

**UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION**

Puget Sound Energy, Inc.,
Complainant,

Docket Nos. EL01-10-000
EL01-10-001

v.

All Jurisdictional Sellers of Energy and/or Capacity
at Wholesale Into Electric Energy
and/or Capacity Markets in the Pacific
Northwest, Including Parties to the
Western Systems Power Pool Agreement,
Respondents.

**PREPARED DIRECT TESTIMONY
OF
ROBERT F. McCULLOUGH**

1 Q. Please provide you name and address.

2 A. I am Robert McCullough, Managing Partner of McCullough Research, 6123 S.E. Reed
3 College Place, Portland, Oregon 97202. I have been active in bulk power issues in the
4 Pacific Northwest and California since the early 1980s. My firm has followed the California
5 crisis since its start in May of 2000. Our research on the causes and mechanisms of the
6 California problems has been central to the policy discussions and analyses of the problem
7 from the start of the crisis. My full qualifications are included in Exhibit No. 1, (RFM-1) to
8 this testimony.

9

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1 Q. **What is the purpose of your testimony today?**

2
3 A. My testimony addresses the calculation of a fair and reasonable rate for the Pacific
4 Northwest. I will address three major issues:

5 1. The definition of the Pacific Northwest used in this proceeding;

6 2. The appropriate definition of spot purchases suitable for refund;

7 and,

8 3. The appropriate marginal production cost to be used in the computation of a fair and
9 reasonable rate.

10
11 **Defining The Pacific Northwest**

12
13 Q. **How would you define the Pacific Northwest for the calculation of the fair and**
14 **reasonable rate?**

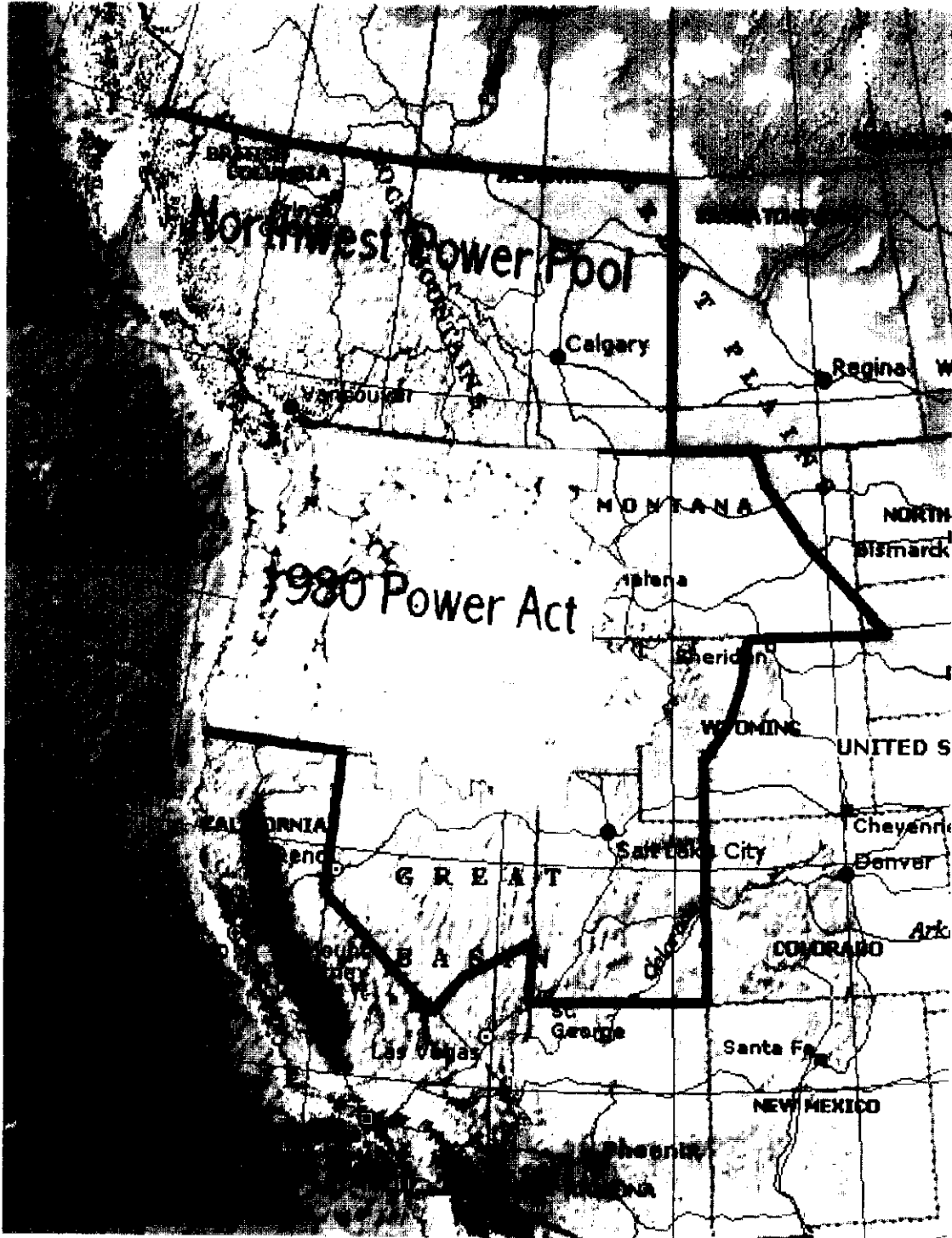
15 A. Several proposals have been put forward – the definition found in the 1980 Pacific Northwest
16 Electric Power Planning and Conservation Act (PNEPPCA), the Northwest Power Pool, and
17 the service territories of the utilities that lie within the four Pacific Northwest states.

18
19 I believe the correct answer is strictly determined by the use to which the fair and reasonable
20 rate is to be put. This calculation is primarily intended to set a fair standard for purchases
21 within the power marketing area. The Pacific Northwest Power Pool is an area the includes
22 the utilities that are active in trading electricity within the Pacific Northwest. It is logical to

1 use the marketing area of the Pacific Northwest, not an arbitrary geographic division. The
2 NWPP has been in operation since 1957 and the Coordination Agreement governing the
3 relationship of Northwest utilities was signed in 1962. This is a definition of very long
4 standing.

5
6 **Q. The use of the drainage basin of the Columbia River and its tributaries as defined in
7 PNEPPCA has also been proposed. Why would this not be appropriate?**

8 **A.** This definition was adopted by the framers of this legislation for the specific purpose of
9 allocating the benefits of the Columbia River projects owned by the U.S. Government and
10 marketed by the Bonneville Power Administration. While this definition tends to include most
11 resources and most loads within the area, the division of resources and loads are largely
12 random. The PNEPPCA definition, for example, excludes half of PacifiCorp's loads and the
13 majority of its thermal resources. Since PacifiCorp is integrated into the Pacific Northwest,
14 this would tend to overstate summer surpluses and understate the load/resource pattern in the
15 winter. The following map shows the PNEPPCA defined Pacific Northwest as well as the
16 Pacific Northwest Power Pool:



1 Q: Is BPA's relationships with Pacific Northwest utilities limited to the geographic scope
2 of PNEPPCA?

1 A. No. BPA has contracts with PacifiCorp that are critical to the operation of their territories
2 in the western states of Oregon and Washington as well as the eastern states of Idaho,
3 Montana, and Utah. In practice, BPA is fully integrated with Pacific's service territories both
4 within and without the PNEPPCA definition. By the same token the proposed Northwest
5 RTO also includes all of Pacific's service territories.

