help select PSE's portfolio planning level for energy and for capacity and to determine its resulting need for new electric resources. A second major use of the model was for the evaluation of various combinations of new electric resources to meet the Company's need for new resources. Also described in greater detail below, this analysis was used to develop PSE's long-term strategy for types, amounts and timing of new electric resource additions. The model was also used to perform other analyses of PSE's electric resource portfolio, including sensitivity studies.

Q: Can you provide more detailed information about the inputs that go into the Portfolio Screening Model?

A: A detailed description of the inputs to the Portfolio Screening Model is provided as **Ex. ____ (CJB-20)**.

Q: Did PSE use consistent input assumptions for both AURORA and the Portfolio Screening Model?

A: Yes. While AURORA and the Portfolio Screening Model use slightly different logic, consistent data inputs were used for both models where possible.

Q: What kinds of output results does the Portfolio Screening Model produce?

A: One of the key outputs from the model is a 20-year net present value (NPV) of expected costs for the portfolio, including fixed costs for new resources and variable costs for all resources included in a particular portfolio being evaluated. Another

important type of output is portfolio risk, including standard deviation in the 20-year NPV expected cost for the portfolio. Additional outputs include dispatch results in MWh for each type of generating resource technology, megawatt-hour quantities and dollar amounts for power purchases and sales, fuel and O&M costs and air emissions. Revenue requirements, taking into consideration End Effects for resources with different lives, are also produced for each potential new generating resource technology included in a particular portfolio being evaluated. Additional risk measures are also produced, including standard deviations for purchased power costs and power sales revenues.

Q: Please explain what you mean by the term "End Effects".

A: For planning purposes we are using a twenty year time frame; the resources we were evaluating in the portfolio model, however, could have shorter or longer lives than twenty years. To measure the impact a particular resource had on the Company's portfolio, it was necessary to quantify this timing difference. This adjustment is what we are calling the "end effects" and its purpose is to put all the resources on an equal basis during the planning period.

Q: How does the model address End Effects for utility-owned generating resources?

A: Thermal resources, for example, have 30-year book lives that leave a 10 year "overhang" for resources added in year one. This overhang increases for resource additions made in later years of the evaluation period. PSE dealt with this effect by developing a market value of the overhang from all new supply resources in the portfolio and subtracting the year-end book value in the last year of the evaluation period in order to calculate a net present value (NPV). The year-one NPV of this net market value, whether positive or negative, was then added to the Expected Cost of the portfolio to compensate for the overhang issue. (A negative net market value increases Expected Cost and a positive net market lowers Expected Cost.)

Q: How does the model address End Effects for power purchase agreements (PPAs)?

A: Many PPAs have contract terms of less than 20 years. In this case, when the PPA expires, generic supply resources are added to replace the PPA. These supply resources are then treated as described above, where the net market value is developed and added to - or subtracted from - the Expected Cost as appropriate.

Q: Does the Portfolio Screening Model calculate revenue requirements for PSE's entire electric resource portfolio?

A: No. It does not include fixed, or economically "sunk" costs for PSE's existing electric resources. Therefore, the results of the Portfolio Screening Model are most useful for purposes of relative comparisons between alternatives, rather than for the purposes of determining absolute levels of costs or revenue requirements for rate-setting purposes.

Q: Please describe some of the strengths of the Portfolio Screening Model.

A: Strengths of the Portfolio Screening Model include:

(1) the model provides the capability to perform portfolio risk analyses of multiple uncertainty factors, including correlations among the uncertainty factors;

(2) the model includes both fixed costs for potential new resources and variable costs for existing resources and potential new resources;

(3) reasonably quick run-time allows the model to be used to evaluate a wide range of portfolio strategies;

(4) the model is customized to reflect PSE's electric resource portfolio;

(5) the model has been well-described to Commission Staff and members of the Least Cost Plan Advisory Group; and

(6) the model is flexible and can be updated as improvements are identified.

Q: Please describe some of the limitations of the Portfolio Screening Model.

A: Limitations of the Portfolio Screening Model include:

(1) the model does not represent certain operational constraints for electric generating facilities, including ramp rates, and minimum unit run time requirements;

(2) the model assumes that addition of new resources to PSE's electric resource portfolio has no effect on power prices in the regional market;

(3) the model stretches the limits of Excel (thus, it may be hard to expand it further); and

(4) care must be taken to test and document changes to model logic and data structures, to avoid risks that such changes could have unintended and unnoticed effects.

Q: Is the Portfolio Screening Model an industry-standard resource planning tool?

A: Not entirely. The model includes generation dispatch logic that has been used to simulate markets in other parts of the United States. However, the model also includes several components that were developed to specifically represent PSE's electric resource portfolio as well as its financial and regulatory circumstances. The model is not familiar to many parties beyond Commission Staff and members of the Least Cost Plan Advisory Group.

Q: Is the Portfolio Screening Model a simulation model or an optimization model?

A: It is a simulation model. In other words, the model can be used to evaluate cost and risk for a wide variety of resource alternatives and portfolio strategies, but it does not include logic designed to identify the "best" resource or strategy. As such, the Portfolio Screening Model can be viewed as an analytical tool that supports and assists the process leading to the utility's resource strategy – including application of judgment to the model results. It is not a "black box" that attempts to make all of the

internal computations that would be needed to represent and balance all of the various considerations involved in selection of the "best" resource strategy.

V. PORTFOLIO PLANNING LEVEL AND NEED FOR NEW RESOURCES

A. Overview Of Analysis And Planning Levels Considered

Q: Is there a specific, prescribed standard for long-term resource sufficiency that PSE must use as an input to its Least Cost Plan?

A: As a vertically-integrated utility regulated by the Commission, PSE has a public service obligation to have sufficient electric resources to meet the needs of its retail electric customers. However, neither the Commission nor the Western Electricity Coordinating Council have defined a specific standard for resource sufficiency that utilities must use for their long-term resource planning. Therefore, PSE did not assume a predefined long-term resource sufficiency standard as a fixed input to its Least Cost Plan.

