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May 24, 2007

VIA OVERNIGHT DELIVERY

Public Utility Commission of Oregon
Attention: Filing Center
550 Capitol St NE #215
Salem OR 97308-2148

Re: ***Docket UM 1002 – Wah Chang, Petitioner v. PacifiCorp, Respondent***
PacifiCorp's Reply Testimony and Exhibits

Dear Sir or Madam:

Enclosed for filing are the original and five (5) copies of PacifiCorp's Reply Testimony and Exhibits, as described in the attached chart, and a Certificate of Service. Please note that pages 81 and 85 of Exhibit PacifiCorp/23 (Reply Testimony of Charles J. Cicchetti, Ph.D.) cite material which Wah Chang has designated as confidential pursuant to Order No. 01-149, the Protective Order entered in this proceeding. Accordingly, those pages are filed under seal (pages are marked "confidential" and printed on yellow paper). A redacted version of Exhibit PacifiCorp/23 omitting pages 81 and 85 has been filed electronically with the Commission.

Very truly yours,

James M. Van Nostrand

cc: Service List
ALJ Patrick Power

24878-0008/LEGAL13273947.1

BEFORE THE PUBLIC UTILITY COMMISSION OF OREGON

UM 1002

WAH CHANG, Petitioner, v. PACIFICORP, Respondent.	CERTIFICATE OF SERVICE OF PACIFICORP'S REPLY TESTIMONY AND EXHIBITS

I certify that I have this day served the documents listed in the Attachment, consisting of 1 page, to this certificate, constituting PacifiCorp's Reply Testimony and Exhibits, upon all parties of record in this proceeding by delivering a copy in person or by mailing a copy properly addressed with first class postage prepaid, or by electronic mail pursuant to OAR 860-013-0070, to the following parties or attorneys of parties:

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DATED: May 24, 2007.

PERKINS COIE LLP

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BEFORE THE PUBLIC UTILITY COMMISSION
OF THE STATE OF OREGON

UM1002

Wah Chang, Petitioner
v.
PacifiCorp, Respondent

PACIFICORP'S REPLY TESTIMONY AND EXHIBITS

Description	Exhibit No.	Pages
Testimony of Charles J. Cicchetti	PacifiCorp/23	1-88 (pages 81 and 85 filed under seal)
Professional Experience of Charles J. Cicchetti	PacifiCorp/24	1-4
Publications of Charles J. Cicchetti	PacifiCorp/25	1-7
Previous Testimony of Charles J. Cicchetti	PacifiCorp/26	1-36
Description of Dow Jones COB Index	PacifiCorp/27	1-2
Normal Northwest River Flows and Desert Southwest Temperature Patterns	PacifiCorp/28	1-4
Summary of Findings From Studies	PacifiCorp/29	1-9
Description of Enron Schemes	PacifiCorp/30	1-14
Description of Statistical Analysis	PacifiCorp/31	1-4
Description of Potential Hedges	PacifiCorp/32	1-15

REDACTED VERSION

BEFORE THE PUBLIC UTILITY COMMISSION

OF OREGON

UM 1002

WAH CHANG,		)
		)
	Petitioner,	)
		)
v.		)
		)
PACIFICORP,		)
		)
	Respondent.	)

Reply Testimony

Of

Charles J. Cicchetti, Ph.D.

Pacific Economics Group, L.L.C.

on behalf of

PacifiCorp

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Section I: Qualifications

Q. Please state your name, business and address.

A. My name is Charles J. Cicchetti. My address is Pacific Economics Group, 301 South Lake Street, Suite 330, Pasadena, California 91101.

Q. What is your position with Pacific Economics Group?

A. I am a Co-Founding Member of Pacific Economics Group.

Q. What are your duties as a member of Pacific Economics Group?

A. I actively consult with clients on price, costs, environmental, natural gas and electricity market issues, as well as competition and antitrust policies, particularly as those policies relate to regulated industries.

Q. Do you hold any other positions?

A. Through May 2007, I have been teaching economics and finance at the University of Southern California, where I previously served as the Jeffrey J. Miller Chair in Government, Business, and the Economy.

Q. What is your educational background?

A. I attended the United States Air Force Academy, and I received a B.A. degree in Economics from Colorado College in 1965 and a Ph.D. degree in Economics from Rutgers University in 1969. From 1969 to 1972, I engaged in post-doctoral research on energy and environmental matters at Resources for the Future.

Q. Please summarize your professional experience.

A. I served as the Environmental Defense Fund's first economist from 1972 to 1975, and was a faculty member at the University of Wisconsin Madison from 1972 to 1985, ultimately earning the title of Professor of Economics and Environmental

Studies. From 1975 through 1976, I served as the Director of the Wisconsin Energy Office and as Special Energy Counselor for the Governor. In 1977, I was appointed by the Governor as Chairman of the Public Service Commission of Wisconsin and held that position until 1979, and served as a Commissioner until 1980. In 1980, I co-founded the Madison Consulting Group, which was sold to Marsh & McLennan Companies in 1984. In 1984, I was named Senior Vice President of National Economic Research Associates and held that position until 1987. From 1987 until 1990, I served as Deputy Director of the Energy and Environmental Policy Center at the John F. Kennedy School of Government at Harvard University, and from 1988 to 1992, I was a Managing Director and ultimately Co-Chairman of the economic and management consulting firm, Putnam, Hayes & Bartlett, Inc. In 1992, I formed Arthur Andersen Economic Consulting, a division of Arthur Andersen, LLP. In late 1996, I left Arthur Andersen to co-found Pacific Economics Group, L.L.C. My professional experience is listed in Exhibit PacifiCorp/24.

Q. Have you published any papers or articles?

A. Yes. I have published articles on energy and environmental issues, public utility regulation, competition and antitrust. A complete listing of my publications is included as Exhibit PacifiCorp/25.

Q. Have you ever given expert testimony in a court or administrative proceeding?

A. Yes. A list of the proceedings in which I have provided expert testimony is included as Exhibit PacifiCorp/26.

Q. Do you have any particular expertise in issues involving electricity pricing in western United States markets during the 2000 - 2001 western energy crisis?

A. Yes, I do. I first became involved in the energy crisis in late 2000 when the California State Auditor Bureau of State Audits retained me and four others to explore the causes of the burgeoning crisis in California. For that assignment, we prepared a report entitled *Energy Deregulation: The Benefits of Competition Were Undermined by Structural Flaws in the Market, Unsuccessful Oversight, and Uncontrollable Competitive Forces.*[1] I also co-authored a book, *The California Electricity Crisis: What, Why, and What's Next,*[2] that explored further the California crisis. In addition, in the various refund cases before the Federal Energy Regulatory Commission (FERC) related to the western energy crisis, I provided expert testimony and economic and econometric analyses for the Competitive Suppliers Group and the Transaction Finality Group on the factors that caused electricity prices to change, the factors that caused natural gas prices to change, the statistical distribution of "Reported Natural Gas Price Indices," mitigated market clearing prices, and refund liability. I have also provided expert reports and testimony in several cases involving electricity and natural gas long-term contract disputes and debt issuance.

Q. Who retained you for this testimony?

A. I was retained on behalf of PacifiCorp by Perkins Coie LLP, its legal counsel in this proceeding.

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[1] This report ("State Audit Report") is publicly available on the website for the California State Auditor, Bureau of State Audits: http://www.bsa.ca.gov/pdfs/reports/2000-134.1.pdf

[2] C.J. Cicchetti, *et al.*, The California Electricity Crisis: What, Why, and What's Next, Kluwer Academic Publishers, Boston (2004).

Q. What is the purpose of your testimony?

A. The underlying purpose of my testimony is to respond to the allegation that PacifiCorp's actions in 2000 and 2001 improperly affected Dow Jones index prices at the California-Oregon Border (COB). These index prices were used as the basis for the price that Wah Chang paid to PacifiCorp under the last two years of its Master Electric Service Agreement (MESA).

Q. Please summarize the conclusions you reach.

A. My conclusions are as follows:

- First, although Wah Chang witness McCullough discusses several specific "gaming" practices, he has conducted no analyses that even attempt to show a relationship between such practices and the COB index price used as the basis for PacifiCorp's charges to Wah Chang under the MESA.
- Second, the majority of gaming behavior that Mr. McCullough discusses is not likely to have had any effect on the COB index price. The statistical analyses that I conducted demonstrate that COB prices were quite different statistically from the prices in the market operated by the California Independent System Operator (CAISO). The CAISO was the primary market in which products related to transmission and reliability were targeted for the types of gaming discussed by Mr. McCullough. Thus, any alleged manipulation of the CAISO market is not relevant to the COB index price paid by Wah Chang under the MESA.
- Third, Mr. McCullough is an "outlier" in his belief that market manipulation was a significant contributor to the high prices during the western energy

crisis. Many independent and governmental agencies have found that there were a myriad of reasons why western energy prices exploded in 2000 – 2001, none of which have anything to do with the gaming allegations discussed by Mr. McCullough. The so-called "gaming" was, at most, a small activity and had about as much to do with the western energy crisis as the effect one diseased tree in a forest has to do with the forest's destruction in a severe forest fire.

- Fourth, Mr. McCullough's "evidence" regarding knowing participation by PacifiCorp in these "gaming" strategies is non-existent. Rather, Mr. McCullough cites to a few isolated instances where "either through design or mischance" PacifiCorp "found itself on the wrong side of these transactions."[3] With respect to one "gaming" strategy in particular, Mr. McCullough acknowledges that the evidence he cites regarding PacifiCorp's participation could simply have been the product of "a data entry error."[4]
- Fifth, there is a complete disconnect between the relief requested by Wah Chang in this proceeding – abrogating the MESA and instead charging Wah Chang according to PacifiCorp's tariff – and the evidence presented in Mr. McCullough's testimony. The Wah Chang case, as presented in Mr. McCullough's testimony, is built upon cumulative layers of irrelevance and speculation: (1) Mr. McCullough exaggerates the role of "gaming" with respect to its effect on prices experienced during the western energy crisis, (2) the evidence fails to show that PacifiCorp was a knowing participant in

[3] McCullough Deposition of Apr. 11, 2007 ("McCullough Deposition"") at 46:6-8.
[4] *Id.* at 64:16-18.

any of the "games" discussed by Mr. McCullough, and (3) even if PacifiCorp were shown to be a knowing participant, the "games" were directed at the CAISO market, which is completely unrelated to the COB index upon which the MESA prices are based.

- Sixth, Wah Chang is attempting to hold PacifiCorp responsible for Wah Chang's failure to take reasonable actions with respect to the risks it undertook when it signed the MESA. Although Wah Chang may have acted prudently when it signed the contract, Wah Chang thereafter did not reasonably take steps to reduce risk and did not timely mitigate its potential alleged damages by hedging or other actions. (In contrast, Wah Chang's parent company did in fact "hedge" by selling electricity it had purchased for a plant it closed, thus profiting from the difference between the contract price for electricity to the closed plant and the market price at which it sold the electricity.)

Q. How is your testimony organized?

A. In Section II, I present background information regarding the MESA between PacifiCorp and Wah Chang. This proceeding arises from relief requested by Wah Chang related to the manner in which prices under the MESA were calculated, and it is important to keep these contractual terms in mind as we consider the speculative and unrelated allegations raised in Mr. McCullough's testimony.

In Section III, I discuss my views on the causes of the western energy crisis. In this section, I focus on market factors, anomalous weather patterns, and regulatory design flaws. I also discuss the causes of the dramatic increase in natural gas prices during this period, and explain that these increases were

primarily caused by world markets, California's failure to store natural gas in sufficient quantities, a pipeline explosion, and constrained natural gas pipelines.

In Section IV, I discuss what others, including Mr. McCullough, have said about the western energy crisis and its causes.

In Section V, I discuss the "gaming" issue raised by Mr. McCullough and others. I review the so-called "Enron schemes" and describe those "schemes" and how they affected the market for electricity. In this section, I explore and explain game theory and commodity markets. In the context of explaining the various "schemes," I also explain why these games are not germane to this case because they had little or no relevance to or effect upon prices at COB, on which Wah Chang's market-based contract was based.

In Section VI, I analyze possible relationships between COB prices and organized California market prices. This includes discussing and analyzing the complexities in the California market design, as well as some statistical comparisons and analyses.

In Section VII, I discuss PacifiCorp's trading activity and how FERC has effectively exonerated PacifiCorp from the gaming and other allegations that Mr. McCullough raises. I also discuss how PacifiCorp was more of a buyer than a seller and, therefore, could hardly benefit if it facilitated or supported any "games" intended to increase market prices. I also discuss the relative infrequency of the PacifiCorp actions that Mr. McCullough alleges harmed his client, Wah Chang.

In Section VIII, I review the prudence of Wah Chang's choices, as well as its failure to hedge so as to offset inherent uncertainty, and its duty and ability to mitigate its damages through hedging and other actions.

In Section IX, I review the conclusions I have reached.

Section II: The Master Electric Service Agreement (MESA)

Q. When did PacifiCorp and Wah Chang enter into the MESA?

A. The contract between PacifiCorp and Wah Chang was signed on September 11, 1997. The MESA required PacifiCorp to sell and Wah Chang to purchase Wah Chang's electric needs for its Millersburg facilities. The initial contract demand was set at 40 MWs.[5] The contract term was five years and there were two distinct pricing arrangements: one for the first three years (9/1/97-8/31/00) and one for the remaining two years (9/1/00-9/1/02).

Q. What was the price for the electricity PacifiCorp sold to Wah Chang under the contract for the first three years?

A. For the first three years of the contract, Wah Chang agreed to pay PacifiCorp a minimum bill of $223,840 per month for 8,000 MWh (regardless of actual consumption) at $27.98/MWh. The same average $27.98/MWh price would also apply to all purchases between 8,000 and 14,000 MWh. Any purchases above 14,000 MWh would be priced at $25.13/MWh.

Q. How was pricing determined for the final two years of the contract?

A. For the final two years of the contract, the contract's pricing was based upon the monthly spot market index determined by the daily average of the DJ COB prices

[5] Exhibit WC 101, MESA at p. 3, § 3.1.

during the Billing Period plus $11/MWh.[6] These prices were weighted by the firm index for peak hours and by the non-firm index for non-peak hours.[7]

Q. What are the COB index prices?

A. The Wall Street Journal publishes the Dow Jones COB index prices. A description of the Dow Jones COB index is reproduced in Exhibit PacifiCorp/27, directly from the Dow Jones website.[8] It is reproduced verbatim in Exhibit PacifiCorp/27 because it is important to understand how the index is created in order to understand the lack of any logical foundation to Mr. McCullough's "gaming" allegations which, even if true, would not likely have affected the way in which the prices under the COB index were derived.[9] The Dow Jones website provides, in part, as follows:

> The Dow Jones California/Oregon Border Electricity Price Indexes are volume weighted averages of specifically-defined bilateral, wholesale, physical transactions quoted in either dollars per megawatthour ($/MWH) or dollars per megawatt ($/MW). Calculations for these indexes average together power transactions from the California/Oregon border (COB).
>
> Index participants provide Dow Jones with their itemized bilateral transactions and volume for eligible electricity products sold at COB. Participants are asked to provide Dow Jones with daily index data by 10 a.m. Pacific time on the power flow date. Although some Dow Jones Electricity Indexes are calculated for 365 days year, publication occurs only on business days. If a holiday falls during the week, data should be transmitted to Dow Jones on the first business day following a break.

[6] Exhibit WC 101, MESA at p. 4, § 4.3.2.
[7] *Id.*
[8] I am informed that in 2000 and 2001, Dow Jones calculated its index in the same manner as shown here except that in 2000 and 2001, Nevada-Oregon Border (NOB) prices were also used. I consider this to be a minor change in the formula, and one that does not affect my analysis or conclusions here.
[9] The Dow Jones website is located at: http://www.djindexes.com/mdsidx/?event=energyUSDaily.

Q. What is the "Billing Period" in the MESA?

A. The MESA defines the Billing Period as "[t]he period of approximately thirty (30) days intervening between regular successive meter readings."[10]

Q. Please explain what this means.

A. I interpret this contractual language to mean that the price Wah Chang would pay for electricity in any given month would be a single price per MWh that was the monthly average of the daily spot prices in the reference month used to establish the COB index price plus $11 per MWh.

Q. Please explain how this monthly average spot price was weighted.

A. This monthly average spot price was weighted by peak and off-peak hours. The peak prices were determined by the "average of the daily on-peak firm prices from the previous month."[11] At the time the contract was signed, the Dow Jones did not publish a price for firm off-peak deliveries. Because of this, the average of the daily non-firm peak prices was to be used to estimate the off-peak component until the Dow Jones began to publish an off-peak firm index, at which time those actual published off-peak prices would be used for the weighted average price.[12]

Q. How does Dow Jones calculate its Firm Daily Price Index?

A. Again, the Dow Jones website explains the process:

> The firm daily indexes average together blocks of power sold on a one-day forward pre-scheduled basis. No real-time power is included in these indexes. Transactions are limited to power traded in 16-hour blocks during on-peak hours and 8-hour blocks for off-peak. Transactions which call for delivery for more than

[10] Exhibit WC 101, MESA at p. 1, § 1.3.
[11] *Id.* at p. 4, § 4.3.2.1.
[12] Shortly after the Wah Chang contract was signed, the Dow Jones began to publish a daily off-peak price.

one day are not included in calculations for these indexes except for the standard multi-day trading that occurs on Thursdays and Fridays and NERC holidays. Multi-day trading that occurs as a result of schedulers' conferences of month end trading is also included. Trading must follow the standard WSPP trading schedule. Volume is reported as total megawatts (MW) transacted per hour.

Q. The contractual language is specific that the average of the daily on-peak firm prices from the "previous month" are to be used to determine peak prices for weighting purposes. How does this language compare to the language in the MESA requiring that prices from the "Billing Period" be used?

A. It is not entirely clear that the words "previous month" mean the "Billing Period." Nevertheless, while I am not a legal expert for the purposes here, I interpret the words "from the previous month" to be equivalent to the words "Billing Period" because the MESA specifically states that pricing is to be based on the average monthly spot price for the Billing Period.[13] It would be inconsistent to weight the peak portion of the bill using prices from any month other than the Billing Period.

Q. The MESA is silent as to what month is to be used for the off-peak weights. Do you have an opinion as to what month should be used?

A. Yes. The language from the MESA is ambiguous in this respect because it does not indicate any particular month to be used for the weighting. However, the implication is that this language was meant to parallel the language with respect to the peak pricing component. This interpretation is consistent with using the Billing Period, or previous month, as I discussed above.

[13] Exhibit WC 101, MESA at p. 4, § 4.3.2.

Q. Are there any other pricing adjustments called for in the MESA?

A. Yes. The $11/MWh addition to the price was to be adjusted annually by adding or subtracting one-half of the net percentage change in the Consumer Price Index (CPI) for the Portland, Oregon area since September 1, 1997.[14]

Q. What does all this mean with respect to the MESA for purposes of this proceeding?

A. The MESA was indexed to the COB index price. The COB index is not a market or auction like the California spot markets. Instead, bilateral trades are reported to Dow Jones. These trades are spot trades in the sense that they are for the hours in short-term or balance-of-the-month contracts for a particular day. These reported prices are volume-weighted for particular time periods and types, such as during "6 X 16" (non-Sunday or holiday for the hours from 7 AM to 11 PM each day).

Q. Are there any "Real-Time" trades used to calculate the Dow Jones COB index?

A. I understand that the Dow Jones COB index does not include any real-time transactions when it calculates its firm index. However, its non-firm index is a combination of one-day-ahead transactions and real-time transactions. The MESA called for a price weighted by the COB index price for firm transactions for peak hours and by the COB index price for non-firm transactions for non-peak hours. Thus, some portion of the weight to be attached to non-peak hours did include some real-time transactions. However, the most that can be claimed is

[14] *Id.* at p. 5, § 4.3.2.3.

that the COB index would depend partially on market forces and circumstances, including the California Power Exchange's (CPX) Day-Ahead markets.

Most of the transactions that would have been used to create the COB index price would close well in advance of the time that the CAISO Real-Time or Out-of-Market (OOM) prices would be established. The COB index is also a weighted average of multiple independent trades and was not designed, as were the California markets, to be a "single price" market. In fact, no trader at COB would necessarily pay the COB index price, which was established the next day, because the index is a volume weighted average of all trades reported to Dow Jones.

Q. Please describe the California CPX and CAISO spot markets.

A. There were two separate trading institutions in California from April 1998 to the end of 2000. These were the CPX and the CAISO. The intention and expectation was that the CPX's Day-Ahead market would trade most of the MWhs for the organized market that supplied Pacific Gas &Electric (PGE), Southern California Edison (SCE), and San Diego Gas & Electric (SDG&E). This primary market used an auction process to match demand and supply schedules submitted by the buyers and the generators. The buyers were mostly load-serving investor-owned utilities (IOUs) and some smaller volume competitive energy service providers (ESPs).

Schedules were often submitted well in advance and could be changed until about hour "7" (or between 6 AM and 7 AM) on the day prior to the market. At this time, 17 hours in advance, market participants typically offered selling and

purchasing schedules for each of the 24 hours of the next day, often with varying quantities and prices that increased for sellers and decreased for purchasers.

The CAISO organized a Real-Time market and Ancillary Services markets. The CAISO's primary role was to relieve transmission congestion, which included any inter-zonal constraints. The CAISO also closed any gaps due to unanticipated differences between the planned and as-bid demand loads and the various accepted generation offers in the CPX's Day-Ahead market. This actual or physical supply and demand true-up occurred, literally, in real time. Hence, it was called the CAISO's Real-Time market. Sellers and buyers were asked to, and many did, offer to "inc" and "dec." In other words, to increase or decrease supply (*i.e.*, MWhs generated) if and when necessary. They were also asked to price such potential price adjustments. The CPX Day-Ahead schedules typically had pairs of volumes and prices. However, market participants could change their offerings (made in the CPX Day-Ahead market) as the time to close physically approached. Using "incs" and "decs," the CAISO could rebalance supply and demand in real time. The CAISO also maintained a secondary OOM market where the CAISO would seek to purchase any additional MWhs necessary to guarantee that supply would meet load if and when the real-time volumes were insufficient.

Q. What can you say about the relationship between CPX and CAISO prices and the COB index?

A. Prices shown in the COB index were not set using a similar method or in the same time frame as the CPX's Day-Ahead prices. In fact, the COB "price" is an

average or index price that no transaction would necessarily reflect. A case can be made that when buyers under-scheduled successfully in the CPX market, the COB index, if it was affected at all, would have been suppressed ***below*** competitive market levels due to the successful monopsony (buyer) market power. In other words, buyer under-scheduling resulted in decreased demand, which, in turn, drove CPX prices down. As such, this particular "game" would have ***reduced*** the COB index price if it had any effect at all.

Section III: The Western Energy Crisis

Overview of the Causes of the Crisis

Q. Have you investigated what caused the western energy crisis?

A. Yes. I have been involved in analyzing the western energy crisis and its causes from the time I was retained by the State of California in November 2000 to investigate the causes of rising prices in California. As part of that assignment, I co-authored a report for the California State Auditor entitled *Energy Deregulation: The Benefits of Competition Were Undermined by Structural Flaws in the Market, Unsuccessful Oversight, and Uncontrollable Competitive Forces.*[15] The title embodies my four principal conclusions concerning the western energy crisis of 2000 – 2001.

I also systematically and statistically tested these conclusions with two of my State Audit Co-Authors, Dr. Jeffrey A. Dubin and Colin M. Long, in a book

[15] As previously noted, the State Audit Report can be found on the website for the California State Auditor, Bureau of State Audits: http://www.bsa.ca.gov/pdfs/reports/2000-134.1.pdf

entitled *The California Energy Crisis: What, Why, and What's Next* (Kluwer Academic Publishers (2004)).

Q. Did you reach any conclusions with respect to the California market?

A. Yes. In both our initial and subsequent research, we analyzed the crisis and reached four conclusions. These are: (1) during the first two years following wholesale market deregulation, customers enjoyed lower prices; (2) there were structural flaws in the market; (3) market oversight was unsuccessful; and (4) there was a growing gap between supply and demand caused by uncontrollable market forces.

Our primary conclusion was that the rising prices in California were due to the confluence of uncontrollable market forces, structural flaws, and ineffective market monitoring. My subsequent research and analyses confirmed and strengthened these initial conclusions that, regardless of whether there were market trading anomalies, market forces alone would have caused electricity prices in California to have surged, as indeed they did, during much of the May 2000 through June 2001 period.

However, as I discuss below, there were other factors involved. These include flawed market designs and an unsuccessful or delayed political/regulatory response.

Customer Benefits

Q. How did customers benefit during the first two years of wholesale market deregulation?

A. In the first two years of wholesale market deregulation (April 1998 to about May 2000), there were indeed benefits enjoyed by customers in terms of sharply reduced average wholesale prices (in the $25 to $30 per MWh range) relative to regulated cost-of-service prices (in the $50 to $60 per MWh range) for IOU generation in California. Undoubtedly, the excess capacity and low natural gas prices that persisted at that time had a great deal to do with this positive result, which, among other things, meant an accelerated recovery of stranded and transition costs.