6
7 **Q. What adjustments are appropriate if we accept the Northwest Power Pool as a suitable
8 definition for the Pacific Northwest?**

9 A. As can be seen from the map, the NWPP includes two Canadian provinces with very different
10 characteristics and legal environments that are not subject to FERC jurisdiction. Since the
11 data is readily available for the U.S. portion of the Northwest Power Pool at both the WSCC
12 and the NWPP, it would seem appropriate to focus on an area within FERC's jurisdiction.

13 14 **Spot Purchases**

15
16 **Q. How would you define the "spot market" for the Pacific Northwest?**

17 A: For many years FERC has recognized that the Pacific Northwest and other primarily
18 hydroelectric systems operate very differently from thermal systems like those in California.

19
20 The Northwest Power Pool generation mix is dominated by hydroelectric generation. Of the

1 72,084 MW of capacity identified by the WSCC for December 1999, 63.8% is hydroelectric.¹

2
3 Hydroelectric resources are fuel limited, not capacity limited, so the concept of a marginal
4 thermal resource has little meaning in such an environment. This is why FERC does not
5 require marginal thermal dispatch costs from hydroelectric systems in the annual FERC Form
6 714 submissions.²

7
8 **Q. How do hydroelectric systems dispatch to meet load?**

9 **A.** The best load following resource is also the resource with the lowest marginal cost –
10 hydroelectricity. In the Pacific Northwest, load following is entirely accomplished by
11 adjusting the generation of the major projects along the Columbia River and its tributaries.

12
13 The operating problem that faces Pacific Northwest generators is that the hydroelectric
14 projects do not have enough water to meet all of the loads – even though they might well
15 have sufficient capacity to meet peak loads without the need for any other resources.

16
17 Thermal operations and purchased power transactions are designed to “fill in” the ability of
18 the hydroelectric projects to meet load. Since the hydroelectric projects are not capable of
19 running all of the time, the utilities in the Pacific Northwest make purchases on an hourly,

¹10-Year Coordinated Plan Summary, October 2000, WSCC, page 35.

²See FERC’s instructions on the preparation of the FERC Form 714 System Lambda at <http://www.ferc.gov/ELECTRIC/f714/2000instructions.htm>.

1 daily, weekly, or monthly basis to “refill” reservoirs.

2
3 **Q. Since the start of the California crisis there has been a tendency for the concepts and**
4 **terminology of WSCC power markets to revolve around the California market. This**
5 **tends to make it appear that Pacific Northwest markets are less extensive and less**
6 **sophisticated. Is this correct?**

7 **A. No. Actually the exact opposite is the case.**

8
9 AB-1890, the law that set out the framework of the California market, envisaged a centralized
10 market where prices were set by computer programs rather than true markets.

11
12 The Pacific Northwest operates as a true commodity market where prices are set by bilateral
13 negotiation, rather than administered by a separate authority. In this way, the Pacific
14 Northwest far more closely approximates true commodity markets like the Chicago Board
15 of Trade and the London Metal Exchange.

16
17 One reason why real world commodity exchanges avoid the administered prices of the
18 California model is that these types of markets have proven relatively easy to manipulate.
19 Manipulation of prices in the WSCC outside of California is difficult since no central authority
20 can be “gamed.”

21
22 The spot (or “non-firm”) markets in the Pacific Northwest have been in operation for over

1 twenty years. While many transactions take place at “Mid-Columbia,” spot transactions also
2 take place from one end of the region to the other.

3
4 Relatively few transactions take place on an hourly basis. This simply reflects the operating
5 realities of the electric system. Few control areas can wait until the hour of operation to
6 arrange for supply. Almost all players purchase power on a forward basis – usually daily,
7 weekly, or monthly. Only a small market for hourly supplies occurs – mainly to balance
8 supply with demand in the very near term. Any increase in hourly sales has simply reflected
9 the unsettled conditions at the California ISO.

10
11 **Q. Would restricting the analysis to hourly transactions make much sense?**

12 **A.** No. Spot transactions are a continuum. Simply pulling one highly restrictive definition out
13 of the hat would not reflect the market exposure of Northwest buyers. Outside of the highly
14 artificial rules of California, any supplier has the right to package hourly supplies in whatever
15 fashion the market dictates. Since customers are filling in deficits – refilling reservoirs, so to
16 speak – it would be inefficient for them to seek hour to hour purchases. They would expect
17 suppliers to make offers for periods that reflect their requirements. Thus spot purchases tend
18 to reflect the longer operational needs of the ultimate consumers.

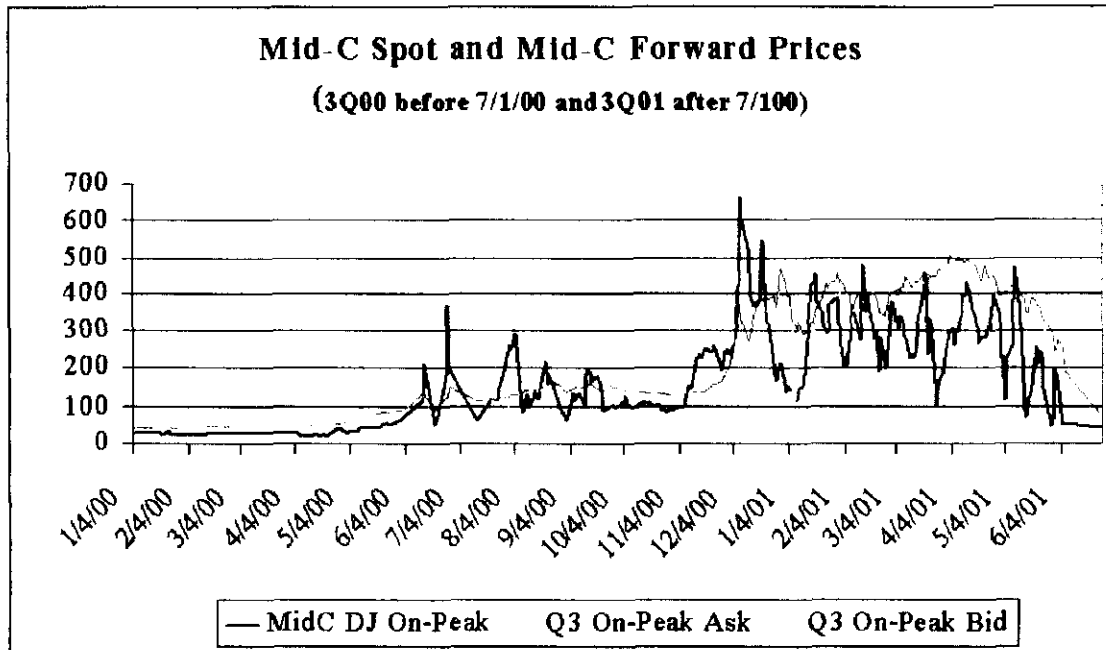
19
20 On the suppliers side, sellers also need not pursue a new negotiation for every hour. It is
21 efficient for sellers to package hourly supplies into daily, weekly, or monthly blocks in order
22 to meet the needs of the buyers.

1 Q. **How do the prices of hourly and monthly markets compare?**

2 A. The correlation between short term and longer term pricing is very high. Since May 2000,
3 the centralized markets in California have been the basis of pricing throughout the WSCC.
4 While longer term markets do not exist in California – especially after the cessation of
5 business of the California Power Exchange in January 2001, the opportunity cost of the
6 hourly market clearly drives longer term offers elsewhere in the WSCC.

7
8 After May 2000, the correlation between short term and long term prices has increased.
9 While the causes for may be subjective, the logical implication is that as fundamentals declined
10 in value as an explanation for prices in California, traders were forced to depend increasingly
11 on trends in their estimates of future prices.