Q: How did PSE address long-term resource sufficiency in its Least Cost Plan?

A: As part of the April 30 Least Cost Plan, PSE evaluated a wide range of resource sufficiency standards, or "portfolio planning levels", including impacts of each level on cost and risk for PSE's electric resource portfolio. The Company analyzed costs and risks for the different portfolio planning levels and applied its best informed judgment to select the portfolio planning level for its Least Cost Plan.

Q: What portfolio planning levels did PSE analyze?

A: PSE analyzed eight different portfolio planning levels, including various combinations of energy resource sufficiency standards and winter peak capacity sufficiency standards. The lowest portfolio planning level evaluated was a "Do Nothing" level that would not add any new long-term electric generating resources. The highest portfolio planning level evaluated was one that included long-term energy resources to meet 110

percent of PSE's forecasted retail electric load in each month and capacity resources to meet peak loads on a cold winter day when the minimum-hour temperature at Sea-Tac Airport drops to 13 degrees Fahrenheit. **Ex. ____ (CJB-21)** provides a listing of the eight portfolio planning levels that PSE considered.

Q: Please provide a summary of the major steps that PSE used to analyze these portfolio planning levels.

A: In the first step of the analysis, PSE identified the need for new resources implied by each portfolio planning level. Then, in the second step of the analysis, PSE constructed portfolios with various mixes of new resource technologies to meet the need for new resources at each portfolio planning level. In the third step of the analysis, PSE used the Portfolio Screening Model to quantify costs and risks for portfolios that meet each portfolio planning level and its associated need for new resources.

Q: What portfolio planning level did PSE select in its Least Cost Plan?

A: PSE selected the "B2" portfolio planning level identified in **Ex. ____ (CJB-21)**. The "B2" portfolio planning level provides sufficient energy resources to meet its retail electric customers' energy needs in each month under 40-year average hydroelectric conditions, and that provides sufficient capacity resources to serve peak loads on a winter day that the minimum-hour temperature at Sea-Tac Airport drops to 16 degrees Fahrenheit. As I will discuss further below, PSE selected this portfolio planning level based on the results of extensive analysis and application of its best informed judgment.

B. Need For New Resources At Each Portfolio Planning Level

Q: Please describe how PSE identified the need for new electric resources at each portfolio planning level.

A: For each of the eight portfolio planning levels, PSE identified the amount of new electric resources, including energy and capacity, needed to satisfy the particular portfolio planning level being analyzed. For example, at the lowest planning level, ("Do Nothing"), no new generating resources were added to PSE's portfolio of existing electric resources. For the highest portfolio planning level, the need for new resources included 674 aMW of energy in 2004, increasing to 1,874 aMW in 2013, and 1,558 MW of capacity in 2004, increasing to 3,562 MW in 2013. **Ex. ____ (CJB-22)** provides a table and graph showing the annual need for new energy resources at each of the portfolio planning levels. **Ex. ____ (CJB-23)** provides a table and graph showing the annual need for new capacity resources at each of the portfolio planning levels.

Q: Is PSE's need for new energy resources the same in each month of a given year, or does it vary seasonally?

A: PSE's need for new energy resources varies seasonally, with a larger need for new resources during the winter months. **Ex. ____ (CJB-24)** illustrates the seasonal variation in monthly need for energy resources for 2004 and for 2013, at the various portfolio planning levels for energy that were analyzed for the April 30 Least Cost Plan.

Q: What other assumptions did PSE make about its existing electric resources when determining the need for new resources at each portfolio planning level?

A: Information and assumptions about PSE's existing resources, including expiration of power supply contracts, were noted in Section IV.B. above, and are detailed **Exs. ____ (CJB-9)** and **____ (CJB-10)**. To determine the need for new resources at each

portfolio planning level, PSE made several additional assumptions about its existing electric resources, including: (1) Hydroelectric generation at 40-year average; (2) Capacity but no energy from PSE's single-cycle gas turbines; (3) Existing displaceable combined-cycle gas turbine cogeneration (Encogen and Tenaska) at full annual energy production capability.

Q: Why did you assume average hydroelectric generation, and capacity, but no energy, from PSE's single-cycle gas turbines?

A: PSE's existing single-cycle gas turbines serve several basic purposes in the Company's electric resource portfolio. First, they provide a source of capacity to help meet the winter peak loads of PSE's retail electric customers. Second, they can also be used to provide energy during periods when generation from PSE's hydroelectric resources is reduced during periods of below-normal streamflows. Thus, for the purposes of determining the need for new resources at each portfolio planning level, PSE combined the assumption of average hydroelectric generation with the assumption that PSE's single-cycle gas turbines will be kept available to provide winter peaking capacity and to provide generation when actual hydroelectric generation is below-normal. *See* **Ex. ____ (CJB-3)** at Chapter IX, pages 3-4.

Q: Are there other reasons not to rely on PSE's single-cycle gas turbines as an energy resource under average hydroelectric conditions?

A: Yes. PSE's existing single-cycle gas turbines have a net fuel-to-electricity conversion efficiency of about 28 percent. In contrast, new combined-cycle gas-fired generation has an efficiency of about 47 percent to over 50 percent. As a result, fuel costs for PSE's existing single-cycle gas turbines would be roughly two-thirds more expensive than new combined-cycle gas-fired generation. In addition to magnifying fuel costs, risks due to natural gas price uncertainty would also be magnified. Further, the same multiplier effect would also lead to roughly two-thirds more air emissions from

baseload use of PSE's existing single-cycle gas turbines, compared to new combined-cycle gas-fired generation. Further, extensive reliance on PSE's single-cycle gas turbines would raise various operational issues, which are described in **Ex. ____ (CJB-3)** at Appendix E.