Structural Flaws

Q. What structural flaws were present in the market design?

A. There were several structural flaws in the market design. First, virtually all the MWhs purchased for retail consumers had to be secured in spot markets (a day ahead or less). There were, in stark contrast to more successfully deregulated wholesale markets, no meaningful forward or futures purchase options that would have allowed market participants to diversify their resource portfolios and thereby reduce exposure to market volatility. Table 1 shows, in contrast to the California market design, the relatively large proportion (80 to 90%) of the firm or hedged MWhs in other restructured wholesale markets. According to California's market rules, the IOU generation remaining after the IOUs had

divested most of their gas-fired units was "bid" into these wholesale spot markets as a price taker.

TABLE 1
Market Hedges Compared to the Spot Market in Other Deregulated Electricity Markets

	Percentage of Market Hedged (long-term forward contracts or self-owned generation)	Percent of Unhedged Spot Market
Pennsylvania, New Jersey, Maryland (PJM)	85-90%	10-15%
New England	80%	20%
Australia	90%	10%
Norway	85-90%	10% - 15%
Sweden	85-90%	10% - 15%

See Cicchetti, C.J., J.A. Dubin, and C.M. Long, The California Electricity Crisis: What, Why, What Next, Kluwer Academic Publishers, Boston (2004).

Second, sequential spot markets were adopted in California to distinguish between energy (*e.g.,* CPX Day-Ahead) and reliability markets (*e.g.* CAISO Real-Time). This separation created opportunities for hedging and speculation. While this is not necessarily a market design flaw, large buyer (IOU) under-scheduling was soon matched by generator (or seller) under-scheduling. This reduced CPX prices relative to CAISO prices and pushed an unanticipated large number of MWhs from the principal energy markets of the CPX to the CAISO Real-Time market and, eventually, its OOM purchases. Table 2 shows the dramatic shift from the CPX to the CAISO that occurred during late 2000 (when both entities co-existed).

TABLE 2
Volume of Megawatts Purchased Out of Market June-December 2000

	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average Hourly OOM MWs Purchased Hours 12-19	26,880	79,205	46,872	45,150	40,796	208,950	487,382

Source: ISO Market Analysis Group "Market Analysis Report", January 16, 2001.

We stated in our Audit Report that the original market design expected that only a very small percent of CAISO energy purchases would be made to balance supply and demand (about 3% or less). During the latter months in 2000, CAISO purchases increased to about 30%.[16]

Third, retail electricity prices were effectively frozen under the compromise legislation that restructured markets in California (known as AB 1890). While SDG&E retail prices had been unfrozen, the other two much bigger California IOUs (SCE and PG&E) could not increase their retail prices when wholesale prices exploded. This meant that other than voluntary conservation, there were no new price-induced incentives for more conservation, demand side management, or energy efficiency to help reduce demand.

Fourth, prior to deregulation, there had been a reasonable degree of coordination and reporting of planned and unplanned outages. This was virtually lost with deregulation. This became particularly problematic in the fall of 2000 when: (a) many older generating stations that had been pressed into extreme service in the spring and summer were forced into significant overhauls in the fall; and (b) the San Onofre Nuclear Generating Station (SONGS) operated by SCE went down and stayed out of service for an extended period, causing its

[16] C.J. Cicchetti, *et al.*, The California Electricity Crisis: What, Why, and What's Next, *supra* at p. 65.

municipal co-owners to become net MWh purchasers, not sellers, in the spot markets in the west; and (c) the lack of NO_X emission credits idled generation in the fall as these emission credits had been used earlier in the summer to keep the lights on in California.

Lack of Oversight

Q. Why do you say that market oversight was unsuccessful?

A. The issue was not that those responsible for market oversight (both the CAISO and CPX internal staff and outside, mostly independent, market monitors) missed the problems and anomalies in trading (*i.e.,* the under-scheduling in the CPX and the resulting surge in Real-Time and OOM purchases in the CAISO). Indeed, during our audit, we discovered a growing monitor and oversight awareness of the mounting problems, particularly the buyer under-scheduling and sellers increasingly selling MWhs out-of-market. Rather, the problems were caused by inaction due to stakeholder board stalemates. These were exacerbated due to little or no cross-market coordination between the CPX and CAISO. Adding to this problem was a federal and state jurisdictional schism that made it virtually impossible to know who was responsible and who could act. Making matters worse, the actions of the State of California and FERC were not coordinated, with each side blaming the other for not doing more.

Supply and Demand Factors

Q. Please explain what caused the gap between supply and demand.

A. The basic economic conditions shifted in 2000 in California, causing a significant gap between demand and supply. This gap was caused by many uncontrollable

market forces including: (1) a lack of new capacity coming on line; (2) unusual weather patterns; (3) rising natural gas prices; and (4) rising NO_X emission credit costs. I discuss each of these below.

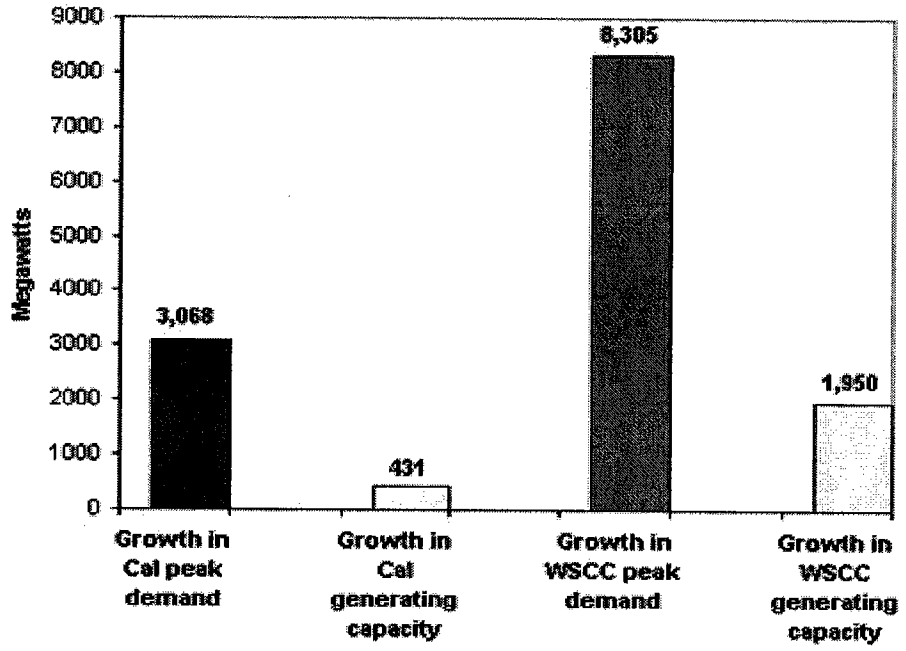
- *Lack of Capacity*

Q. Please explain why there was a lack of capacity.

A. Prior to the enactment of AB 1890 in 1996, California found itself in an unusual economic position. High energy prices were generally perceived to be a state problem that was impeding economic recovery. Deregulating wholesale markets in the late 1990s initially caused wholesale prices to fall because supply exceeded demand. At the time, most of the prior utility and regulatory forecasts projected new capacity would not be needed until late 2001 or 2002. With deregulation, official forecasting ended and no one seemed to be aware that the state's economic recovery, fueled by construction and new energy-intensive telecom and internet growth, meant that by 2000 the excess supply gap unexpectedly had virtually disappeared. Table 3 compares the growth in peak demand in California and the Western States Coordination Council (WSCC) to the growth in generating capacity in California and the WSCC region.[17]

[17] The WSCC is now called the Western Electricity Coordinating Council (WECC).

TABLE 3
Comparison of Growth in Peak Demand Versus Growth in Generating Capacity, 1996-2000



Source: California Energy Commission (CEC).

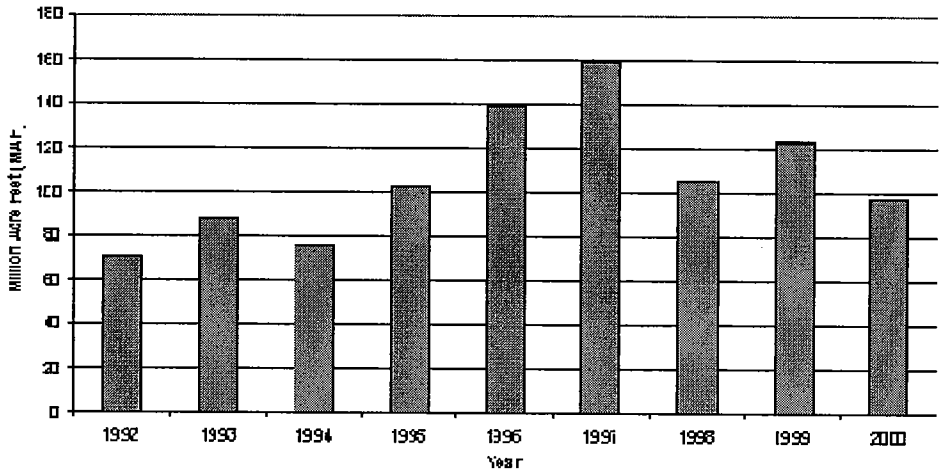
- *Unusual Weather Patterns*

Q. What was unusual about the weather and how did that contribute to the problem?

A. Under conventional wisdom, "normal" weather means pairings that are typically "wet and hot" or the opposite, "dry and cool." In 2000 – 2001, however, these "normal" pairings did not happen. Very abnormally, the Northwest was "dry" – which ***decreased the supply*** of electricity due to reduced hydro generation – while the desert Southwest was very "hot" – which ***increased the demand*** for electricity for air conditioning loads. The unusual weather patterns thus caused a significant net reduction in supply relative to demand, effectively resulting in a net loss of

8,000 to 12,000 MWs of capacity[18] as the western states' drought and unusually hot southwestern temperatures skewed markets. An effective loss of 8,000 MWs represented about 20% of California's demand to the CAISO control area, which peaked above 40,000 MWs. Charts 1 and 2 show how hydroelectric supply fell and summertime market demand increased in 2000 causing prices to surge relative to 1998 and 1999, when wholesale prices were relatively low.

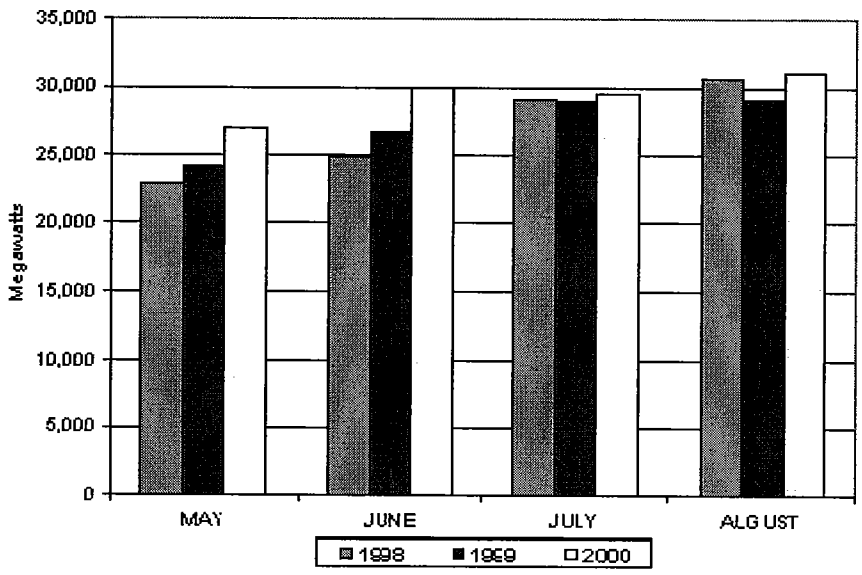
CHART 1
January to July Volumes in Run-Off in the Northwest, 1992-2000



Source: FERC Staff Report (November 1, 2000) and CPX Compliance Unit.

[18] *See* State Audit Report at p. 59.

CHART 2
CAISO Actual Averge Demand from May to August 1998-2000



Source: FERC Staff Report (November 1, 2000).

Q. Have you tested the reasonableness for expecting such a "normal" relationship between river flows in the Northwest and temperature conditions in the Southwest?

A. Yes. I have collected monthly data for the past one hundred years or so for Mid-Columbia river flows and temperatures in Arizona and New Mexico. I test the hypothesis that high temperatures correlate with high river flows, and *vice versa.*

The regression analyses and associated charts are shown in Exhibit PacifiCorp/28. This analysis "confirms" with a high degree of statistical significance the conventional wisdom that "normal" weather means pairings will be "wet and hot" or the opposite, "dry and cool."

Under this conventional wisdom, it would have been prudent in the first half of 2000 to view the emerging dry period in the Pacific Northwest as suggesting a reasonably cooler late spring, summer, and early fall in the desert Southwest. Based upon typical patterns, this expectation would have been reasonable more than ninety-five percent of the years.[19] As noted above, however, these "normal" pairings did not happen in 2000 – 2001, and contributed substantially to the gap between demand and supply.

- *High Natural Gas Prices*

Q. How did natural gas prices contribute to the crisis?

A. Natural gas prices are particularly relevant for electricity markets because natural gas is the fuel used by the marginal generating station during most of the hours of the year in California. In the late 1990s, oil and natural gas prices were unusually low. In fact, prior to 2000, natural gas prices in North America averaged a bit more that $2.00 per MCF at the well head. Various well-documented events in 2000 caused both world oil prices and natural gas prices to surge. In late 2000, natural gas prices at Henry Hub, the primary natural gas trading location in North America, hit about $10 per MCF, a five-hundred percent increase from the prior year.

California's natural gas markets were hit even harder. There were several reasons for this:[20] (1) California intrastate pipelines had insufficient in-state take-away capacity and could not meet intrastate demand as more natural gas was

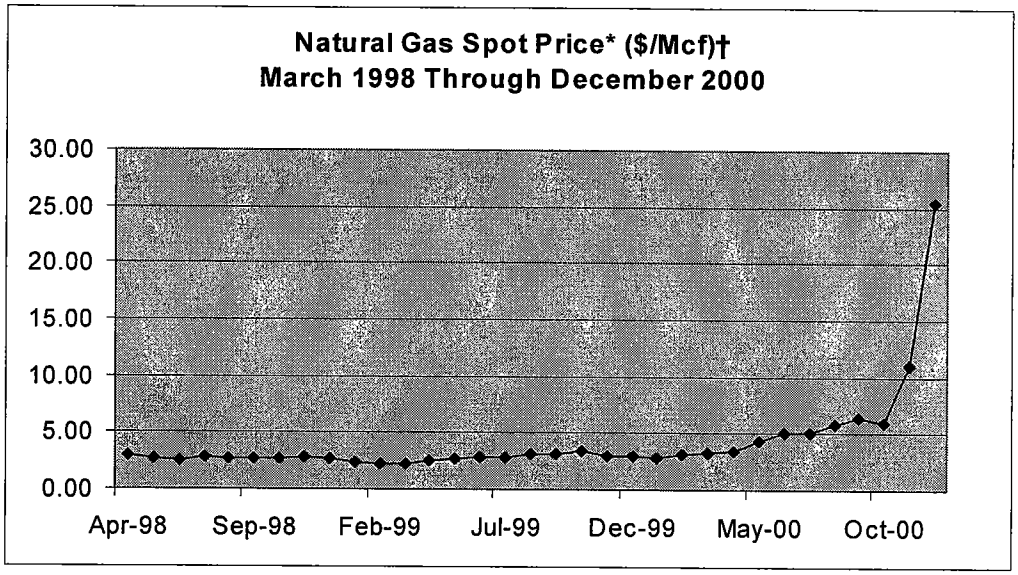
[19] This, as I explain in Section VIII, does not mean that Wah Chang would face uncertainty in future spot month prices at COB beginning on September 1, 2000. Accordingly, Wah Chang should have considered potential hedges to reduce risk.

[20] *See* C.J. Cicchetti, *et al.*, The California Electricity Crisis: What, Why, and What's Next, Kluwer Academic Publishers, Boston (2004).

needed to run California's electric generation stations; (2) there was a significant and unplanned failure of newly released non-core industrial users to store natural gas for peak winter months; (3) more natural gas was used, not stored to meet spring and summer time electricity load, and to replace the net loss of hydroelectric imports; (4) there was an accident on the El Paso Pipeline, one of the primary pipelines into California, which reduced supply into California; and (5) utilities east of California reduced their usual pipeline capacity release programs to protect their own state's consumers, causing less natural gas to flow into California, effectively exacerbating the shortages in California.

The result of this confluence of events was two-fold. First, in December 2000, average natural gas prices in California surged to about $30 per MCF. (See Chart 3) When there are no constraints and storage is plentiful, North American natural gas trading hubs tend to be highly correlated. However, in 2000 during the crisis, the natural gas prices in California diverged sharply from prices in the rest of the North American natural gas trading hubs because California failed to store natural gas, failed to build sufficient take-away natural gas pipeline capacity, and market shortages caused extreme upward pressure on in-state natural gas prices.

CHART 3



Source: Energy Information Administration (EIA)

Second, with heat rates for some older generating stations in California at about 20,000 BTU/KWh, a $30 per MCF natural gas price would cause the marginal fuel cost of operating these marginal units to equal about $600 per MWh, which was well above the $25 to $30 per MWh paid to purchase MWhs in the deregulated markets in 1998 and 1999.

- *High Emission Credit Prices*

Q. How did NO_X emission credits contribute to the crisis?

A. California's Air Quality Boards used a cap and trade system to restrict NO_X emissions. The state issues a limited number of NOx emission credits to existing emission sources (like power plants) each year and that number declines by 8% each year. Those emissions credits can be traded in the open market. In order to operate, a power plant must either use its own emissions credits or purchase enough credits on the open market to offset their emissions.

In spring 2000, NO_X emission credits traded at about $5 per pound. (One credit is equal to one pound of emissions.) This was a dramatic increase from about $1 per pound earlier in the year. Due to the hot and dry conditions during summer 2000, plants were run very hard and, as a consequence, many plants used up their emission credits and were forced to purchase credits from a declining supply, which drove up prices. The option was to shut down or face potentially large fines from the state for violating emissions allowances. In December 2000, NO_X credits were scarce and prices surged to $46 per pound.[21] A typical natural gas-fired plant will emit one to two pounds of NO_X for each MWh produced. For a plant that produced two pounds of emissions per MWh, a $46 per pound price meant that the increase in the price of emission credits in and of itself resulted in an increase of about $90 in the cost of producing each MWh.

- *Summary of Supply and Demand Factors*

Q. What does all this mean?

A. Whether or not market manipulation was occurring during this period, these fundamental market forces alone would have caused electricity prices in California to surge, as indeed they did, during much of the May 2000 through June 2001 period. Mr. McCullough, for his part, is an "outlier" in his substantial disregard of the effect of these fundamental market conditions in causing the western energy crisis. Mr. McCullough cites market manipulation as a substantial cause of the crisis, and claims that "the belief that the crisis was caused by

[21] *See* C.J. Cicchetti, *et al.*, The California Electricity Crisis: What, Why, and What's Next, Kluwer Academic Publishers, Boston at p. 62 (2004).

fundamentals is generally a discredited position."[22] In fact, as discussed in the next section, it is Mr. McCullough's position that has not been endorsed or adopted.

Section IV. Other Views on the Western Energy Crisis

Q. Have others opined as to the causes of the western energy crisis?

A. Yes. There have been many thoughtful analyses conducted by respected economists examining the causes of the western energy crisis. While there has been some divergence of opinion, it is almost universally agreed that uncontrollable market forces, a flawed market design, and ineffective market monitoring were the key elements in causing electricity prices to increase dramatically in 2000 – 2001. Mr. McCullough is, however, an outlier amongst these respected economists and experts insofar as he attributes market manipulation as a substantial cause of the western energy crisis.

Mr. McCullough's View and Conclusions

Q. What did Mr. McCullough say about the western energy crisis?

A. In January 2001, Mr. McCullough prepared a paper for *The Public Utility Fortnightly*.[23] Typically, articles in this journal are not peer reviewed. In the article, Mr. McCullough states the "favorite" explanations for the summer 2000 price spikes in California electricity markets are: higher natural gas prices, decreased hydroelectric runoff, and increases in demand. In his paper, he accepts

[22] McCullough Deposition at 54:21-23.
[23] Robert R. McCullough, *Price Spike Tsunami,* The Public Utility Fortnightly, Jan. 1, 2001.

the fact that natural gas prices were higher, but argues that this accounts for only a portion of the price increases in electricity.

Mr. McCullough's views on the other two "favorite" explanations are contrary to what just about every other independent expert, government analysis, and report has to say about the crisis.

In addition, he dismisses findings associated with generation availability and his definition of reserves. He is seemingly unwilling to accept the explanations and findings of others that demonstrate that the independent generators operated their mostly old fleet of natural gas-fired plants, which they had acquired from the California IOUs, more often and at greater output levels than had the IOUs when they operated the plants.

Others' View and Conclusions

Q. What did other researchers have to say about the western energy crisis?

A. I reviewed many studies, analyses, and opinions that discuss the western energy crisis. I find that nine are particularly relevant. These have been conducted by well-trained and expert economists/statisticians. Their work has often been sponsored by various stakeholders in the public policy debate. That said, these papers were prepared by independent academic studies to which researchers now and in the future will reference.

I have selected their primary conclusions, as well as those I find particularly relevant to this case. I conclude that these studies point to the errors and omissions in Mr. McCullough's analysis. The nine published studies are:

- Borenstein, S., J. Bushnell, and F. Wolak, 2002. "Measuring Market Inefficiencies in California's Restructured Wholesale Electric Market." *American Economic Review* 92 (5): 1376-1405.
- Borenstein, S., J. Bushnell, C.R. Knittel, and C. Wolfram, 2004. "Inefficiencies and Market Power in Financial Arbitrage: A Study of California's Electricity Markets." Center for the Study of Energy markets. Paper CESM WP-138. University of California, Berkeley.
- Fox-Penner, Peter S, 2001. "The California Crisis and the its Lessons for the EU." The Brattle Group, Special Edition.
- Harvey, S. and W. Hogan, 2001. "Identifying the Exercise of Market Power in California" Center for Business and Government, John F. Kennedy School of Government, Harvard University.
- Harvey, S. and W. Hogan, 2002. "Market Power and Market Simulations" Center for Business and Government, John F. Kennedy School of Government, Harvard University.
- Joskow, P. and E. Kahn, 2002. "A Quantitative Analysis of Pricing Behavior in California's Wholesale Electricity Market During Summer 2000." *Energy Journal* 23 (4): 1-35.
- Pope, S.L., 2001. "California Electricity Price Spike: An Update on the Facts." Report available at http://www.lecg.com/website/home.nsf/OpenPage/Energy-ResearchPapersTestimony.
- Reiss, P.C. and M.W. White, 2003. "Demand and Pricing in Electricity Markets: Evidence from San Diego During California's Energy Crisis." NBER Working Paper No. 9986.
- Sweeney, J.L., 2002. *The California Electricity Crisis.* Hoover Institution Press: Stanford University.

My Exhibit PacifiCorp/29 summarizes the findings from these nine studies and includes my observations regarding the relevance of these findings to this case.

Agencies' Rejections of Mr. McCullough's View and Conclusions

Q. Did the CAISO and FERC review Mr. McCullough's findings related to the causes of the western energy crisis?

A. Yes. Both entities reviewed Mr. McCullough's findings and were devastatingly critical.

Q. What did FERC conclude?

A. Mr. McCullough presented testimony and analyses in the *Nevada Power* case, which Mr. McCullough calls the "Morgan Stanley case" in his deposition,[24] that purported to demonstrate that the CAISO and CPX spot markets adversely affected the long-term bilateral markets. In finding that Complainants failed to establish that the dysfunctions in the CAISO and CPX adversely affected the long-term bilateral markets, Administrative Law Judge (ALJ) Carmen Cintron found that the Complainants' arguments were based on Mr. McCullough's testimony, which she ruled "is entitled to very little weight."[25] ALJ Cintron found that Mr. McCullough's spot price conclusions were based on flawed and overly simple regressions. She found that the "major flaw in this testimony is his failure to establish any causal link between the ISO and PX spot market prices and forward prices. Staff's and Respondent's argument that correlation does not establish causation is persuasive."[26]

Further, ALJ Cintron found that Mr. McCullough's regression failed to account for market fundamentals that affected spot and forward prices. This bias, she said, created "a correlation that may not exist if market fundamentals had been included."[27] Mr. McCullough also did not test for serial correlation, a failure that was so significant that Complainants' other experts (Drs. Mount and Bidwell) were forced to admit that "they would not have run the analysis in a similar

[24] *Nevada Power Company, Sierra Pacific Power Company v. EnronPower Marking, Inc., et al.*, 101 FERC ¶ 63,031 (December 19, 2002), referred to in McCullough Deposition at p. 52:12-14.
[25] *Id.* at ¶ 66, fn. 147.
[26] *Id.* at ¶ 90.
[27] *Id.* at ¶ 92.

fashion."[28] Further, when Drs. Harvey and Hogan, experts for Respondents, corrected Mr. McCullough's errors, they found no significant correlation for the variables Mr. McCullough included in his overly simple regression.

Q. In what context did the CAISO Staff address Mr. McCullough?

A. Mr. McCullough submitted two memoranda to the California Select Committee (of the Legislature) to Investigate Price Manipulation of the Wholesale Energy Market.[29] Dr. Hildebrandt, the CAISO's Manager, Market Investigations, responded to those memoranda.

