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MISSOURI PUBLIC SERVICE COMMISSION

CASE NO.: EO-2011-0390

SURREBUTTAL TESTIMONY

OF

DR. C.K. WOO

ON BEHALF OF

KCP&L GREATER MISSOURI OPERATIONS COMPANY

Kansas City, Missouri
April 2012

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SURREBUTTAL TESTIMONY

OF

DR. C.K. WOO

Case No. EO-2011-0390

Q: Please state your name and business address.

A: My name is Dr. C.K. Woo. My business address is Energy & Environmental Economics, Inc., 101 Montgomery Street, Suite 1600, San Francisco, California 94104.

Q: Are you the same Dr. C.K. Woo who prefiled direct testimony in this matter?

A: Yes.

Q: What is the purpose of your Surrebuttal Testimony?

A: I have been retained by Great Plains Energy Services Incorporated, an affiliate of KCP&L Greater Missouri Operations Company ("GMO") to respond to the following statement in Direct/Rebuttal Testimony of Dana E. Eaves dated March 21, 2012 ("Eaves Direct/Rebuttal" hereafter):

> Q. Does Dr. Woo give an opinion, in his direct testimony, that GMO's actual on-peak purchased power hedging activities are prudent?
>
> A. Not that Staff could find. After reviewing Dr. Woo's testimony Staff found this statement on page 19, lines 20-22 and ending on page 20, line 2, that may support GMO's hedging activates:
>
> > Q. When is cross hedging likely effective in this case?
> >
> > A. When E=1, cross hedging is perfectly effective. This occurs when Var(u)=0 and the electricity spot price and the Henry Hub natural gas spot price are perfectly correlated. Hence, cross hedging is likely to be highly effective when the two spot prices are highly correlated.
>
> Q. Does Dr. Woo provide any analysis based on GMO's specific hedging activities which show they are prudent?
>
> A. No, he does not.

My Surrebuttal Testimony rebuts certain Q&A in Eaves Direct/Rebuttal Testimony, so as to affirm that it is prudent to use NYMEX natural gas futures to effectively cross hedge the daily on-peak electricity price, which is defined as the daily average of hourly electricity prices during the 16-hour on-peak period (06:00 – 22:00, Monday through Friday, excluding holidays). It also demonstrates that it is prudent to use NYMEX natural gas futures to effectively cross hedge the daily per MWh on-peak procurement cost of an electric utility that owns natural-gas-fired generation.

Q: Do you believe that GMO's specific hedging activities during the FAC review period in this case were prudent?

A: Yes. This is a fundamental point that will be addressed throughout the remainder of this testimony.

Q: How is your testimony organized?

A: Section I discusses how to use NYMEX natural gas futures to cross hedge the daily average of hourly on-peak prices and the hourly on-peak price for a given hour. Section II discusses how to use NYMEX natural gas futures to cross hedge the daily per MWh procurement cost of a utility that owns natural-gas-fired generation. Section III is an analysis of (a) the correlation between on-peak electricity prices and natural gas prices at Henry Hub; and (b) the correlation between on-peak per MWh procurement costs and natural gas prices at Henry Hub. Section IV rebuts certain Q&A in Eaves Direct/Rebuttal.

Q: What are your findings?

A: Staff witness Dana Eaves' analysis in his Direct/Rebuttal Testimony is erroneous for the following reasons:

- While the spot electricity market is hourly, NYMEX natural gas futures can be used to cross hedge the daily on-peak price.
- Cross hedging can reduce the procurement cost risk of an electric utility that owns natural-gas-fired generation.
- A correlation coefficient around 0.8 would indicate that daily on-peak and natural gas prices are highly correlated because (a) 1.0 is the coefficient for perfect (positive) correlation, and (b) these daily prices can be highly volatile, with potentially large daily fluctuations.
- It is inappropriate to use the *ex post* (after the fact) price correlation to determine the prudence of a cross hedging decision made *ex ante* (before the fact). Hence, the relevant price correlation should be based on the price data available when making an *ex ante* cross hedging decision.
- For December 2007 through May 2009, the 18-month period immediately before the 18-month review period of June 2009 through November 2010, the coefficients of correlation between the daily on-peak price and the daily natural gas price at Henry Hub are 0.824 for Ameren ("AMRN") and 0.853 for Associated Electric Cooperative, Inc. ("AECI").
- The daily price for a given on-peak hour (e.g., hour ending 14:00) can be highly correlated with the daily natural gas price at Henry Hub. While the 16 coefficients of correlation vary by hour, they reject the claim of zero correlation in Eaves Direct/Rebuttal.

- The daily on-peak per MWh procurement cost of a utility that owns natural-gas-fired generation is highly correlated with the daily natural gas price at Henry Hub, thus justifying the utility's use of cross hedging to manage its procurement cost risk.
- For the 18-month period of December 2007 through May 2009, the coefficients of correlation evaluated at heat rates of 7, 9 and 11 MMBTU/MWH are (a) AMRN: 0.921, 0.886, and 0.860; and (b) AECI: 0.937, 0.906, and 0.879.