Q: Was this topic addressed with the Least Cost Plan Advisory Group?

A: Yes. Several members of the group initially expressed the view that PSE should rely on its existing single-cycle gas turbines to meet a significant portion of its need for energy resources. However, through discussion, including review of the considerations noted above, various members of the group acknowledged that reliance on PSE's existing single-cycle gas turbines to meet its need for energy resources, including under normal hydroelectric conditions, would create several problems. This led to increased recognition that PSE's Least Cost Plan should not be constrained to a starting assumption that PSE's existing single-cycle gas turbines would be used to meet its energy needs under average hydroelectric conditions.

Q: When you used the Portfolio Screening Model to analyze PSE's electric resource portfolio under the eight portfolio planning levels, did you constrain PSE's single-cycle gas turbines from operating only to meet winter peak capacity needs and to backstop below-average hydroelectric generation?

A: No, the modeling analysis assumed that the single-cycle gas turbines would also be available to be dispatched on an economic basis, within the limits of existing permits.

Q: Why did you assume full annual energy production capability for PSE's existing displaceable combined-cycle gas turbine cogeneration resources?

A: PSE has several existing sources of combined-cycle gas turbine cogeneration, including the PSE-owned Encogen plant and the QF contract with Tenaska, that the Company can displace for economic purposes under certain circumstances. While not as fuel-efficient as the newest available combined-cycle gas-turbine technology, these

plants are much more fuel-efficient than single-cycle gas turbines. As such, they involve much lower fuel costs and produce significantly fewer air emissions than single-cycle gas turbines. These characteristics make PSE's existing combined-cycle gas-turbine cogeneration a more suitable type of resource to include as an available source of energy production. Further, if PSE were to assume economic displacement of these resources in determining its need for new energy resources, this displacement could cause a misleading increase in the amount of the Company's apparent need for energy. Therefore, for the purposes of determining the need for new energy resources at each portfolio planning level, PSE included the full annual energy production capability of these resources in its assumptions.

Q: When you used the Portfolio Screening Model to analyze PSE's electric resource portfolio under the eight portfolio planning levels, did you force the displaceable cogeneration resources in PSE's portfolio to full operation?

A: No, the modeling analysis assumed that PSE's displaceable cogeneration resources could be displaced to the extent possible only when economically efficient to do so.

C. Construction Of Portfolios To Meet The Need For New Resources

Q: What basic steps did you follow to create portfolios to meet the need for new electric resources?

A: For each portfolio planning level, PSE constructed hypothetical portfolios composed of new resources to satisfy the need for new resources at the level being considered. PSE accomplished this by first creating various mixes of 'generic' new electric energy resources in the amounts and timing needed to meet each year's need for energy. PSE then identified the amount of winter peak capacity that would be provided by the resources that had been added to meet the energy need, and subtracted this from the need for winter peak capacity. Finally, PSE added 'generic' new electric capacity resources to meet the remaining need for winter peak capacity in each year.

Q: What types of new electric resources did PSE include in the portfolios that it used for the analysis?

A: The portfolios that PSE analyzed included various combinations of the resource technologies described in **Ex. ____ (CJB-11)**. For the analysis of portfolio planning levels, PSE constructed portfolios composed of nine different combinations of electric generating resources, including (1) All Gas, (2) All Coal, (3) Gas and Coal, (4) All Wind, (5) 5% Wind, Gas and Coal, (6) 10% Wind, Gas and Coal, (7) 2% Wind and Gas, (8) 5% Wind and Gas, and (9) 10% Wind and Gas. Each of the nine portfolio mixes is described in **Ex. ____ (CJB-25)**.

Q: You noted earlier that PSE's need for new electric energy resources varies seasonally, including a greater need for new resources during the winter months. Did PSE consider portfolios that include new resources that are shaped to reflect the seasonal nature of the need?

A: Yes. For the April 30 Least Cost Plan, PSE constructed portfolios based on several seasonal shaping techniques for new resources. One method assumed that PSE would enter into long-term sales agreements, on a shared-cost basis, for new combined-cycle gas turbine generation during the months of May through August. Another method assumed that PSE sells single-cycle gas turbine capacity during May through October, again on a shared-cost basis. A third seasonal shaping approach that was analyzed would involve system exchanges where PSE would deliver power to another party during May through August, and receive energy from that party during September through April.

D. Analysis Of Cost And Risk

Q: How did PSE analyze the various portfolio planning levels, mixes of new resource technologies, and seasonal shaping approaches for the April 30 Least Cost Plan?

A: PSE used the Portfolio Screening Model to analyze cost and risk for the various portfolio planning levels and resource mixes described above.

Q: How was cost defined in the analysis of portfolio planning levels?

A: For the April 30 Least Cost Plan, PSE used the Portfolio Screening Model to model expected costs for each of the eight portfolio planning levels. Expected costs were defined to be the 20-year net present value (NPV) of variable costs for all (existing and new) resources, plus recovery of fixed costs for new resources.

Q: What were the results of this analysis?

A: The analysis showed that expected costs generally increased at portfolio planning levels that provided higher levels of resource sufficiency. This result is illustrated by **Ex. ____ (CJB-26)**.

Q: Did PSE further analyze expected costs for the portfolio planning levels?

A: Yes. PSE then used the Portfolio Screening Model to perform an analysis of expected costs across various energy planning levels, while holding the capacity planning level at the "A1" level described in **Ex. ____ (CJB-21).**

Q: What were the results of this analysis?

A: The analysis showed that at a given portfolio planning level for capacity, expected costs decreased at portfolio planning levels for energy that provided higher levels of energy resource sufficiency. This result is illustrated by **Ex. ____ (CJB-27)**.

Q: Did PSE also analyze expected costs for various levels of capacity sufficiency while holding the level of energy sufficiency constant?

A: Yes. PSE used the Portfolio Screening Model to perform an analysis of expected costs across various portfolio planning levels for capacity, while holding the portfolio planning level for energy at the "B1" level described in **Ex. ____ (CJB-21)**.