12
13 The following graph shows the relationship between Dow Jones daily prices and the following
14 third quarter bid to Seattle City Light. The purpose of this comparison is to show the highly
15 related nature of markets of very different durations – 16 hours for the Dow Jones index and
16 an offer for the 1,264 on-peak hours for the full third quarter.



1

2

Approximately 57% of the variance in the third quarter bid can be explained by the current Dow Jones index.

3

4

5

Q. What does this imply for Pacific Northwest utilities that would normally purchase blocks of power?

6

7

A. The wild variations in prices characteristic of California's centralized mechanisms rapidly affect prices throughout the WSCC and, as well, affect prices for longer term products. In effect, there is no hedge or purchasing strategy that is not affected by short term California prices.

8

9

10

11

1 Q. **So how would you define the “spot market” in the Pacific Northwest?**

2 A. The Pacific Northwest treats all purchases and sales of less than one year duration as spot
3 purchases. The term of art used in the Pacific Northwest for such transactions is “secondary”
4 or “non-firm” since these purchases change from year to year.

5
6 This terminology is based on the Pacific Northwest Coordination Agreement which controls
7 how the major projects are dispatched. This Agreement envisages that all purchases and
8 thermal dispatch will be block loaded to stretch the available supply of hydroelectricity.

9
10 **Fair and Reasonable Marginal Production Cost**

11
12 Q. **Would a marginal cost for a Pacific Northwest combustion turbine reflect a fair and
13 reasonable cost?**

14 A. No. As is clear from the discussion above, this does not reflect the operational realities of a
15 hydroelectric system. Moreover, the highest cost running combustion turbine in the region
16 would simply reflect the distortions caused by gaming in the California market.

17
18 This can be easily seen by a simple example. This past year, prices in the California market
19 reached unbelievable heights – heights that cannot be explained by any fundamental forces.

20
21 These high prices dispatched a variety of resources throughout the WSCC that would never
22 have operated except for the market manipulations within the California market. For the sake

1 of argument, let's assume that the aged turbines at Roseburg Lumber's mill were dispatched
2 to meet these distorted prices. This would not make the prices "fair and reasonable" simply
3 because obsolete equipment was taken out of mothballs to respond to the distorted market.

4
5 To make the example more extreme, during some periods, Roseburg Lumber does not have
6 access to its standard fuels – natural gas and the wood wastes of its lumber mill. If prices are
7 high enough, market prices would have paid the owners of Roseburg Lumber to "chip"
8 finished lumber ready for shipment to the construction and furniture markets. In effect, when
9 the market distortions in California were at their height, Roseburg Lumber might have
10 responded by burning furniture in their obsolete units. Again, this would not make this cost
11 fair or reasonable.

12
13 The bottom line is that fair and reasonable should be based on real data and real operations,
14 setting aside the market manipulations in the California market. Burning furniture in response
15 to unfair and unreasonable prices would not be reasonable.

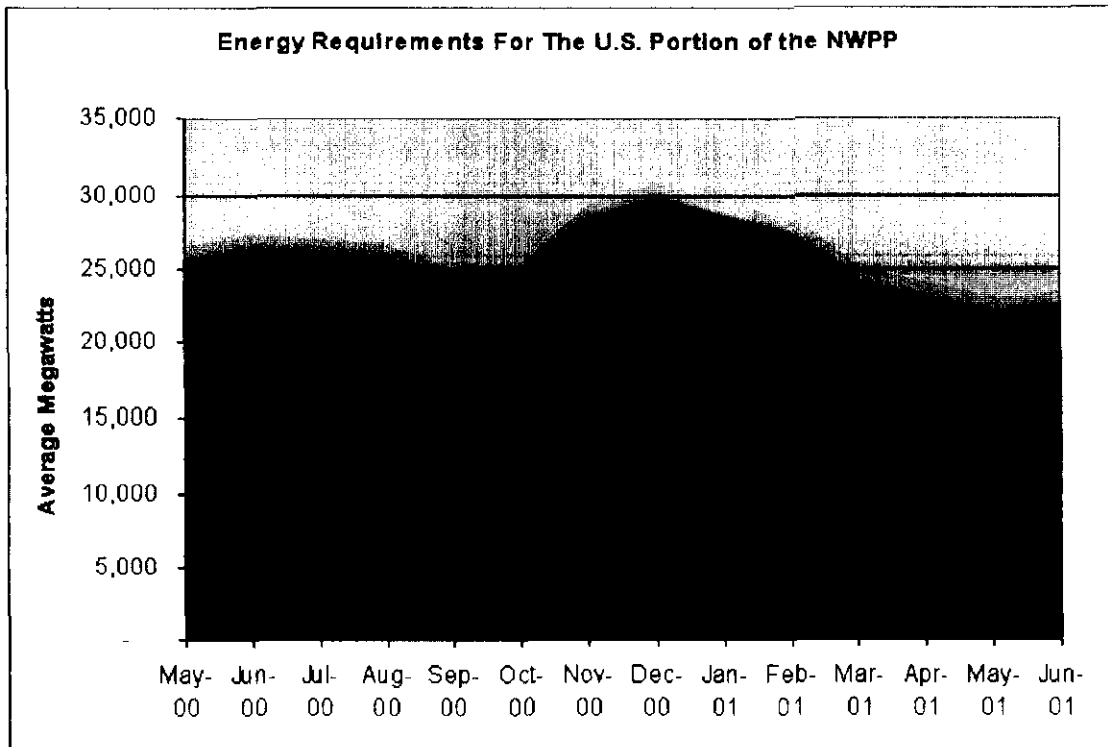
16
17 **Q. What is a fair and reasonable price for the Pacific Northwest?**

18 **A.** The most straightforward answer is the cost of the marginal thermal resources that were
19 dispatched to meet Pacific Northwest loads. Given the monthly block operations of the
20 Pacific Northwest, this data is readily available from the Northwest Power Pool, the Federal

1 Energy Regulatory Commission, and the Energy Information Administration.³

2 The first step is to calculate the energy requirements to meet U.S. Northwest Power Pool

3 Loads. The following chart shows the monthly energy requirements since May of 2000.

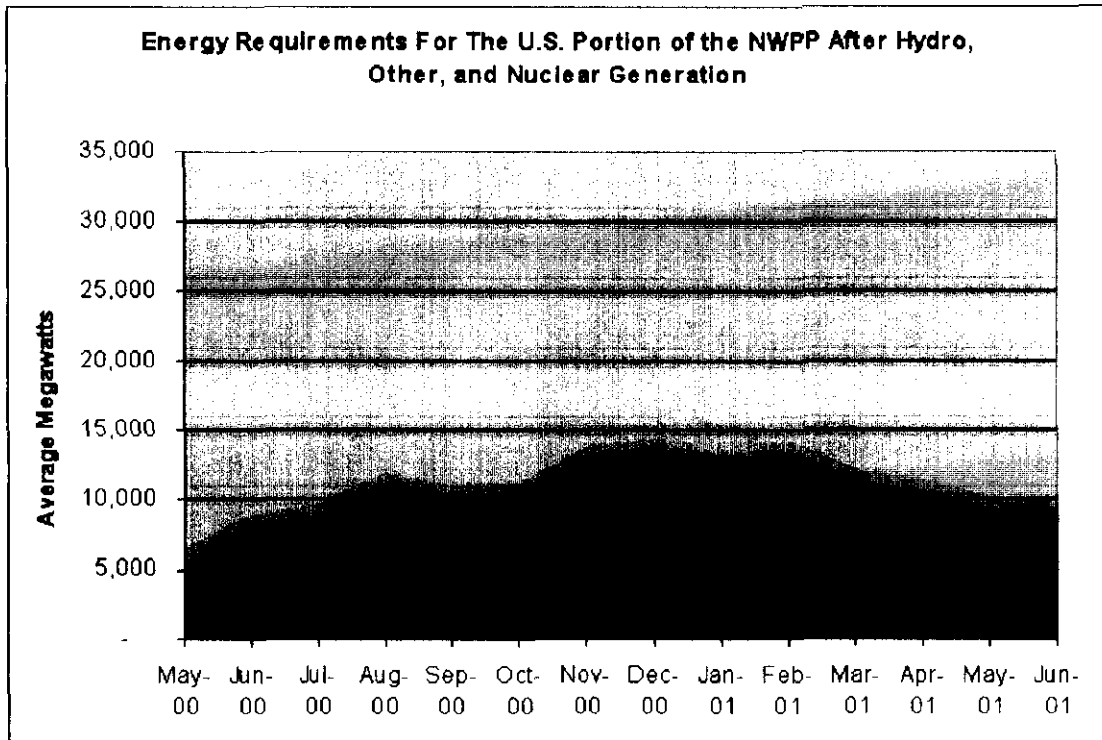


4 Hydro electric generation, the generation of the WPPSS 2 nuclear station and “other
5 generation” are generally not subject to economic dispatch.