Q. What did the CAISO say?

A. In his first response to Mr. McCullough, Dr. Hildebrandt addressed whether any of Enron's trading and scheduling practices contributed to outages in California. Mr. McCullough had argued that these practices had contributed to outages in California. Dr. Hildebrandt disagreed. Dr. Hildebrandt wrote that the CAISO's analysis of Enron trading practices demonstrated that these practices did not contribute to the blackouts in the winter of 2001. Instead, he asserted that the blackouts were the result of two factors: (1) limited supply of energy; and (2) limited transmission capacity.[30] Dr. Hildebrandt disputed Mr. McCullough's findings and stated that "all of the trading and scheduling strategies outlined in the Enron memos would cause detrimental financial impacts, primarily in the Day-Ahead and Hour-Ahead markets, but would typically not impact system

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[28] *Id.* at ¶ 92, fn. 228.
[29] Memorandum on *Congestion Manipulation in the ISO California* by Robert McCullough to McCullough Research Clients (Jun. 5, 2002). Mr. McCullough submitted additional comments in a memorandum, entitled *Three Crisis Days at the California ISO* (Sept. 16, 2002).
[30] Memorandum entitled *Did Any of Enron's Trading and Scheduling Practices Contribute to Outages in California?* by Eric Hildebrandt at p. 2 (2002).

reliability, particularly in the manner suggested by McCullough."[31] Further, Dr. Hildebrandt pointed out that overscheduling load and schemes based on fictitious load would actually create an oversupply of energy in real time, and were thus not the cause of outages in winter 2001.[32]

Further, Dr. Hildebrandt disputed Mr. McCullough's suggestion that creating "phantom congestion" led to blackouts. Dr. Hildebrandt argued that "McCullough's fundamental argument is contradictory" and that "what McCullough's logic misses is that … there is simply no financial incentive" for a market participant to reverse the schemes to increase congestion.[33]

Q. Did Dr. Hildebrandt comment on any other of Mr. McCullough's assertions?

A. Yes. Dr. Hildebrandt stated that "McCullough incorrectly assumes that Death Star and other circular scheduling schemes create 'phantom congestion.'" Dr. Hildebrandt observed that "if anything, such schedules may have the opposite impact in that they may provide 'phantom relief' of actual congestion."[34]

Dr. Hildebrandt also critiqued Mr. McCullough's assertions with respect to megawatt laundering, which Dr. Hildebrandt says "would have increased supply ultimately offered given the lack of any other creditworthy buyer and the uncertainty about potential refunds that might ultimately be ordered by FERC."[35]

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[31] *Id.*
[32] *Id.*
[33] *Id.*
[34] *Id.*
[35] *Id.*.

Q. Did Dr. Hildebrandt have any further comments on Mr. McCullough's assertions?

A. Yes. Dr. Hildebrandt filed an Addendum to his report addressing Mr. McCullough's assertion that the Fat Boy Strategy led to the price spikes in the CAISO on May 22, 2000.[36] Dr. Hildebrandt argued that Mr. McCullough's implication that Enron's Fat Boy strategy was designed to create and profit from price spikes was based on "the mistaken assumption or impression that practice of overscheduling of load could somehow lead the ISO to unnecessarily declare a system emergency due to a belief that this overscheduled generation was not available to meet project load or to believe that loads would be higher than the ISO forecast."[37] Dr. Hildebrandt asserted that Mr. McCullough's assumption was simply wrong and that the only effect of overscheduling would be to reduce the CAISO's projected demand for imbalance energy needed to meet real-time load.

Q. Did the CAISO have other occasions to dispute Mr. McCullough's assertions or analyses?

A. Yes. On January 10, 2001, Dr. Hildebrandt responded to issues raised in a letter Mr. McCullough sent to the CAISO Board asserting that the capacity margin across the ISO's emergencies averaged 32% in summer 2000. Dr. Hildebrandt stated that Mr. McCullough's analysis was based on erroneously using nameplate capacity rather than actual available capacity in his analysis. Dr. Hildebrandt concluded that Mr. McCullough's reliance on nameplate ratings and assumptions about planned and forced outages ignored actual generating capacity available to

[36] Memorandum entitled *Was "Fat Boy" Strategy Used to Help Cause May 22, 2000 Price Spikes?* by Eric Hildebrandt, *response to McCullough's Sept. 16, 2002 memorandum and testimony.*
[37] *Id.*

the market. This caused Mr. McCullough to grossly exaggerate the amount of capacity available to the market. Dr. Hildebrandt chastised Mr. McCullough for this approach, stating that ignoring reality "leads to erroneous conclusions that a surplus of capacity exists in California, and thereby only hinders efforts to deal with California's energy situation."[38]

Conclusions Regarding Causes of Western Energy Crisis

Q. What do you conclude after reviewing what others have said about the western energy crisis?

A. My research and other independent experts found a myriad of "causes" for high energy prices in the mid-2000 to mid-2001 period. Mr. McCullough's views are true outliers. He gives short shrift to many of the market forces, climate anomalies, and structural flaws that occurred or existed. I think the evidence proves him wrong.

That said, I will grant that he emphasizes so-called "gaming" as the true culprit. I will turn to the effect of "gaming" in the next section.

Section V: Gaming

An Overview

Q. Mr. McCullough avers that "gaming" was the true cause of the California energy crisis. Is that relevant here?

A. No. There are several problems with Mr. McCullough's interjection of the "Enron schemes" as the major emphasis of his testimony. These include the following:

[38] *Id.*

- "Gamers" generally try to fool each other, for example, by seeking payment for false congestion. They mostly do ***not*** seek to move the broader market price because they would likely sell fewer MWhs. In fact, in the CPX market, allegedly anomalous or gaming practices of buyers and sellers virtually neutralized one another. Mr. McCullough has failed to demonstrate that gaming behavior moved the market prices in California.
- Even if we assume that gaming activities caused prices in California to increase, that is not relevant to the Wah Chang contract because that contract was based on COB index prices as reported in the Wall Street Journal. I demonstrate in my statistical analysis in Section VI of my testimony that it is extremely unlikely that any of the "games" identified by Mr. McCullough had any effect whatsoever on the COB index price. In fact, I demonstrate that the markets that Mr. McCullough claims were affected by gaming – the CAISO markets – have prices that are statistically different from the COB index price. (In contrast, the CPX markets had prices that were statistically similar to the COB index prices; but these are not the prices allegedly gamed using the Enron schemes.)
- Mr. McCullough's discussion of "gaming" is thus not at all relevant to the prices at issue in this case – which are established by reference to the COB index price.
- The irrelevance of Mr. McCullough's discussion of "gaming" is compounded by his failure to establish any knowing or meaningful participation by PacifiCorp in these games, as discussed in Section VII of my testimony.

Q. What is "gaming"?

A. Some define "gaming" only in the pejorative or negative sense, *i.e.*, illegal or at least anomalous trading practices. This misuses the term "gaming," in my opinion. Indeed, I believe that "gaming" ***within the rules*** can do more good than bad because it helps to make markets perform efficiently. This does not mean that people responsible for organizing and monitoring markets should not review outcomes and, if deemed necessary, change the rules. Markets need to enforce rules and participants should follow them and trade in a legal manner.

The word "gaming" invites sports analogies. All games have rules that restrict players' actions and have referees or umpires to enforce the rules. For example, it is not unusual for various sports oversight bodies (*e.g.,* the NCAA, NBA, NFL, etc.) to change rules after the season, permitting conduct in future seasons that would have violated the rules in previous seasons and also assigning penalties in upcoming seasons for actions that had been previously permitted. Commodity markets and the exchanges and others that regulate such markets also can and routinely do change the rules.

Investigating the organized California markets suggests this same focus, with one exception: the analysis becomes more complicated due to the rather vaguely stated tariff language in the voluminous CPX and CASIO tariffs. This language is known as the CAISO's Market Monitoring and Information Protocol (MMIP). The MMIP defines gaming, in part, as "taking unfair advantage of the rules and procedures set forth in the PX or ISO tariffs, Protocols or Activity Rules…to the detriment of the efficiency of, and of consumers in, the ISO

Markets." FERC states that the "CAISO tariff, through the MMIP defines anomalous market behavior, in part as 'behavior that departs significantly from the normal behavior in competitive markets that do not require continuing regulation or as behavior leading to unusual or unexplained market outcomes.'"[39]

Some have averred that this language is akin to "unsportsmanlike conduct" and, in effect, permits post-game review with the possibility of changing market outcomes. The position that people take on this is often a function of whether they focus on what traders did relative to the rules at the time, or whether traders are held to a higher, almost impossible-to-achieve standard, where rules are made or clarified *ex post.* Like much of the western energy crisis, this matter is by no means clear-cut.

Q. Why was "gaming" relevant in the California market?

A. To understand the concept of "gaming," it is perhaps best to step back and briefly describe the California electricity market as it existed after the market was restructured by AB 1890. The California market design was very complex, and "gaming" was predicted and observed. In retrospect, there was strong evidence that buyers, sellers, and even the CAISO played games in attempting to affect the market's outcome.

The lesson here is that uncertain and not fully vetted markets invite "gaming." This is neither surprising nor bad, so long as the trading strategy stays ***within the rules*** and the market overseers or monitors can ***change the rules*** if they deem observed strategies to be unfair or inefficient.

[39] *American Electric Power Service Corporation, et al.*, 103 FERC ¶ 61, 345 (Jun. 25, 2003).

Q. But what exactly is "gaming" in the context of the California electricity market?

A. "Gaming" refers to individual market participants engaging in various actions (often legal and within the rules) that are mostly contrary to the overall market. Gamers mostly do not try to move the full market. Instead, they seek profits from anticipated market price moves, in effect, from betting against the overall market. Gaming works best when it is applied individually, not collectively. If everyone "games" the same way, there are likely few or no opportunities for "gamers" to beat the market. It would be like everyone betting on the same horse: no one wins but the horse and the house because the odds pay less than a dollar for every dollar bet.

Q. Why was "gaming" possible in the California market?

A. The CAISO MMIP (made effective by the FERC in December 1997) did not actually prohibit "gaming." After first defining "gaming" as behavior that takes "undue" or "unfair" advantage of the rules,[40] the CAISO tariff merely subjected gaming to scrutiny. Even as defined, gaming behavior did not automatically lead to the imposition of remedies. Instead, the CAISO tariff authorized the Market Surveillance Unit (MSU) to review gaming behavior in order to assess its potential effect. Such assessments could result in recommendations by the MSU to make structural changes, to make tariff changes, or to proscribe specific behavior.[41]

[40] Exhibit WC 1109, CAISO MMIP at p. 7.
[41] *Id.* at pp. 8 (§§ 2.1.4 , 2.1.5), 9 (§2.3.1).

The CAISO tariff underscores the valuable and necessary function these natural market activities play in a commodities market – and how the CAISO itself recognized that "gaming" could constitute legitimate aggressive competition. In retrospect, Californians would have been better off if the state had taken more time to design its markets and not rushed ahead to get the benefits of lower prices, since initially supply exceeded demand. The decision to fix flaws in the future proved costly and fatal to some.

The Enron Schemes

Q. What specific Enron schemes did Mr. McCullough raise as relevant in this proceeding?

A. In his direct testimony, Mr. McCullough discusses the following Enron schemes:

- Ricochets (also called "megawatthour laundering"): pages 55; 69-71; 125-131;
- Fat Boys (also called "parking"): pages 31; 37-45; pages 131-142;
- Death Stars (also called "perpetual loops," "Red Congo," and "Forney's Perpetual Loop"): pages 45-47; 49-53; 55; 83- 104-125;
- Selling non-firm energy as firm energy: page 3;
- Buy/Sell transactions (also called "wash trading"): pages 3-6; 73-82; and
- Physical and economic withholding: pages 15; 33-37.

Q. Did these Enron schemes have any effect on the COB index prices?

A. Most of these gaming strategies were designed to collect congestion revenue, and would not have had much, if any, affect on the prices in the CPX market, the California market with prices that are statistically similar to the COB index prices. It is even less likely that these games would have had any price effect on the Dow Jones index price for COB, the index price derived primarily from reported

bilateral contracts at COB and not traded in California. Neither Mr. McCullough nor Wah Chang has presented any analysis supporting the conclusion that the Enron schemes had any effect on the COB index prices.

Q. How do the Enron schemes fit into this market?

A. In 2002, a memo written by Yoder and Hall, working for Enron, outlined Enron's market strategies in California. However, before examining the specific strategies discussed by Yoder and Hall, one fundamental fact should be kept in mind. This fact requires one to carefully and objectively question the role that these trading strategies would have and did play in the western energy crisis. As I discussed in the previous section, the western energy crisis was caused by a confluence of events made up of (1) traditional strong competitive market forces (such as climate, very high natural gas prices, lack of new supply, and a wildly successful economic expansion in California [demand]), (2) major structural, or market design flaws, (3) regulatory failure, and (4) profound political ineptitude. The so-called "gaming" was, at most, a small activity and had about as much to do with the western energy crisis as one diseased tree in a forest has to do with the forest's destruction in a severe forest fire.

Q. What were the Enron schemes?

A. The Hall and Yoder memos received much publicity, and have been associated with Enron's demise. Other entities' trading strategies have also been investigated. Some of these trading strategies have rather colorful names, which seemingly have heightened the concern that surrounds them. These strategies include: Load Shift, Export of California Power, Ricochet or Megawatt Hour

Laundering, Fat Boy or Inc'ing Load, Death Star (and its progeny: Forney's Perpetual Loop, Black Widow, Red Congo, Cong Catcher, and Big Foot), Wheel Out, Non-Firm Exports, Get Shorty, and Selling Non-Firm Energy as Firm.

Q. Please explain what these schemes entail.

A. Exhibit PacifiCorp/30 includes a brief description of each of the Enron schemes, including the definitions from my book *The California Energy Crisis: What, Why, and What's Next.* My testimony will focus on the more pertinent issue for this proceeding: why the Enron schemes are irrelevant to the COB index prices under which PacifiCorp priced its electricity sales to Wah Chang.

The Irrelevance of the Enron Schemes to the Wah Chang MESA

Q. On page 38 of his direct testimony, Mr. McCullough states that the "Fat Boy scheme significantly inflated the PX prices." Do you agree with his conclusion?

A. No, I do not. Mr. McCullough attempts to support his conclusion by purportedly calculating the "impact on consumers" from increased market prices by "adding the relevant amount of energy back into the supply curves for each hour and recalculating the supply/demand balance point." Mr. McCullough also added what he calls "Ricochet scheme energy" in this calculation. Mr. McCullough purports to show the results of his analysis in a chart on page 39 of his direct testimony. To date, Mr. McCullough has not provided his work papers, so it is not possible to ascertain exactly how he calculated his "price effects." Nevertheless, there is a serious fatal problem inherent in Mr. McCullough's analysis.

Q. What is that problem?

A. Mr. McCullough has ignored what the Fat Boy scheme entailed. Recall from Exhibit PacifiCorp/30, Cicchetti/5-6 that Fat Boy was a seller response to buyers' underscheduling in the CPX market. The buyers' goal was to lower the price paid in the CPX market, shifting the balance of their purchases to the CAISO market. Although prices might be higher in the CAISO market, the California buyers (IOUs) sought to reduce their portfolio costs through underscheduling in the CPX in order to reduce the weighted average prices paid in both these primary markets. In its *Final Report on Price Manipulation in Western Markets* in Docket No. PA01-2-000, FERC Staff observed that the Fat Boy strategy was "conceived and used in response to the procurement strategy used by the three California public utilities" to "minimize their procurement costs."[42] The FERC Staff described the IOU strategy as "a deliberate attempt to push the Cal PX price below the capped price in the Cal ISO real-time market."[43]

Q. How did sellers respond?

A. Sellers responded by reducing the amount of electricity they offered in the CPX market. In essence, sellers would over-schedule their power deliveries into the CAISO market and accept the market clearing price as an uninstructed deviation. Mr. McCullough is apparently adding this over-scheduled energy back into the CPX market and then recalculating what the average price "would have been" with this increased supply. However, in doing so, Mr. McCullough is ignoring the buyers' intentional under-scheduling and resulting lower wholesale prices paid

[42] *See Final Report on Price Manipulation in Western Markets,* Docket No. PA02-2-000, pp. VI-20-21 (Mar. 2003). This document is publicly available on FERC's eLibrary website.
[43] *Id.*

in California's two primary markets. Before recalculating the supply/demand balance point, it is necessary to ***add*** back into the demand side of the equation the amount of under-scheduled demand. Mr. McCullough failed to do so in his analysis, which renders it meaningless.

Q. Do you agree with Mr. McCullough's claim that the Fat Boy strategy "significantly inflated the PX prices"?

A. No. In fact, the FERC Staff stated that the IOU strategy to reduce the amount of load in the CPX market had the effect of ***reducing*** the price of every MWh purchased in that market. Thus, another flaw in Mr. McCullough's argument is that the "Average Monthly Prices With Schemes" he shows in his chart on page 39 of his direct testimony are likely lower than they would have been without the buyers' under-scheduling in the CPX. If it were possible to reconstruct the CPX market absent the IOU underscheduling and the sellers' Fat Boy response, it is likely that the CPX average monthly prices would be ***higher***, not lower. In effect, this is what FERC has intended in its Refund Proceedings.

Further, the IOU underscheduling in the CPX markets created reliability problems for the CAISO to such an extent that at least one CAISO employee encouraged the Fat Boy trading strategy.[44] Further, as I noted above, the CAISO actually criticized Mr. McCullough's analyses with respect to Fat Boy trading strategies, considering the strategies to be benign or even helpful in reducing the CAISO's need to purchase OOM electricity.[45]

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[44] *Id.* at p. VI-24.

[45] *See Analysis of Trading and Scheduling Strategies Described in the Enron Memos*, California ISO Department of Market Analysis, p. 4 (Oct. 4, 2002). This document can be located at the following website address: http://www.ksg.harvard.edu/hepg/Papers/CAISO_enron.trading.analysis_10-4-02.pdf

Q. Do any of these Enron schemes have any relevance to this case?

A. No. The majority of these strategies are designed to obtain revenues from relieving congestion, real or not, in the CAISO's ancillary services markets. The remaining strategies are designed to arbitrage between markets, which was not prohibited under false or deceptive practices. The CAISO-based games and strategies to relieve false congestion or reliability likely had no effect on the broader CPX market clearing energy price in the California markets, which was more closely correlated with COB index prices.

Q. Please explain how you reach this conclusion.

A. Several of these schemes were designed not to increase the market price, but to increase a company's congestion revenue. These strategies include those known as Load Shift, Death Star (and all its progeny), Wheel Out, and Non-Firm Exports. None of these strategies had any affect whatsoever on the market clearing prices in the day-ahead energy markets in California.

The export of power outside of California to capture prices higher than the artificial price caps established in the organized California markets was a legitimate business decision for sellers not required to sell their energy to the CPX or CAISO because they could legally sell MWhs to the highest priced market. Such export strategies meant that the unrestricted sellers were out-of-market price takers, not price setters, in the organized California markets. For example, sellers engaging in the Ricochet strategy effectively sold electricity to the CAISO in the OOM market because there was no requirement for them to sell in the organized

price-capped CPX and CAISO markets. The rules were such that the OOM price could ***not*** set the market clearing price.

Under the Fat Boy strategy, sellers would over-schedule their power deliveries into the market and accept the market clearing price as an uninstructed deviation. These uninstructed deviations did ***not*** set the market clearing price, therefore market prices remained as they were. The Get Shorty strategy was a simple arbitrage strategy where a scheduling coordinator (SC) would sell ancillary services in one market with the hope, if called upon to supply, of purchasing ancillary services to cover its sales in a later market at a lower price. Again, this strategy would have ***no effect*** on the market clearing price of electricity in the organized, deeply traded California market. Finally, selling non-firm energy as firm energy would have ***no adverse effect*** on the market clearing price in the California markets. In fact, some sellers have argued that this strategy actually increased the supply of electricity into California and/or lowered the market clearing prices. Consequently, I conclude that none of these schemes would have caused the market clearing price to increase in the California markets.

Q. Did any of these schemes have an influence on the COB index price that Wah Chang paid under its contract with PacifiCorp?

A. It is highly unlikely that the prices Wah Chang paid at COB were influenced or affected by any of these alleged trading games that, as I explained, mostly attempted to make money through deceptions based on being paid for false services in the non-mainstream, highly traded organized energy markets in California.

Table 4 shows each alleged scheme with a brief description and my conclusion as to whether that scheme could have had any influence on the market clearing prices in the CPX auction markets or for the COB index price. I conclude that while some of these schemes may have had some effect on the CPX price, most did not because they were schemes designed to collect congestion relief payments, not to move the CPX market clearing price. More importantly, I conclude that none of the schemes is likely to have affected the COB indexed spot price that Wah Chang paid.

TABLE 4

GAME	BRIEF DESCRIPTION	AFFECT ON PX PRICE	AFFECT ON COB INDEX PRICES
	Transmission Congestion Games		
LOAD SHIFT	Deliberately creates congestion on a transmission line by deliberately over-scheduling in one zone and under-scheduling by a corresponding amount in another zone	NO	NO
WHEEL OUT	Strategy designed to capture congestion payments for relieving congestion by fooling the CAISO's computerized congestion management program. Here, a company would schedule transmission over a line that it knew was out-of-service to get paid for scheduling a counter-flow schedule.	NO	NO
NON-FIRM EXPORT	Strategy designed to capture congestion payments for relieving congestion by fooling the CAISO's computerized congestion management program. Here, a company recieves a counter-flow congestion payment by scheduling non-firm energy from a point in California to a control area outside of California. The company then cuts the non-firm energy after it recieves the counter-flow payment.	NO	NO
DEATH STAR (aka Forney's Perpetual Loop, Red Congo, Black Widow, Big Foot, and Cong Catcher)	Strategy that involved submitting circular schedules, defined as a series of two of more export and import schedules that begin and end in the same control area. The strategy was designed to "fool" the CAISO's computerized congestion management system and purpose was to receive congestion payments.	NO	NO
	Games Where CAISO MCP is Accepted as a Price Taker		
FAT BOY (Inc'ing Load)	Strategy designed by the IOUs' to underschedule load in the CPX market. Sellers responded and shifted sales from the CPX to the CAISO Real-Time market	MAYBE	NOT LIKELY
	Games Involving Price Differences Between Markets		
GET SHORTY	This strategy is known as paper trading of ancillary services. In effect, a company agrees to provide ancillary services in the CPX market, and if called upon to provide the services, buys them in the CAISO market if the prices are lower.	NO	NO
SELLING NON-FIRM AS FIRM	Under this strategy, a company sells non-firm energy to the CPX claiming it is firm energy. A company using this strategy is at financial risk if its non-firm supplies were cut and it had to purchase in the CAISO's real-time market to cover the energy. This tends to lower CPX prices as supply increases.	NO	NO
EXPORT OF CALIFORNIA POWER	Energy was purchased in the CPX and sold in the uncapped markets outside of California. Takes advantage of the price spread between capped and uncapped markets. If more demand was placed in the CPX markets, prices would tend to increase, other things equal. However, to the extent this increase replace IOU demand . CPX prices might not have differed from what they would or should have been.	YES/MAYBE	NO/MAYBE
	Other Games That Did Not Set the MCP		
RICOCHET (Megawatt Laundering)	Designed to avoid the CAISO price cap by buying energy from the CPX in the day-ahead market, exporting it to a second entity and then reselling the energy in the CAISO real-time market as an OOM transaction. Did not set the MCP. If more demand was placed in the CPX markets, prices would tend to increase, other things equal. However, to the extent this increase replace IOU demand strategically shifted, CPX prices might not have differed from what they would or should have been.	YES/MAYBE	NO/MAYBE

Q. What do you conclude from this analysis?

A. I conclude it is highly unlikely that any of the "games" that were being played in the California market, most of which were designed to collect congestion revenue, had much if any affect on the prices in the COB market. Further, the price paid by Wah Chang in its contract with PacifiCorp was the Dow Jones COB index price, which was an index price derived from reported bilateral contracts at COB. It is even less likely that any "games" played by market participants in the California markets would have affected the prices at COB based on longer term bilateral contracts entered into well in advance that were used to calculate the Dow Jones COB index price reported in the Wall Street Journal.

Section VI: A Detailed Review of the Analyses of Possible Relationships Between California Prices and COB Prices

Q. Why is it necessary to discuss California market prices in the CPX and CAISO when the price used in the MESA between Wah Chang and PacifiCorp is the COB index price?

A. Mr. McCullough asserts that the prices in the California markets were affected by the "gaming" activities of market participants. He asserts by implication that the energy prices in the California markets increased the COB index price. Below I explain that only the CPX market prices are statistically similar to COB index prices. Further, I explain in this analysis that if "gaming" had any effect on prices in the CPX market, the effect was likely to ***decrease***, not increase, CPX prices. The vast majority of the "gaming" activity Mr. McCullough discusses involved intra-market participant payments to each other in the CAISO markets. These do

not move or set the market clearing prices established in very deeply traded energy auction markets. This analysis demonstrates that CAISO prices, which often involved relatively thinly traded products, are not statistically similar to COB index prices. Thus, I conclude California CAISO prices have very little, if any, relevance to COB index prices.

Q. Did the structure and complexity of the California markets lead to any uncertainty?

A. Yes. There were two anticipated sources of uncertainty: unexpected changes in load and unplanned outages. There were also 24 separate geographic zones due to potential transmission constraints that led to further complexity and uncertainty. The CPX matched supply and demand bids in order to "clear" the market volume and establish hourly market prices. These market prices could also vary by zone when the grid was congested.

