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TESTIMONY OF
ROBERT W. ANDERSON, ROBERT J. PETTY, AUDREY PERINO, AND JEFF KING
Witnesses for Bonneville Power Administration

SUBJECT: Marginal Cost Analysis Study

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5 **SUBJECT: MARGINAL COST ANALYSIS STUDY**

6 **Section 1: Introduction and Purpose of Testimony**

7 *Q. Please state your name(s) and qualifications.*

8 A. My name is Robert Anderson and my qualifications are contained in WP-02-E-BPA-01.

9 A. My name is Robert Petty and my qualifications are contained in WP-02-E-BPA-58.

10 A. My name is Audrey Perino and my qualifications are contained in WP-02-E-BPA-57.

11 A. My name is Jeff King and my qualifications are contained in WP-02-E-BPA-35.

12 *Q. What is the purpose of your testimony?*

13 A. The purpose of this testimony is to sponsor the Marginal Cost Analysis (MCA) Study
14 included in BPA's 2002 Initial Rate Proposal.

15 *Q. How is your testimony organized?*

16 A. This testimony contains five sections including this introductory section. Section 2
17 defines marginal cost and describes its relevance to BPA. Section 3 explains how and
18 why the MCA is used in the rate case. Section 4 describes the methodology used to
19 estimate marginal costs. Section 5 reviews the public process that BPA participated in to
20 develop the marginal cost estimates.

21 **Section 2: Definition of Marginal Cost**

22 *Q. What is marginal cost?*

23 A. Marginal cost is defined as the additional cost of producing or acquiring an extra unit of a
24 product or service. In economic theory, when supply and demand are in equilibrium the
25 market price will equal the variable cost of the marginal unit of production. This is
26 because producers will find it in their interest to add production as long as the price they

1 can receive exceeds the marginal cost of production. For the electric energy market, this
2 definition translates to the variable cost of the marginal generating unit, where the
3 marginal generating unit is the last unit dispatched in least cost order to meet energy
4 demand.

5 *Q. Please define the specific quantities that you use to represent the marginal costs.*

6 A. The marginal cost in the MCA is equal to the hourly variable cost of the marginal
7 resource for energy available at the Mid-Columbia trading hub. Equivalently, this value
8 may also be referred to as the “market clearing price.”

9 *Q. Why is the market clearing price relevant to BPA?*

10 A. The marginal cost is used as an indication of a market clearing price for hourly bulk
11 energy transactions. Therefore, it is related to the cost that BPA could experience to
12 acquire additional energy, or the price that BPA could realize in selling surplus bulk
13 energy. The actual cost BPA experiences for bulk power transactions may not be exactly
14 equal to the hourly market clearing price because BPA may buy or sell a different
15 product than what is traded in an hourly market. In addition, BPA bulk energy
16 transactions may occur at a price not exactly set by the marginal resource in a particular
17 hour. In either case, the hourly marginal cost is related to the market clearing price for
18 bulk energy and is therefore used as a starting point for the price that BPA will
19 experience for hourly bulk energy transactions.

20 **Section 3: Uses in the Rate Case**

21 *Q. How is the MCA used in the rate case analysis?*

22 A. The MCA is used for two purposes in the rate case. First, it is used to inform, but not to
23 directly set, the price level at which BPA buys and sells in the bulk power market. For a
24 complete description of BPA’s bulk revenue forecast, see BPA’s Risk Study, WP-02-E-
25 BPA-03. Second, the MCA provides a basis for sending price signals through BPA’s rate
26 design. For example, marginal costs are used as a starting point in deriving the relative

1 levels of the monthly energy rates, and also in deriving the relative levels of heavy load
2 hour energy rates versus light load hour energy rates in a given month. Marginal costs
3 are important in setting the relative levels of rates so that BPA's rates send an appropriate
4 price signal. For a complete discussion of how the marginal costs are used in BPA's rate
5 design, see the Wholesale Power Rate Development Study, WP-02-E-BPA-05.

6 *Q. Why is it important to send price signals?*

7 A. Overall economic efficiency is most likely to be achieved when consumers face a set of
8 prices for alternative products and services that are generally priced at their marginal
9 cost. For example, when the consumer is facing the decision to purchase more or less
10 electrical energy versus more or less conservation it is important that both price signals
11 reflect the marginal cost of providing an additional unit of each. If they do not, then the
12 consumer may make a decision that minimizes his or her individual costs but does not
13 reflect the cost of the resources that are used to satisfy that decision. In order to make
14 appropriate decisions, prices should reflect the marginal costs of obtaining or disposing
15 of one additional unit of any good or service. The specific importance of marginal costs
16 to BPA's rates is described in the testimony of Burns, *et al.*, WP-02-E-BPA-08).

17 **Section 4: Estimation Methodology**

18 *Q. What technique has BPA used to forecast marginal costs?*

19 A. BPA uses an electric market model called AURORA.

20 *Q. Please briefly describe the theory behind AURORA's modeling technique.*

21 A. AURORA is an economic fundamentals based approach that models wholesale energy
22 transactions in a competitive pricing system. AURORA uses a demand forecast and
23 supply cost information to find an hourly market clearing price, or equivalently, the
24 marginal cost. To determine price in a given hour, AURORA models the dispatch of
25 electric generating resources in a least cost order to meet the load (demand) forecast. The
26 price in the given hour is equal to the variable cost of the marginal resource. Over time,

1 AURORA will add new resources and retire old resources based on the net present value
2 of the resource. In this way, AURORA models the functioning of competitive economic
3 market system.