6
7 The next chart shows the remaining load to be met by thermal generation after these three
8 types of generation.

³Outside of California, most utility operating data is public. The Northwest Power Pool publishes a weekly summary of loads and resource operations by utility control area. This data, in aggregate, corresponds to the Northwest Power Pool data used in WSCC reports and studies. The EIA provides plan level operating data for almost all Northwest Power Pool plants in their EIA Form 906 database. FERC Form 423 provides monthly plant fuel costs.

1 The next step is to see which resources would have met this load without the disruption
2 caused by the California markets.



3 The WSCC 2000 Summer Assessment provides a detailed breakdown of the resources
4 available in the U.S. portion of the NWPP to meet these loads. Resources adjusted for
5 planned outages and the Hunter outage are summarized in Exhibit No. 2, (RFM-2).

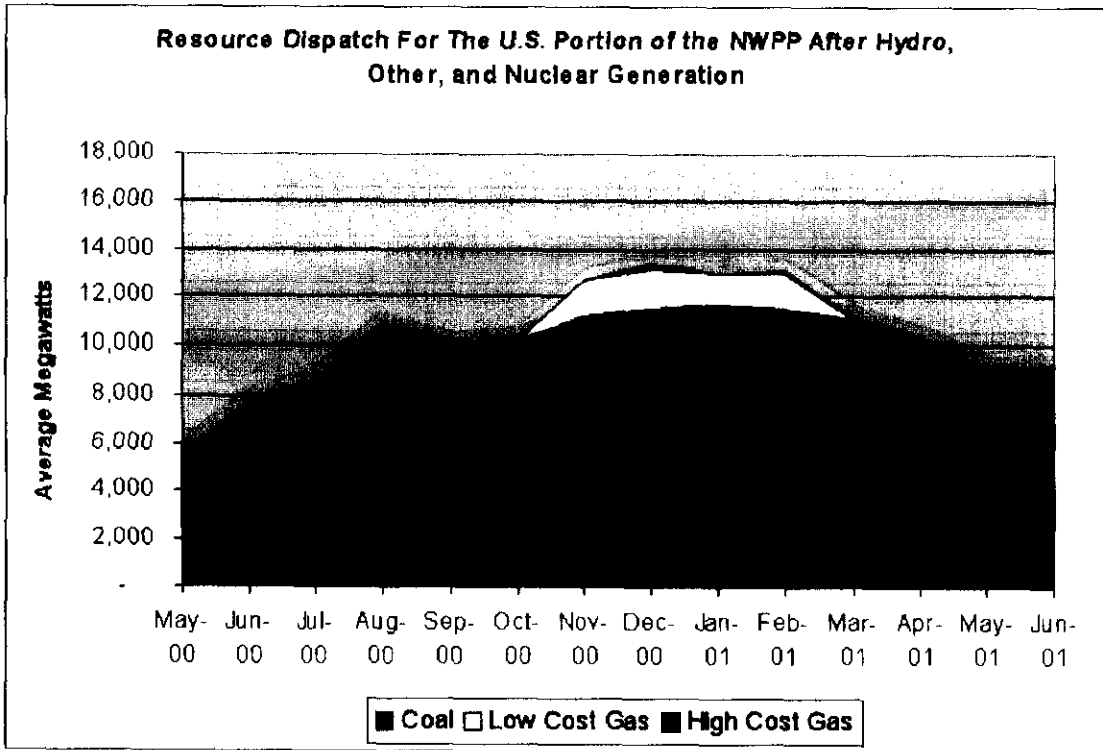
6
7 Since the NWPP dispatches resources on a block basis, we can reproduce the dispatch that
8 would have occurred with California's disruption of the market. After hydro, nuclear, and
9 other generation has been considered, the region's coal resources are then dispatched. After
10 coal, combined cycle units are dispatched and finally, high cost natural gas units.

11

1 The dispatch analysis indicates that the appropriate choice for energy dispatch was coal until
2 November 2000 and after March 2001. Low cost natural gas units operate from November
3 through March and high cost natural gas units in December and February.
4

5 **Q. Can we estimate the costs of these units?**

6 **A.** No estimation is necessary. FERC Form 423 provides the monthly fuel costs for most of the
7 units in the NWPP. While it would be possible to calculate operating costs on a resource by
8 resource basis, the simplest approach is to take the highest cost units in each classification.
9 For base load coal, the highest cost base load coal unit is the Centralia plant in central
10 Washington state. PacifiCorp's 2000 FERC Form 1 gives an average fuel cost for Centralia
11 of 16.86 mills. For low cost gas units, we choose the Coyote Springs plant outside of
12 Boardman, Oregon. This plant has a higher heat rate than average for its class, 7700. Coyote
13 Spring's natural gas based production costs ranged from 30.57 to 27.16 mills from November
14 through March. The high cost gas unit selected was Beaver, a 9679 heat rate unit outside of
15 Portland, Oregon. Beaver's actual production costs in December and February were 81.62
16 mills and 67.45 mills. I have added 3.00 mills to these costs to cover variable operations and
17 maintenance.
18



1 **Q. Using this data, what would you estimate the fair and reasonable rate for the pacific**
 2 **Northwest?**

3 **A. The fair and reasonable rate, by month, would be:**

4 **May, 2000: 19.86 mills**

5 **June, 2000: 19.86 mills**

6 **July, 2000: 19.86 mills**

7 **August, 2000: 19.86 mills**

8 **September, 2000: 19.86 mills**

9 **October, 2000: 19.86 mills**

10 **November, 2000: 30.57 mills**

1	December, 2000:	81.62 mills
2	January, 2001:	23.18 mills
3	February, 2001:	66.47 mills
4	March, 2001:	27.16 mills
5	April, 2001:	19.86 mills
6	May, 2001:	19.86 mills
7	June, 2001:	19.86 mills

8

9 **Q. These costs are substantially lower than the estimates you would calculate by taking**
10 **Sumas prices gas and generating through a combustion turbine. How would their**
11 **accuracy compare to the combustion turbine methodology?**

12 **A.** The combustion turbine methodology simply isn't accurate or particularly relevant to the
13 Pacific Northwest. First, we simply do not use combustion turbines for load following. While
14 combustion turbines were dispatched over the past year, they reflected a response to the
15 California market distortions and not an attempt to meet peak loads in the Pacific Northwest.
16 Second, using assumed fuel costs – even with a good theoretical basis – instead of actual data
17 is unnecessary. We have actual fuel costs for plants that were used to meet loads. Third, the
18 Pacific Northwest utilities operate on a monthly basis, as is appropriate for hydroelectric
19 utilities, not an hour to hour basis.