Q. But isn't COB the relevant market here?

A. Yes. That is precisely the point. However, Mr. McCullough avers this case is about California. This is why I examined the statistical relationship between COB index prices and prices in the CPX and CAISO, respectively. PacifiCorp's contract with Wah Chang required that during the final two years of the contract, (September 1, 2000 through September 1, 2002), Wah Chang would pay a market price based "upon the monthly spot market index determined by the daily average of the COB prices as published in the Wall Street Journal (Dow Jones COB prices) for the previous month." Just as none of the alleged gaming or trading strategies that I have discussed had any effect on the market clearing price in the

California markets, none of these California-based trading strategies would have had any effect on the spot electricity price at COB, which is the only relevant market in this case, and one that is far removed from the market where the alleged "gaming" strategies were directed. More compelling, the energy products traded at COB were not the same as the congestion, reliability, and ancillary services products allegedly manipulated through illegal or unethical "gaming."

Q. What can you say about the relationship between the COB index prices and the California market prices (*i.e.*, CPX and the CAISO prices)?

A. To the extent that COB trades reflected California market conditions, the leading candidate for price interdependence between COB and California would be the CPX Day-Ahead market, not the CAISO's Real-Time prices, which trailed in time and were intended to balance unanticipated savings in demand and/or supply in real time. Furthermore, prices at COB were not set using a similar method or in the same time frame as the CPX Day-Ahead prices. In fact, the COB "price" is an average or index price that no transaction would necessarily reflect.

The CPX market was likely influenced, if at all, by the under-scheduling gaming strategy, which would have tended to ***reduce***, not increase, the more likely reference prices for COB (*i.e.*, the CPX prices). In our State Auditor Report, we reported buyer under-scheduling of load in the CPX market and the subsequent shift of load, and thus purchasing requirements, to the CAISO's Real-Time and OOM markets. Below, I reproduce Figures 3 and 4 from the State Auditors Report that demonstrate this shift in 2000 relative to 1999.

A case can be made that when buyers under-scheduled successfully in the CPX market, the COB index, if it was affected at all, would have been suppressed ***below*** competitive market levels due to the successful monopsony (buyer) market power. In other words, this "game" would have ***reduced*** the COB index price if it had any affect at all.

Statistical Analyses

Q. Have you performed any statistical analyses to test for any relationship between COB prices and the prices in the market that Mr. McCullough avers were manipulated through various gaming strategies?

A. Yes. I accept as a starting point Mr. McCullough's belief that the CAISO energy markets (Real-Time and OOM) were manipulated because traders engaged in various "gaming" schemes. I also accept Mr. McCullough's belief that some sellers often under-scheduled their potential sales in the CPX markets. If just these events had happened, the prices in the CPX market would have tended to increase. However, my State Audit Report, as well as other analyses (*e.g.*, those completed by Professor Sweeney and most significantly FERC) found that buyers also under-scheduled their load or purchases in the same CPX markets.

Effectively, this means that both demand and supply would have been under-scheduled. Thus, CPX prices might not have been much different than they would have been assuming no mutual, albeit contrary, under-scheduling activities. That said, CPX under-scheduling would shift more final sales to the CAISO's two primary energy markets: the Real-Time and, if insufficient MWhs were provided

in the Real-Time market, to the OOM market. This would have occurred until FERC altered its rules concerning OOM.

Q. How does this affect your analyses?

A. Based upon the above, I have formulated and statistically tested two hypotheses. These are:

1. CPX prices, which are generally unaffected by the alleged manipulation, are statistically distinguishable from corresponding COB prices.
2. The allegedly manipulated CAISO prices are statistically distinguishable from corresponding COB prices.

Q. Have you reached any conclusions?

A. I conclude that COB prices were, on average, quite different from the CAISO prices, the markets where Mr. McCullough alleges "games" occurred. Sometimes different means greater, other times different means less. The point is that I find CAISO and COB prices to be statistically different from each other. This also means that, on average, COB index prices are different statistically than the corresponding CAISO markets that Mr. McCullough alleges were manipulated. Therefore, the alleged manipulation of the CAISO market is not relevant to the COB index price paid by Wah Chang under the MESA.

However, there is a similarity, on average, for COB index prices and CPX markets prices (where supply and demand under-scheduling tended to cancel out). This similarity suggests that, on average, both the CPX and COB markets tended to be influenced by similar market forces (supply shortages, increased consumption, high natural gas and NO_X input prices, etc.) as well as market

design flaws and inter-regional congestion. The alleged games in the CAISO market mostly were intended to capture payments for deceptive practices related to specific products and were not designed to affect the market clearing prices for the vast amount of MWhs sold. And, as I discussed earlier, any "gaming" that occurred in the CPX market was done by both sellers and buyers, and in effect cancelled out the effects. If anything, "gaming" in the CPX market likely lowered the CPX price, not raised it. Therefore, if the prices in the CPX market were statistically similar to the COB Index prices, there exists an implication that if prices were lower in the CPX due to the limited "gaming" that was directed towards that market, prices were also lower in the COB market.

Q. What tests did you perform?

A. I compared the mean value of prices at COB and the two organized California markets. The purpose of this test is to determine if these pairs of mean values are statistically different from one another, assuming they have the same underlying statistical distribution.

Q. What did you find?

A. I found that, based upon the corresponding mean values of COB prices and CPX prices, there was no significant statistical difference in either the mean values of peak prices (6 X 16) or off-peak prices (night time, Sundays, and holidays). Thus, I reject the first hypothesis.

Next, I tested the same hypothesis for CAISO market. Here I could not reject the hypothesis. In effect, I found that the mean values for the peak period

CAISO prices were statistically less than the corresponding COB prices over a multi-year period of time.

The off-peak CAISO prices were marginally statistically less than the COB off-peak prices.

Q. Please describe these results in more detail.

A. My statistical analyses are described in greater detail in Exhibit PacifiCorp/31.

Section VII: PacifiCorp's Trading Activity and the Various Regulatory Findings with Respect to PacifiCorp's Trading Activity

Q. What is the purpose of this Section of your testimony?

A. I address the specific allegations made by Mr. McCullough with respect to PacifiCorp trading activity, and explain why they are irrelevant to the relief sought by Wah Chang in this proceeding. I also describe how, in many instances, the PacifiCorp trading activity was investigated and resolved by FERC.

Q. Which specific allegations do you address?

A. This section of my testimony address (1) buy/sell transactions, (2) physical withholding, (3) "gaming" and other anomalous trading, (4) PacifiCorp's actions on May 22, 2000, (5) Mr. McCullough's incorrect and unsupported exaggeration of PacifiCorp's role with respect to Enron's schemes, and (6) PacifiCorp's unsuccessful efforts at FERC to obtain relief in circumstances similar to Wah Chang's.

Buy/Sell Transactions

Q. Mr. McCullough discusses what he calls "non-transmission buy/resell" beginning at page 64 of his direct testimony. How does he define these transactions?

A. Mr. McCullough states that he uses the term to refer to a "simultaneous 'purchase' and 'sale' of the same quantity of power at the same location with the same counterparty for a fee equal to the difference between the nominal purchase and sale price." He further alleges that such a buy/resell transaction is a "sham or wash transaction that does not involve actual transmission of energy."

Q. Do you concur with Mr. McCullough's definition?

A. No. The crucial disagreement I have is that the transactions identified by Mr. McCullough have a different price for the purchase and sales. A wash or match trade is one where the purchase and sale price are the same, the transaction is between the same parties, at the same location, and at virtually the same time. In the case of the transactions identified by Mr. McCullough, it is undeniable that the price is different. Therefore, I conclude that these buy/resell transactions were not match or wash trades. It is difficult to question PacifiCorp's decision to purchase electricity at one price and sell it for a higher price, especially since no matter how great the difference in prices, the similar trades turn a profit or reduce portfolio trading risk.

Q. Does FERC agree with you?

A. Yes. The FERC definition of match or wash trades is different than the definition proposed here by Mr. McCullough. FERC defines a wash trade as being for the

same quantity, the same product, the same counterparty, the same day, and the same price.[46] The transactions that Mr. McCullough discusses in his testimony do not match FERC's definition because PacifiCorp sold the electricity at a price that was different from the price at which it purchased the electricity.

Q. Were wash or match trades prohibited?

A. No. Match trades were not illegal or prohibited by any FERC rule or regulation. FERC Staff recognized this reality in its Report.[47] In fact, in its Report, FERC Staff recommended that FERC follow the Commodity Futures Trading Commission approach and "establish specific rules banning any form of prearranged wash trading activities through industry indices."[48] The fact is that PacifiCorp did not violate any FERC rule then in existence when it entered into these trades with Enron.

In addition, trading practices similar to "wash" or "near wash" trading have often existed in other commodity markets. There are various reasons why this has been so. Sometimes, these practices are not permitted. However, unless there are such commodity market restrictions, they are neither unusual nor do they represent trading violations or anomalies.

Q. Can such buy/resell transactions have legitimate business purposes?

A. Most certainly. Mr. McCullough admits at page 65 of his direct testimony that such transactions can have legitimate business purposes. Mr. McCullough accurately cites financial sleeves, where a seller insists on a credit-worthy

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[46] *See Final Report on Price Manipulation in Western Markets,* Docket No. PA02-2-000, p. VII-2 (Mar. 2003). This document is publicly available on FERC's eLibrary website.
[47] *Id.* at p. VII-1 (noting that "the Commission has no regulations on wash trading").
[48] *Id.* at p. VII-15.

middleman as an example of a legitimate business purpose. In such an instance, power would be transferred to one entity and then immediately transferred to a different entity, with the middleman receiving a fee for acting as the go-between. He also describes the situation where traders exchange energy at different locations as being a legitimate purpose for a buy/resell transaction as he defines it.

Q. Are there other examples of legitimate business purposes for buy/resell agreements?

A. Yes. There are several possible explanations and legitimate business reasons for entering into a match trade. Among these are the possibility of testing the interest of other participants in the market and creating an audit trail to support an end-of-day market-to-market valuation. Most trading companies have risk limitations that restrict traders. The units measured are revenue (price X quantity) and the portfolio is valued using a net present value method. At the end of each day, a trader's portfolio is revalued based on current market conditions using forward prices. This requires a trader's risk manager to determine an appropriate market price to "mark" the trader's open positions to market in order to evaluate whether the trader's portfolio value is within the designated risk parameters and to calculate the trader's daily profit or loss, if any.

Q. Does Mr. McCullough dispute that these buy/resell transactions have a legitimate business purpose?

A. Mr. McCullough has no way of actually knowing why PacifiCorp entered into any transaction. He nonetheless asserts at page 66 of his direct testimony that these transactions were "components of Ricochets and Death Stars." However, as

I discuss in greater detail below, FERC fully investigated PacifiCorp's trading activities and found no evidence that PacifiCorp had engaged in the trading practices known as Ricochet or Death Star.

Q. How many of these so-called "buy/resell" transactions does Mr. McCullough identify?

A. At page 121 of his direct testimony, Mr. McCullough refers to an affidavit filed by Mr. Watters of PacifiCorp in the FERC docket investigating anomalous trading behavior. In that affidavit, Mr. Watters identifies 767 of these so-called buy/resell transactions that took place between July 2000 and November 2000. These involved a total of 40,376 MWhs. During this same period, PacifiCorp completed approximately 45,000 transactions in the WSCC. Thus, these so-called buy/resell transactions made up only 1.7% of PacifiCorp's transactions during this period.

Most of these transactions predated the September 1, 2000 start date for the Wah Chang contract. Further, these contracts made up an insignificant part of PacifiCorp's trading practices. The 40,376 MWhs represented by these transactions over this five-month period are an insignificant percentage of the total MWhs traded in the California market during this period. The California market during the 2000 to 2001 time period was approximately 45,000 MWs or 394,200,000 MWhs, or an average of 32,850,000 MWhs per month. For the five months (July 2000 through November 2000), this would be approximately 164,250,000 MWhs. As these months represent the hottest months in the California year, this likely understates the total MWhs. Nevertheless, the 40,376

MWhs represented by PacifiCorp's so-called "buy/resell" transactions represent only 0.025% of this California market, a total that is *de minimis*.

Physical Withholding

Q. Please discuss Mr. McCullough's assertions regarding the withholding of energy supply from the California market.

A. At page 33 of his direct testimony, Mr. McCullough asserts that withholding of energy supply was a central feature of the 2000 – 2001 western energy crisis, asserting that "merchant generators averaged operations at only 50% of capacity during California ISO declared emergencies."

Q. Does Mr. McCullough provide any specific examples?

A. At pages 33-36 of his direct testimony, he references Reliant's decisions to cut output in the summer of 2000 and Enron's "cookbook" for cutting operations. He includes selected snippets of conversations between traders to support his contentions. He also attaches an email from a former Enron junior trader who is now employed by PacifiCorp. Of course, this tidbit concerning a PacifiCorp trader's former employment is utterly irrelevant to this proceeding because that employee was still working for Enron in July 2001 (when the email was sent), and that came after the FERC established Western region-wide price caps.

Q. Did Mr. McCullough accuse PacifiCorp of withholding generation from the market?

A. Yes. He references one conversation that is alleged to have taken place on January 21, 2001 where a PacifiCorp employee discusses bringing the Hermiston generating plant "down" by 100 MWs, adding "we will be bringing them right

back." This conversation took place during a CAISO Stage 3 Emergency. While Mr. McCullough admits that there might be a legitimate purpose to bring Hermiston down by 100 MWs, he still feels compelled to opine that PacifiCorp's actions were "odd given that it occurred in the midst of a Stage 3 Emergency." He never explains why he thinks it is odd. Mr. McCullough admitted during his deposition that this was the only example he found of alleged physical withholding by PacifiCorp, and that he had undertaken no further actions to investigate whether or not there was a legitimate purpose for the Hermiston reduction.[49] At best, Mr. McCullough's supposition is grossly incomplete.

Q. Why was the instruction given to bring Hermiston down by 100 MWs?

A. As I understand the circumstances, this was a matter of load balancing. For the particular hour in question, I am informed that PacifiCorp's west control area was receiving 12.75 MWs per minute but that its load pickup was only 2.5 MW per minute. In other words, energy that was needed at the end of the hour had to be backed off from the unit at the beginning of the hour while PacifiCorp waited for the load to arrive. The instruction given to the Hermiston operator was intended to accomplish this load balancing.

Q. Would PacifiCorp have benefited from withholding capacity from the market on this particular date (January 21, 2001) in order to drive up prices?

A. No. On January 21, 2001, PacifiCorp purchased 9,957 MWh in the Real-Time markets for a cost of slightly more than $1,500,000. During this same period,

[49] McCullough Deposition at 58:13-21.

PacifiCorp sold 160 MWh for $97,600. Just as FERC found in its investigation, PacifiCorp was a net purchaser. One does not conspire to drive up prices in a market where one is purchasing substantially more than one is selling. The facts highlight the errors inherent in Mr. McCullough's unfounded suppositions.

Q. Please discuss FERC's finding that PacifiCorp was a net purchaser.

A. Subsequent to FERC Staff releasing its "Final Report on Price Manipulation in Western Markets" in Docket No. PA02-2-000 (March 2003), FERC instructed its Staff to investigate the existence of physical withholding of power from California by generators. The investigation covered the period May 1, 2000 through June 30, 2001. In its investigation, Staff reviewed 129 entities, including PacifiCorp.

Q. What did FERC Staff conclude with respect to PacifiCorp after its investigation?

A. FERC Staff concluded that 4 entities, including PacifiCorp, were IOU or municipally-owned utility (MOU) net purchasers. FERC Staff stated that its net buyer status indicated that PacifiCorp had neither the opportunity nor the incentive to withhold capacity from the market. FERC Staff further concluded that PacifiCorp did not have sufficient generation to serve its native load and frequently relied upon the Real-Time market for power to serve this load. Consequently, PacifiCorp and the other three IOU/MOU net purchasers were dropped from the investigation.

"Gaming" and Other Anomalous Trading

Q. Did FERC conduct any other investigation in which PacifiCorp was included?

A. Yes. In its Final Staff Report, FERC Staff recommended that various trading entities, including PacifiCorp, be investigated further. Two dockets were opened. The first was an *Order to Show Cause Concerning Gaming and/or Anomalous Market Behavior Through the Use of Partnerships, Alliances, or other Arrangements and Directing Submission of Information.*[50] FERC stated that, following the FERC Staff Final Report, it found that there was evidence that Enron (and its affiliates) "[w]orked in concert through partnerships, alliances or other arrangements (collectively, Partnership Entities) to engage in activities that constitute gaming and/or anomalous market behavior (Gaming Practices)...during the period January 1, 2000 to June 20, 2001." Significantly, PacifiCorp was ***not*** one of the market participants named in this Order to Show Cause.

PacifiCorp was, however, identified as an entity that was involved with "apparent partnerships, alliance, and other arrangements (*e.g.*, coordinating activities) that were similar to the Enron Partnerships" (Docket No. EL03-197-000) and was included in the Order to Show Cause.

Q. What was the result of this Order to Show Cause?

A. After examining the evidence, FERC Trial Staff filed a Motion to Dismiss the allegations that PPM Energy (formerly known as PacifiCorp Power Marketing, Inc., which had been substituted for PacifiCorp), finding that it had not engaged in

[50] *Enron Power Marketing, Inc., et al.,* 103 FERC ¶61,346 (Jun. 25, 2003).

any False Import Strategy with Public Service Company of New Mexico (PSNM). There were four reasons for reaching this conclusion: (1) none of the transactions took place between May 1 and October 1, 2000; (2) PPM did not purchase any of the power it "parked" with PSNM in the California day-ahead or day-of markets, nor did it export any purchased power out of the state; (3) since all of the transactions took place in January 2000, none of them were "above the cap"; and (4) PPM lost money on the transactions.[51]

Q. What was the second Order to Show Cause?

A. In the FERC Show Cause proceeding regarding gaming and anomalous market behavior,[52] PacifiCorp was named as potentially having engaged in several "gaming" activities, including:

- Ricochet;
- Congestion Related (Circular Scheduling aka Death Star); and
- Congestion Related (Cutting Non-Firm).

In this Order to Show Cause, FERC declined to investigate the game known as Fat Boy ("inc"-ing load), concluding it had taken place in response to the under-scheduling by the IOUs.

Q. What was the result of this investigation?

A. ALJ Cintron approved an Agreement and Stipulation between PacifiCorp and FERC Trial Staff resolving the allegations that had been made against PacifiCorp

[51] *Colorado River Commission of Nevada, et al.,* 106 FERC ¶ 61,022 *(Order on Motions to Dismiss Show Cause Proceedings)* (Jan. 22, 2004).
[52] *American Electric Power Service Corporation, et al.,* 103 FERC ¶ 61,345 (*Order to Show Cause Concerning Gaming and/or Anomalous Market Behavior)* (Jun. 25, 2003).

in the Order to Show Cause.[53] Over the objections of California Parties and Wah Chang, FERC on March 8, 2004[54] approved the Agreement and Stipulation between PacifiCorp and FERC Trial Staff resolving the allegations made against PacifiCorp in the Order to Show Cause.

Q. Did FERC make any specific findings?

A. Yes. With respect to Ricochet or False Import, FERC found that the CAISO data claimed that PacifiCorp engaged in 1,098 hours of False Import. The Fox-Penner data submitted by the California Parties purported to identify 1,116 hours of single-party False Import.

With respect to the allegations regarding Cutting Non-Firm, FERC referenced the finding of Dr. Fox-Penner, who identified seven hours between January 1, 2001 and June 20, 2001 where PacifiCorp had engaged in this activity. FERC found that PacifiCorp made $12.08 from these practices.

With respect to allegations concerning Circular Scheduling or Death Star, FERC found that neither the CAISO data nor the CAISO Report of the Fox-Penner data identified PacifiCorp as having engaged in Circular Scheduling, although the Fox-Penner data claimed seven instances where PacifiCorp engaged in Circular Scheduling transactions with Enron.

With respect to the allegations concerning Wheel-Out, FERC referenced both the Fox-Penner and CAISO data, which showed six hours of this practice with total congestion earnings of $67,745.

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[53] *PacifiCorp*, 105 FERC ¶ 63,043 (*Certification of Contested Settlement*) (Dec. 15, 2003).
[54] *PacifiCorp*, 106 FERC ¶ 61,235 (*Order Approving Contested Settlement Agreement)* (Mar. 8, 2004).

Q. What were the terms of the Agreement and Stipulation?

A. Given that the results of the investigation revealed effects that were *de minimis,* FERC Trial Staff and PacifiCorp reached a settlement for $67,745 (which was the total revenue PacifiCorp made in its Wheel Outs). FERC Trial Staff found that ***none*** of the alleged Ricochet transactions occurred during the relevant period and the prices did ***not*** exceed the applicable price cap. Thus, the transactions did not meet FERC Staff's definition of a Ricochet.

The Show Cause Order described False Import or Ricochet during the time period January 1, 2000 to June 21, 2001 as follows:

> This practice...took advantage of the price differentials that existed between the day-ahead or day-of markets and out-of-market sales in the real-time market. A market participant made arrangements to export power purchased in the California day-ahead or day-of markets to an entity outside the state and to repurchase the power from the out-of-state entity, for which the out-of-state entity received a fee. The "imported" power was then sold in the California real-time market at a price above the cap.
>
> The essence of the False Import practice was to "park" day-ahead or day-of California energy with a company outside of California, buy it back for a small fee and then sell it to the ISO as 'imported' out-of-market power. When power was parked under this practice, no power actually left the state of California. The reason for creating this fictional import was to take advantage of the fact that the ISO was making out-of-market purchases that were not subject to the price cap during real time whenever there was insufficient supply bid into its markets.

Staff also found that the Cutting Non-Firm allegations were based on transactions that did not meet the $10,000 threshold established by FERC for disgorgement.

Staff was further unable to substantiate any revenue earned that PacifiCorp earned from alleged Death Star practices.

Under the Agreement and Stipulation, $67,745 was accepted as full settlement for all revenues for the Wheel Out activity, False Import (Ricochet), Cutting Non-Firm, Circular Scheduling (Death Star), and Wheel Out. Thus, all "gaming" allegations were resolved by this settlement approved by FERC.

Q. Which parties opposed the settlement?

A. Both the California Parties and Wah Chang opposed the settlement. Wah Chang argued that the settlement was deficient because it failed to take into account the profits PacifiCorp earned from False Imports by providing parking services to third parties. Wah Chang claimed that such market behavior caused Wah Chang to overpay by about $25 million for electricity it purchased during the period September 2000 to May 2001. FERC Trial Staff countered that this issue of partnerships with others was part of the Enron Power Marketing (Partnership Order) discussed above, from which PacifiCorp and PPM were dismissed, and that the parking allegations were irrelevant to the False Import offense.

Ultimately, FERC approved the Settlement, stating that (1) the definition of False Import was binding on this proceeding, (2) the revenues from Cutting Non-Firm did not reach the threshold $10,000 level, (3) the record showed no revenue from Death Star practices, and (4) all revenues from Wheel Out were being disgorged.

Q. Did FERC address the issue of PacifiCorp's alleged participation in Fat Boy?

A. As noted above, FERC declined to investigate the "game" known as Fat Boy, concluding it had taken place in response to the under-scheduling by the IOUs. Whether or not FERC addressed PacifiCorp's alleged participation in the Fat Boy

scheme, Mr. McCullough fails to provide any basis for investigating this issue at all in this proceeding.

Q. Please explain.

A. First, as noted above, the Fat Boy scheme, rather than "significantly inflate[ing] the PX prices," as Mr. McCullough claims, the strategy of reducing the amount of load in the CPX market had the effect of ***reducing*** the price of every MWh purchased in that market. Second, with respect to PacifiCorp's role in that scheme, Mr. McCullough has virtually no evidence of PacifiCorp's knowing or meaningful participation. Mr. McCullough stated in his deposition that there were not "more than 40 or 50" instances in which PacifiCorp filed schedules in excess of load, and that "[i]t seemed quite possible to me that more egregious ones could simply have been a data entry error."[55] According to Mr. McCullough:

> [T]he scale is not significant enough to believe that it was an ongoing process. Could be as easily a computer error as an attempt to profit.[56]

In contrast to these "40 to 50" instances cited by Mr. McCullough, "PowerEx and Enron filed Fat Boy schedules on virtually every hour of every day for the entire crisis."[57]

Q. PacifiCorp recently settled claims of overcharges during the western energy crisis. Does this settlement affect any of your conclusions?

A. No. The pending $28 million settlement, which must still be approved by the FERC, resolves the last remnants of claims pending against PacifiCorp by various California Parties, including the investor-owned utilities, the California Electricity

[55] McCullough Deposition at 64:7-23.
[56] *Id.* at 102:17-21.
[57] *Id.* at 64:1-3.

Oversight Board, the California Department of Water Resources, and the California Attorney General. In essence, it resolves PacifiCorp's potential responsibility for paying refunds arising from FERC's resetting the market clearing price to what it considered was a just and reasonable level, the so-called mitigated market clearing price. Almost $12 million of the settlement will come from funds that the CPX is still holding that were never paid to PacifiCorp for electricity it provided to California during the crisis. The settlement has nothing to do with any alleged wrongdoing on the part of PacifiCorp. All such claims were resolved, as I discussed above, favorably to PacifiCorp. This settlement simply resolves PacifiCorp's potential liability in the refund case resulting from the FERC Orders related to the California Refund Proceeding that established a just and reasonable, or mitigated market clearing price. This was done to the entire market, without PacifiCorp admitting any wrongdoing. It does not change any of the opinions I have expressed.