Q: What is your conclusion based on the above findings?

A: My conclusion is that Eaves Direct/Rebuttal (pp. 2-3) is erroneous in stating:

> • Staff's position that the average monthly prices of natural gas, upon which NYMEX natural gas futures contracts are settled, during the prudence review period are not sufficiently correlated with the spot market prices of electricity during the on-peak periods in that same review period for it to have been prudent for GMO to use NYMEX natural gas futures contracts to hedge its on-peak spot market purchases of electricity. Since the spot market is hourly and the cost of gas in NYMEX natural gas futures contracts is an average monthly price it is difficult to see how there could be a strong correlation between the two sufficient enough to hedge the more time granular spot market prices with the less time granular gas cost of the NYMEX futures.

I will explain the reasons for my conclusion that Eaves' Direct/Rebuttal Testimony is in error in the following sections of my testimony.

I. USING NATURAL GAS FUTURES TO CROSS HEDGE ON-PEAK ELECTRICITY PRICES

Q: Please define the daily average of hourly electricity prices ($/MWh) during the on-peak period.

A: The Southwest Power Pool's 16-hour on-peak period is 06:00 – 22:00, Monday-Friday, excluding holidays. Let P_h be the price in hour h = 7 for hour ending 07:00, …, 22 for hour ending 22:00. The daily average of the 16 hourly on-peak prices is defined by $P = \Sigma_h P_h / 16$. For easy reference, P will be referred to as the daily on-peak price.

Q: Please describe the relationship between the daily on-peak electricity price *P* ($/MWh) and the daily natural gas price *H* ($/MMBTU) at Henry Hub.

A: Empirical evidence suggests that the relationship can be described by the following regression:[1]

$$P = \alpha + \beta H + \mu \qquad (1)$$

where α = intercept, β = slope coefficient, and μ = random error with zero mean and finite variance. The intercept α in equation (1) aims to capture the average effect on P of factors unrelated to the natural gas spot price. The slope coefficient $\beta > 0$ measures the effect of a $1 increase in the daily Henry Hub natural gas price on the daily on-peak price. The random error μ is the daily electricity price deviation from the regression line.

Q: Absent cross hedging, what is the daily on-peak price risk?

A: To simplify the derivation of this risk, I assume that α and β are known.[2] Now, the price risk is the standard deviation of P, which is the square root of the following price variance under the assumption that H and μ are uncorrelated:[3]

$$\mathrm{Var}(P) = \beta^2\,\mathrm{Var}(H) + \mathrm{Var}(\mu). \qquad (2)$$

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[1] C.K. Woo, I. Horowitz, A. Olson, A. DeBenedictis, D. Miller and J. Moore, *Cross-Hedging and Forward-Contract Pricing of Electricity in the Pacific Northwest*, 32 MANAGERIAL AND DECISION ECONOMICS 265-279 (2011).

[2] Relaxing this assumption complicates the derivation of the price variance, without qualitatively changing the subsequent discussion. For a discussion on using an estimated regression to derive the electricity spot price variance, see C.K. Woo, I. Horowitz and K. Hoang, *Cross Hedging and Value at Risk: Wholesale Electricity Forward Contracts*, 8 ADVANCES IN INVESTMENT ANALYSIS AND PORTFOLIO MANAGEMENT 283-301 (2001).

[3] A.M. Mood, F.A. Graybill and D.C. Boes, INTRODUCTION TO THE THEORY OF STATISTICS (McGraw Hill, 1974) at 178.

Q: Please describe how to use natural gas futures contracts to cross hedge the daily on-peak price.

A: For simplicity, consider a two-period example in which the utility wishes to buy natural gas futures in Period 1, so as to cross hedge the daily on-peak price in Period 2. Cross hedging in this case entails the following transactions:

(1) Buy β MMBTU of natural gas futures at \$$F$ per MMBTU in Period 1 for delivery in Period 2.

(2) Take β MMBTU delivery at Henry Hub, pay \$$F$ per MMBTU, and resell the delivered natural gas at \$$H$ per MMBTU in Period 2, yielding \$$\beta(H-F)$.

(3) Buy on-peak electricity at \$$P$ per MWh in Period 2.

Under cross hedging, the net daily on-peak price that the utility would pay is:

$$
\begin{aligned}
P' &= \alpha + \beta H - \beta(H-F) + \mu \\
&= \alpha + \beta F + \mu \qquad (3)
\end{aligned}
$$

Equation (3) shows that cross hedging replaces the potentially volatile Henry Hub price H in Period 2 with the locked-in futures price F in Period 1.

Q: Does cross hedging reduce the utility's exposure to daily on-peak price risk?

A: Yes. Since F is a fixed number with zero variance, the variance of the hedged price P' is:

$$\mathrm{Var}(P') = \mathrm{Var}(\mu), \qquad (4)$$

which is less than the variance of the unhedged price P given by equation (2).

Q: How do you measure the effectiveness of natural gas futures in cross hedging the daily on-peak price?