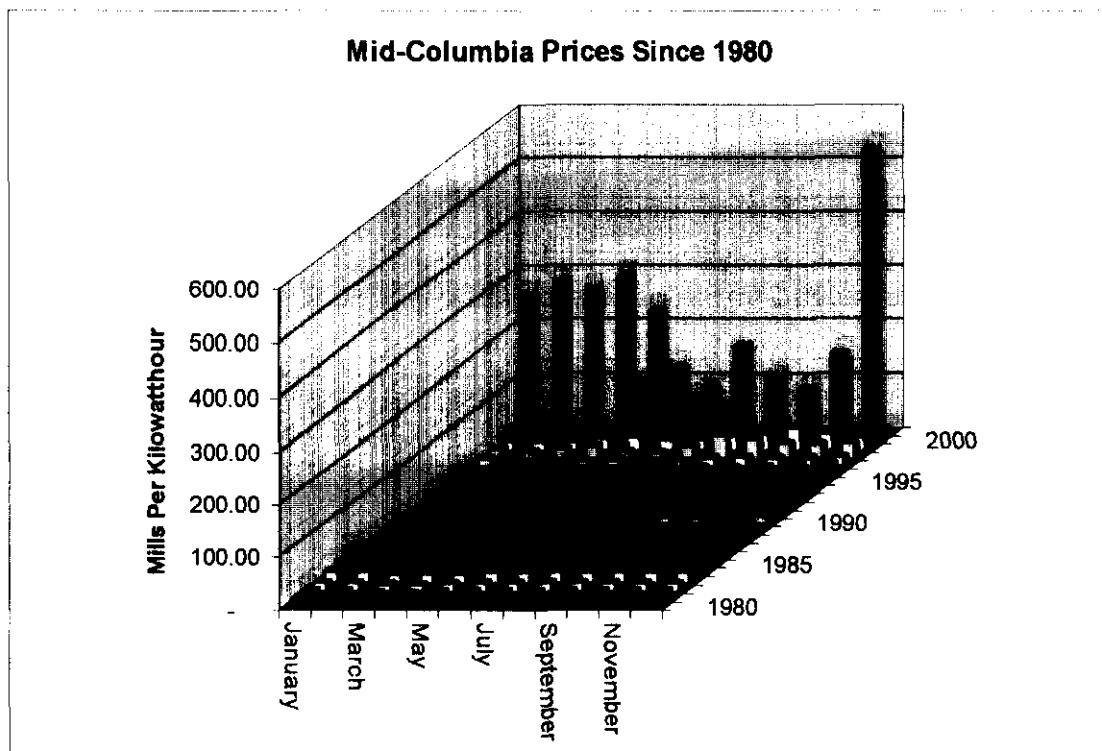
20

21 **Q. Are these results consistent with twenty years of operations in the Pacific Northwest?**

22 **A.** Absolutely. We have two decades of experience with bulk power markets in the Pacific

1 Northwest. These results reflect the vast majority of market behavior we have observed since
2 1980. They also reflect good economic logic. Plants are block dispatched in merit order.
3 Prices reflect the incentive required to bring up a unit. There are no arbitrary “market
4 mechanisms” where state officials attempt to direct the market or market participants exert
5 market power.

6
7 The following chart shows monthly spot prices since January 1980. It is important to note
8 that during the period in the late 1980s when gas prices were high and a major drought took
9 place spot prices were reflective of operating costs.



10 Q. **Is a creditworthiness adder relevant to the Pacific Northwest?**

11 A. No. None of the utilities in the Pacific Northwest faced bankruptcy due to the California

1 crisis. In the main, bankruptcy risk was an artifact of the decision by the California PUC to
2 force the utilities completely into the hourly market. Real markets do not operate under such
3 extreme and ill-judged pronouncements. The Pacific Northwest investor owned utilities have
4 limited vulnerability to the price excursions and have largely hedged the risk they faced. The
5 publicly owned utilities have substantial assets, and, in many cases, are wholly owned
6 subsidiaries of larger political units. The only utilities with few assets and limited resources
7 are the full requirements customers of Bonneville, and these utilities are, by definition, not
8 active in the bulk power markets.

9
10 The creditworthiness adder is appropriate only for California and only in a few carefully
11 delineated cases.

12
13 **Q. Does this complete your testimony?**

14 **A. Yes.**

UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

Puget Sound Energy, Inc., et al.) Docket Nos. EL01-10-000
) Docket EL01-10-001

AFFADAVIT OF WITNESS

I, Robert McCullough, being duly sworn, depose and say that the statements and exhibits contained in the testimony on behalf of Seattle City Light in this proceeding are true and correct to the best of my knowledge, information, and belief.
Executed on this 16th day of August 2001



Robert McCullough

COUNTY OF MULTNOMAH
STATE OF OREGON, to wit:

Subscribed and sworn to me this 16th day of August 2001.

My commission ends: 7/18/09





Notary Public

ROBERT McCULLOUGH
Managing Partner

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Fax: 503-436-9112

Employment Experience:

- July 1985 to the Present: Managing Partner of McCullough Research. Providing strategic planning assistance, litigation support, and planning for a variety of customers in energy, regulation, and primary metals.
- Sep. 1996 to the Present: Adjunct Professor, Economics, Portland State University.
- Dec. 1990 to Aug 1991: Director of Special Projects and Assistant to the Chairman of the Board. Conducted special assignments for the Chairman in the areas of power supply, regulation, and strategic planning.
- June 1988 to Dec. 1990: Vice President in Portland General Corporation's innovative bulk power marketing utility subsidiary, Portland General Exchange. Primary negotiator on the purchase of 550 MW transmission and capacity package from BPA. Primary negotiator of PGX/M, PGC's joint venture to establish a bulk power marketing entity in the Midwest. Negotiated power contracts for both supply and sales. Coordinated research function.
- June 1987 to June 1988: Manager of Financial Analysis, Portland General Corporation. Responsible for M&A analysis, restructuring planning, and research support for the financial function. Reported directly to the CEO on the establishment of Portland General Exchange. Team member of PGC's acquisitions task force. Coordinated PGC's strategic planning process. Transferred to the officer's merit program as a critical corporate manager.
- June 1981 to June 1987: Manager of Regulatory Finance, Portland General Electric. Responsible for a broad range of regulatory and planning areas. These include preparation and presentation of PGE's financial testimony in the state rate cases in 1980, 1981, 1982, 1983, 1985, and 1987 before the Oregon Public Utilities Commission. Also responsible for preparation and presentation of PGE's wholesale rate case with BPA in 1980, 1981, 1982, 1983, 1985, and 1987. Coordinated activities at Bonneville and FERC on wholesale matters for the ICP (InterCompany Pool, the association of investor owned utilities in the Pacific Northwest) since 1983. Created BPA's innovative aluminum tariffs, adopted by BPA in

1986. Led PGC activities, reporting directly to the CEO and CFO on a number of special activities including litigation and negotiations concerning WPPSS, the Northwest Regional Planning Council, various electoral initiatives, and the development of specific tariffs for major industrial customers. Member of the Washington Governor's Task Force on the Vancouver Smelter (1987) and the Washington Governor's Task Force on WPPSS Refinancing (1985). Member of the Oregon Governor's Work Group On Extra-Regional Sales (1983). Member of the Advisory Committee to the Northwest Regional Planning Council (1981).
- Dec. 1979 to June 1980: Economist, Rates and Revenues Department. Portland General Electric. Responsible for financial and economic testimony in the 1980 general case. Coordinated testimony in support of the creation of the DRPA (Domestic and Rural Power Authority) and was a witness in opposition to the creation of the Columbia Public Utility District in state court. Member of the Scientific and Advisory Committee to the Northwest Regional Power Planning Council.
- Sept. 1976 to Dec. 1979: Graduate student, Cornell University. Worked at Cornell as an economist for Institutional Research directly for the Vice-President of Planning. Co-investigator on a major grant from the Department of Labor's Bureau of International Labor Affairs. Performed statistical and demographic analysis for the New York State Consumer Protection Agency.
- Sept. 1973 to Sept. 1976: Portland State University. Worked as Research Assistant in the Economics Department. Summer work for the U.S. Bureau of Land Management and the Institute On Aging.
- Jan. 1974 to June 1974: Economist, Legislative Research. Researched bills before the legislature on issues from land use to economic development.
- Jan. 1973 to Sept 1973: Researcher, Willamette Management Associates. Responsible for economic research and writing in various financial periodicals. Supported corporate valuation analysis.