Q: What were the results of this analysis?

A: The analysis showed that at a given portfolio planning level for energy, expected costs increased at portfolio planning levels for capacity that provided higher levels of capacity resource sufficiency. This result is illustrated by **Ex. ____ (CJB-28)**.

Q: How did PSE analyze tradeoffs between cost and risk for the different portfolio planning levels?

A: In addition to producing the 20-year NPV of expected costs, the Portfolio Screening Model also produces the standard deviation in 20-year NPV expected costs, as a measure of risk. *Expected Cost vs. Risk,* **Ex. ____ (CJB-29),** provides a scatter plot showing the expected cost and risk for each of the portfolio planning levels.

Q: What does the comparison of cost and risk for different portfolio planning levels indicate?

A: **Ex. ____ (CJB-29)** shows that for portfolio planning levels with the same level of capacity resource sufficiency, increasing the level of energy resource sufficiency generally reduces expected cost. However, at portfolio planning levels that provide progressively more energy than is needed to meet customer needs under average hydroelectric conditions, risk also tends to increase. So at portfolio planning levels that go beyond balancing the portfolio on an energy basis, risk is increased due to the necessity for PSE to make short-term sales to dispose of surplus power, and the associated volatility in revenues from such sales. In other words, this analysis helped demonstrate that while having "too few" energy resources in the portfolio (and relying on short-term market purchases to fill deficits) can increase risk, having "too many" energy resources in the portfolio (and relying on short-term market sales to dispose of excess power) can also increase risk.

E. Judgment And Policy Direction On Portfolio Planning Levels

Q: Did PSE apply judgment to the results of its analysis of cost and risk for various portfolio planning levels?

A: Yes. In addition to the modeling analysis of portfolio planning levels described above, PSE used its best informed judgment to select a portfolio planning level in its April 30 Least Cost Plan.

Q: What types of factors did PSE consider in applying its judgment to selection of a portfolio planning level?

A: One such source of input to the Company's judgment was the 2003 Update to the Washington State Energy Strategy, including two of its Guiding Principles to (a) encourage load-serving entities to ensure they have adequate resources to meet their obligation to serve their customers' long-term needs, and (b) provide reliable power and reduce consumers' vulnerability to supply shortage and price volatility. Another related and important source of direction was PSE's obligation, as a vertically-integrated utility, to plan and have adequate resources to serve its retail electric customers' long-term needs. A third consideration was based on a qualitative review of how PSE should manage its load-resource balance within the broader Northwest regional context, including PSE's contribution to maintaining overall regional load-resource balance. This review identified substantial risks for resource strategies that would attempt to "time" the market by deliberately keeping the utility's resource portfolio in deficit during periods that it believes the region will have surplus resources, or by adding surplus resources to the utility's portfolio during periods that it believes the region will not have sufficient resources. Yet another consideration involved a critical assessment of the limitations inherent in making resource planning decisions on the basis of power price forecasts that assume all market participants have accurate foresight, that they will behave in an economically rational manner and that the market will achieve and maintain equilibrium. PSE concluded that over-reliance on

such forecasts of market equilibrium does not adequately address the real-world prospect – and risks – that market imbalances in power supply and demand will occur. *See* **Ex. ____ (CJB-3)** at Ch. XII.

Q: What are the long-term prospects for the electric resource adequacy in the Northwest?

A. Currently, the Northwest region has adequate electric resources to meet its needs. However, the majority of investor-owned utilities will be deficit for firm resources past 2004, without acquisition of new resources. The outlook for the development of new electric resources in the region remains uncertain in the current environment, which does not create incentives for merchant generators to develop new resources. *See* Testimony of Eric Markell, **Ex. ____ (EMM-1T)**, at 6-7. Recent draft analysis by the Northwest Power and Conservation Council, under below-normal (1937) hydro conditions, shows that the region has a resource deficit in the months of January, February and March of 2004 (even with single-cycle combustion turbines running to produce energy). Further, these winter resource deficits increase in the following years. *See* **Ex. ____ (CJB-30).** Without new resource development, the Northwest region may find itself confronting a supply crisis.

Q: As part of the April 30 Least Cost Plan, did PSE also consider an approach that would defer making long-term resource commitments?

A: Yes. PSE evaluated how it might pursue a strategy to defer making substantial long-term commitments to new electric resources, including use of short-term hedging transactions to fill the existing need for new resources. PSE reached the conclusion that it would not be feasible or prudent to pursue such a strategy, due to implementation challenges, costs and risks, including market illiquidity, exposure to short-term price volatility and credit requirements. PSE discussed these topics in several meetings with the Least Cost Plan Advisory Group. Deferral of long-term

resource acquisitions is also addressed in various sections of the April 30 Least Cost Plan report, including Chapter III, "Planning Issues", Chapter IV, "PSE's Current Situation", and Chapter XII ("Electric Portfolio Analysis"), Section C ("Deferral of Long-Term Resource Acquisitions"). Implementation issues related to deferral of long-term resource acquisitions are also addressed in detail in the testimony of Julie Ryan.

Q: Did PSE evaluate the impact of deferring long-term electric resource acquisitions?

A: Yes. PSE analyzed the impact a deferral or "Do-Nothing" strategy for the A1, B1, and B2 planning standards. The analysis assumed a five-year deferral of energy and capacity additions and assessed the impact from both a cost and a risk standpoint. **Ex. ____ (CJB-31)**, titled *Deferral Analysis,* shows the cost and the risk of deferring exceeded the cost and the risk of acquiring new electric resources more promptly.

Q: Was the PSE Board of Directors involved in selecting the portfolio planning level?