A: To measure the effectiveness of cross hedging, I use:

$$E = 1 - \mathrm{Var}(P') / \mathrm{Var}(P), \qquad (5)$$

the percentage reduction in the variance of the unhedged electricity spot price.

Q: When is cross hedging likely effective in this case?

A: When $E = 1$, cross hedging is perfectly effective. This occurs when $\mathrm{Var}(\mu) = 0$ and the daily on-peak price and daily Henry Hub natural gas price are perfectly correlated. Hence, cross hedging is likely to be highly effective when the two daily prices are highly correlated.

Q: How would you determine if the two daily prices are highly correlated?

A: A correlation coefficient around 0.8 would indicate that the two daily prices are highly correlated because (a) 1.0 is the coefficient for perfect (positive) correlation, and (b) daily electricity and natural prices can be highly volatile, with potentially large daily fluctuations.

Q: If the two daily prices are found to be highly correlated, is cross hedging prudent in managing daily on-peak price risk?

A: Yes, because high correlation implies effective cross hedging.

Q: How would you cross hedge the electricity price risk in a given on-peak hour *h*?

A: Instead of equation (1), I would use an hourly price regression:

$$P_h = \alpha_h + \beta_h H + \mu_h \qquad (6)$$

where P_h = price in hour h (e.g., h = 13 for hour ending 13:00) on a working weekday (e.g., January 5, 2011), α_h = intercept for hour h, β_h = slope coefficient for hour h, H = daily natural gas price on the same day (i.e., January 5, 2011), and μ_h = random error in hour h with zero mean and finite variance.

Q: When is cross hedging likely effective in this case?

A: Cross hedging is perfectly effective when Var(μ_h) = 0, requiring that the daily electricity price in hour h be perfectly correlated with the daily Henry Hub natural gas price. Hence, cross hedging is likely to be highly effective when the two prices are highly correlated.

II. GENERATION OWNERSHIP AND CROSS HEDGING

Q: Staff witness Lena Mantle discusses the building of generation facilities as a hedge for electricity price risk (Mantle Rebuttal, pp. 1-6). Do you have any comments?

A: Yes.

Q: How does generation ownership affect a utility that procures electricity to meet its obligation to serve?

A: Consider a utility that, on a daily basis, can decide to (a) procure on-peak electricity from the spot market at $\$P$ per MWh; or (b) generate the same electricity at $\$\eta G$ per MWh, where η = heat rate (MMBTU/MWh) and G = local natural gas price (\$/MMBTU).[4] Least-cost dispatch implies that the utility's per MWh procurement cost is $C = \min(P, \eta G)$, which is less than the on-peak price P. Thus, generation ownership yields a per MWh savings of $(P - C)$.

Q: Given generation ownership's per MWh savings, how do you determine if generation ownership is cost-effective?

A: Generation ownership is cost-effective when the expected per MWh savings is projected to exceed the per MWh cost of acquiring generation capacity.

[4] C.K. Woo, A. Olson and R. Orans, *Benchmarking the Price Reasonableness of an Electricity Tolling Agreement*, 17(5) ELECTRICITY JOURNAL 65-75 (2004).

Q: For a utility that already has natural-gas-fired generation, how do you compute the utility's per MWh procurement cost risk?

A: Suppose the empirical relationship between the utility's per MWh cost C and Henry Hub natural gas price H is:[5]

$$C = \theta + \gamma H + \varepsilon \qquad (7)$$

where θ = intercept, γ = slope coefficient, and ε = random error with zero mean and finite variance. Assuming that θ and γ are known, the per MWh cost risk is the standard deviation of C, which is the square root of the following cost variance under the assumption that H and ε are uncorrelated:

$$\mathrm{Var}(C) = \gamma^2\, \mathrm{Var}(H) + \mathrm{Var}(\varepsilon). \qquad (8)$$

Q: Does generation ownership eliminate the need for using natural gas futures contracts to cross hedge the daily per MWh cost?

A: No. For simplicity, consider a two-period example in which the utility wishes to buy natural gas futures in Period 1, so as to cross hedge the daily per MWh cost in Period 2. Cross hedging in this case entails the following transactions:

(1) Buy γ MMBTU of natural gas futures at \$$F$ per MMBTU in Period 1 for delivery in Period 2.

(2) Take γ MMBTU delivery at Henry Hub, pay \$$F$ per MMBTU, and resell the delivered natural gas at \$$H$ per MMBTU in Period 2, yielding \$$\gamma(H - F)$.

(3) Procure on-peak electricity at \$$C$ per MWh in Period 2.

Under cross hedging, the net daily per MWh cost that the utility would pay is:

$$C' = \theta + \gamma H - \gamma(H - F) + \varepsilon$$

$$= \quad \alpha + \gamma F + \varepsilon \qquad (9)$$

Equation (9) shows that cross hedging replaces the potentially volatile Henry Hub price H in Period 2 with the locked-in futures price F in Period 1.

Q: Does cross hedging reduce the utility's exposure to the per MWh cost risk?

A: Yes. Since F is a fixed number with zero variance, the variance of the hedged cost C' is:

$$\mathrm{Var}(C') \quad = \quad \mathrm{Var}(\varepsilon), \qquad (10)$$

which is less than the variance of the unhedged price C given by equation (8).