Major Economic Consulting Experience:

- Jan. 2000 to Present: Advisor to the California Attorney General on possible market manipulations in the WSCC power markets

Jan. 2000 to Present: Advisor to the VHA power purchasing program.

Jan. 2000 to Present: Expert witness in WECCO/PacifiCorp litigation.

Dec. 2000 to Present: Expert witness in Wah Chang/PacifiCorp litigation.

Sept. 2000 to Present: Expert witness in SCE/BPA litigation.

June 2000 to Present: Advisor to Blue Heron Paper on West Coast price spikes

June 2000 to Nov. 2000: Expert witness for Georgia Pacific and Bellingham Cold Storage in WUTC proceeding on power costs

Nov. 1999 to May 2000: Expert witness for the Large Customer Group in PacifiCorp's Utah general rate case

Sept 1999 to April 2000 Expert witness for Tacoma City Light regarding termination of WAPA contract.

Sept 1999 to present Advisor to the Manitoba Cree on energy issues in Manitoba and Minnesota.

Sept. 1999 to Oct. 1999 Advisor to GTE regarding Internet Access in a competitive telecommunications market.

July 1999 to present: Expert report to the Center Helios on Freedom of Information in Quebec.

July 1999 to present Analysis of PacifiCorp power costs for Nucor Steel and Geneva Steel.

April 1999 to present: Advisor to the Grand Council of the Cree on Hydro-electric Development

April 1999 to Sep. 1999: Advisor to Logansport Municipal Utilities

January 1999 to present: Advisor to Bayou Steel on alternative energy supplies

January 1999 to present: Advisor to Abitibi-Consolidated on energy supply issues

November 1998 to present: Advisor to Cominco Metals on possible sale of hydro-electric dams in British Columbia

- September 1998 to present: Advisor to the Betsiamites on the possible purchase of hydro-electric dams in Québec
- June 1998 to June 1999: Advisor to the Illinois Chamber of Commerce on its affiliate electric and gas program
- June 1998 to present: Advisor to Edmonton Power on utility plant divestiture in Alberta
- January 1998 to Jan. 2000: Energy buyer for California Steel
- February 1998 to present Retained as energy advisor for Boise Cascade
- April 1998 to Aug. 1998 Intervention in Québec's first regulatory proceeding on behalf of the Grand Council of the Cree.
- August 1998 to Jan. 2000: Energy buying and transmission negotiations for Nucor steel
- January 1998: Market forecasts for Montana Power's restructuring proceeding
- Nov. 1997 to Oct. 1999: Advisor to the Columbia River Intertribal Fish Commission on Columbia fish and wildlife issues.
- April 1997 to August 1997: Advisor to Kansai Electric on restructuring in the electric power industry Nationally, with emphasis on the California markets.
- March 1997 to June 1997: Expert witness in the Alcan/British Columbia litigation.
- January 1997 to Jan. 1998: Advisor to Port of Morrow regarding power marketing with respect to existing gas turbine plant.
- January 1997 to Jan. 1998: Expert witness in the Tenaska/BPA litigation
- Nov. 1996 to April 1997: Bulk power purchasing for the Association of Bay Area Cities
- July 1996 to June 1997: Advisor to Texas Utilities on industrial issues
- April 1996 to Sept. 1997: Expert witness in the Puget/March Point litigation
- January 1995 to present: Bulk power supplier for a variety of Pacific Northwest industrials
- November 1995 to present: Advisor to Tacoma Utilities on contract issues.
- July 1995 to Jan. 1996: Expert witness in the Tacoma/WAPA litigation

- January 1995 to present: Advisor to Seattle City Light on industrial contract issues.
- January 1994 to Dec. 1995: Advisor to Idaho Power on Southwest Intertie Project marketing.
- January 1993 to present: Northwest representative for Edmonton Power.
- January 1993 to Aug. 1997: Expert witness in the MagCorp/PacifiCorp litigation
- August 1992 to Aug. 1994: Negotiator on proposed Bonneville Power Administration aluminum contracts
- March 1992 to March 1995: Advisor to the Citizen's Energy Corporation
- Jan. 1992 to July 1992: Bulk power marketing advisor to Public Service of Indiana
- August 1991 to June 2000: Strategic advisor to the Chairman of the Board, Portland General Corporation
- August 1991 to March 1992: Financial advisor on the Trojan owners' negotiation team.
- July 1991 to July 1993: Chairman of the Investor Owned utilities' (ICP) committee on BPA financial reform
- July 1991 to Nov. 1991: Advisor to Shasta DAM PUD on COTP and related issues.
- March 1991 to present: Advisor to the Grand Council of the Cree on energy issues in Québec.
- Jun. 1990 to Feb. 1991: Advised the Chairman of the Illinois Commerce Commission on issues pertaining to the 1990 General Commonwealth Rate Proceeding. Prepared an extensive analysis of the bulk power marketing prospects for Commonwealth in ECAR and MAIN.
- Jan. 1988 to Sept. 1988: Facilitated the settlement of Commonwealth Edison's 1987 general rate case and restructuring proposal for the Illinois Commerce Commission. Reported directly to the Executive Director of the Commission. Responsibilities included financial advice to the Commission and negotiations with Commonwealth and interveners.
- Oct. 1987 to July 1988: Created the variable aluminum tariff for Big Rivers Electric Corporation. Responsibilities included testimony before the

Kentucky Public Service Commission and negotiations with BREC's customers. The innovative variable tariff was adopted by the Commission in August 1987. Supported negotiations with the REA in support of BREC's bailout debt restructuring. Various minor consulting projects from 1981 through 1989 including financial advice for the Oregon AFL-CIO, statistical analysis of equal opportunity for Oregon Bank, cost of capital for the James River dioxin review, and economic analysis of qualifying facilities for Washington Hydro Associates. Taught classes in senior and graduate forecasting, micro-economics, and energy at Portland State University from 1980 to 1986.

Education:

- A.B.D. Economics, Cornell University, 1979. Teaching Assistant in Micro and Macro-economics.
- M.A. Economics, Portland State University, 1975. Research Assistant.
- B.A. Economics, Reed College, 1972. Undergraduate thesis "Eurodollar Credit Creation"

Areas of specialization include micro-economics, statistics, and finance.

Volunteer Activities:

- Chairman: Portland State Economics department advisory committee.
- Member: Portland State College of Arts and Sciences advisory committee.

Professional Affiliations:

American Economic Association, American Financial Association, and the Econometric Society.

Publications and Presentations:

Numerous publications in industry journals and presentations to industry groups. The most recent presentations include: The Perfect Storm on March 22nd, 2001 and Tsunami: Prices Since May 22nd on October 11, 2000. Most recent publications are: "Power Spike Tsunami" in the January 1st, 2000 Fortnightly and "FERC's December 15th California Order" in the February 1st, 2000 Fortnightly.

