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Witness: *John H. Herbert*
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Case Nos.: *GR-2001-382, GR-2000-425, GR-99-304 and GR-98-167 (Consolidated)*
Date Testimony Prepared: *January 15, 2003*

MISSOURI PUBLIC SERVICE COMMISSION

UTILITY SERVICES DIVISION

DIRECT TESTIMONY

OF

JOHN H. HERBERT

MISSOURI GAS ENERGY

CASE NOS. GR-2001-382, GR-2000-425, GR-99-304 AND GR-98-167 (Consolidated)

Jefferson City, Missouri
January 2003

Exhibit No. 6
Case No(s). GR-2001-382
Date 3-12-03 Rptr KS

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BEFORE THE PUBLIC SERVICE COMMISSION

OF THE STATE OF MISSOURI

In the Matter of Missouri Gas Energy's Purchased	)	
Gas Adjustment Factors to be Reviewed In Its	)	Case No. GR-2001-382
2000-2001 Actual Cost Adjustment	)	

AFFIDAVIT OF JOHN H. HERBERT

STATE OF VIRGINIA	)	
184-34-4445	)	ss.
COUNTY OF FAIRFAX	)	

John H. Herbert, of lawful age, on his oath states: that he has participated in the preparation of the foregoing Direct Testimony in question and answer form, consisting of 10 pages to be presented in the above case; that the answers in the foregoing Direct Testimony were given by him; that he has knowledge of the matters set forth in such answers; and that such matters are true and correct to the best of his knowledge and belief.

John H. Herbert

John H. Herbert

Subscribed and sworn to before me this 13 day of January 2003.

Notary Public

My Commission Expires: 8/31/04

TABLE OF CONTENTS

DIRECT TESTIMONY OF

JOHN H. HERBERT

CASE NOS. GR-2001-382, GR-2000-425, GR-99-304 AND GR-98-167

(CONSOLIDATED)

SCOPE OF TESTIMONY 3

MAIN PURPOSE OF UTILITY HEDGING 3

MANAGEMENT OF CUSTOMER PRICE RISK EXPOSURE BY UTILITIES 3

THE IMPORTANCE OF UTILITY PRICE RISK MANAGEMENT 5

TOOLS FOR MANAGING UTILITY CUSTOMER PRICE RISK EXPOSURE BY UTILITIES 6

VOLUMES THAT SHOULD BE HEDGED 9

EXAMPLES OF THE MORE THAN 70 ARTICLES/REPORTS/PROCEEDING PUBLICATIONS DURING GOVERNMENT SERVICE 7

DIRECT TESTIMONY

OF

JOHN H. HERBERT

MISSOURI GAS ENERGY

CASE NOS. GR-2001-382, GR-2000-425, GR-99-304 AND GR-98-167

(CONSOLIDATED)

Q. Please states your name, occupation and business address.

A. My name is John H. Herbert. I am an independent consultant who has been retained by the Staff of the Missouri Public Service Commission. My business address is 2929 Rosemary Lane, Falls Church, Virginia 22042.

Q. In what capacity are you being retained by the Staff?

A. I am being retained as an expert in utility price risk management with extensive and in depth experience in statistical and economic analyses both of which are particularly relevant to this increasingly important part of the utility business.

Q. Please summarize your professional background.

A. I have over 20 years of experience in both the private and public sectors dealing with natural gas and power prices, trends and issues. I have written more than 50 refereed journal articles, authored a history of the development of markets for natural gas in the United States "Clean Cheap Heat" published by Praeger, New York in 1992 and contributed to more than 20 government reports. I joined the Energy Information Administration (EIA) in 1979 and was a senior economist at EIA/DOE for almost 20 years.

While at EIA, I was an outside expert to the Commodity Futures Trading Commission, the National Weather Service and a variety of other government organizations, both national and international, on the natural gas spot and derivatives markets. While at EIA, I was involved in the analysis of the natural gas futures contract markets and related derivatives markets from their inception. Since leaving EIA at end of 1997, I have served more than 30 clients in every sector of the industry. These clients include Lehman Brothers, Questar Corporation, Sempra, the New York Commission and Reliant Minnegasco. My education and professional background is further summarized in Schedule 1.