Q: When is cross hedging likely effective in this case?

A: Cross hedging is perfectly effective when $\mathrm{Var}(\varepsilon) = 0$, requiring that the daily per MWh cost be perfectly correlated with the daily Henry Hub natural gas price. Hence, cross hedging is likely to be highly effective when the daily per MWh cost and the daily Henry Hub natural gas price are highly correlated.

III. CORRELATION ANALYSIS

Q: Staff witness Dana Eaves discusses the correlation between the natural gas prices and electricity prices (Eaves Direct/Rebuttal, pp. 3-5, 11-22). Do you have any comments?

A: Yes. I disagree with Mr. Eaves' analysis.

Q: For the purpose of this surrebuttal, did you assess the correlation between the daily average of hourly on-peak prices and the daily natural gas price at Henry Hub?

A: Yes. My assessment uses the hourly AMRN and AECI price data for the Energy Imbalance Service ("EIS") Market of the Southwest Power Pool ("SPP") and the daily

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[5] C.K. Woo, I. Horowitz, A. Olson, B. Horii and C. Baskette, *Efficient Frontiers for Electricity Procurement by an LDC with Multiple Purchase Options*, 34 OMEGA 70-80 (2006).

natural gas price data for December 2007 – May 2009, the 18-month period immediately before the 18-month review period of June 2009 – November 2010.

Q: Why did you choose the AMRN and AECI prices?

A: Even though SPP currently reports pricing for more than 5,000 different nodes, SNL Financial has identified 7 nodes as representative of the SPP market. Of those 7 nodes, GMO has told me that it primarily transacts at AMRN and AECI. Hence, I chose the AMRN and AECI prices for my correlation analysis.

Q: Why did you choose this period?

A: I chose this period for two reasons. First, the period has the most recent 18 months of data for computing the price correlation that could be known *ex ante* when determining how to manage electricity price and procurement cost risks in the subsequent 18-month review period. Second, it is inappropriate to use the *ex post* price correlation to judge the prudence of an *ex ante* cross hedging decision.[6]

Q: What are your results for this period?

A: As shown in the second row of Table 1 below, the correlation coefficients are 0.824 for AMRN and 0.853 for AECI, indicating that the daily on-peak price and daily Henry Hub natural gas price are highly correlated.

Table 1: Coefficients of correlation between the daily average of hourly on-peak prices and daily natural gas price at Henry Hub

Period	AMRN	AECI
18-month: December 2007 – May 2009	0.824	0.853
12-month: June 2008 – May 2009	0.859	0.885
28-month: February 2007 – May 2009	0.713	0.748

Q: Are your results sensitive to the choice of assessment period?

A: Yes. The third row of Table 1 shows that the correlation coefficients for the 12-month period of June 2008 – May 2009 are higher than those for the 18-month period. However, the bottom row of Table 1 shows that the correlation coefficients for the 28-month period of February 2007 - May 2009 are lower than those for the 18-month period, reflecting the poor price correlation in the early months of the EIS market.

Q: For the purpose of this surrebuttal, did you assess the correlation between the daily price for an on-peak hour and the daily natural gas price at Henry Hub for the periods in Table 1?

A: Yes. Figure 1 summarizes the 16 correlation coefficients for the 18-month period, which shows (a) low correlation for the early morning (06:00-10:00) hours; (b) moderate correlation for the late morning (10:00-12:00) and evening (18:00 – 22:00) hours; and (c) high correlation for the remaining hours (12:00 – 18:00). When compared to Figure 1, Figure 2 shows that shortening the 18-month period to the 12-month period increases correlation coefficients. However, Figure 3 shows that lengthening the 18-month period to the 28-month period reduces correlation coefficients.

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[6] C.K. Woo, D. Lloyd and W. Clayton, *Did a Local Distribution Company Procure Prudently during the California Electricity Crisis*? 34 ENERGY POLICY 2552-2565 (2006).