Since 1994

Market Opportunities in Transmission: The Next Decade in the Pacific Northwest NELPA Presentation	March 28, 1994
Competition in the 1990s: Hard Work, Low Prices, Opportunities for Expansion Industrial Customers of Northwest Utilities Annual Meeting	January 10, 1995
Stranded Costs: Accountants Full Employment for the 1990's (Northwest Electric Light & Power)	February 16, 1995
Using the "R" Word Bonneville's Decision to Release 4000 Megawatts to the Market NELPA Annual Accounting Meeting	June 12, 1995
Bringing Ports and Utilities Together Pacific Northwest Ports Association	June 22, 1995
Restructuring in Alberta and California Change is inevitable so market needs to be competitive Governor's Energy Symposium, Springfield, Illinois	August 20, 1995
Retail Wheeling as a Quid Pro Quo for Plant Location Discussion of Competition, Regulation and innovative solutions New York Infocast Seminar	August 28, 1995
Estimating the Competitive Dividend (Competitive Utility)	October, 1995
Teaching the Hippopotamus to Dance: Negotiating with A New Utility Discussion of competition and market positioning for industry.	October 10, 1995
Teaching the Hippo To Dance: Negotiating with The "New" Utility. Bringing competition to a non-competitive world Pulp and Paper Association Annual Energy Meeting	October 12, 1995
Teaching the Hippopotamus to Dance: Bringing the Competitive Electric Market to Evanston Discussion of competition in the marketplace	October 18, 1995
Should We Be Waiting for FERC? (Or Congress, or the State	November 29, 1995

Commissions)?
Megawatt Markets

Predators and Prey: 1995 through 2010 in the WSCC
Surplus power and plummeting natural gas prices
NELPA/PSU Energy Symposium December 4, 1995

Big Rivers Electric Cooperative: A Stranded Investment Case Study?
Overview, history, market value of BREC Stranded Investment December 12, 1995

The Alberta Power Pool 1996
Analysis of creation and implementation of Alberta Power Pool December 18, 1995

"Predators and Prey", printed in Competitive Utility January, 1996

Western States Power Supply
Industrial rates are turning downward and special arrangements
should be viewed with care January 26, 1996

Primary Metals: Energy Supply Case Study
Pasha Symposium on Energy Supply February 3, 1996

Acquiring and Using a Resource Portfolio in Open Access
Profile of change for large industrial user vs competition February 3, 1996

Power Contracts: Writing the Deal February 2, 1996

Supply Power to Industrials: Competitive Bidding, Houston, TX February 2, 1996

Is PoolCo Just the Status Quo?
Competition will allow other players to choose other suppliers February 23, 1996

Energy Strategies for the Turn of the Century
Do not commit - the market is changing daily
Presentation to Weyerhaeuser Senior Management March 19, 1996

Market Fundamentals West Coast Forecast 1996-2010
Presentation to Seattle City Light Senior Management March 21, 1996

Surviving the New Industrial Markets
Shifts at BPA have opened new alternatives April 17, 1996

Power Supply Option Under Central Lincoln's 1981 Power Sales Contract May 9, 1996

Competition is keen. It is a buyers market and many opportunities exist for medium term firm suppliers

Fifty Ways to Leave Your Lover May 10, 1996
Another argument for choosing interruptibility

Sliding Towards Home May 17, 1996
New markets and new prices will be determined by the customer
Northwest Pulp and Paper Association

Lions, Tigers, and Bears: The New Zoology of the North American June 5, 1996
Electric Business.
1996 PowerMart Opening Presentation

Electricity/Gas Cross Market Opportunities June 24, 1996
Exploiting the synergies between gas and electricity will increase the supply of both commodities.
InfoCast Electric/Gas Symposium

Timing New Industrial Power Contracts August 21, 1996
Minimize any commitments under current arrangements and avoid any new entanglements.

Power Supplies for New Municipals: Designing an Effective RFP August 26, 1996
and Evaluating Responses.

What Do Industrials Need? September 7, 1996
Need to be responsive to customer's needs in a competitive world
1996 PowerMart

West Coast Overview September 14, 1996
Summary of progress in region
Retail Wheeling III, Washington, D.C.

Knowing When to Save Millions, printed in Competitive Utility October, 1996

Trading on the Index: Spot Markets and Price Spreads in the October 21, 1996
Western Interconnection: Public Utilities Fortnightly
Tying contracts to prices index. Evaluation of best index and adjustments for delivery points.

Breaking Up Is Hard to Do October 20, 1996
Discussion of Restructuring Marketplace after Competition

EEl Distribution Committee

California Gas Forecasts October 28, 1996
Base forecasts, heavy use/constrained supply, fully competitive

Watching the Hippos Dance: Electricity in the 1990's November 6, 1996
Competition discussion since 1992

Stakeholders Under Restructuring November 14, 1996
Return of competition shifts interest of players dramatically
NWPPA Annual Energy Meeting

Assessing Real Power Markets for Real Customers November 18, 1996
Buyers and Sellers unwilling to commit to long-term agreements.

Evanston Energy Supply Solutions November 27, 1996
Evanston, Illinois Energy Symposium

What are we Waiting for? (Megawatt Markets) Winter/1996

Getting The Best Deal for the Customer: at Buying and Selling January 16, 1997
Electricity in the West Options for customers in the changing
competitive environment. Law Seminars Annual Energy Meeting

Markets, Transmissions & Resources January 10, 1997
Overview of US/Canadian Power Market for the Edmonton Power Authority

Clark County Utilities: A Revisionist View of the Future January 20, 1997
Clark County Executive Retreat
Discusses the future of utilities in a competitive market

Power Supplies for New Municipals January 28, 1997
Designing and Effective RFP and Evaluating Responses

Economic Evaluations of Municipalization: InfoCast's April 3, 1997
Municipalization in a Changing Power Industry, Arlington VA

The Fifth Fiasco May 15, 1997
Clark County PUD Energy Symposium

Electric Competition April 9, 1997
Opening Presentation at the 1997 GasMart
Chicago, Illinois

A Revisionists History of the Future, Energy Buyer's Guide	June, 1997
How Regional Issues Have Shaped the Landscape for Tomorrow's Competition Keynote Address at Electricity Choices for Consumers	June 3, 1997
Buying Cheap Power in California InfoCast Seminar, San Francisco, California	June 20, 1997
Negotiating A Better Deal For Your Power Supply InfoCast Seminar, Chicago, Illinois	June 23-24, 1997
Buying Cheap Power in the Northeast and Mid-Atlantic States InfoCast Presentation, Boston, Massachusetts	July 25, 1997
Select Aggregation Partners That Offer the Greatest Cost Savings, The Center for Business Intelligence seminar, Boston, Ma.	August 14, 1997
A Primer on Price Volatility, <u>Energy Buyer</u> . Analysis of spot price history and concludes they really haven't changed much.	August 1997
Pacific Northwest: An Overview, <u>Energy Buyer</u> . A brief history of power issues past and present confronting the Pacific Northwest.	October 1997
Negotiating a Better Deal for your Power Supply, InfoCast presentation, Chicago, Illinois.	October 27, 1997
Is Capacity Dead? <u>Energy Buyer</u> . Discussion of capacity as a pricing component in a deregulated environment.	November 1997
RFP Development: A step-by-step guide. AIC Conference, Chicago, Illinois	November 17, 1997
Buying Cheap Power in California, InfoCast presentation, Santa Monica, Ca.	November 18, 1997
Getting There is Half the Cost: How Much is Transmission Service? <u>Energy Buyer</u> . Discussion of cost of transmission service in a deregulated market.	December 1997
Tools of the Trade: End-User Purchasing Strategies in the New Market, The Energy Institute conference, Las Vegas, Nevada	December 12, 1997
Pondering the Power Exchange, <u>Energy Buyer</u>	January, 1998