A: Yes. At its meeting on February 19, 2003, the Board of Directors reviewed a progress report on development of the Least Cost Plan, including the analysis of portfolio planning levels. The Board considered a recommendation to establish the portfolio planning level at the "A1" level shown on **Ex. ____ (CJB-21)**. The Board noted, however, that the analysis was based on an AURORA forecast of market prices for power that assumed market participants have perfect foresight and make economically rational decisions, and that the market seeks and maintains continuous equilibrium. Members of the Board pointed out that over-reliance on such 'steady-state' forecasts can obscure the existence, magnitude and effects of real-world risks. The Board also addressed policy considerations, including PSE's obligations to have resources to meet the long-term electric energy and winter peak needs of its retail electric customers, and guiding principles from the Washington State Energy Strategy Update. As a result, the

Board requested further work be done to incorporate these considerations into the development of PSE's portfolio planning level.

Q: What happened after the February 19, 2003 meeting?

A: Following the February 19, 2003 meeting, PSE staff and management incorporated guidance received from the Board of Directors into further analysis of portfolio planning levels. Policy considerations, including PSE's public service obligations and guidance from the State Energy Strategy Update, were also factored into the application of judgment.

Q: Did the further analysis and application of judgment address the energy component of the portfolio planning levels?

A: Yes. For example, as described earlier, the analysis indicated that increasing the amount of energy resources led to lower expected costs for the electric resource portfolio. *See* **Ex. ____ (CJB-27)**. Therefore, PSE concluded that moving to a somewhat higher standard for energy resource sufficiency would be justified on the basis of expected cost.

Q: Did the further analysis and application of judgment address the capacity component of the portfolio planning levels?

A: Yes. As also described earlier, the analysis indicated that increasing the amount of capacity resources led to higher expected costs for the electric resource portfolio. *See* **Ex. ____ (CJB-28)**. However, PSE noted its analysis was based on a simplifying assumption that the only incremental source of winter peaking capacity resources would be single-cycle gas turbines. PSE also noted that at progressively higher capacity planning levels, during any given winter it becomes progressively less likely that the last unit of peaking capacity would actually be required to serve PSE customer peak loads. PSE then determined that other forms of peaking resources, including customer demand response measures, may represent a more cost-effective peaking

resource than relying on single-cycle gas turbines to meet a portion of customer peak demands during extreme cold (i.e., lower-probability) events. Therefore, PSE concluded that moving to a somewhat higher standard for capacity resource sufficiency would likely result in lower costs than the analysis had indicated, particularly if peaking resources beyond single-cycle gas turbines could be used to meet a portion of the need for winter peaking capacity.

Q: What portfolio planning level did PSE ultimately select for the April 30 Least Cost Plan?

A: Based on the results of extensive analysis and application of its best informed judgment, PSE identified the "B2" portfolio planning level identified in **Ex. ____ (CJB-21)**. The "B2" portfolio planning level provides sufficient energy resources to meet its retail electric customers' energy needs in each month under 40-year average hydroelectric conditions, and that provides sufficient capacity resources to serve peak loads on a winter day that the minimum-hour temperature at Sea-Tac Airport drops to 16 degrees Fahrenheit.

Q: Did the PSE Board of Directors approve the "B2" portfolio planning level?

A: PSE staff and management presented the revised recommendation at a meeting of the PSE Board of Directors on March 7, 2003. At the March 7, 2003 meeting, the Board approved the recommendation to use the "B2" portfolio planning level.

Q: Did PSE revisit the topic of portfolio planning levels for the August Least Cost Plan Update?

A: No. PSE used the same "B2" portfolio planning level for the August Least Cost Plan Update.

Q: Did PSE analyze additional forms of winter peaking resources for the August Least Cost Plan Update?

A: Yes. As part of the August Least Cost Plan Update, PSE addressed customer demand response as a potential form of winter peaking capacity resource. One component of the analysis assessed the potential amount of demand response that exists among PSE's retail electric customer loads. This assessment found that the potential for demand response is sufficient such that on a cold winter day when the minimum-hour temperature at Sea-Tac Airport drops to 16 degrees Fahrenheit, PSE's peak-hour loads could be limited to the level that would occur on a day that the minimum-hour temperature drops to a less-extreme 23 degrees. The analysis also included an evaluation, using the Portfolio Screening Model, of the potential cost reductions that demand response could provide. This evaluation concluded that if 200 MW of demand response could be acquired at a cost of less than $7 million to $9 million per year, such an approach would be more cost-effective than relying exclusively on single-cycle gas turbines to meet the need for peak capacity resources.

VI. NEED FOR NEW ELECTRIC RESOURCES

Q: Please identify PSE's need for new resources under the portfolio planning standard that was selected as part of the April 30 Least Cost Plan.

A: As developed for the April 30 Least Cost Plan, PSE's need for new energy resources and its need for new capacity resources at the "B2" portfolio planning level are shown in **Ex. ____ (CJB-32)**. For the August Least Cost Plan Update, PSE updated its determination of need for new energy resources and new capacity resources at the "B2" portfolio planning level. The updated need for new energy resources and need for new capacity resources are shown in **Ex. ____ (CJB-33)**.

Q: What caused PSE's determination of its need for new resources to change from the April 30 Least Cost Plan to the August Least Cost Plan Update?

A: Four factors contributed to the change in need:

(1) The load forecast was updated, showing lower demand;

(2) The Northwest Power Pool's "2002-2003 Final Regulations" were applied to PSE's owned and contract purchases of hydroelectric resources, resulting in a shift between months, but staying consistent with data PSE uses for its short-term energy portfolio management;

(3) PSE's White River Project was excluded as a planned resource as of January 15, 2004;

(4) The date for termination of the PG&E exchange was assumed to be December 31, 2009 rather than December 31, 2006.

See **Ex. ____ (CJB-34).**

VII. RESOURCE MIX FOR THE APRIL 30, 2003 LEAST COST PLAN

A. Resource Portfolio Analysis

Q: How did PSE develop the mix of new resources for its April 30 Least Cost Plan?