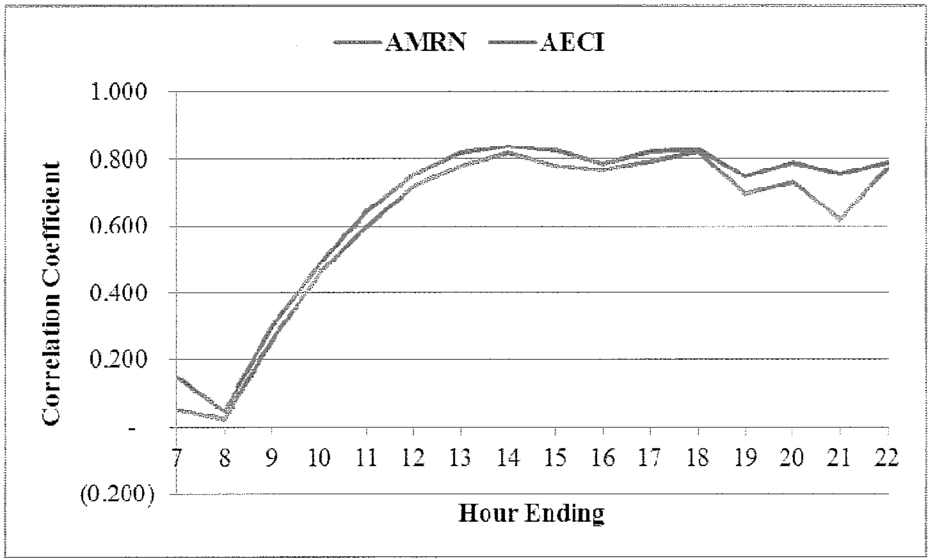


Figure 1: Correlation between the on-peak electricity price for a given hour (= 7, …, 22) and the daily natural gas price at Henry Hub for the 18-month period of December 2007 – May 2009.

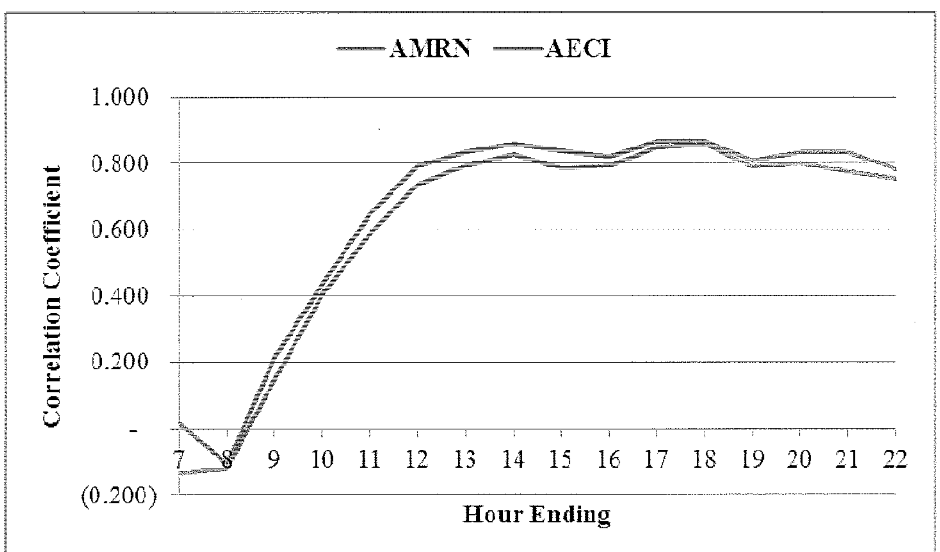


Figure 2: Correlation between the on-peak electricity price for a given hour (= 7, …, 22) and the daily natural gas price at Henry Hub for the 12-month period of June 2008 – May 2009.

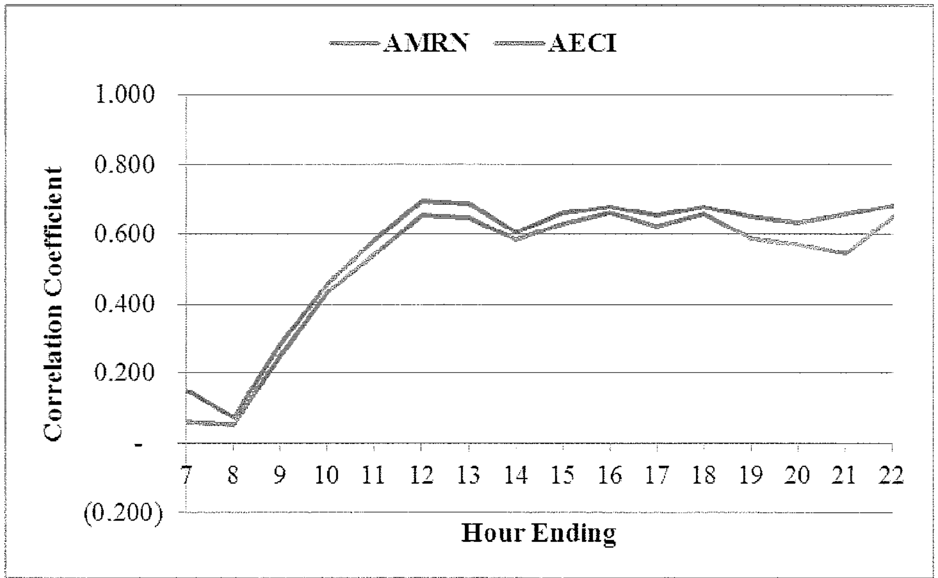


Figure 3: Correlation between the on-peak electricity price for a given hour (= 7, …, 22) and the daily natural gas price at Henry Hub for the 28-month period of February 2007 – May 2009.

Q: For the purpose of this surrebuttal, did you assess the correlation between the daily on-peak per MWh procurement cost of a utility that owns natural-gas-fired generation and the daily natural gas price at Henry Hub?