- Coping With Interruptibility, Energy Buyer February 1998
- Selecting a Power Supplier: Fundamentals, Fundamentals, Fundamentals. February 19, 1998
LSI conference, February 19-20. Discussion of various approaches to selecting a power suppliers in a competitive environment.
- Can Electricity Markets Work Without Capacity Prices? March 15, 1998
Public Utility Fortnightly. Analysis of the feasibility of future energy only power markets.
- A Revisionist's History of the Future. May 5, 1998
Presentation to Tacoma City Light Board. A synopsis of energy use from the past and how markets have changed in a competitive environment.
- Participation In BPA's Conscripton Process: Opportunity or Extortion? May 19, 1998
Presentation to the Snohomish Public Utilities Board
- Running a Competitive Bidding Program for Energy Services and Supplies. May 7, 1998
InfoCast-The Institutional Energy Users Forum, San Francisco, California. Discussion of purchasing processes, RFP structuring, pricing and insights into the prices of power past and future.
- FORSCOM Utility Deregulation Panel of Experts. May 14, 1998
Armed forces panel formed to solve the problem of procuring gas and electricity energy services and manage their use under a deregulated utility industry.
- Participation in BPA's Conscripton Process: Opportunity or Extortion? May 19, 1998
Presentation to Snohomish Public Utilities, Snohomish, Washington. Discussion of BPA's historical background, current market forces, and choices to be made in a competitive energy environment.
- Managing Electricity Price Risk: Practical Methods in the Emerging Markets. May 20, 1998
Presentation to Tacoma City Light, Tacoma, Washington. Discussion of risk management issues in a changing power market.
- Succeeding In Aggregation. June 13, 1998
Presentation to the New Mexico Retail Association. Durango, Colorado. History of regulation in energy market and suggestions and methods to aggregate power in a deregulated environment.
- Visions of Power Markets of the Future. June 18, 1998
Presentation to the Pacific Northwest Gas/Electric Integration group meeting. Discussion of power markets in deregulated market.

Pricing Strategies. Presentation to the June 26, 1998 session of the American Management Association on technical pricing and contract trends.	June 26, 1998
Are Customers Necessary? Analysis of the failure of the California retail market published in Public Utilities Fortnightly.	July 15, 1998
Proactive Strategies and Electricity Markets. Presentation to Abitibi Consolidated, Inc. Strategies for purchasing and selling power in competitive environments.	July 16, 1998
Marketing Priest Rapids and Wanapum Presentation to Grant County PUD #2. Discussion of issues district relating to FERC orders and deregulation trends.	September 15, 1998
Evaluating Electric Supply Risk Presentation to Georgia Pacific, Bellingham, WA. Discussion of power markets, spot prices and hedging options.	October 20, 1998
Electric Markets—Challenges and Solutions Presentation to Puget Power's Industrial Customers. Discussion of issues affecting power markets in a competitive environment.	November 5, 1998
Electric Markets Western Power Markets, Las Vegas Nevada Analysis of responses to recent changes in western power markets	December 16, 1998
Factors Driving the Market Buying and Selling Electricity In the West, Seattle, Washington Discussion of markets in the restructured energy market.	January 14, 1999
Coping With Capacity Prices Presentation at Metals Week Aluminum Meeting Analysis of responses to recent spot price spikes	January 25, 1999
Electric Competition, One Year Later: Winners and Losers in California Analysis of deregulation in the California energy market.	March 1, 1999
Winners & Losers in California. <u>Public Utilities Fortnightly</u> , Discussion of electric competition in the California market.	March, 1999

Presentation to the ISO Market Oversight Committee Seminar sponsored by the Power Industry Computer Application group San Jose, California.	May 17, 1999
Winners and Losers in California. An overview of the deregulated California energy market. Presentation to the Western Power Trading Forum.	June 8, 1999
How to Buy Power in the Pacific Northwest: A Buyer's Perspective. Presentation to Megawatt Daily, Generation Week and Financial Times Energy Conference.	June 22, 1999
Northwest Reliability Issues Presentation to the Oregon Public Utilities Commission	January 12, 2000
Northwest Power Developments Presentation to Georgia Pacific Management	May 5, 2000
Magnesium Corporation Developments Presentation to the Utah Public Utilities Commission	May 10, 2000
Northwest Market Power Presentation to Georgia Pacific Management	June 5, 2000
Northwest Market Power Presentation to the Oregon Public Utilities Commission and Oregon State Energy Office	June 10, 2000
Northwest Market Power Presentation to Governor Locke of Washington Seattle, Washington	June 30, 2000
Anatomy of a Corrupted Market Presentation to the Oregon Public Utilities Commission and Oregon State Energy Office Salem, Oregon	August 14, 2000
Tsunami: Market Prices Since May 22 nd Presentation to Price Spikes Symposium Portland, Oregon	October 11, 2000
Tsunami Presentation to the International Association of Refrigerated Warehouses Los Vegas, California	October 26, 2000

“Power Spike Tsunami”
Public Utilities Fortnightly

January 1st, 2001

“FERC’s December 15th California Order”
Public Utilities Fortnightly

February 1st, 2001

Wholesale Pricing and Location of New Generation
Buying and Selling Power In the Pacific Northwest
Seattle, Washington

January 19th, 2001

Exhibit RFM_2

	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR
RESOURCES - HYDRO - CONVENTIONAL	28,987	32,179	32,538	32,277	32,193	31,552	31,690	32,326	32,708	32,021	30,657	30,019
HYDRO - PUMPED STORAGE	-	-	-	-	-	-	296	304	308	304	291	-
NET STEAM - COAL	10,227	11,162	11,324	11,322	11,214	11,009	11,229	11,521	11,658	11,534	11,019	10,706
STEAM - OIL	-	-	-	-	-	-	-	-	-	-	-	-
STEAM - GAS	602	657	667	665	659	647	660	677	687	679	649	631
NUCLEAR	1,000	1,091	1,107	1,104	1,094	1,074	1,095	1,124	1,139	1,127	1,077	1,046
COMBUSTION TURBINE	1,480	1,616	1,628	1,625	1,713	1,722	1,783	1,829	1,854	1,835	1,727	1,638
COMBINED CYCLE	1,234	1,341	1,356	1,351	1,555	1,568	1,610	1,658	1,458	1,436	1,366	1,299
GEOHERMAL	103	113	114	114	113	133	136	139	141	140	133	108
INTERNAL COMBUSTION	132	145	147	146	145	141	135	138	150	148	142	139
OTHER	598	666	675	674	668	663	676	694	684	676	646	626
TOTAL RESOURCES	44,364	48,969	49,556	49,278	49,353	48,508	49,310	50,409	50,787	49,901	47,708	46,212

Source: Workpapers from the 2000 WSCC Summer Assessment

Readme.txt for RFM Testimony

Enclosed find files:

010815_RFM_Testimony.pdf and 010815RFM Testimony.wpd - e Direct Testimony of

Robert F. McCullough on Docket Nos EL01-10-000 and EL01-10-001 on behalf of All

Jurisdictional Sellers of Energy and/or Capacity at Wholesale Into Electric Energy and/or

Capacity Markets in the Pacific Northwest, Including Parties to the Western Systems

Power Pool Agreement, Respondents.

Also enclosed find:

Exhibit RFM_1.wpd and Exhibit RFM_1.pdf - Full qualifications of Robert F.

McCullough

Exhibit RFM_2.wpd and Exhibit RFM_2.pdf - Resources adjusted for planned outages

and the Hunter outage summarized.