PacifiCorp's Actions on May 22, 2000

Q. Mr. McCullough seems to attribute significance to events that occurred on May 22, 2000. Please describe what he asserts.

A. May 22, 2000 is the day Mr. McCullough identifies as the start of the 2000 – 2001 western energy crisis. At pages 10-15 of his direct testimony, Mr. McCullough asserts that on May 22, 2000 (Monday) the "trading schemes … first had drastic effect" and that the CAISO issued its first Stage 2 Emergency (a situation where reserves fall below 5%). He further asserts that COB prices went from $75.53 on Monday (May 22, 2000) to $177.80/MWh on Tuesday (May 23, 2000).

Mr. McCullough asserts that the CAISO explained that it had called the Stage 2 Emergency because it perceived "an apparent shortfall of 7,400 megawatts in its computer markets and a possible supply of only 5,000 megawatts to meet it."

Q. What is the significance of any of this?

A. Not much, in my opinion. Mr. McCullough is back to beating the Enron drum. On May 22, 2000, Mr. McCullough claims that Enron "ran a deficit in SP-15. In other words, it bought electricity in the Los Angeles area, sold it to PacifiCorp at COB for $75/MWh, bought it back for $80/MWh and then resold it to the CAISO after the emergency declaration. Mr. McCullough seems to think that this transaction was the precursor to the energy crisis.

Q. Was this transaction large?

A. No. This transaction involved 100 MWs for 3 hours on which PacifiCorp made $5 per MWh, or $1,500, on the deal. Even Mr. McCullough is forced to admit that this transaction was a small part of the supply shortfall perceived by the CAISO. Nevertheless, he unabashedly claims, without explanation, that this transaction between Enron and PacifiCorp is a "particularly egregious example of market manipulation."

Q. Does Mr. McCullough know why PacifiCorp entered into this contract with Enron?

A. No, he does not. But Mr. McCullough is not shy in offering his opinion as to why PacifiCorp "might" have made this transaction (omitting the $5 per MWh it made on the deal). He opines that maybe the transaction was motivated by the fact that:

- Traders were awarded bonuses based in part on the revenues from the trading group's transactions; or
- PacifiCorp received higher prices when it sold power at manipulated prices. For example, he asserts that on May 22, 2000, PacifiCorp sold 100 MW for 2 hours for $500/MWh to the CAISO. He asserts that this was a profit of $42,000 per hour based on a COB on-peak price of $76/MWh, (*e.g.*, $422/MWh X 100 = $42,200).

Q. Does PacifiCorp deny that it bought and sold power?

A. Of course not. As FERC Staff concluded after its withholding investigation (discussed above), PacifiCorp was a net buyer. It bought more than it sold. Mr. McCullough has cherry picked one transaction to show the "large" profits made by PacifiCorp, but he has ignored PacifiCorp's net buyer status and the obvious fact that buyers prefer lower, not higher, prices. Intuitively, one would conclude that as a net buyer, PacifiCorp would want lower, not higher, prices.

Q. Does Mr. McCullough assert that anything else untoward happened on May 22, 2000?

A. Yes. McCullough also asserts that economic and physical withholding by merchant generators occurred on May 22, 2000. But, again, he offers no proof that this occurred or that PacifiCorp withheld power. In fact, FERC Staff specifically found that PacifiCorp, as a net buyer, had neither the incentive nor the ability to withhold generation from the market. Consequently, FERC Staff terminated its investigation of PacifiCorp in its withholding investigation.

Mr. McCullough offers no evidence that PacifiCorp withheld generation from the market, because no such evidence exists.

The Incorrect and Unsupported Exaggeration of PacifiCorp's Role with Respect to Enron's Schemes.

Q. In what manner does Mr. McCullough exaggerate PacifiCorp's role with respect to Enron's schemes?

A. A good example is Mr. McCullough's direct testimony at page 43, lines 7-13, where he claims that PacifiCorp's role was "significant" with respect to Enron's short-term trading. In support of this conclusion, he cites to a November 5, 2001 email from Enron's Tim Belden referring to PacifiCorp as "the most important counterparty for both our short term northwest an[d] short term southwest desks." This email is irrelevant because, as Mr. McCullough knows, this email has no bearing whatsoever on whether PacifiCorp participated in the Enron schemes he cites in his testimony. At the time this email was written – in November 2001 – the western energy crisis was over; it had ended nearly six months earlier when FERC imposed west-wide price caps on June 19, 2001. The issue at the time Mr. Belden wrote his email in November 2001 was Enron's imminent bankruptcy – which occurred one month later – and the "scarce margin" available to Enron in terms of which counterparties would even do business with Enron.

Mr. McCullough admitted in his deposition that this was the context in which PacifiCorp was identified as a "significant" counter-party:

> [W]e have a finite amount of credit support available to Enron at the period that was just before the bankruptcy. In fact, less than a month before the bankruptcy announcement.[58]

[58] *Id.* at 65:15-19.

This period is completely irrelevant to the issue of whether PacifiCorp participated in Enron's schemes during the western energy crisis.

Mr. McCullough disingenuously takes an email written after the fact and attempts to create the impression that throughout the western energy crisis, PacifiCorp was (a) a "significant" participant in Enron's schemes, and (b) even aware of the content of the email, months after the crisis ended. The evidence clearly shows otherwise.

Q. Are there other instances in which PacifiCorp's role is exaggerated?

A. Yes. Mr. McCullough attempts to create the impression in his direct testimony that PacifiCorp was a knowing and material participant in Enron's schemes. Yet when pressed during his deposition, he declined to accuse PacifiCorp of knowingly engaging in any of Enron's schemes:

> Q. Are there any other Enron-type gaming activities that you believe PacifiCorp ***engaged in*** during the energy crisis?
>
> A. I would disagree with the characterization embedded in that question. What I've said in this testimony is that there is clear evidence that PacifiCorp ***facilitated*** Ricochet and Death Star. There is some evidence of Fat Boy, but as I said, the scale is not significant enough to believe that it was an ongoing process. Could be as easily a computer error as an attempt to profit.[59]

In other words, Mr. McCullough draws a clear distinction between whether PacifiCorp knowingly ***engaged in*** "gaming" during the western energy crisis, or simply unknowingly facilitated "gaming" by others. Mr. McCullough sums up PacifiCorp's role in the following excerpt from his deposition:

[59] *Id.* at 102:10-21 (emphasis added).

> [O]ur review of the data indicates that PacifiCorp, ***either through design or mischance***, found itself on the wrong side of these transactions. The most kindly way to put it is PacifiCorp chose its friends poorly at this point.[60]

This illustrates a reason why I find a complete disconnect between the relief requested by Wah Chang in this proceeding – abrogating the MESA and instead charging Wah Chang according to PacifiCorp's tariff – and the evidence presented in Mr. McCullough's testimony. There is no evidence to support penalizing PacifiCorp in the manner proposed by Wah Chang for actions consisting merely of "mischance," choosing friends "poorly," or "a computer error." Moreover, as discussed above, whether or not PacifiCorp knowingly participated, the "games" were directed at the CAISO market, which is completely unrelated to the COB index upon which the MESA prices are based.

PacifiCorp's Unsuccessful Efforts at FERC to Obtain Relief in Circumstances Similar to Wah Chang's.

Q. Has PacifiCorp, as a buyer, sought relief from any of the contracts it entered into during the crisis?

A. Yes. However, PacifiCorp has been unsuccessful in its attempts to overturn $67 million in high-priced power purchase contracts it had entered into during the height of the western energy crisis. PacifiCorp sought to be relieved from 12 contracts involving 370,000 MWhs of electricity it bought in April, May, and June 2001 for delivery in summer 2002. The contracts were priced between $126 and $262 per MWh, which "reflected generally prevailing market prices at the

[60] *Id.* at 46:5-10.

time the contracts were issued."[61] At the time of delivery, these prices were higher than the west-wide price cap for spot market sales. These contracts were purchased from Reliant Energy Services, Morgan Stanley Capital Group, Williams Energy Marketing, and El Paso Merchant Energy.

Q. Why was PacifiCorp unable to get relief from these contracts?

A. FERC found that PacifiCorp "[s]imply found itself with contracts that had become uneconomic with the passage of time."[62] In other words, PacifiCorp's "regrets" in entering the contracts simply did not overcome FERC's predisposition to treat contracts as binding, or satisfy the public interest standard required to abrogate these contracts. This is remarkably similar to the situation here, where Wah Chang simply has regrets that a contractual decision it made several years before the western energy crisis did not pan out the way it had hoped it would.

Section VIII: Wah Chang's Duty and Ability to Mitigate Its Damages

Q. Have you examined whether Wah Chang had any ability to mitigate the higher prices it incurred under the MESA, and whether it actually took such actions?

A. Yes, I have. I preface my conclusions by stating that, in my non-legal opinion, Wah Chang had an obligation to mitigate any potential damages it might have suffered, such as by hedging the MESA or displacing the power purchases through co-generation. I conclude that Wah Chang failed to take timely action to

[61] *PacifiCorp v. Reliant Energy Services, Inc.*, 102 FERC ¶ 63,030 (Jun. 26, 2003).
[62] *PacifiCorp v. Reliant Energy Services, Inc.*, 105 FERC ¶ 61,184 (*Order on Rehearing and Clarification*) (Nov. 10, 2003).

do so. However, Wah Chang's parent company, Allegheny Technologies (Allegheny), did actively participate in the western energy markets during the very time that Wah Chang complains about high prices. Allegheny marketed electricity in the western energy markets and sold it to various utilities at prices exceeding what it paid for it and, in effect, used the profits from these sales to offset the expense of Wah Chang's contract with PacifiCorp.[63] I find it ironic that Wah Chang complains about the high price of electricity when it is the purchaser but remains mute about the profits its parent earned by selling into the same western energy markets.

Q What types of hedges would have been available to Wah Chang?

A. As a general matter, financial hedges do not need to be contracts for the same commodity, the same geographic market, or even in the same time period. The essential determination of the utility of financial hedges is the statistical interdependence between the price of the commodity intended to be used and the price of an alternative commodity, product, or financial contract. Specifically, the efficiency of a hedge can be measured using the R^2, or multiple correlation coefficient, between commodity A and commodity B. The higher the R^2, the greater the efficiency of a particular hedge. Furthermore, (1-R) reflects the reduction in price risk due to the hedge.[64]

As noted above, under the MESA, Wah Chang agreed to pay market prices using the COB index price. In addition to operational hedges, such as

[63] Exhibit WC 400, Rebuttal Testimony of Eric Larson at pp. 5-6.
[64] Leland Johnson, "The Theory of Hedging and Speculation in Commodity Futures," Review of Economic Studies (27), 1960, pp. 139-151.

building cogeneration, Wah Chang could have availed itself of various types of financial hedges. Four examples are:

(1) Entering futures contracts to purchase electricity at COB in the future at a fixed price using contracts traded on the NYMEX Futures Market,

(2) Entering contracts to sell electricity in the Palo Verde market for spot prices,

(3) Entering futures contracts to buy/sell electricity at fixed prices at Palo Verde using the NYMEX Futures Market, or

(4) Entering natural gas contracts at Henry Hub using spot index fixed price or futures contracts.

Q. How would such hedges work?

A. Suppose Wah Chang deemed it useful to "lock in" an electricity price of $50 per MWh. The PacifiCorp contract would settle at an unknown price of $X per MWh. Consider two cases:

(1) Suppose $X equals $100 per MWh. If Wah Chang secured a Futures NYMEX contract to purchase at $50 per MWh and sell the MWhs into the spot market at $100 per MWh. Effectively, these buys (from NYMEX) and sells (at Spot) would cancel and Wah Chang would have achieved its objective operationally to purchase MWhs at $50.

(2) Suppose $X equals $30 per MWh. Here, the same futures contract would mean that Wah Chang would buy at NYMEX for $50 per MWh and sell at $30 per MWh into the spot market. This would mean a loss of $20 per MWh on the hedge. However, Wah Chang would also purchase its

operational needs at the same $30 per MWh spot price. The cost to Wah Chang for the MWhs used and its hedge loss would be: $30 per MWh plus $20 per MWh, or the same $50 per MWh that Wah Chang had locked in. The other types of hedges in other geographic markets and alternative commodities, such as natural gas which is the marginal fuel used to generate electricity in the west, work in much the same way.

Q. Does this mean that Wah Chang should have hedged all its operational needs?

A. No. The optimal hedge ratio conceptually is the slope of the regression line, similar to the BETA statistics in the Capital Asset Pricing Model (CAPM), between the operational commodity and the product or contract used to hedge. It would be rare to hedge the operational needs 100% because, if this was desired, the consumer would likely not have freely entered into a contract with such risk that could be hedged fully (*i.e.* 100%).

Hedging is also rather like any financial investment portfolio. New facts, market fundamentals, *etc.* can and would typically cause entities to alter their exposure to risk and optimal hedging strategies over time.

Q. Would you have advised Wah Chang to hedge its exposure to price variability when its contract switched to an index spot price in September 2000?

A. Yes. To demonstrate why, I have estimated hedging efficiency and risk-reducing conditions using regression equations for spot and futures contracts for electricity at COB, Palo Verde (a liquid trading hub in the region), and a Henry Hub (the

most important continental natural gas trading hub). I tested several potential hedges that Wah Chang could potentially have relied upon to reduce this risk under the PacifiCorp contract when, beginning in September 2000, the contract established the prices Wah Chang would pay to equal the monthly spot price at COB for the prior billing month, plus $11 per MWh. The potential hedges I considered, and the regressions used to analyze them, are presented in Exhibit PacifiCorp/32.

Q. What does Exhibit PacifiCorp/32 show?

A. Based on the results of the seven "experiments" I conducted to evaluate potential hedging opportunities, I identified at least three highly efficient hedging strategies based on information and data available at the time that Wah Chang could have pursued: (1) trading in 12-month futures contracts at Palo Verde, (2) COB futures electricity contracts for delivery on September 1, 2000 (the first date of the new pricing terms in the Wah Chang MESA), and (3) Palo Verde futures electricity contracts for delivery on September 1, 2000.

Q. Does this analysis show that Wah Chang could have reduced the inherent price risk under it contract with PacifiCorp?

A. Most definitely, yes.

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The information contained herein may be shown only to qualified persons as defined in the Order.

Q. Was this the end of the negotiation between Wah Chang and PacifiCorp to modify the MESA with some sort of hedge?

A. No. PacifiCorp provided Wah Chang with a range of fixed prices based on Wah Chang's load variability and the associated price risk. Wah Chang indicated that the quoted price was too high, and no contract modification was agreed upon.[71] Mr. Griswold also testified that on August 15, 2000, Mr. Larson told PacifiCorp that he still had not pursued hedging opportunities for Wah Chang. At that time PacifiCorp and Wah Chang also discussed the possibility of Wah Chang generating some of its own electricity in a co-generation facility to reduce the amount it would need to purchase from PacifiCorp under the MESA.[72]

Q. What did Wah Chang do next?

A. In October 2000, Wah Chang was becoming increasingly concerned about rising electricity prices and again met with PacifiCorp to discuss ways to hedge this risk. Mr. Larson advised PacifiCorp that it still had not obtained a hedge, but that Duke Power was looking into hedging type options for the company. PacifiCorp urged Wah Chang to pursue hedging opportunities as soon as it could.[73]

Q. When did the issue of co-generation come up?

A. At the August 15, 2000 meeting, PacifiCorp urged Wah Chang to consider the co-generation option. At that time, PacifiCorp provided Wah Chang with a list of items to consider.[74] However, Wah Chang delayed the start of construction, and the generators that would have provided about two-thirds of Wah Chang's load

[71] *Id.* at 2:21-25.
[72] *Id.* at 3:6-11.
[73] *Id.* at 3:15-24.
[74] *Id.* at 4:3-7.

were not operational until the end of June 2001, just when, with hindsight, we know that the energy crisis began to abate and prices eased.[75]

Q. What was the effect of Wah Chang's decision to delay constructing the co-generation facility?

A. Mr. Griswold testified to the Commission that if Wah Chang had decided in August 2000 to install co-generation facilities, those generators would have been operational by January 2001 and Wah Chang would have saved about $3.52 million during the first three months of 2001.[76] Mr. Larson of Wah Chang testified that his estimate of Wah Chang's cost to co-generate was $55 per MWh,[77] which meant that the savings to Wah Chang would have been about one million dollars more than the amount Mr. Griswold estimated, or about $4.5 million.

Q. Why did Wah Chang delay installing the co-generation facilities?

A. Mr. Larson testified that Wah Chang thought electricity prices were going to come down. Therefore, Wah Chang decided to wait.[78] Wah Chang's forecasts eventually proved accurate during summer 2001. However, its timing was off and Wah Chang now has regrets for the higher prices it paid from September 2000 through June 2001.

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[75] *Id.* at 4:19-21.

[76] These estimates were based on a co-generation cost of about $100 per MWh, a three-month reduction in energy purchases of 22,000 MWh, using an average COB price of $260/MWh during the first three months of 2001. To achieve these savings, the cost to generate (22,000 X $100 = $2,200,000) would be subtracted from the cost of the COB power (22,000 MWh X $260/MWh = $5,720,000). Therefore, net savings would have been about $3.52 million. Exhibit PacifiCorp/2, Direct Testimony of Bruce Griswold at 4:23-26, 5:1-3.

[77] *See Wah Chang v. PacifiCorp,* Docket UM 1002, Hearing Transcript (hereinafter "TR.") at 45:11-16 (Larson) (Jun. 22, 1001).

[78] *Id.* at 43:11-15 (Larson).

Q. Earlier, you mentioned that Wah Chang had contacted Duke Energy to investigate hedges. Did Wah Chang ever engage Duke Energy for this purpose?

A. Not directly. Allegheny did engage Duke Energy to help manage energy at all of the parent's locations.[79] Allegheny also owned a company called Oremet. The Oremet plant, like Wah Chang, had contracted for electricity to be delivered. However, Allegheny made a corporate decision to shut down the Oremet plant. This meant that the electricity that had been purchased became an asset that could be sold into the market. Allegheny sold this electricity to Idaho Power and other utilities in the Pacific Northwest.[80] Consequently, Allegheny was able to take advantage of the high prices for electricity that prevailed at the time. The profit that Allegheny made at the corporate level by profitably selling electricity was, in effect, offset against the COB index price that Wah Chang was paying for its electricity supply. While not a hedge in the traditional sense of the term, this is a hedge at the parent company level.

Q. Did Duke Energy provide any advice to Wah Chang with respect to acquiring a hedge?

A. Yes. In October 2000, Duke Energy recommended that Wah Chang obtain a financial hedge. In fact, Mr. Larson testified that Wah Chang obtained an estimate from Enron for just such a hedge.[81] This occurred in November 2000.

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[79] *Id.* at 47:12-14 (Larson).
[80] Exhibit WC 400, Rebuttal Testimony of Eric Larson at 6:4-9.
[81] TR. at 48:3-5 (Larson).

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The information contained herein may be shown only to qualified persons as defined in the Order.

want to commit to a fixed purchase quantity. In essence, Wah Chang wanted PacifiCorp either to absorb the risk (even though Wah Chang had received the benefit of lower prices for the previous three years of the MESA), or assumed that PacifiCorp would bail out Wah Chang for its mistakes and delays. Wah Chang seems to have consistently ignored the advice it received from experts in energy markets and delayed taking action. These delays cost Wah Chang the ability to hedge the MESA and mitigate its potential costs. Wah Chang eventually made the moves that had been recommended, but made them a few months too late.

Section IX: Conclusions

Q. What are your conclusions?

A. Mr. McCullough swings a big stick at PacifiCorp, but he misses the mark. My conclusions are as follows:

- Market forces, anomalous climate, very high natural gas prices, and mismanagement combined to cause the very high electricity prices in the west.
- Others agree with these conclusions, and Mr. McCullough is a distinct outlier when it comes to assigning blame.
- COB prices were quite different statistically from CAISO prices, the primary market targeted for "gaming." Thus, alleged manipulation of the CAISO market is not relevant to the COB index price paid by Wah Chang under the MESA.
- So-called "gaming" most likely did not move prices higher in the primary California energy markets organized under the CPX.

- Mr. McCullough fails to recognize that PacifiCorp did not engage in the alleged games to manipulate the California market.
- Many of the alleged games were designed to capture congestion payments, not to increase the market prices in the organized California markets. These games would have little, if any effect, on the prices at the CPX or COB.
- PacifiCorp has been thoroughly investigated and found not to have done anything wrong or to have taken actions that caused prices to increase in California. In particular, FERC found the wash trades discussed by Mr. McCullough not to be wash trades at all.
- As a net buyer, PacifiCorp is a victim. PacifiCorp would not and did not gain from any market games in California that caused prices to increase.
- The CPX and COB market prices have some statistical similarities. None of the alleged games were intended to raise the CPX prices, which were similar to prices at COB. Many of the alleged games would have caused CPX prices to be lower, not higher.
- The market games that Mr. McCullough and others consider were intended to earn money at the fringes of these complex markets, often through deception. PacifiCorp played no role in such games and the resulting product prices were not statistically related to COB prices.
- Wah Chang failed to mitigate and to hedge. This was contrary to the advice it sought and received.
- Wah Chang's parent company did hedge and profit from the energy sales it made in the western energy markets during the crisis.

- Mr. McCullough would, in effect, reward Wah Chang for not hedging because he proposes retroactively returning Wah Chang to a tariff rate. This would be wrong and would impose unnecessary additional costs on other retail customers.

Q. Does this conclude your testimony?

A. Yes.

BEFORE THE PUBLIC UTILITY COMMISSION

OF OREGON

UM 1002

WAH CHANG,		)
		)
	Petitioner,	)
		)
v.		)
		)
PACIFICORP,		)
		)
	Respondent.	)

Exhibit 24 Accompanying Reply Testimony

Of

Charles J. Cicchetti, Ph.D.

Professional Experience

CHARLES J. CICCHETTI

PROFESSIONAL EXPERIENCE

1996-present	Co-Founder, Pacific Economics Group, Pasadena, Ca and Madison, WI.
2006-present	Professor of Economics and Finance, University of Southern California
1998-2006	Jeffrey J. Miller Professor in Government, Business, and the Economy, University of Southern California;
1990-1997	Adjunct Professor of Economics, University of Southern California;
1992-1996	Managing Director, Arthur Andersen Economic Consulting;
1991-1992	Co-Chairman, Putnam, Hayes & Bartlett, Inc.;
1988-1991	Managing Director, Putnam, Hayes & Bartlett, Inc.;
1987-1990	Deputy Director, Energy and Environmental Policy Center, John F. Kennedy School of Government, Harvard University;
1984-1987	Senior Vice President, National Economic Research Associates;
1980-1984	Co-Founder and Partner, Madison Consulting Group;
1979-1986	Professor of Economics and Environmental Studies, University of Wisconsin-Madison;
1977-1979	Chairman, Public Service Commission of Wisconsin, Appointed by Governor Patrick J. Lucey (member until 1980);
1975-1976	Director, Wisconsin Energy Office and Special Energy Counselor for Governor Patrick J. Lucey, State of Wisconsin;
1974-1979	Associate Professor, Economics and Environmental Studies, University of Wisconsin-Madison;
1972-1974	Visiting Associate Professor, Economics and Environmental Studies, University of Wisconsin-Madison;
1972	Associate Lecturer, School of Natural Resources of the University of Michigan;
1969-1972	Resources for the Future, Washington, D.C.;
1969	Ph.D., Economics, Rutgers University;
1968-1969	Instructor, Rutgers University;
1965	B.A., Economics, Colorado College;
1961-1964	Attended United States Air Force Academy.

EDITORIAL AND ADVISORY BOARDS

Journal of Environmental Economics and Management, Former Member
Energy Systems and Policy, Former Member;
Land Economics, Former Editor.

Faculty Advisor to Campus Republicans at USC, 2002 to 2005
Alliance for Energy Security; Former Member;
Association of Environmental and Resource Economics, Former Executive Committee, Former Member;
Association of Environmental and Resource Economics, Contributing Members Program Committee;
California ISO Market Advisory Group – appointed by Governor Gray Davis;
Center for Public Policy Advisory Committee, Former Member;
Department of Energy, Fuel Oil Marketing Advisory Committee, Former Member;
Graduate School of Public Policy at the University of California, Berkeley; Former Board Member;
Institute for the Study of Regulation;
National Association of Regulatory Utility Commissioners, Executive Committee and Chairman of the Ad Hoc Committee on the National Energy Act, Former Member;
New Century Land Renewals;
Public Interest Economics Center, Board of Directors, Former Member;
Rutgers University, Energy Research Advisory Board;
U.S. Chamber of Commerce Energy and Natural Resources Committee, Former Member.

PUBLICATIONS

Books and Monographs

Working Paper entitled "Natural Gas: the Other California Energy Crisis" with Colin M. Long, November 2006.

The California Electricity Crisis: What, Why, and What's Next, with Jeffrey A. Dubin and Colin M. Long, July 2004

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Restructuring Electricity Markets: A World Perspective Post-California and Enron, with Colin M. Long and Kristina M. Sepetys, May 2003.