A: Yes. Since the utility's per MWh procurement cost depends on the heat rates of the generation fleet, my assessment assumes three heat rates: (1) 7 MMBTU/MWh for a relatively new combined cycle gas turbine; (2) 9 MMBTU/MWh for a relatively new combustion turbine; and (3) 11 MMBTU/MWh for a relatively old combustion turbine.[7] Table 2 reports the correlation coefficients by heat rate for AMRN and AECI. These coefficients indicate that the daily per MWh procurement cost and the daily Henry Hub natural gas price are highly correlated, supporting the use of cross hedging to effectively manage the per MWh procurement cost risk.

[7] C.K. Woo, I. Horowitz, B. Horii, R. Orans and J. Zarnikau, *Blowing in the Wind: Vanishing Payoffs of a Tolling Agreement for Natural-Gas-Fired Generation of Electricity in Texas*, 33(1) THE ENERGY JOURNAL 207-229 (2012).

Table 2: Coefficients of correlation by heat rate (MMBTU/MWh) between the daily on-peak per MWh cost and daily natural gas price at Henry Hub

Period	AMRN			AECI		
	7 MMBTU / MWh	9 MMBTU / MWh	11 MMBTU / MWh	7 MMBTU / MWh	9 MMBTU / MWh	11 MMBTU / MWh
18-month: December 2007 – May 2009	0.921	0.886	0.860	0.937	0.906	0.879
12-month: June 2008 – May 2009	0.926	0.909	0.895	0.937	0.922	0.908
28-month: February 2007 – May 2009	0.903	0.847	0.795	0.921	0.871	0.820

Note: Least cost dispatch implies daily on-peak per MWh cost = min(daily on-peak electricity price, heat rate × daily local natural gas price). This table assumes that the daily local natural gas price is the Panhandle Eastern Pipeline ("PEPL") spot natural gas price index.

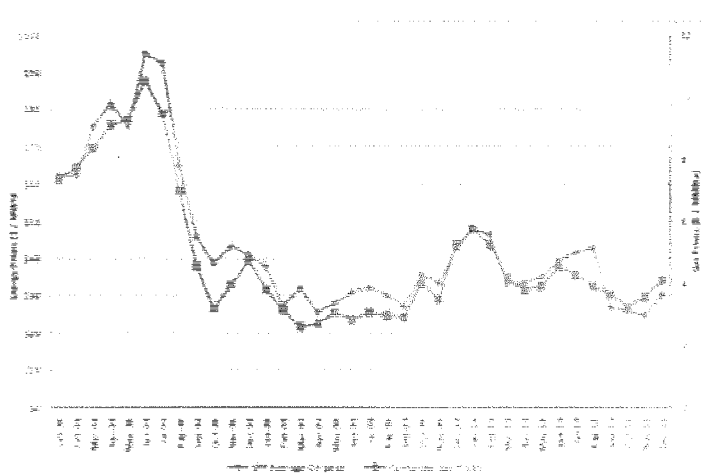
IV. RESPONSE TO CERTAIN Q&A IN EAVES DIRECT/REBUTTAL

Q: What is your opinion on the following Q&A in Eaves Direct/Rebuttal (p. 13)?

> Q. Are the Pacific Northwest electric markets comparable with the Midwest electric markets?
>
> A. I have no reason to think they are. Dr. Woo explains the Mid-C region is heavily reliant on hydro facilities while the Midwest region relies heavily on coal and nuclear generation.

A: My opinion is that if cross-hedging can be effective for the Mid-C region for managing daily on-peak electricity price risk, it is likely effective for a region that primarily uses natural gas as the marginal generation fuel during the on-peak period. An example of such a region is SPP, as explained by SPP's 2011 market report: "Figure II.6 [below] compares the average Panhandle hub gas price and the SPP monthly average price for 2008-2010. Gas prices are very closely associated with average system prices in the SPP region. This is logical, because the marginal resources that set overall prices are most often gas units."[8]

Figure II.6 Comparison of Average Monthly SPP Prices and Panhandle Natural Gas Prices



Q: What is your opinion on the following Q&A in Eaves Direct/Rebuttal (p. 16)?

> Q. Did Staff determine the correlation co-efficient for the data it used to create the preceding figure?
>
> A. Yes. For the period November 2010 thru October 2011 the data has a correlation co-efficient of 0.61755.

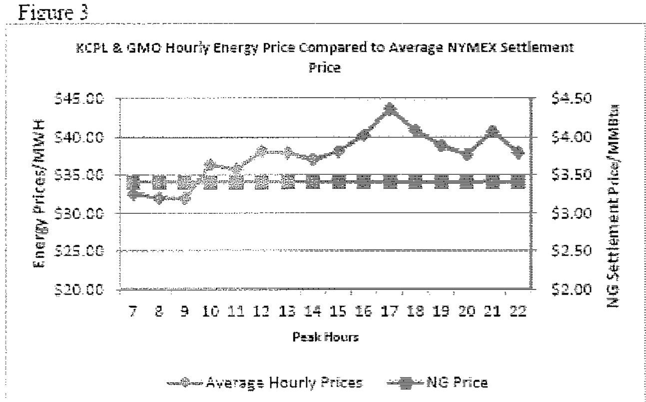
A: My opinion is that the 0.61755 correlation coefficient in Eaves Direct/Rebuttal is an *ex post* correlation, not relevant for determining the prudence of an *ex ante* cross hedging decision made before the review period of June 2009 – November 2010. Moreover, the correlation coefficients in Table 1 in Section III above suggest high price correlation, supporting that it is prudent to use cross hedging to effectively manage daily on-peak price risk. Finally, the high correlation coefficients in Table 2 in Section III above