A: As noted in Section V. C. of my testimony above, PSE used the Portfolio Screening Model to analyze cost and risk for portfolios composed of PSE's existing electric resources plus various combinations of potential new electric generating resource alternatives. The amount and timing of new resource additions was determined by the "B2" portfolio planning level need for new electric resources as shown in **Ex. ____ (CJB-21)**. The nine combinations of potential new electric generating resources that PSE analyzed are identified in Section V.C. above. Also as noted above, the portfolios also included 15 aMW per year of new electric conservation.

Q: What basic conclusions emerged from the analysis of new resource mixes?

A: One of the most important conclusions from the analysis is that a diversified mix of new resources helps to mitigate risks more effectively than relying exclusively on a single resource technology to meet PSE's entire need for new electric resources. Each of the available resource technologies has its own set of advantages and drawbacks, including its costs (e.g., level and structure of costs, availability of tax credits), degree of exposure to fuel price risks and environmental characteristics. PSE addressed these tradeoffs by using the Portfolio Screening Model to analyze portfolio cost and risk for different combinations of new resources under key uncertainties. **Ex. ____ (CJB-35)** illustrates results of PSE's analysis of cost and risk tradeoffs for several portfolio mixes.

B. Other Analyses

Q: You noted earlier that PSE's need for new electric resources is greater during the winter months than at other times of the year. Did PSE analyze strategies to address the seasonal shape of its need for new electric resources?

A: Yes. PSE used the Portfolio Screening Model to analyze portfolios that included seasonal shaping of new resource additions to improve the month-to-month load-resource balance of PSE's overall electric resource portfolio. PSE evaluated several forms of seasonal shaping arrangements for new resources, including joint ownership approaches, forward capacity sales and seasonal power exchanges. The results of these analyses indicated that such seasonal shaping arrangements can significantly reduce risk in PSE's electric resource portfolio, mainly by avoiding the ongoing and increasing need for PSE to make short-term sales of surplus power during the summer months. In other words, by helping to avoid creating large summer surpluses in PSE's electric resource portfolio, seasonal shaping arrangements can reduce PSE's exposure to variability in revenues from sales of surplus power into volatile shot-term markets. However, the analysis also indicated that achieving reduced risk through seasonal

shaping arrangements would also increase the expected cost of power for PSE's overall resource portfolio. In other words, the analysis identified a tradeoff between cost minimization and risk management.

C. Application Of Judgment And Resource Mix

Q: Did PSE also apply judgment to the results of its analysis of portfolio mixes?

A: Yes. For example, PSE's analysis using the Portfolio Screening Model assumed that new single-cycle gas turbines would be used to "back up" the intermittent generation from new wind power resources included in the portfolio. However, PSE recognized that such an approach likely overstates the costs associated with intermittent wind generation. PSE also noted that a portfolio that includes wind power to meet 10 percent of its retail customers' electric loads by 2013 has lower risk than a portfolio that meets 5 percent of loads by 2013. PSE also noted that in addition to wind power, other forms of renewable resources could help to further diversify its electric resource portfolio.

Q: What portfolio mix did PSE select for its April 30 Least Cost Plan?

A: Based on its analysis and application of its best informed judgment, PSE selected a portfolio mix for 2004-2013 for its April 30 Least Cost Plan that includes:

(1) 15 aMW per year of new electric conservation

(2) a goal to acquire renewable resources to meet 10 percent of PSE's retail customers' electric loads by 2013

(3) a mix of new thermal generating resources, including combined-cycle gas turbines, single cycle gas turbines, and coal-fired generation as needed to meet the remaining need for new electric resources at the B2 portfolio planning level

(4) resource shaping arrangements to improve the overall seasonal load-resource balance for PSE's electric resource portfolio

A chart showing the portfolio strategy from PSE's April 30 Least Cost plan is provided as **Ex. ____ (CJB-36)**.

VIII. RESOURCE MIX FOR THE AUGUST LEAST COST PLAN UPDATE

A. Scope Of Analysis

Q: What was the primary focus for the August Least Cost Plan Update?

A: For the August LCP Update, PSE performed an extensive assessment of the conservation resource potential that is expected to be available in its service area during the next 20 years. PSE then used this conservation resource assessment to update its electric resource portfolio mix for 2004-2023.

B. Conservation Potential Assessment

Q: Please summarize the results of PSE's assessment of its long-term electric conservation resource potential.

A: PSE's assessment identified 1,016.0 aMW of cumulative 20-year technical conservation potential. Of this technical potential, 328.3 aMW is estimated to be achievable, including 176.0 aMW of achievable conservation potential in the residential sector, 143.1 aMW in the commercial sector and 9.2 aMW in the industrial sector.

Q: How did PSE prepare the assessment of achievable conservation potential for use in the August Least Cost Plan Update?

A: First, PSE aggregated the estimates of achievable conservation potential into 17 "bundles". Then, for each bundle, PSE developed a conservation "supply curve" that indicated the amount of conservation that could be acquired at each of four specified levels of cost per unit of conservation. Finally, PSE created several conservation acquisition scenarios for the supply curves, including a scenario that assumes a

constant rate of conservation during 2004-2023, and a scenario that assumes accelerated acquisition of lighting measures during the next decade.

C. Resource Portfolio Analysis

Q: How did PSE use the conservation supply curves for its August Least Cost Plan Update?

A: For the August Least Cost Plan Update, PSE used the Portfolio Screening Model to analyze conservation resources head-to-head with electric generating resources. In brief, PSE did this by creating a number of portfolios composed of different combinations and levels of conservation, using cost-quantity points taken from the conservation supply curves described above. Depending on the total amount and timing of conservation resource acquisition assumed for any given portfolio, new electric generating resources were then added to that portfolio so that it would meet PSE's need for new electric resources at the B2 portfolio planning level. For each portfolio of conservation and generation resources created in this manner, PSE then used the Portfolio Screening Model to analyze expected costs for the portfolio. These cost results for the various portfolios were then plotted on a chart, to identify the overall level and mix of conservation acquisition that is expected to produce the lowest expected cost for PSE's electric resource portfolio. These results are shown on **Ex. ____ (CJB-37)**.