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The Economic Theory of Enhanced Natural Gas Service to the Industrial Sector: An Applied Approach, Vol. I with L.D. Kirsch and R. Shaughnessy, for the Gas Research Institute, Contract No. 5080-380-0349, May, 1981.

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Alaskan Oil: Alternative Routes and Markets, for Resources for the Future, Baltimore: Johns Hopkins University Press, December 1972.

The Demand and Supply of Outdoor Recreation: An Econometric Analysis, Ph.D. Thesis: Rutgers University, 1969. Also, with J.J. Seneca and P.

PUBLICATIONS (Cont.)

Davidson, Washington, D.C.: U.S. Department of Interior, Bureau of Outdoor Recreation, Contract No. 7-14-07-4, 1969.

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BEFORE THE PUBLIC UTILITY COMMISSION

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WAH CHANG,	)
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Petitioner,	)
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Respondent.	)

Exhibit 25 Accompanying Reply Testimony

Of

Charles J. Cicchetti, Ph.D.

Publications

CHARLES J. CICCHETTI

PUBLICATIONS

Journal Articles

"A Brief History of Rate Base: Necessary Foundation of Regulatory Misfit" with Charles J. Cicchetti, Public Utility Fortnightly, July 2006.

"ISOs and Transcos: What's at Stake?" with Gary D. Bachman and Colin M. Long, The Electricity Journal, December 2000.

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Less Technical Articles

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"The Political Economy of the Energy Crisis," with R. Haveman in Carrol Business Review, Winter 1974.

"The Wrong Route," Environment, Volume 15, No. 5, June 1973.

"Benefit-Cost Analysis and Technologically Induced Relative Price Changes: The Case of Environmental Irreversibilities," with J.V. Krutilla, Natural Resources Journal, 1972.

"A Review of the Empirical Analyses that Have Been Based Upon the National Recreation Surveys," Journal of Leisure Research, Vol. 4, Spring 1972.

"How the War in Indochina is Being Paid for by the American Public: An Economic Comparison of the Periods Before and After Escalation," Public Forum, July 1970, (reprinted in the Congressional Record, August 13, 1970).

"User Response in Outdoor Recreation: A Reply," with J.J. Seneca, Journal of Leisure Research, Vol. 2, No. 2, Spring 1970.

"User Response in Outdoor Recreation: A Production Analysis," with J.J. Seneca, Journal of Leisure Research, Vol. 1, No. 3, Summer 1969.

Miscellaneous Articles

"Competitive Battlefield: A View from the Trenches," Northeast Utilities 1987 Annual Report, Competition: A Matter of Choices, 1987.

BEFORE THE PUBLIC UTILITY COMMISSION

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WAH CHANG,	)
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Petitioner,	)
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PACIFICORP,	)
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Respondent.	)

Exhibit 26 Accompanying Reply Testimony

Of

Charles J. Cicchetti, Ph.D.

Previous Testimony

CHARLES J. CICCHETTI, Ph.D.
Pacific Economics Group
Co-founding Member

Dr. Charles J. Cicchetti is a co-founding member of Pacific Economics Group and the Jeffrey J. Miller Professor of Government, Business, and the Economy at the University of Southern California. He is the former Managing Director of Arthur Andersen Economic Consulting and former Co-Chairman of Putnam, Hayes & Bartlett, Inc., and Deputy Director of the Energy and Environmental Policy Center at Harvard University's John F. Kennedy School of Government. He was co-founder of Madison Consulting Group, which merged with National Economic Research Associates, Inc. (NERA), where he served as Senior Vice President. Dr. Cicchetti chaired the Wisconsin Public Service Commission and directed the Wisconsin Energy Office. He has worked in developing nations throughout the world and has served on numerous federal international energy and environmental committees.

Dr. Cicchetti has testified before regulatory agencies in the U.S. and abroad on tariff design, rate of return, and organizational structure in the natural gas, electricity, water and telecommunications industries. He has prepared expert testimony for various federal proceedings on a variety of diverse topics. His work in environmental litigation includes experience in natural resource damage assessment and cost allocation under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and the Oil Pollution Act.

The author of numerous books and articles, Dr. Cicchetti's publications include Restructuring Electricity Markets: A World Perspective Post California and Enron, Restructuring Electricity Markets: A World Perspective, Alaskan Oil: Alternative Routes and Markets; Perspectives on Power, co-authored with Edward Berlin and William Gillen; The Marginal Cost and Pricing of Electricity: An Applied Approach, with William Gillen and Paul Smolensky; The Costs of Congestion: An Economic Analysis of Wilderness Recreation, with V. Kerry Smith; and Forecasting Recreation in the United States. He has edited Energy Systems Forecasting, Planning and Pricing, with W.K. Foell; and Studies in Electric Utility Regulation, with John Jurewitz.

Dr. Cicchetti received a B.A. from Colorado College and a Ph.D. from Rutgers University, both in economics. He did post-doctoral research at Resources for the Future, served as chief economist for the Environmental Defense Fund and was a professor of economics and environmental studies at the University of Wisconsin, Madison. He is currently teaching environmental and energy economics at the University of Southern California in Los Angeles.

March 2007

ADMINISTRATIVE AND CIVIL LITIGATION TESTIMONY SINCE 1980

Before the Superior Court of California County of Placer, Expert Report of Charles J. Cicchetti, Ph.D., In People of The State of California, ex rel. Edmund G. Brown, Jr., Attorney General of California, State Air Resources Board and The Placer County Air Pollution Control District v. Sierra Pacific Industries, Inc, No. SCV 17449, March 19, 2007.

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Before the Alberta Energy and Utility Board, Expert Testimony of Charles J. Cicchetti, Ph.D., In Support of The Direct Energy Regulated Services Default Rate Tariff and Regulated Rate Tariff Application in 2007 and 2008, December15, 2006.

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Before the Alberta Energy and Utility Board, Expert Testimony of Charles J. Cicchetti, Ph.D., In Support of The Enmax Energy Corporation Application for Approval of a Regulated Rate Tariff (RRT) to take effect July 1, 2006, Pursuant to Section 103 of the Electric Utilities Act and Section 23 of the Regulated Rate Option Regulation, April 4, 2006.

Before the Alberta Energy and Utility Board, Expert Testimony of Charles J. Cicchetti, Ph.D., In Support of The Direct Energy Regulated Services Application for Approval of a Regulated Rate Tariff (RRT) to take effect July 1, 2006, Pursuant to Section 103 of the Electric Utilities Act and Section 26 of the Regulated Rate Option Regulation, March 21, 2006.

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PROFESSIONAL EXPERIENCE

1996-present	Co-Founder, Pacific Economics Group, Pasadena, Ca and Madison, WI.
2006-present	Professor of Economics and Finance, University of Southern California
1998-2006	Jeffrey J. Miller Professor in Government, Business, and the Economy, University of Southern California;
1990-1997	Adjunct Professor of Economics, University of Southern California;
1992-1996	Managing Director, Arthur Andersen Economic Consulting;
1991-1992	Co-Chairman, Putnam, Hayes & Bartlett, Inc.;
1988-1991	Managing Director, Putnam, Hayes & Bartlett, Inc.;
1987-1990	Deputy Director, Energy and Environmental Policy Center, John F. Kennedy School of Government, Harvard University;
1984-1987	Senior Vice President, National Economic Research Associates;
1980-1984	Co-Founder and Partner, Madison Consulting Group;
1979-1986	Professor of Economics and Environmental Studies, University of Wisconsin-Madison;
1977-1979	Chairman, Public Service Commission of Wisconsin, Appointed by Governor Patrick J. Lucey (member until 1980);
1975-1976	Director, Wisconsin Energy Office and Special Energy Counselor for Governor Patrick J. Lucey, State of Wisconsin;
1974-1979	Associate Professor, Economics and Environmental Studies, University of Wisconsin-Madison;
1972-1974	Visiting Associate Professor, Economics and Environmental Studies, University of Wisconsin-Madison;
1972	Associate Lecturer, School of Natural Resources of the University of Michigan;
1969-1972	Resources for the Future, Washington, D.C.;
1969	Ph.D., Economics, Rutgers University;
1968-1969	Instructor, Rutgers University;
1965	B.A., Economics, Colorado College;
1961-1964	Attended United States Air Force Academy.

EDITORIAL AND ADVISORY BOARDS

Journal of Environmental Economics and Management, Former Member

Energy Systems and Policy, Former Member

Land Economics, Former Editor

Faculty Advisor to Campus Republicans at USC, 2002 to 2005

Alliance for Energy Security; Former Member

Association of Environmental and Resource Economics, Former Executive Committee, Former Member

Association of Environmental and Resource Economics, Contributing Members Program Committee

California ISO Market Advisory Group – appointed by Governor Gray Davis

Center for Public Policy Advisory Committee, Former Member

Department of Energy, Fuel Oil Marketing Advisory Committee, Former Member

Graduate School of Public Policy at the University of California, Berkeley; Former Board Member

Institute for the Study of Regulation

National Association of Regulatory Utility Commissioners, Executive Committee and Chairman of the Ad Hoc Committee on the National Energy Act, Former Member

New Century Land Renewals

Public Interest Economics Center, Board of Directors, Former Member

Rutgers University, Energy Research Advisory Board

U.S. Chamber of Commerce Energy and Natural Resources Committee, Former Member

BEFORE THE PUBLIC UTILITY COMMISSION

OF OREGON

UM 1002

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Exhibit 27 Accompanying Reply Testimony

Of

Charles J. Cicchetti, Ph.D.

Description of the Dow Jones COB Index

Description of the Dow Jones COB Index[1]

The Dow Jones California/Oregon Border Electricity Price Indexes are volume weighted averages of specifically-defined bilateral, wholesale, physical transactions quoted in either dollars per megawatthour ($/MWH) or dollars per megawatt ($/MW). Calculations for these indexes average together power transactions from the California/Oregon border (COB).

Index participants provide Dow Jones with their itemized bilateral transactions and volume for eligible electricity products sold at COB. Participants are asked to provide Dow Jones with daily index data by 10 a.m. Pacific time on the power flow date. Although some Dow Jones Electricity Indexes are calculated for 365 days year, publication occurs only on business days. If a holiday falls during the week, data should be transmitted to Dow Jones on the first business day following a break.

INDEX CATEGORIES

DAILY

Firm On-peak

Firm Off-peak

Non-firm On-peak

Non-firm Off-peak

Daily Indexes: The firm daily indexes average together blocks of power sold on a one-day forward pre-scheduled basis. No real-time power is included in these indexes. Transactions are limited to power traded in 16-hour blocks during on-peak hours and 8-hour blocks for off-peak. Transactions which call for delivery for more than one day are not included in calculations for these indexes except for the standard multi-day trading that occurs on Thursdays and Fridays and NERC holidays. Multi-day trading that occurs as a result of schedulers' conferences or month end trading is also included. Trading must follow the standard WSPP trading schedule. Volume is reported as total megawatts (MW) transacted per hour.

Non-firm Daily Indexes: The non-firm indexes combine one day ahead pre-scheduled transactions with real-time transactions. The non-firm indexes follow the same convention as the firm indexes with respect to single day delivery. Volume should reflect the total number of MWh transacted for the entire ON- or OFF-PEAK reporting period.

Revisions: Participants are encouraged to report any errors or revisions to submitted data promptly. Please note the revision and the reasons the revision are made.

Confidential Disclosure Agreement: A confidential disclosure agreement with an audit provision must be signed by both parties before a participants data can be used for the calculation of this index.

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[1] The Dow Jones website is located at http://www.djindexes.com/mdsidx/?event=energyUSDaily.

Terminology

On-peak Hours: Hours ending 0700 to 2200 (6 a.m. - 10 p.m.) Pacific time, Monday through Saturday, except NERC holidays.

Off-peak Hours: Hours ending 0100 - 0600 (12:00 midnight through 6:00 a.m.) and hours ending 2300 - 2400 (10:00 p.m. through 12:00 midnight) Pacific time, Monday through Saturday except NERC holidays, hours ending 0100 - 2400 (12:00 midnight to 12:00 midnight).

Firm Energy: Firm energy is defined as being financially firm and backed with liquidating damages. Firm energy for the COB indexes may also be defined as physically firm, meaning energy which meets the requirements of the Western Systems Power Pool Schedule C.

Non-firm Energy: Non-firm energy is defined as being subject to interruption at any time for any reason. Any recall provision would be for less than one hour from the scheduled start of service.

NOTE: Power conforming to any other measures of "firmness" should not be included the COB indexes.

Index Dates

Daily Indexes: INDEX DATE = POWER DELIVERY DATE

The date on a daily index corresponds to the date the power is delivered. For example, prescheduled power transacted on Monday for delivery on Tuesday is averaged to form Tuesday's index. For indexes that include real-time power, Monday's prescheduled transactions are combined with Tuesday's real-time transactions to form Tuesday's index.

The COB firm daily indexes are calculated Monday through Saturday, excluding NERC holidays for the on-peak. The off-peak indexes are calculated for 7 days and NERC holidays.

The COB non-firm on-peak index is calculated Monday through Saturday, excluding NERC holidays

The COB non-firm off-peak index is calculated seven days a week including NERC holidays.

Calculating the Indexes

All indexes are volume weighted averages of bilateral, wholesale transactions which take place at defined delivery points.

$$\text{Index} = \frac{\text{SUM (Average Contributor Price x Total Volume per Contributor)}}{\text{SUM (Total Volume per Contributor)}}$$

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Exhibit 28 Accompanying Reply Testimony

Of

Charles J. Cicchetti, Ph.D.

Normal Northwest River Flows and

Desert Southwest Temperature Patterns

NORMAL NORTHWEST RIVER FLOWS

AND

DESERT SOUTHWEST TEMPERATURE PATTERNS

This analysis tests the hypothesis that: River Flows in the Pacific Northwest and Temperatures in the Desert Southwest are positively correlated. This would mean that when droughts are present, temperature would likely be cooler; and when hydro capacity increases, temperatures would likely be warmer. Such a relationship would bring synergy to the west because electric generating capability would move up and down with the expected weather demands in the region.

The data used to test this hypothesis are monthly National Oceanic Atmospheric and Administration (NOAA) temperature data from 1931 through 2001. The temperature data reflect the monthly temperatures from all the official measuring stations in Arizona and New Mexico. For the mean and max temperatures in the analysis, we take the average values for the two states.

The River Flow monthly data comes from the Middle Columbia River. This data is reported in cubic feet per second, which we convert to cubic meters per second in the regression. The U.S. Geological Survey (USGS) reports this data for the corresponding months:

	Mean Temperature (.01 Degrees F	Max Temperature (.01 Degrees F)
Constant	394.76 (122.0)	535.64 (127.6)
M-Columbia River Flow	1608.49 (3.82)	1720.07 (3.15)
Period 1 (31-40)	-5.595 (-2.58)	-1.206[1] (-.43)
Period 2 (41-75)	-8.920 (-5.12)	-2.873[2] (-1.27)
January	-13.053 (-3.45)	-14.252 (-2.90)
February	26.847 (7.08)	31.149 (6.34)
March	80.300 (21.12)	92.597 (18.77)
April	154.985 (39.89)	177.727 (35.27)
May	233.400 (53.24)	259.802 (45.69)
June	319.264 (66.74)	349.609 (56.35)
July	370.927 (92.79)	380.143 (73.32)
August	356.770 (94.16)	359.735 (73.21)
September	299.506 (78.99)	311.690 (63.38)
October	193.945 (51.10)	212.108 (43.09)
November	73.209 (19.32)	84.395 (17.18)
Number	852	852
R^2	.97407	.95989
DW	1.59	1.51
Mean	572.789	730.133
[1] Not Significant		
[2] Marginally Significant		

Additional tests were performed using monthly data from 1905 to 2002. This yielded similar statistical conclusions and results. However, NOAA told us that the Arizona data was suspect before 1931. The regression results "explain" more than 97 percent of the monthly variation in mean temperatures and about 96 percent of the monthly variation in max temperatures. The River Flow variable is positively related to temperature with more than 99.9 percent reliability in both equations.

Chats A-1 and A-2 show the annual movements in Max Flow, Mean Flow, and Max Temperature. Most years, River Flow and Temperatures move together, either up or down. In 2000 – 2001, the gap is great: Temperatures are up, while River Flow is down. This unusual circumstance would not have been expected. Its occurrence is one of the major contributing factors to the western energy crisis.

Chart A-1
1931-2004
Mxtemp v. Mxflow

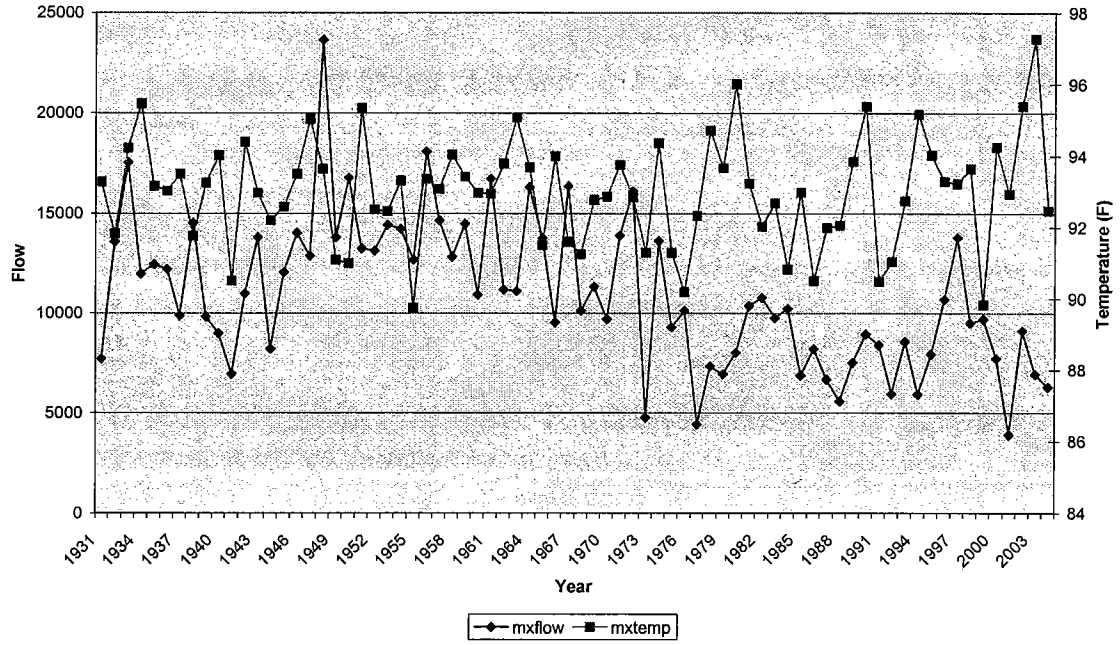

Chart A-2
1931-2004
Meflow v. Mxtemp

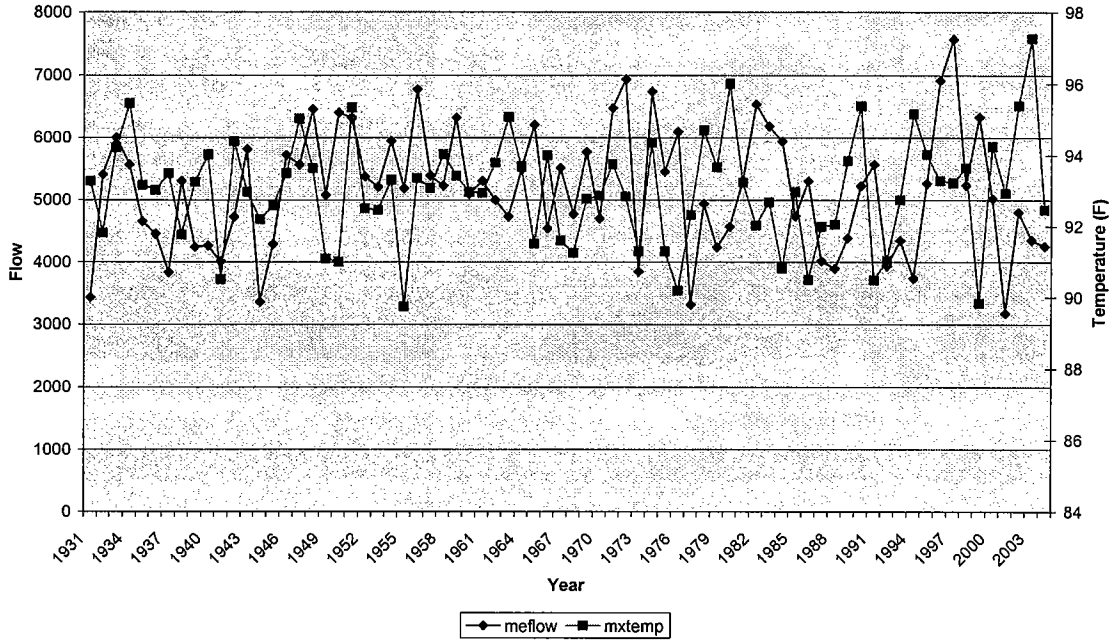

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Exhibit 29 Accompanying Reply Testimony

Of

Charles J. Cicchetti, Ph.D.

Summary of Findings From Studies

SUMMARY OF FINDINGS FROM STUDIES

The nine published studies reviewed by Dr. Cicchetti are:

- Borenstein, S., J. Bushnell, and F. Wolak, 2002. "Measuring Market Inefficiencies in California's Restructured Wholesale Electric Market." *American Economic Review* 92 (5): 1376-1405.
- Borenstein, S., J. Bushnell, C.R. Knittel, and C. Wolfram, 2004. "Inefficiencies and Market Power in Financial Arbitrage: A Study of California's Electricity Markets." Center for the Study of Energy markets. Paper CESM WP-138. University of California, Berkeley.
- Fox-Penner, Peter S, 2001. "The California Crisis and the its Lessons for the EU." The Brattle Group, Special Edition.
- Harvey, S. and W. Hogan, 2001. "Identifying the Exercise of Market Power in California" Center for Business and Government, John F. Kennedy School of Government, Harvard University.
- Harvey, S. and W. Hogan, 2002. "Market Power and Market Simulations" Center for Business and Government, John F. Kennedy School of Government, Harvard University.
- Joskow, P. and E. Kahn, 2002. "A Quantitative Analysis of Pricing Behavior in California's Wholesale Electricity Market During Summer 2000." *Energy Journal* 23 (4): 1-35.
- Pope, S.L., 2001. "California Electricity Price Spike: An Update on the Facts." Report available at http://www.lecg.com/website/home.nsf/OpenPage/Energy-ResearchPapersTestimony.
- Reiss, P.C. and M.W.White, 2003. "Demand and Pricing in Electricity Markets: Evidence from San Diego During California's Energy Crisis." NBER Working Paper No. 9986.
- Sweeney, J.L., 2002. *The California Electricity Crisis.* Hoover Institution Press: Stanford University.

Borenstein, Bushnell, and Wolak Study (2002)

This paper focuses on Summer 2000 relative to the first two years (1998 and 1999) of the restructured energy markets. The paper makes several assumptions and utilizes various methods to separate the initial increase in wholesale California prices into three categories: (1) production costs (input prices); (2) competitive rents (shortages in supply relative to demand); and (3) market power. Professors Borenstein, *et al* found that while

each of their three categories contributed, market power had the largest relative effect on Summer 2000 prices. They also explain that design flaws, bad judgment, and confusion may be reflected in the assessment of the "market power" category.

The COB index pricing used in the PacifiCorp/Wah Chang MESA is not effective until September 2000, and so occurs mostly after the summer of 2000 period that Professors Borenstein, *et al* analyzed in this paper.

Borenstein, Bushnell, Knittel and Wolfram Study (December 2004)

Professors Borenstein, Bushnell, Knittel and Wolfram (December 2004) reported that Pacific Gas & Electric reduced the fraction of its load purchased in the CPX markets from "about 80 percent in January-April 2000 to about 50 percent in August through November 2000."[1] By shifting load to the CAISO, the IOUs would reduce the price paid in the CPX market. The IOUs hoped that the weighted average of the lower CPX price and higher CAISO price would be lower than they might pay if they had bid their entire load into the CPX market according to their retail customer requirements. This condition is important in deciding which entities caused the shift to out-of-market sales and any resulting gaming.

Borenstein, *et al* and our State Audit Report suggest that sellers did not ignore these shifts and, in some cases, responded by shifting their supplies between the CPX and CAISO to counter the IOUs' purchase-driven gaming strategies. In some cases, these resources were shifted to Real Time bids. This was also known as the Fat Boy strategy. In other cases, strategies involving MWh laundering (also known as Ricochet) or shifting

[1] Borenstein, et al., page 34.

resources out of state in order to sell them into the CAISO's out-of-market (OOM) were uncovered.

Fox-Penner and the Brattle Group Study (2001)

In June 2001, the Brattle Group prepared an in depth analysis of what was then known to have contributed to the California energy crisis. They found the following causes:

- No new power plants constructed in a decade.
- Significant economic growth and unusually hot weather caused total demand to increase in 2000.
- Reduced hydropower due to insufficient rain and snowfall.
- Insufficient transmission capacity across "Path 15" connecting northern and southern California.
- Most generating stations were older and required more down time for maintenance.
- High natural gas prices and particularly tight supplies in southern California.
- No strong incentives for consumers to conserve or shift use.
- California's price increases appear to have been exacerbated by generator market power.

The first seven of these factors are consistent with the causal factors I found in our State Audit Report. The last causal factor is deficient, in part, because the Brattle Group failed to consider the market power of two buyers (SCE and PG&E) and the IOU under-scheduling of load.