[8] SPP, 2010 STATE OF THE MARKET (Southwest Power Pool, 2011) at 36; available at: http://www.spp.org/publications/2010-State-of-the-Market-Report.pdf

suggest that it is prudent to use cross hedging to effectively manage the daily on-peak procurement cost risk faced by a utility that owns natural-gas-fired generation.

Q: What is your opinion on the following Q&A (Eaves Direct/Rebuttal, p. 17)?

> Q. Did Staff prepare any other analysis?
>
> A. Yes. Staff randomly chose August 3, 2009, and compared what GMO actually paid for peak spot market electricity to GMO's actual NYMEX monthly natural gas settlement price. The result is presented graphically in the following chart labeled Figure 3.
>
> Figure 3



> Q. What is the correlation co-efficient of the data set used in creating Figure 3?
>
> A. It is almost 0 (-1E-15).
>
> Q. Based upon that result, is it Staff's opinion monthly NYMEX natural gas settlement prices and the spot market prices GMO actually paid for electricity in August 2009 are highly correlated?
>
> A. No. The analysis results show that the two data sets are not correlated.

A: My opinion is that Eaves' analysis is wrong. Eaves' almost-zero correlation coefficient is inappropriately based on 16 ***intra-day*** hourly electricity prices on a given day (August 9, 2009) and the single natural gas price for the same day. Equation (6) and the corresponding discussion imply that the correlation computation should be based on the ***inter-day*** electricity prices for a given hour and the ***inter-day*** natural gas prices in a sample period (e.g., June 2008 – May 2009). Figures 1-3 in Section III above show that the daily on-peak price for a given hour can be highly correlated with the daily natural gas price.

Q: What is your opinion on the following Q&A in Eaves Direct/Rebuttal (p. 17)?

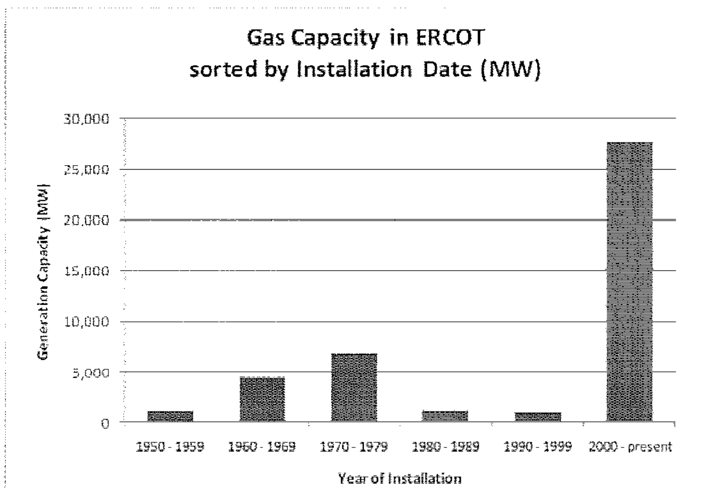
> Q. How would you explain this data in context of Mr. Woo's statement, "Hence, cross hedging is likely to be highly effective when the two spot prices are highly correlated."?
>
> A. After analyzing the data specifically related to GMO's hedging practice, Staff's opinion is that the data shows little or no correlation when placed in context of GMO's actual practices, which involve buying power at hourly market prices cross hedged with NYMEX futures. Staff points out that when actual daily on-peak energy prices are compared to the Last Day Settlement Price ("LDSP"), the method used in valuing the monthly NYMEX natural gas futures settlement price, it reveals this relationship is not correlated. Staff's analysis shown in Figure 3 dramatically demonstrates this lack of correlation when analyzing GMO's actual data and practices.

A: Based on equation (6) and the corresponding discussion, Figure 3 in Eaves' Direct/Rebuttal is incorrect for illustrating the correlation between 16 intra-day hourly on-peak electricity prices on a single day and the single natural gas price for the same day. Figures 1-3 in Section III above show that the daily on-peak price for a given hour can be highly correlated with the daily natural gas price.

Q: What is your opinion on the following Q&A in Eaves' Direct/Rebuttal (p. 20)?

> Q. Can Staff provide any quantification of the impact of natural gas prices on on-peak spot market electricity prices?
>
> A. Yes. In Project No. 21409, Rulemaking Relating to Price to Beat, before The Public Utility Commission of Texas, on page 25, as attached as DEE-7, the Texas Commission reported:
>
>> Reliant and other commenters[sic] asserted that natural gas prices have not historically been perfectly correlated with power prices. In fact, Reliant asserted that since power began trading in ERCOT gas price movements explain only 17% of the variance in electric price movements.