4 *Q. Is this technique fundamentally different from the way BPA estimated marginal costs in*
5 *BPA's 1996 rate case?*

6 A. No. BPA used a production costing model (PMDAM) in BPAs' 1996 rate case.
7 PMDAM followed the same fundamental theory. The theory is that price is determined
8 by the variable cost of the marginal resource and the resource portfolio adjusts over time
9 as determined by the net present value of resources.

10 **Section 5 MCA Development Process**

11 *Q. What process did BPA use to select AURORA?*

12 A. BPA reviewed several models and consulted with the public on the selection of the
13 appropriate model for the MCA. This public consultation was conducted in open
14 workshops. First, BPA issued a request for proposals to a broad range of organizations to
15 provide a tool for use in the MCA. From the responses to this request, three models were
16 selected as possibly adequate for the task that were reasonably priced: PMDAM – owned
17 by New Energy Associates; IREMM - owned by Resource Data International; and
18 AURORA – owned by EPIS. BPA facilitated the public review of these models by
19 having representatives for each model make presentations on their models in a public
20 workshop. BPA also reviewed the results of preliminary price forecasts from each of
21 these models and shared these results with the public.

22 *Q. Why did BPA choose AURORA?*

23 A. Public participants in the workshops noted several strengths of AURORA and BPA
24 agreed with these comments. AURORA is the most accessible model to review and
25 operate, while at the same time providing a good level of accuracy. A local company
26 owns AURORA, and this allows for quicker and better user support. AURORA had been

1 recently used by the Northwest Power Planning Council (NWPPC) and was reviewed and
2 tested by the NWPPC and energy experts assisting in this analysis.

3 *Q. Has AURORA been used for a similar purpose before?*

4 A. Yes. AURORA is commercially available and is used by several other organizations.
5 The most relevant previous application was by the Northwest Power Planning Council
6 (NWPPC) in the study, “Analysis of the Bonneville Power Administration’s Potential
7 Future Costs and Revenues.” The NWPPC used AURORA to forecast long-term market
8 clearing prices. This analysis was conducted with oversight by both a technical work
9 group and a policy work group. As stated in the introduction to the NWPPC’s study,
10 “[E]ach group was made up of respected representatives of key interest groups. The
11 purpose of these groups was to allow access to their expertise and perspectives and to
12 ensure that there was broad understanding of the methods and assumptions driving the
13 results.”

14 *Q. Have interested participants in the rate case had an opportunity review BPA’s use of
15 AURORA?*

16 A. Yes. In order to facilitate public review, BPA paid for a ‘blanket’ usage agreement with
17 EPIS. Under this agreement, BPA paid EPIS to make AURORA available to interested
18 rate case participants at a reduced cost. In addition, as part of this agreement EPIS has
19 conducted three training workshops to work through the theory and operational details of
20 AURORA. BPA has also made the data and assumptions used in the MCA available to
21 the public.

22 *Q. Did the public participants offer comments on BPA’s use of AURORA?*

23 A. Yes. Public participants reviewed the original data base in detail. After this review, the
24 participants offered several very useful suggestions for the data base.

25 *Q. Please describe these suggestions.*

1 A. Several resources were identified that should be added or deleted from the original
2 AURORA data base based on current information. In the original AURORA data base,
3 the amount of capacity for each resource was derived from the nameplate rating. It was
4 suggested to change this to the available capacity as given by the WSCC. Participants
5 also suggested that BPA should add and delete resources so that the data base is
6 consistent with the WSCC geographic boundary. In the original AURORA data base, all
7 nonutility generation was defined as a generic gas fired resource with a heat rate
8 approximately equal to 10,000 Btu/kWh. It was suggested that the data base should
9 account for the individual characteristics of these generating resources and include any
10 updates on additions or retirements to be consistent with current WSCC data.
11 Participants suggested that BPA review and improve, if possible, the minimum
12 generation percentages used in the unit commitment logic. Updates on the amount of
13 transmission capacity and wheeling rates were offered. Workshop participants suggested
14 that curtailment prices should be constant in real dollar terms. It was also suggested that
15 BPA change the definitions of AURORA areas from a state-based definition to one that
16 more clearly matched transmission areas.

17 *Q. How did BPA respond to these suggestions?*

18 A. BPA reviewed these comments and concluded that many were appropriate. BPA set
19 priorities for how best to incorporate these comments within the rate case time lines.
20 BPA incorporated the highest priority comments that were feasible within our timeframe
21 for the initial proposal.

22 BPA added and deleted resources to use more current information. BPA changed
23 the capacity definition from nameplate to available capacity. BPA added and deleted
24 generating resources to be consistent with the WSCC geographic definition. BPA
25 included data for unit-specific nonutility generation instead of a simple generic gas fired
26 resource and updated the resources to be consistent with current WSCC data. BPA

1 researched minimum generation levels for the unit commitment logic and updated this
2 data. BPA updated transmission capacities and wheeling rates. BPA changed the
3 curtailment escalation rate so that curtailment prices remained constant in real dollar
4 terms. BPA was not able to incorporate a change in the definition of AURORA areas
5 within the schedule for preparing BPA's initial proposal. This change would not result in
6 a change in the level of loads or resources in the WSCC. BPA will continue to review
7 changes to AURORA for inclusion in further analysis.

8 *Q. Does this conclude your testimony?*

9 *A. Yes.*

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