Harvey and Hogan Studies (2001, 2002)

Dr. Harvey and Professor Hogan analyzed a more specific matter related to the presence and exercise of market power in two papers (2001 and 2002) I reviewed for this proceeding. On the question of the "existence" or "absence" of market power, the authors claimed that neither can be demonstrated and sensitivity analyses often yielded "errors as

large as the effect that was estimated."[2] They do, however, conclude with no ambiguity that there were fundamentally flawed market design features present in the California markets.

More fundamentally, Professor Harvey and Dr. Hogan understand that market power is about withholding supply to drive up market clearing prices. Economists recognize that such monopoly power or illegal collusion would use supply withholding to cause the entire market price to increase.

Two observations are important. First, so-called market manipulation is different from market or monopoly power. Market manipulation is often done for the purpose of isolated, specific transactions. It often occurs below the radar, and is not intended to cause full market price movement. Second, Dr. Hogan and Professor Harvey are engaged in a series of back and forth papers with Professor Paul Joskow and Dr. Edward Kahn. Both teams are well respected. One works for Mirant, a generator. The other team works for SCE. They both deal with allegations related to economic withholding.

I tend to side with Hogan and Harvey. Regardless, neither side claims to know the answers to the numerous questions each raises concerning withholding. Here, I recommend referring to FERC's conclusions. The academic research (see the 2001 and 2002 papers) agrees that more analyses of company-specific bidding data, which has mostly been found to proprietary, is needed in order to attempt to gain better insight into any patterns of withholding that may have been intended to or did actually move the market.

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[2] Hogan and Harvey (2001) at page iii.

I often have observed that in contested commodity markets with multiple sellers, any withholding seller that moves the market price pays the firm level price of not making a sale. In other words, the cost of withholding a unit is losing the price that sales from that unit would have garnered. Accordingly, it is difficult to hide the collusive system that would likely be necessary to enable sellers to be compensated from any withholding. Furthermore, when I have personally analyzed allegations of firm level withholding, I always found that innocent actions and data errors explained virtually all such transactions.

Joskow and Kahn Study (2002)

As did Dr. Eric Hildebrandt (2001), Joskow and Kahn base their analyses on what they construct as short-run marginal cost mark-ups. A weakness in these approaches is that they do not detect whether any subsequent "mark-ups" in corresponding prices above short-run marginal costs are due to market power (such as withholding) or legitimate economic rents because demand exceeded legitimately available supply. Nonetheless, FERC adopted the so-called mitigated market clearing price (MMCP) as the conceptual basis for granting refunds predicated on just such an approach.

A second weakness in this study is its narrow focus on just one month (July 2000). That said, the authors did an extensive analysis of publicly available data and also explained the limitations for research and policy analyses inherent in the publicly available data because detailed transaction level bids were effectively masked.

Pope Study (2002)

Dr. Pope was affiliated with the same consulting firm as Dr. Hogan and Professor Harvey. In her 2002 report, Dr. Pope found the same types of mutually contributing factors as we reported in the State Audit Report and our textbook. She stated:

- "Electricity prices were high in the West during 2000 and 2001 at least in part because of a shift in the demand/supply balance, leading to a supply shortage more extreme than in any year in recent history, including the drought year of 1994.
- In all but two months between January 2000 and June 2001, electricity consumption was higher than in the same month of any prior year (1993-1999).
- Decreased hydroelectric generation was a significant factor in the supply shortage. The data clearly show that this decline began in June 2000, when hydro generation was almost 20 percent lower than in prior years (1995-1999).
- There was a large decline in the output of nuclear plants, particularly in the period from January 2001 through May 2001 when the 1,080 MW San Onofre Nuclear Generating Station Unit 3 was out of service.
- The overall supply shortage was dramatic and sustained. From May 2000 to June 2001, the electricity demand that had to be met month after month by generating resources other than hydro, coal and nuclear plants was typically 3,000 GWh more than in prior years (1003-1999) and rose to a high of 8,784 GWh (60 percent) in May 2001. This sustained shortfall in hydro, coal and nuclear electricity supply was predominantly met by running existing gas-fired generators at *much* higher levels than in the past. In May 2001 alone, the 7,684 GWh shortfall in hydro, nuclear and coal output amounted to a need to operate the equivalent of 48 more 250 MW gas-fired units (at full capacity) than would been required to meet electricity demand in previous years.
- The data confirm that the electricity output and hours on-line of gas and oil-fired generators, including those owned by non-utility generators, were significantly higher from May 2000 to June 2001 that they had been in any previous year (1994-1999). From January 2001 through May 2001, for example, the output of non-utility generating units was 57 percent higher than during January-May of the drought year of 1994.
- As the supply shortage led to dramatically increased demand for gas-fired generation, electricity prices rose through a combination of dramatically higher gas prices, higher prices for NO_X emission allowances (required for some gas-fired generation) and the inevitable use of less efficient gas-fired generating plants."

Reiss and White Study (2003)

Professors Reiss and White focus primarily on San Diego, which did not initially have frozen retail prices because SDG&E had fully recovered its transition and stranded costs. As a result, retail prices in San Diego could move with the market. While the other IOU service territories (SCE and PG&E) were limited to public awareness campaigns and requests to conserve, SDG&E customers paid sharply higher prices.

Reiss and White found a 12 to 13 percent reduction in residential electricity in San Diego, which they report was "a non-trivial behavioral change for most households."[3] They also compare this drop to the average residential air conditioning use in San Diego, which is about 15 percent of total use.

With respect to what caused the crisis, Professors Reiss and White refer the reader to others such as Borenstein (2002), Borenstein, Bushnell and Wolak (2002), Joskow and Kahn (2002), and Wolak (2003). They conclude in footnote 5 at page 5 that:

> "The causes and consequences of the wholesale price run-up are many, including increases in production costs (natural gas and air permits, chiefly), flaws in California's wholesale market design, and the behavior of suppliers."

I concur with these explanations and would add two more. First, large in-state IOU energy purchasers, such as SCE and PG&E, purposely under-scheduled their CPX purchases (load) in order to reduce their weighted average price of electricity. Second, there were several regulatory and governance missteps and mistakes that exacerbated the problems in California. In particular, since retail consumers continued to consume

[3] Reiss and White page 21.

relatively inexpensive power, the CAISO's "must-buy-at-any-price" policy meant that financial ruin was inevitable.

Sweeney Study (2002)

Professor Sweeney has written a very significant and rather full exposition of the facts leading up to the crisis, the actual causes of the crisis, the corresponding effect of political and regulatory errors, as well as the "blunders mode" that he says turned the "crisis to blight."[4]

Professor Sweeney begins his assessment of the reasons for higher electricity prices in his book by examining demand and supply conditions in 2000 in California. Among his more relevant finds, he observes:

- California is a net importer of power from surrounding states, and in 2000, these imports fell significantly.
- Lower hydroelectric flows reduced imports from the Pacific Northwest.
- Hotter weather reduced the availability of imports into California from the Southwest.
- Growth in demand in the late 1990s exceeded forecasts.
- While output in 2000 from the divested generation exceeded all prior years, it was insufficient to close the supply gap.
- While new construction was underway in California, it mostly did not come into service in 2000.
- Natural gas prices surged in 2000, causing higher electricity prices in California.
- The price of NO_X emission credits also surged, causing higher electricity prices.
- The market design may have contributed to both buyer and seller strategies to shift their bids to different markets and to bid units strategically.

[4] Sweeney, Chapter 5.

- Prohibiting long-term purchase contracts made things worse and compounded the adverse effect of these various market forces.
- Fixed retail price caps made the crisis worse.
- The state's purchases of very long-term contracts at the height of the crisis made the bad results much worse, turning crisis to blight.

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Exhibit 30 Accompanying Reply Testimony

Of

Charles J. Cicchetti, Ph.D.

Description of Enron Schemes

DESCRIPTION OF ENRON SCHEMES

Load Shift

Load Shift occurred when market participants submitted multiple bids in advance of a market's close; and, based upon updated information (*e.g.*, emergency warnings, weather conditions, etc.) would later alter their bids. The tariffs in California were initially designed to encourage this form of arbitrage behavior because this is how all commodity markets work and such arbitrage and hedging activities are essential for markets to be efficient.

The electricity crisis in California began in May 2000. Soon there were price cap changes and difference in energy prices in the CPX and CAISO markets. For example, the CPX price cap was, at times, ten times greater than the CAISO's market cap. Buyers, primarily investor-owned utilities in California, could protect themselves by under-scheduling in the CPX market, which had a significantly higher $2,500 per MWh price cap, and by shifting purchases to the CAISO's market, which had a $250 per MWh price cap. The same retail load serving buyers could also expect to benefit if CPX prices fell relative to more expensive real time CAISO prices. The resulting shift of MWh purchases to the CAISO real time market was completely unanticipated. This load shift to CAISO real time and out-of-market (OOM) continued until the FERC imposed full regional western state market participation requirements and bidding rules that eventually led to regional price caps.

FERC Staff's Description.[1] FERC Staff described Load Shift as a strategy where a company submits a phony load schedule to receive inter-zonal payments.[2] FERC Staff stated that the strategy involved deliberately creating congestion on a transmission line to increase the value of a company's Firm Transmission Rights (FTRs).[3] The appearance of congestion is created by deliberately over-scheduling in one zone (*i.e.*, the Southern Zone) and under-scheduling by a corresponding amount in another zone (*i.e.*, the Northern Zone).[4] This practice potentially increased congestion prices and benefited those companies that possessed FTRs on the paths that became "congested." This type of Load Shift was intended to increase transmission and reliability income, not to increase the market price of electricity. FERC Staff specifically found that Enron was generally ***not*** able to move the cost of congestion because SCE and PG&E often set the price for congestion relief over a large band of load used for congestion relief.[5] Enron was, however, able to profit by receiving congestion payments by artificially increasing congestion, even thought it generally was unable to move the price paid.[6]

CAISO's Description.[7] The CAISO describes Load Shift in much the same way that FERC Staff did. The CAISO stated that this strategy required that a company have FTRs

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[1] All references to "FERC Staff's Description" are from *FERC Staff Initial Report on Company Specific Separate Proceedings and Generic Evaluations, Published Natural Gas Price Data, and Enron Trading Strategies,* Docket No PA02-2-000 (Aug. 13, 2002) ("FERC Staff Report"). This document is publicly available on FERC's eLibrary website.
[2] FERC Staff Report at p. 84.
[3] *Id.* at p. 85.
[4] *Id.*
[5] *Id.* at pp. 83-84.
[6] *Id.* at p. 84.
[7] All references to "CAISO's Description" are from *Analysis of Trading and Scheduling Strategies Described in the Enron Memos*, California ISO Department of Market Analysis (Oct. 4, 2002) ("CAISO DMA Analysis"). This document can be located at the following website address:
http://www.ksg.harvard.edu/hepg/Papers/CAISO_enron.trading.analysis_10-4-02.pdf

connecting CAISO zones.[8] The FTR owner would create congestion by falsely scheduling loads in different zones.[9] The FTR owner would then be paid to relieve the congestion and collects additional congestion revenues for FTRs it did not use to schedule its own load/generation.[10]

Export of California Power

FERC Staff's Description. FERC Staff described this strategy as buying energy at the CPX to export outside of California to take advantage of the price spread between the price-capped California market and the uncapped markets outside of California.[11] FERC Staff explained that "while it may be true that any individual company may have acted in an economically rational manner by exporting its power to a market with higher prices, collectively the large amount of exports contributed to the scarcity in California during 2000-2001."[12] FERC Staff concluded that the export trading strategy was "largely the result of asymmetrical market rules within which products were sold where they brought the highest price."[13]

CAISO's Description. CAISO stated that its analysis showed that high prices in the California wholesale markets tended to drive high prices in nearby regional markets, rather than being driven by prices in those regional markets.[14] The CAISO observed that export of power from one control area to another is always a concern when supplies are

[8] CAISO DMA Analysis at p. 13.
[9] *Id.*
[10] *Id.*
[11] FERC Staff Report at p. 88.
[12] *Id.* at p. 90.
[13] *Id.* at p. 92.
[14] CAISO DMA Analysis at p. 5.

tight and price caps in one area are lower than in the surrounding area.[15] This led to a second related trading strategy, sometimes called Ricochet or MWh Laundering.

Ricochet

This strategy took advantage of a 2000 CAISO tariff provision that "capped" the price of electricity sold by "market participants" in California to the CAISO. Also, recall that the CPX market cap was ten times greater than the CAISO market cap in early 2000. California entities such as municipally-owned utilities (*e.g.,* LADWP and SMUD) and many out-of-state generators were exempt from the CAISO's price cap. Under "Ricochet" or Megawatt Hour Laundering (some called it leakage), entities that were subject to the price cap for energy that they sold directly to the CAISO could sell the energy to exempt entities at prices above the CAISO price cap. These exempt entities could then sell that same energy to the CAISO unfettered by the CAISO's price cap. When the strategy worked, energy was sold at prices above the CAISO cap. When the strategy failed, energy would still be sold to the CAISO, but prices would be below the price cap. Either way, energy was generally available. The purpose of the strategy was to avoid the CAISO price cap.

Enron's strategy was to find exempt entities and engage in a series of such trades to avoid California's narrow price cap

FERC Staff's Description. FERC Staff described this strategy as one entity, typically a trading entity rather than a load-serving entity, buying energy from the CPX in the day-ahead market and exporting it to a second entity.[16] The second entity would receive a fee

[15] *Id.*
[16] FERC Staff Report at p. 92.

or margin from the first company when the second company resold the energy to the CAISO in the real-time market outside the cap, or as an OOM sale.[17] There was, however, one important consideration: the OOM purchases were paid their bid price, but did ***not*** affect the market clearing price for energy. FERC Staff found that entities routinely engaged in arbitrage where they try to capture profits from price differences that exist between different time periods, such as purchasing day ahead and selling in real time.[18] The practice was not prohibited. However, until June 2001, such trades made California pay more for MWhs.

CAISO's Description. The CAISO narrowly defined this strategy as exporting power from the CPX to another entity for a fee in order to resell the same energy back into the CAISO's real time market.[19] The CAISO noted several variations to this strategy. One such variation was the export of power from the CPX for resale into the CAISO's Real Time market by the same entity without reselling and repurchasing the energy.[20] Thus, a scheduling coordinator (SC) would export the power to its portfolio of resources in another control area and then resell power back to California from the same portfolio. In a second strategy, an SC would export power from its own resource portfolio within the CAISO system for resale into the CAISO's Real Time market.[21] A third variation included strategies designed (1) to circumvent the $250 hard price cap in late 2000; (2) to

[17] *Id.*
[18] *Id.* at pp. 93-94.
[19] CAISO DMA Analysis at p. 28.
[20] *Id.* at pp. 28-29.
[21] *Id.*

avoid cost reporting and refund obligations for sales to the CAISO under the $250/$150 soft cap; and (3) to reduce credit risk by engaging creditworthy entities in the trades.[22]

Fat Boy

The gaming strategy known as Fat Boy was also known as "inc-ing" load. Under the FERC-approved tariffs and market rules, SCs were required to submit balanced supply and demand schedules to the CPX. The behavior described as "Fat Boy" in the Yoder-Hall memo circumvented this requirement. This strategy involved artificially increasing ("inc-ing") load (demand) on the balanced schedule submitted. Since the entire demand did not exist, sellers would not actually be called upon in the CPX to supply energy to the CAISO's real-time or imbalance energy market. The name implies sellers exaggerating load; however, the major electricity buyers, the utilities in California, adopted a strategy to reduce their average prices by under-scheduling purchases in the day-ahead market and making up the difference in the CAISO real-time market.

The three key points about "Fat Boy" are as follows:

- First, the essence of "Fat Boy" – buying low and selling high – is not an original or novel concept.
- Second, the CAISO was well aware of the potential for market participants both to over-schedule load and others, such as IOUs, to under-schedule load.
- Third, and perhaps most important, market developments in California in late 2000 caused the "inc-ing" game, buyer underscheduling in the CPX day-ahead market, to reach unimaginable levels in which the CAISO was supplying about one-fourth of the load in real time. See Chart 2 and Table 2 in Section III of the

[22] *Id.*

> testimony, Exhibit PacifiCorp/23. When the CAISO was designed and launched in 1998, the CAISO's real-time markets were expected, at most, to supply about 3 percent of California's overall electricity market. In late 2000, the CAISO's real-time market grew by more than ten-fold, and in December 2000, the CAISO's real-time market supplied about 30 percent of the electricity demand in California due to California IOUs under-scheduling their load in day-ahead markets.

When this happened, this strategy was discovered and the various market monitors informed their respective boards of directors. California had representative boards that were neither truly independent nor represented specific market interests. The boards managed the CPX and CAISO, but failed to remedy the obvious problems caused by shifting load to the CAISO real-time market. Regulators also failed, until much too late, to close this design flaw by changing the bidding rules.

FERC Staff's Description. FERC Staff describes this Fat Boy strategy as an SC artificially increasing (*i.e.,* "inc-ing") load on the schedule it submitted to the CAISO for the amount of generation of its schedule, which were required to be balanced (*i.e.,* load and generation had to be equal) in each market.[23] The sellers would dispatch MWhs for the amount of generation in the CPX's inflated schedule. Since its actual load was less, the resulting excess generation would be automatically sold to the CAISO to keep the network in balance. The CAISO would then pay the sellers the clearing price established in the real time market. FERC Staff also found that this seller's trading strategy was developed to respond to the opposite underscheduling-of-load-in-the-CPX market under the procurement strategy the California IOUs adopted to reduce the market clearing

[23] FERC Staff Report at p. 94.

prices they paid.[24] Thus, the IOUs would try to buy energy in the CPX market at prices below the CAISO's capped real-time market prices. FERC Staff stated that PG&E's strategy was "a deliberate attempt to push the Cal PX price below the capped price in the Cal ISO real-time market."[25]

CAISO's Description. The CAISO described this strategy as a form of uninstructed deviation, also known as over-scheduling load.[26] The CAISO stated that this strategy allowed suppliers to receive the real time market price as price takers for the power they provide without a CAISO dispatch instruction.[27] Thus, generators effectively used "inc-ing" to create a CAISO purchase requirement in real time. Sellers could schedule imported generation against a "fictitious" load, which created a positive uninstructed deviation in real time. Sellers would receive the real-time market clearing price for the excess generation. Sellers faced a "minimal" risk that they would receive a zero price for the uninstructed energy that they supplied. The CAISO has specifically disputed Mr. McCullough's argument that this strategy could be used to "hide" generation from the CAISO and cause the CASIO to declare a system emergency or curtail load.[28] The CAISO argued that Mr. McCullough was wrong because the CASIO managed real time energy needs and declared system emergencies based on the actual observed loads and the amount supplied in real time.[29] As explained above, the sellers' risk was supplying at times when real time prices were zero. This was not a case of withholding MWhs. It was a game of attempting to benefit from more favorable prices in different markets.

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[24] *Id.* at pp. 95-96.
[25] *Id.* at p. 95.
[26] CAISO DMA Analysis at p. 2.
[27] *Id.*
[28] *Id.* at p. 4.
[29] *Id.*

Death Star

The Death Star strategy involved market participants submitting bids to sell energy and bids to relieve congestion. This could happen when sellers bid to sell against the primary direction of energy flow or submit bids to reduce demand in the primary direction of energy flows. The rules and prices for congestion relief were complex. Traders could play by the rules and win by doing nothing. This approach for congestion relief was a bad market design. Worse, the CAISO had been pre-warned and failed to act until Enron made a rather outlandish trade of this sort (Silver Peak). To its credit, the CAISO then fixed this flaw in its transmission tariff. There were various permutations on this basic strategy to manipulate payments for what were falsified types of transmission congestion. The Yoder-Hall memo used colorful names (*e.g.* Forney's Perpetual Loop, Black Widow, Red Congo, Cong Catcher, and Big Foot) to describe these Death Star-related transmission flow and congestion relief payment strategies.

FERC Staff's Description. FERC Staff described Death Star as a trading schedule designed to capture payments for relieving transmission congestion by "fooling" the CAISO's computerized congestion management program, where a company would schedule energy in the opposite direction of congestion (counter-flow), but no energy would actually be put onto or taken off the grid.[30]

CAISO's Description. The CAISO called these strategies circular schedules, which it defined as a series of two or more export and import schedules that begin and end in the same control area.[31] These do not result in the physical flow of energy, but may reduce

[30] FERC Staff Report at p. 96.
[31] CAISO DMA Analysis at p. 8.

congestion charges in the Day Ahead and Hour Ahead market.[32] This would happen when they caused the CAISO's "congestion management model to 'divert' energy scheduled by other SCs over the congested path over the transmission lines outside the ISO system over which the circular schedule is made."[33]

Wheel Out

The Wheel out strategy was based on the value inherent in information related to transmission line outages. This is akin to suggesting that there is value in weather service forecasts for "orange juice" futures. There is nothing inherently sinister in valuing information. Enron and others invested in gathering information, which was neither sinister nor illegal.

FERC Staff's Description. FERC Staff described the Wheel Out strategy as attempting to capture payments for relieving transmission congestion by "fooling" the CAISO's computerized congestion management program.[34] This would not have been permitted. This would happen when a party knew that an inter-tie was completely constrained (*i.e.*, available capacity is zero) or out of service, and the party scheduled transmission over that line to secure payments when "relieving" the additional congestion. This strategy would result in payments when the CAISO reduced the seller's scheduled delivery, even though the seller did not actually send any energy over the unavailable inter-tie. The CAISO described this Wheel Out strategy occurring when the SC submitted transmission schedules and adjustment bids across an inter-tie that had been de-rated to zero capacity

[32] *Id.*
[33] *Id.*
[34] FERC Staff Report at p. 96.

in order to be paid for providing a counter-flow schedule that the CAISO, on paper, reduced in real time.[35] This was a complete subterfuge.

Counter-Flow

CAISO's Description. The CAISO identified these strategies as opportunities for an SC to earn congestion revenues for counterflow schedules in the Day-Ahead and Hour-Ahead markets and then cancel those schedules prior to real time.[36] This practice was eliminated under the MMIP on July 21, 2002, and does not appear to have happened since that time. The CAISO analysis showed that the counter flow revenues from cutting CPX-based delivery schedules in real time for the period January 2000 through June 2002 were about $2.7 million.[37]

Non-Firm Exports

FERC Staff's Description. FERC Staff again described this trading strategy as one designed to capture payments for relieving transmission congestion by "fooling" the CAISO's computerized congestion management program.[38] In this strategy, a company received a counter-flow congestion payment from the CAISO by scheduling non-firm energy from a point in California to a control area outside of California.[39] The SC would then reduce this non-firm energy (in effect not flowing the energy) and collect the counter-flow payments.

CAISO's Description. The CAISO stated that this strategy involved scheduling non-firm export that the supplier did not intend to deliver or could not deliver by selecting an

[35] CAISO DMA Analysis at p. 24.
[36] *Id.* at p. 25.
[37] *Id.* at p. 9.
[38] FERC Staff Report at p. 96.
[39] *Id.*

importing inter-tie was congested.[40] The SC would be paid congestion relief revenue and would cancel the export after the close of the Hour-Ahead market, so no energy exports or delivery would actually occur. This scam would provide payments for the false relief of congestion prior to real time. There was no actual congestion relief because there were no intended exports.

Get Shorty

The Get Shorty strategy is another example of a very colorful name attached to a somewhat mundane commodity trading strategy. This "game" is a rather common practice among commodity and stock traders. Quite simply, a trader agrees to buy or sell a product at a specified price in advance. As the date or time to execute the transaction approaches, the actual spot price in that market becomes more certain. The trader would likely change or alter his/her trading position based upon the updated and more certain current spot price information. There would be nothing sinister or illegal with such portfolio corrections. Short selling as forward and future market strike dates approach is a "Trading 101" concept. Enron did not invent this strategy.

FERC Staff's Description. FERC Staff described the Get Shorty strategy as "paper trading" of ancillary services, where an SC would commit to provide ancillary services in the CPX day-ahead market and then cover its position by purchasing the same services in the CAISO's hour-ahead market.[41] The purpose of such dual trades was to profit from higher CPX prices when CAISO prices were less for the same ancillary services.[42] FERC

[40] CAISO DMA Analysis at p. 7.
[41] FERC Staff Report at p. 98.
[42] *Id.*

Staff recognized this as a legitimate form of arbitrage permitted by the CAISO Tariff.[43] However, SCs that offered to sell ancillary services were required to have physical resources available. SCs that submitted false information to the CAISO with respect to the specific generating unit it had on standby would have violated the rules.

CAISO's Description. The CAISO identified two separate Ancillary Services strategies. The first involved taking advantage of systematic differences in the Day-Ahead and Hour-Ahead market prices for Ancillary Services.[44] The SC would sell ancillary services in the Day-Ahead market and plan to purchase them at a lower price in the Hour-Ahead market to meet its own needs. The second strategy involved selling Ancillary Services in the Day-Ahead market that were not available and purchasing them in the Hour-Ahead market to meet the necessary supply requirements.[45]

Selling Non-Firm as Firm

FERC Staff's Description. FERC Staff described this strategy as a company deliberately selling or reselling non-firm energy to the CPX and falsely claiming that it was selling a higher-valued firm energy.[46] The SC would utilize this strategy and accept some financial risk related to covering the energy in the CAISO's real-time market where, in effect, it became a price taker if its non-firm energy supplies were sold at prices less than it purchased. FERC Staff was opposed to this deceptive strategy because it used

[43] *Id.*
[44] CAISO DMA Analysis at p. 20.
[45] *Id.*
[46] FERC Staff Report at p. 99.

false information and created potential reliability problems because the non-firm energy was neither reliable nor backed up with reserve generation.[47]

[47] *Id.* at pp. 99-100.