A: My opinion is that the order cited by Eaves is irrelevant here for the following reasons. First, the order was issued on March 20, 2001,[9] more than 10 years ago. Second, gas-fired generation capacity has increased dramatically since then. A 2011 ERCOT report states "[a]s is depicted in the chart [below], over 27,000 MW of gas-fired generation capacity has been installed in ERCOT in the last 11 years…"[10]

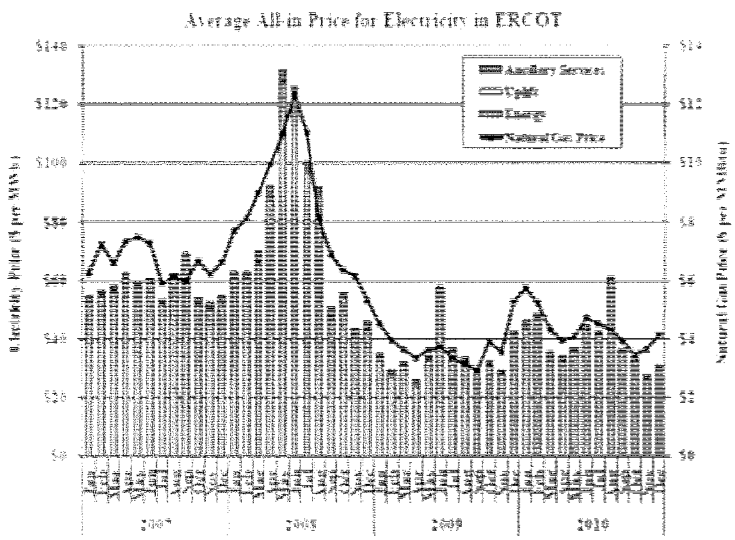


Finally, the low price correlation inferred from the order by Eaves is contradicted by the 2010 market report issued by the independent market monitor: "[T]he changes in energy prices from 2009 to 2010 were largely a function of natural gas price movements. … The figure [below] indicates that natural gas prices were a primary driver of the trends in electricity prices from 2007 to 2010. Again, this is not surprising given that natural gas is a widely-used fuel for the production of electricity in ERCOT, especially among

[9] Available at: http://www.puc.state.tx.us/agency/rulesnlaws/subrules/electric/25.41/21409adt.pdf

[10] ERCOT, REVIEW OF THE POTENTIAL IMPACTS OF PROPOSED ENVIRONMENTAL REGULATIONS ON THE ERCOT SYSTEM (2011) at 7. Available at: http://www.puc.state.tx.us/industry/projects/electric/37897/ERCOT_Review_EPA_Planning.pdf

generating units that most frequently set the balancing energy market prices in the zonal market or locational marginal prices in the nodal market.”[11]



Q: Based on the evidence given above, should NYMEX natural gas futures be used for cross hedging the daily on-peak electricity prices at AMRN and AECI?

A: Yes.

Q: Based on the evidence given above, should NYMEX natural gas futures be used for cross hedging the daily on-peak per MWh procurement cost of a utility that owns natural-gas-fired generation?

A: Yes.

Q: Does this conclude your testimony?

A: Yes, it does.

[11] Potomac Economics, 2010 STATE OF THE MARKET REPORT FOR THE ERCOT WHOLESALE ELECTRICITY MARKETS (2011) at iii; available at: http://www.potomaceconomics.com/uploads/ercot_reports/2010_ERCOT_SOM_REPORT.pdf

BEFORE THE PUBLIC SERVICE COMMISSION
OF THE STATE OF MISSOURI

In the Matter of the Third Prudence Review of Costs Subject to the Commission-Approved Fuel Adjustment Clause of KCP&L Greater Missouri Operations Company	))))	Case No. EO-2011-0390

AFFIDAVIT OF C.K. WOO

STATE OF CALIFORNIA)
) ss
COUNTY OF SAN FRANCISCO)

C.K. Woo, being first duly sworn on his oath, states:

1. My name is C.K. Woo. I am employed by Energy and Environmental Economics, Inc. in San Francisco, California. I have been retained by Great Plains Energy Services Incorporated, an affiliate of KCP&L Greater Missouri Operations Company, to serve as an expert witness to provide testimony on behalf of KCP&L Greater Missouri Operations Company.

2. Attached hereto and made a part hereof for all purposes is my Surrebuttal Testimony on behalf of KC&PL Greater Missouri Operations Company consisting of twenty (20) pages, having been prepared in written form for introduction into evidence in the above-captioned docket.

3. I have knowledge of the matters set forth therein. I hereby swear and affirm that my answers contained in the attached testimony to the questions therein propounded, including any attachments thereto, are true and accurate to the best of my knowledge, information and belief.

Woo Chi-K

C.K. Woo

Subscribed and sworn before me this 17th day of April, 2012.

Notary Public

APRIL M. JOHNSON
COMM. #1868368
NOTARY PUBLIC-CALIFORNIA
SAN FRANCISCO COUNTY
My Comm. Expires Nov. 13, 2013

My commission expires: 11-13-13