D. Updated Resource Mix

Q: Please provide the updated resource mix that PSE selected for its August Least Cost Plan Update.

A: Based on its analysis and application of its best informed judgment, PSE selected a portfolio mix for 2004-2023 for its August Least Cost Plan Update that includes:

(1) a goal to acquire new electric conservation resources consistent with the accelerated lighting scenario, including a total of 203 aMW of new conservation during 2004-2013 and a total of 273 aMW during 2004-2023

(2) affirmation of the goal, established in the April 30 Least Cost Plan, to acquire renewable resources to meet 10 percent of PSE's retail customers' electric loads by 2013

(3) a mix of new thermal generating resources, including combined-cycle gas turbines, single cycle gas turbines, and coal-fired generation to meet the remaining need for new electric resources at the B2 portfolio planning level established in the April 30 Least Cost Plan

(4) resource shaping arrangements to improve the overall seasonal load-resource balance for PSE's electric resource portfolio

A chart showing the portfolio strategy from PSE's August 29 Least Cost Plan Update is provided as **Ex. ____ (CJB-38)**.

E. Emissions Analysis

Q: Did PSE evaluate the impact of its updated resource strategy on air emissions?

A: Yes. PSE used the Portfolio Screening Model to estimate the amounts of air emissions that would result from its electric resource portfolio under the updated resource strategy, compared to a strategy that does not include any new conservation or renewable resources. Results of this analysis indicate that PSE's updated resource strategy would result in about an 18 percent reduction in CO2 during 2004-2023, compared to a portfolio strategy that does not include any new conservation or renewable resources.

Q: Did PSE include the costs of a tax on CO2 emissions in its analysis of energy generation portfolios?

A: To date, there are no federal or Washington State taxes, statutes, or regulations applicable to electric generation facilities in Washington State. Accordingly, we did not factor into the portfolio screening analysis a tax or cost on CO2 emissions from electric generation facilities. For the April 30 Least Cost Plan, however, we did analyze the level of CO2 credit cost (in dollars per ton of CO2 emitted) to determine at which point various electric generating technologies become more or less attractive when measured against each other. The results of this analysis indicated that at a CO2 cost greater than approximately three dollars per ton, combined-cycle gas turbine generation becomes economically less expensive than coal-fired generation. Similarly, wind power becomes economically less expensive than coal-fired generation at CO2 cost above a little over eight dollars per ton, and wind power becomes economically less expensive than combined-cycle gas turbine generation at CO2 costs above 20 dollars per ton. *See* **Ex. ____ (CJB-39).**

F. Other Conclusions

Q: Does the August Least Cost Plan Update indicate that PSE could rely on new conservation to meet it entire need for new electric resources?

A: No. PSE's analysis indicates that acquisition of new electric conservation resources can meet a significant portion of the long-term need for new resources. However, other new electric resources, including renewable resources and conventional thermal resources are needed to meet PSE's need for new electric resources.

IX. STATUS OF ONGOING AND FUTURE RESOURCE PLANNING AND ANALYSIS

A. Ongoing Least Cost Planning

Q: When will PSE prepare its next Least Cost Plan?

A: The Commission recently notified PSE that it is required to prepare its next Least Cost Plan before May 1, 2005. PSE is committed to meet this requirement, and intends to formally begin the process leading to its next Least Cost Plan no later than the first half of 2004.

Q: Does this mean that PSE will not do any work related to its Least Cost Plan until mid-2004?

A: No. Least cost planning is an ongoing process – therefore, PSE will continue to refine and develop its resource planning capabilities. PSE will also continue to update its forecasts and other assumptions and will continue to consult with Commission Staff and meet as needed with PSE's Least Cost Plan Advisory Group.

B. Integration With Resource Acquisition

Q: How does PSE's least cost planning process integrate with its resource acquisition process?

A: PSE is also using the same portfolio analysis methods and Portfolio Screening Model that it developed for its Least Cost Plan to evaluate specific resource acquisition opportunities, including impacts on portfolio cost and risk. PSE is also using many of the same forecasts and other assumptions from the Least Cost Plan analysis for analysis of specific new resource acquisition opportunities.

Q: Is PSE developing plans to implement the electric resource strategy set forth in its Least Cost Plan?

A: Yes. PSE is preparing its conservation program plan for 2004-2005. PSE has also developed an electric generating resource acquisition program.

Q: Please describe what PSE is doing to develop its conservation program plans.

A: PSE's programmatic plans to acquire conservation resources during 2004-2005 are being developed in collaboration with the Company's Conservation Resource Advisory Group. PSE expects to file its conservation program plan for 2004-2005 with the Commission by October 31, 2003. A draft of PSE's conservation program plan for 2004-2005 is provided as **Ex. ____ (CJB-40).**

Q: Please describe PSE's electric generating resource acquisition program.

A: PSE's plan to acquire new electric resources, including generating resources, during the next several years is described in the Resource Acquisition Program document included in the Draft Request for Proposals for 150 Megawatts of Wind Power Resources that the Company filed with the Commission on August 25, 2003. The Resource Acquisition Program document is provided as **Ex. ____(CJB-41).**

Q: In its evaluation of specific new resource acquisition opportunities, did PSE compare results produced by the Portfolio Screening model with results produced by AURORA?

A: Yes. PSE compared dispatch results produced by AURORA with dispatch results produced by the Portfolio Screening Model. PSE made this comparison using a resource portfolio that met the "B2" portfolio planning level and included the Frederickson 1 combined-cycle gas turbine resource. The process used to make the comparison included the following steps:

(1) Verify that the dispatch-related assumptions (e.g. fuel cost, variable O&M, heat rate, capacity, forced outage rate, etc.) for Frederickson 1 were consistent in both AURORA and the Portfolio Screening Model.