BEFORE THE PUBLIC UTILITY COMMISSION

OF OREGON

UM 1002

WAH CHANG,	)
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Petitioner,	)
	)
v.	)
	)
PACIFICORP,	)
	)
Respondent.	)

Exhibit 31 Accompanying Reply Testimony

Of

Charles J. Cicchetti, Ph.D.

Description of Statistical Analysis

DESCRIPTION OF STATISTICAL ANALYSES

Table 5 shows the two statistical tests for the CPX and COB, and Northern California CAISO Real-Time (CAISO NP15) and COB. A "t" statistic below 1.96 is considered rejected at the 95% confidence level. The Peak hours show very different results for the two California markets. In the CPX case, there is no support (t = .143) for the hypothesis that CPX prices and COB prices are different. Quite the opposite (t = 4.27) is shown for the CAISO NP15 Real-Time mean peak price in comparison to COB. This means that the hypothesis of ***no*** difference in means between COB and CAISO NP15 RT could reasonably be rejected with only about a one in a million chance of being wrong.

The Off-Peak comparison would also reject the CAISO NP15 comparison with less than a one in ten chance of being wrong (more that a 90% chance of a difference). The corresponding CPX price comparison for Off-Peak is too close to call, with just about a 40/60 chance of a difference or not.[1]

TABLE 5

COB AND ORGANIZED CALIFORNIA MARKETS

CPX 4/1/98 to 1/28/01

Comparison	COB	PX(w)	T-Statistic
Peak	$75.22	$74.34	0.143
Off Peak	$47.66	$53.00	-1.38

ISO Real-Time (NP15) 4/1/98 to 12/29/02

Comparison	COB	ISO-RT(NP)	T-Statistic
Peak	$76.58	$60.04	4.27
Off Peak	$51.12	$46.48	1.87

[1] Table 5 uses CPX data through 1/28/2001, the date the CPX ceased operations.

The same tests were performed for the OOM prices relative to COB for days on which either the CAISO or the California Department of Water Resources, through its California Energy Resources Scheduling division (CERS), entered the OOM markets (Composite OOM). This OOM data is known informally as the CAISO's MWh laundering data and known more formally as the CAISO Analysis of Trading and Scheduling Strategies: Revised July 15, 2003 (described in the Enron Memos). Combined, there were 209 days on which either or both the CAISO and CERS made peak hour OOM purchases that the CAISO believes were related to MWh laundering. There were 171 days where one of the entities made off-peak hour OOM purchases.[2]

Table 6 shows the composite mean OOM purchase price relative to the corresponding mean COB price. The CAISO Staff tracked sales that Scheduling Coordinators inside of California made outside of California on the same days that the CAISO made OOM purchases. The CAISO Staff determined that these potential pairings of outside-of-California sales and purchases could represent evidence of MWh laundering and/or ricochet trading. The data, however, are insufficient to reach any specific findings related to ricochet schemes. Regardless, Table 6 shows that the sales prices when MWhs were imported from outside of California were much greater than COB prices. However, on days when the CAISO had excess MWhs, shown in the bottom half of Table 6, COB prices were statistically greater than the corresponding OOM prices. Therefore, COB prices were likely not affected by CAISO OOM transactions.[3]

[2] There were 87 CAISO peak days and 131 CERS peak days. There were 54 CAISO off-peak days and 124 CERS off-peak days.

[3] The days for the COB versus OOM purchases (imports) do not match up directly with the days for potential MWh sales used for laundering or ricochet. Accordingly, the mean values at COB differ in the two cases.

TABLE 6

COB AND COMPOSITE OOM

PURCHASES (IMPORTS TO CALIFORNIA)

Comparison	COB	COMPOSITE OOM	T-Statistic
Peak	$287.01	$392.88	-5.18
Off Peak	$209.94	$387.80	-12.58

SALES (EXPORTS FROM CALIFORNIA)

Comparison	COB	COMPOSITE OUTSIDE SALES	T-Statistic
Peak	$204.06	$155.93	2.40
Off Peak	$124.00	$84.67	3.97

COB prices were also compared to CAISO SP15 Real-Time prices (Southern California) and the FERC's mitigated market clearing prices (MMCPs). These comparisons are all strongly statistically different from COB. These results are shown in Table 7.

TABLE 7

COB AND TWO OTHER REFERENCE PRICES

MMCP Period 10/1/00 to 6/17/01

Comparison	COB	MMCP	T-Statistic
Peak	$263.96	$94.82	10.3
Off Peak	$187.98	$80.26	13.4

ISO Real-Time (SP15) Period 4/1/98 to 12/29/02

Comparison	COB	ISO-RT(SP)	T-Statistic
Peak	$76.58	$55.80	5.44
Off Peak	$68.33	$50.15	4.14

Conclusion

COB prices were, on average, quite different from the CAISO prices, the markets where Mr. McCullough alleges "games" occurred. This means that, on average, COB prices are different statistically from the corresponding CAISO markets that may have been manipulated.

The similarity, on average, for COB and CPX markets (where supply and demand under-scheduling tended to cancel out) suggests that, on average, both markets tended to be influenced by similar market forces (supply shortages, increased consumption, high natural gas and NO_X input prices, etc.) as well as market design flaws and congestion difficulties. In addition, other data reviewed by Dr. Cicchetti but not tested statistically show that some significant energy traders in the Northwest traded at COB and concentrated on the CPX in California because, while prices were less, the markets were less volatile and less risky.

BEFORE THE PUBLIC UTILITY COMMISSION

OF OREGON

UM 1002

WAH CHANG,	)
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Petitioner,	)
	)
v.	)
	)
PACIFICORP,	)
	)
Respondent.	)

Exhibit 32 Accompanying Reply Testimony

Of

Charles J. Cicchetti, Ph.D.

Description of Potential Hedges- Regressions

DESCRIPTION OF POTENTIAL HEDGES

Experiment 1:

Equations 1-P and 1-O on page PacifiCorp/32, Cicchetti/4 test the usefulness of using spot Palo Verde prices as hedges for COB at peak (P) and off-peak (O) times. These two geographic markets have correlated prices of .38 ($\sqrt{.14122}$) and .46 ($\sqrt{.20990}$), respectively. This makes them potential hedges. However, their efficiency is not as high as I would have accepted without considering other potential hedges.

Experiment 2:

Equations 2-P-C and 2-O-C on page PacifiCorp/32, Cicchetti/5 test the usefulness of using spot natural gas prices at Henry Hub as hedges for spot COB electricity prices. These would both have been rejected.

Equations 2-P-P and 2-O-P on page PacifiCorp/32, Cicchetti/6 test the use of these same Henry Hub spot natural gas prices for Palo Verde spot electricity prices. These both would have been potential hedges for electricity at Palo Verde. However, I would have attempted to find more efficient hedges because these price correlations were just under .6 ($\sqrt{.36}$.

Experiment 3:

The next category of hedges that I would have analyzed would be futures contracts. Equations 3-P-C on page PacifiCorp/32, Cicchetti/7 and 3-O-C on page PacifiCorp/32, Cicchetti/8 test the efficiency of 12-month futures contracts at COB against monthly spot Peak and Off-Peak prices at COB. These futures

contracts combine to perform about the same as the spot Palo Verde hedges in Experiment 2. Accordingly, I considered other potential hedges.

Experiment 4:

The hedges shown in equations 4-P-P on page PacifiCorp/32, Cicchetti/9 and 4-O-P on page PacifiCorp/32, Cicchetti/10 test the efficiency of Palo Verde 12-month futures against Palo Verde spot prices. These are both excellent hedges. An R^2 of .85 would mean a correlation of .92; and, therefore reduce price risk to about 8 %. I would have recommended that Wah Chang should consider trading in 12-month futures contracts at Palo Verde to offset the risk it had accepted in its COB electricity contract with PacifiCorp. However, I would have also analyzed some additional direct COB hedges

Experiment 5:

The hedges shown in 5-P-C and 5-O-C on page PacifiCorp/32, Cicchetti/11 test the efficiency of COB futures electricity contracts for delivery on September 1, 2000, the first date of the new pricing terms in the Wah Chang contract. These hedges are efficient and I would, therefore, have also recommended that Wah Chang should have considered these direct COB futures contracts that correspond to the first delivery date as reasonable risk-reducing hedges for the COB spot prices.

Experiment 6:

The hedges shown in 6-P-C and 6-O-C on page PacifiCorp/32, Cicchetti/12 show similar hedges for the September 1, 2000 delivery using futures contracts at Palo Verde as hedges for the COB monthly spot index. The

efficiency improves slightly. Therefore, I would have recommended these out-of-market futures contracts as even stronger risk-reducing hedges for Wah Chang.

The hedges shown in 6-P-P and 6-O-P on page PacifiCorp/32, Cicchetti/13 are the corresponding Palo Verde Futures hedges for September 1, 2000 delivery. These hedges are very efficient and I would have recommended them as well to Wah Chang.

Experiment 7:

Finally, the hedges shown in 7-P-C on page PacifiCorp/32, Cicchetti/14 and 7-O-C on page PacifiCorp/32, Cicchetti/15 consider the usefulness of 12-month natural gas futures at Henry Hub for spot electricity prices at COB. These are possible hedges, but do not perform as well as the futures electricity hedges. Therefore, I would not have recommended them to Wah Chang.

REGRESSIONS

```
reg dep[cobpk] ind[(1) pvpk]


********* ORDINARY LEAST SQUARES ESTIMATION *********
1-P
Dependent Variable:     cobpk

Independent         Estimated             Standard                t-
 Variable          Coefficient             Error                Statistic

      (1)          -4.18589e+002          81.02720              -5.16603
    pvpk            4.55463                1.51447               3.00741


Number of Observations                    57
R-squared                                  0.14122
Corrected R-squared                        0.12561
Sum of Squared Residuals                   1.07725e+007
Standard Error of the Regression           4.42565e+002
Durbin-Watson Statistic                    0.11687
Mean of Dependent Variable                -2.50357e+002
```

```
reg dep[cobopk] ind[(1) pvopk]


********* ORDINARY LEAST SQUARES ESTIMATION *********
1-O
Dependent Variable:    cobopk

Independent         Estimated             Standard                t-
 Variable          Coefficient             Error                Statistic

      (1)          -6.60085e+002          1.03572e+002          -6.37319
   pvopk           18.27041               4.77973               3.82247


Number of Observations                    57
R-squared                                  0.20990
Corrected R-squared                        0.19553
Sum of Squared Residuals                   1.07842e+007
Standard Error of the Regression           4.42805e+002
Durbin-Watson Statistic                    0.12149
Mean of Dependent Variable                -3.33778e+002
```

```
reg dep[cobpk] ind[(1) hhgd] if[per3]


********* ORDINARY LEAST SQUARES ESTIMATION *********
2-P-C
Dependent Variable:     cobpk

Independent         Estimated             Standard                t-
 Variable          Coefficient             Error                Statistic

      (1)          -1.94870e+002          2.17259e+002          -0.89695
     hhgd          -21.42855              80.27340              -0.26694


Number of Observations                    57
R-squared                                  1.29395e-003
Corrected R-squared                       -1.68643e-002
Sum of Squared Residuals                   1.25278e+007
Standard Error of the Regression           4.77261e+002
Durbin-Watson Statistic                    8.79151e-002
Mean of Dependent Variable                -2.50357e+002


reg dep[cobopk] ind[(1) hhgd] if[per3]


********* ORDINARY LEAST SQUARES ESTIMATION *********
2-O-C
Dependent Variable:    cobopk

Independent         Estimated             Standard                t-
 Variable          Coefficient             Error                Statistic

      (1)          -3.32183e+002         2.26774e+002          -1.46482
     hhgd          -0.61578              83.78899              -7.34921e-003


Number of Observations                    57
R-squared                                  9.82015e-007
Corrected R-squared                       -1.81808e-002
Sum of Squared Residuals                   1.36491e+007
Standard Error of the Regression           4.98162e+002
Durbin-Watson Statistic                    7.57893e-002
Mean of Dependent Variable                -3.33778e+002
```

```
reg dep[pvpk] ind[(1) hhgd] if[per3]


********* ORDINARY LEAST SQUARES ESTIMATION *********
2-P-P
Dependent Variable:      pvpk

Independent         Estimated             Standard                t-
 Variable          Coefficient             Error                Statistic

      (1)          -39.35708             14.35717              -2.74128
     hhgd           29.46391              5.30472               5.55429


Number of Observations                    57
R-squared                                  0.35935
Corrected R-squared                        0.34770
Sum of Squared Residuals                   5.47085e+004
Standard Error of the Regression          31.53887
Durbin-Watson Statistic                    0.67815
Mean of Dependent Variable                36.93652



reg dep[pvopk] ind[(1) hhgd] if[per3]


********* ORDINARY LEAST SQUARES ESTIMATION *********
2-O-P
Dependent Variable:     pvopk

Independent         Estimated             Standard                t-
 Variable          Coefficient             Error                Statistic

      (1)           -6.05617              4.57991              -1.32233
     hhgd            9.23616              1.69220               5.45809


Number of Observations                    57
R-squared                                  0.35134
Corrected R-squared                        0.33955
Sum of Squared Residuals                   5.56713e+003
Standard Error of the Regression          10.06084
Durbin-Watson Statistic                    0.48399
Mean of Dependent Variable                17.85986
```

```
reg dep[cobpk] ind[(1) avee${j}] if[per3]


********* ORDINARY LEAST SQUARES ESTIMATION *********
3-P-C
Dependent Variable:     cobpk

Independent         Estimated             Standard                t-
 Variable          Coefficient             Error                Statistic

      (1)          -9.38998e+002          1.87848e+002          -4.99872
   avee12          27.99499               7.11398                3.93521


Number of Observations                    38
R-squared                                  0.30078
Corrected R-squared                        0.28136
Sum of Squared Residuals                   5.43097e+006
Standard Error of the Regression           3.88407e+002
Durbin-Watson Statistic                    0.31613
Mean of Dependent Variable                -2.42602e+002


Variable:    cobpk     Average COB Peak Price

Mean                   -2.42602e+002 Standard deviation
4.58174e+002
Minimum                -9.99000e+002 Skewness              -1.03249
Maximum                51.02846      Kurtosis               2.04447
Valid observations        38

Variable:   avee12

Mean                   24.87573      Standard deviation     8.97582
Minimum                11.97500      Skewness               0.76204
Maximum                48.54545      Kurtosis               2.69093
Valid observations        38

Correlation and Covariance matrix

                 cobpk            avee12
   cobpk      2.04399e+005      2.19607e+003
  avee12      0.54843          78.44521

      0.54843
ratio of portfolio variances = 0.451567
```

```
reg dep[cobopk] ind[(1) avee${j}] if[per3]


********* ORDINARY LEAST SQUARES ESTIMATION *********
3-O-C
Dependent Variable:    cobopk

Independent         Estimated              Standard                t-
 Variable          Coefficient             Error                Statistic

      (1)          -1.26306e+003          1.83873e+002          -6.86923
   avee12          36.46578               6.96345                5.23674


Number of Observations                    38
R-squared                                 0.43239
Corrected R-squared                       0.41662
Sum of Squared Residuals                  5.20357e+006
Standard Error of the Regression          3.80189e+002
Durbin-Watson Statistic                   0.43802
Mean of Dependent Variable                -3.55952e+002


Variable:   cobopk     Average COB Off-peak Price

Mean                   -3.55952e+002 Standard deviation
4.97764e+002
Minimum                -9.99000e+002 Skewness              -0.52373
Maximum                38.53346      Kurtosis               1.23035
Valid observations        38

Variable:   avee12

Mean                   24.87573      Standard deviation     8.97582
Minimum                11.97500      Skewness               0.76204
Maximum                48.54545      Kurtosis               2.69093
Valid observations        38

Correlation and Covariance matrix

                cobopk           avee12
  cobopk      2.41249e+005     2.86057e+003
  avee12      0.65756          78.44521

      0.65756
ratio of portfolio variances = 0.342439
```

```
reg dep[pv_pk] ind[(1) avee${j}] if[per3]


********* ORDINARY LEAST SQUARES ESTIMATION *********
4-P-P
Dependent Variable:     pv_pk

Independent         Estimated             Standard                t-
 Variable          Coefficient             Error                Statistic

      (1)           -4.81930              4.35926              -1.10553
   avee12            1.28296              9.05998e-002          14.16076


Number of Observations                   42
R-squared                                 0.83370
Corrected R-squared                       0.82954
Sum of Squared Residuals                  1.32758e+004
Standard Error of the Regression         18.21800
Durbin-Watson Statistic                   1.30600
Mean of Dependent Variable               42.36149


Variable:    pv_pk     Palo Verde Peak Price

Mean                    42.36149      Standard deviation     44.12560
Minimum                 13.58321      Skewness                2.69966
Maximum                  2.21660e+002 Kurtosis                9.54728
Valid observations         42

Variable:   avee12

Mean                    36.77488      Standard deviation     31.40373
Minimum                 15.89318      Skewness                2.72541
Maximum                  1.64578e+002 Kurtosis               10.09368
Valid observations         42

Correlation and Covariance matrix

                 pv_pk            avee12
   pv_pk      1.90071e+003      1.23513e+003
  avee12      0.91307           9.62713e+002

      0.91307
ratio of portfolio variances = 0.0869291
```

```
reg dep[pv_opk] ind[(1) avee${j}] if[per3]


********* ORDINARY LEAST SQUARES ESTIMATION *********
4-O-P
Dependent Variable:    pv_opk

Independent         Estimated             Standard                t-
 Variable          Coefficient             Error                Statistic

      (1)            4.09438               1.18463               3.45624
   avee12            0.41342               2.46206e-002         16.79150


Number of Observations                    42
R-squared                                  0.87576
Corrected R-squared                        0.87265
Sum of Squared Residuals                   9.80400e+002
Standard Error of the Regression           4.95076
Durbin-Watson Statistic                    0.93789
Mean of Dependent Variable                19.29773


Variable:   pv_opk     Palo Verde Off-Peak Price

Mean                    19.29773      Standard deviation     13.87321
Minimum                  6.67033      Skewness                2.13663
Maximum                 67.28065      Kurtosis                6.91645
Valid observations         42

Variable:   avee12

Mean                    36.77488      Standard deviation     31.40373
Minimum                 15.89318      Skewness                2.72541
Maximum                  1.64578e+002 Kurtosis               10.09368
Valid observations         42

Correlation and Covariance matrix

                 pv_opk             avee12
  pv_opk       1.87883e+002       3.98002e+002
  avee12       0.93582            9.62713e+002

      0.93582
ratio of portfolio variances = 0.0641801
```

```
reg dep[cobpk]  ind[(1) fcob0900a]


********* ORDINARY LEAST SQUARES ESTIMATION *********
5-P-C
Dependent Variable:     cobpk

Independent         Estimated             Standard                t-
 Variable          Coefficient             Error                Statistic

      (1)          -95.76035             42.92104              -2.23108
 fcob0900            3.35505              0.61657               5.44147


Number of Observations                   19
R-squared                                 0.63527
Corrected R-squared                       0.61381
Sum of Squared Residuals                  1.08366e+005
Standard Error of the Regression         79.84022
Durbin-Watson Statistic                   2.18811
Mean of Dependent Variable                1.15458e+002



reg dep[cobopk] ind[(1) fcob0900a]


********* ORDINARY LEAST SQUARES ESTIMATION *********
5-O-C
Dependent Variable:    cobopk

Independent         Estimated             Standard                t-
 Variable          Coefficient             Error                Statistic

      (1)          -81.41628             19.26114              -4.22697
 fcob0900            2.44812              0.27669               8.84785


Number of Observations                   19
R-squared                                 0.82159
Corrected R-squared                       0.81109
Sum of Squared Residuals                  2.18231e+004
Standard Error of the Regression         35.82890
Durbin-Watson Statistic                   2.56678
Mean of Dependent Variable               72.70600
```

```
reg dep[cobpk]  ind[(1) fpv0900a]


********* ORDINARY LEAST SQUARES ESTIMATION *********
6-P-C
Dependent Variable:     cobpk

Independent         Estimated             Standard                t-
 Variable          Coefficient             Error                Statistic

      (1)          -69.50617             10.73590              -6.47418
 fpv0900a            1.89525              0.15039              12.60186


Number of Observations                   19
R-squared                                 0.90330
Corrected R-squared                       0.89761
Sum of Squared Residuals                  5.47901e+003
Standard Error of the Regression         17.95256
Durbin-Watson Statistic                   2.21557
Mean of Dependent Variable               55.43453



reg dep[cobopk] ind[(1) fpv0900a]


********* ORDINARY LEAST SQUARES ESTIMATION *********
6-O-C
Dependent Variable:    cobopk

Independent         Estimated             Standard                t-
 Variable          Coefficient             Error                Statistic

      (1)          -15.38033              4.72091              -3.25792
 fpv0900a            0.68508              6.61331e-002         10.35909


Number of Observations                   19
R-squared                                 0.86325
Corrected R-squared                       0.85520
Sum of Squared Residuals                  1.05944e+003
Standard Error of the Regression          7.89430
Durbin-Watson Statistic                   0.63073
Mean of Dependent Variable               29.78221
```

```
reg dep[pvpk]  ind[(1) fpv0900a]


********* ORDINARY LEAST SQUARES ESTIMATION *********
6-P-P
Dependent Variable:      pvpk

Independent        Estimated             Standard                t-
 Variable         Coefficient             Error                Statistic

      (1)         -74.86296              7.36741             -10.16137
 fpv0900a           2.00666              0.10321              19.44311


Number of Observations                  19
R-squared                               0.95697
Corrected R-squared                     0.95443
Sum of Squared Residuals                2.58020e+003
Standard Error of the Regression        12.31977
Durbin-Watson Statistic                 1.28919
Mean of Dependent Variable              57.42224



reg dep[pvopk] ind[(1) fpv0900a]


********* ORDINARY LEAST SQUARES ESTIMATION *********
6-O-P
Dependent Variable:     pvopk

Independent        Estimated             Standard                t-
 Variable         Coefficient             Error                Statistic

      (1)          -8.54898              2.72062              -3.14229
 fpv0900a           0.52421              3.81120e-002         13.75442


Number of Observations                  19
R-squared                               0.91755
Corrected R-squared                     0.91270
Sum of Squared Residuals                3.51854e+002
Standard Error of the Regression        4.54943
Durbin-Watson Statistic                 1.11526
Mean of Dependent Variable              26.00847
```

```
reg dep[cobpk] ind[(1) aveg${j}] if[per3]


********* ORDINARY LEAST SQUARES ESTIMATION *********
7-P-C
Dependent Variable:     cobpk

Independent         Estimated             Standard                t-
 Variable          Coefficient             Error                Statistic

      (1)          -6.24576e+002          1.34845e+002          -4.63179
   aveg12           1.84022e+002          48.48466               3.79548


Number of Observations                    81
R-squared                                  0.15423
Corrected R-squared                        0.14352
Sum of Squared Residuals                   1.28915e+007
Standard Error of the Regression           4.03961e+002
Durbin-Watson Statistic                    0.11129
Mean of Dependent Variable                -1.41958e+002


Variable:     hhgd

Mean                      2.51529      Standard deviation      1.18586
Minimum                   1.15520      Skewness                2.57830
Maximum                   8.68950      Kurtosis               11.82345
Valid observations         137

Variable:   aveg12

Mean                      2.31957      Standard deviation      0.82472
Minimum                   1.35782      Skewness                2.14312
Maximum                   5.79986      Kurtosis                7.80452
Valid observations         137

Correlation and Covariance matrix

                  hhgd            aveg12
    hhgd       1.39600          0.25870
  aveg12       0.26646          0.67520

      0.26646
ratio of portfolio variances = 0.73354
```

```
reg dep[cobopk] ind[(1) aveg${j}] if[per3]


********* ORDINARY LEAST SQUARES ESTIMATION *********
7-O-C
Dependent Variable:    cobopk

Independent          Estimated              Standard                t-
 Variable           Coefficient              Error                Statistic

      (1)          -7.79713e+002          1.38056e+002          -5.64782
   aveg12           2.17036e+002          49.63895               4.37229


Number of Observations                    81
R-squared                                  0.19484
Corrected R-squared                        0.18465
Sum of Squared Residuals                   1.35127e+007
Standard Error of the Regression           4.13578e+002
Durbin-Watson Statistic                    9.68345e-002
Mean of Dependent Variable                -2.10514e+002


Variable:     hhgd

Mean                      2.51529      Standard deviation      1.18586
Minimum                   1.15520      Skewness                2.57830
Maximum                   8.68950      Kurtosis               11.82345
Valid observations         137

Variable:   aveg12

Mean                      2.31957      Standard deviation      0.82472
Minimum                   1.35782      Skewness                2.14312
Maximum                   5.79986      Kurtosis                7.80452
Valid observations         137

Correlation and Covariance matrix

                  hhgd            aveg12
    hhgd       1.39600          0.25870
  aveg12       0.26646          0.67520

      0.26646
ratio of portfolio var
```