(2) Use the AURORA model to simulate economic dispatch of the Frederickson 1 generating plant.

(3) Extract the fuel and other variable expenses, as well as the hourly generation amounts (in MWh) from the AURORA results for Frederickson 1.

(4) "Overlay" this AURORA-produced information for Frederickson 1 into the Portfolio Screening Model. This step included pasting variable expenses from AURORA into the variable expense lines of the Portfolio Screening Model. In addition, the hourly generation amounts (in MWh) from AURORA were "plugged" into the Portfolio Screening Model and then used to produce the total portfolio generation and subsequent net market purchase and sale activity.

(5) The expected cost results produced by the Portfolio Screening Model were then compared to the AURORA dispatch results.

The results of the comparison described above are shown in **Ex. ____ (CJB-42).** These results show an almost imperceptible difference between the dispatch cases prepared using the two models. In general, the Portfolio Screening Model produces a slightly lower amount of dispatch (in MWh) from Frederickson 1 than AURORA. This is mainly due to the fact that the Portfolio Screening Model logic does not include operational constraints or start up costs. AURORA does reflect startup costs and other operational constraints that result in slightly different generation results than the Portfolio Screening Model.

Q: Did PSE's resource acquisition process predetermine the outcome of the 2003 LCP?

A: No. Instead, the 2003 Least Cost Plan played a major role in the resource acquisition decision. As mentioned above, the 2003 Least Cost Plan process led the company to conclude that an integrated portfolio approach should be used for the evaluation of specific resource acquisition opportunities.

Q: Does PSE intend to use its integrated resource planning as an input to its ongoing resource acquisition efforts?

A: Yes. PSE will continue to update its resource acquisition program, including to reflect the results from new Least Cost Plans. Analytical assumptions, methods and tools that are developed for resource planning will also be used for resource acquisition, and vice-versa.

Q: Please list the exhibits you are sponsoring in this testimony.

A: I am sponsoring the following exhibits:, which are attached to my testimony:

EXHIBIT LIST

	Description of Exhibit	Exhibit Number
CJB-1T	Testimony of Charlie Black	
CJB-2	Description of Charlie Black's responsibilities and current position	
CJB-3	Copy of PSE's Least Cost Plan filed with the Commission on April 30, 2003	
CJB-4	Copy of PSE's Least Cost Plan Update filed with the Commission on August 29, 2003	
CJB-5	*Comparison of Need Between Least Cost Plans, With and Without Conservation*	

	Description of Exhibit	Exhibit Number
CJB-6	*PSE Least Cost Plan Analysis Flowchart*	
CJB-7	*Load Forecast for April 30 Least Cost Plan*	
CJB-8	*Load Forecast for August 29 Least Cost Plan Update*	
CJB-9	*Existing Resources - April 30 Least Cost Plan*--Overview of assumptions about PSE's existing electric resources	
CJB-10	*Existing Resources - August 2003 Least Cost Plan Update*--overview of assumptions about PSE's existing resources	
CJB-11	*Generic Resource Characteristics for April 2003 LCP*	
CJB-12	*Generic Resource Characteristics for and Efficiency Improvements for August 2003 Least Cost Plan Update*	
CJB-13	*Economic Assumptions for New Electric Generating Resources, April 2003 Least Cost Plan*	
CJB-14	*Economic Assumptions for New Electric Generating Resources, August 2003 Least Cost Plan Update*	
CJB-15	*Achievable Electricity Conservation Potentials by Resource Bundle and Segment*--overview of assumptions about conservation resource potential and costs used in August 29 Least Cost Plan Update	
CJB-16	*Gas Price Forecasts used for the April 2003 Least Cost Plan*	
CJB-17	*Gas Price Forecasts used for the August 2003 Least Cost Plan Update*	
CJB-18	*AURORA Electric Price Forecasts for the April 2003 Least Cost Plan*	
CJB-19	*AURORA Electric Price Forecasts for the August 2003 Least Cost Plan Update*	
CJB-20	Description of inputs to the Portfolio Screening Model	
CJB-21	*Eight Portfolio Planning Levels, April 2003 Least Cost Plan*	

	Description of Exhibit	Exhibit Number
CJB-22	*Need for New Energy at Various Planning Levels, April 2003 Least Cost Plan*	
CJB-23	*Need for New Capacity at Various Planning Levels, April 2003 Least Cost Plan*	
CJB-24	*Seasonal Variation in Need for New Electric Resources, April 2003 Least Cost Plan*	
CJB-25	*Portfolio Descriptions, April 2003 Least Cost Plan*	
CJB-26	Portfolio Screening Model results, costs at various levels of resource sufficiency	
CJB-27	Portfolio Screening Model results.	
CJB-28	Portfolio Screening Model results, costs at various levels of capacity	
CJB-29	*Expected Cost vs. Risk*	
CJB-30	*Regional Load-Resource Balance*	
CJB-31	*Deferral Analysis*	
CJB-32	*Need for New Energy and Capacity Resources, April 2003 Least Cost Plan*	
CJB-33	*Need for New Energy and Capacity Resources, August 2003 Least Cost Plan Update*	
CJB-34	*Determination of Need Updated*	
CJB-35	*Impact of Technology Mix on Expected Cost and Risk*	
CJB-36	*10-Year Resource Addition Strategy, April 2003 Least Cost Plan*	
CJB-37	*Conservation Cost with Acceleration*, April 30 Least Cost Plan	
CJB-38	*Updated Resource Strategy*	
CJB-39	*CO2 Credit Impact*	
CJB-40	*Draft Conservation Program*, 2004-2005	
CJB-41	Description of PSE's Resource Acquisition Program	
CJB-42	Comparison of AURORA and Portfolio Screening Models	

Q: **Does this conclude your testimony?**

A: Yes.