Q. Do you have experience directly related to the issues in this proceeding?

A. I am employed as an adjunct professor of statistics at Virginia Polytechnic Institute and State University (Virginia Tech) and an adjunct professor of finance at Johns Hopkins University where I regularly teach a course in derivatives and price risk management in their MBA program. I have also written articles for the October 1, 2001 and May 1, 2002, *Public Utilities Fortnightly* on utility hedging programs and price risk management. I provided a workshop entitled "Price and Bill Risk Management for Utilities and Regulators" at the 33rd Annual Conference of the Institute of Public Utilities at Michigan State, and similar workshops for the New York and Virginia Commissions. I presented an invited presentation on the basics of utility price risk management for regulators at the National Association of Regulatory Commissions (NARUC) 2001 meeting on February 26, 2001.

I have provided expert testimony on price risk management programs for regulated utilities at several hearings and have advised on implementing price risk management programs at regulated utilities. My consulting work has ranged from market analysis for hedging programs to the estimation of price volatility for pricing options. I also regularly write special analyses for EPRI (Electric Power Research Institute) and other groups on natural gas and power price risk and the implications of this risk for market participants.

Q. Have you previously filed testimony before this Commission?

A. No I have not.

SCOPE OF TESTIMONY

Q. What is the nature of your testimony?

A. My testimony will address the needs and purposes served by utility hedging and how the utility can satisfy such needs and purposes. Why hedging is an important activity for a utility is also addressed. My testimony also summarizes how utility Companies manage price risk by hedging and how utility failure to effectively manage price risk exposure damages its customers and the integrity of the overall management of its business and its interaction with Commission Staff.

MAIN PURPOSE OF UTILITY HEDGING

Q. What is the main purpose of "hedging?"

A. Hedging is an activity intended to limit the exposure of volumes required by utility customers to price risk or uncertainty in price movements. A natural gas utility in Missouri by hedging a certain volume of its customers' future gas requirements, effectively fixes the cost of this gas. Through the hedge, the company expects to eliminate much of the price uncertainty associated with this gas.

MANAGEMENT OF CUSTOMER PRICE RISK EXPOSURE BY UTILITIES

Q. How can Missouri gas utilities manage their customers' exposure to price risk?

A. Utilities in Missouri support hedging activity in two ways.

First the company puts hedges in place prior to the heating for volumes of natural gas expected to be required during the heating season. The expectation is that these hedged volumes are equal to volumes that necessarily will be required by customers during the heating season. These volumes can be hedged using a combination of stored gas, fixed price forward or futures contracts, or other derivative contracts such as call options. These volumes equal to 30% of normal customer requirements are addressed in Staff witnesses Anne Allee's and Lesa Jenkins' direct testimonies, and the damage to customers from not hedging such volumes for each heating season month is represented by a disallowance.

Second, the company is expected to avoid creating price risk exposure for a heating season month either by not taking actions such as terminating a futures contract position prior to the purchase of a corresponding volume of gas on the cash market or by being unreasonable in its use of storage resources. In particular, in the case of MGE, the Company by withdrawing unexpectedly large amounts of gas for early and generally warmer months increased customers' price risk exposure for later and generally colder months. By withdrawing the large amounts of gas in the earlier months, the company effectively lifted a significant part of the hedge for the later month. As a consequence, additional volumes of gas were exposed to price risk in the later month. Staff witness Jenkins addresses how the large planned and actual withdrawals for earlier heating season months, resulted in substantial price risk exposure for the later heating season. The damage to customers from the company withdrawing large amounts of gas in earlier heating season months is represented by a disallowance explained by Staff witness Jenkins and computed by Staff witness Allee.

Ms. Jenkins' addresses how both the company's particular plans and actions for and during heating season 2000/2001 resulted in this damage.

THE IMPORTANCE OF UTILITY PRICE RISK MANAGEMENT

Q. Why is hedging important?

A. The importance of hedging to the customers of a natural gas local distribution company (LDC) lies in the company limiting the exposure of its customers' requirements to price uncertainty or price risk. When a company does not hedge requirements, or else lifts hedges early and recreates price risk exposure, the damage is felt when price rises. This is particularly important because the natural gas commodity is probably the most price volatile commodity among commonly traded commodities on regulated derivative markets. This large price risk, in large part, explains the great growth in the New York Mercantile Exchange (NYMEX) natural gas futures and options contract markets since their inception more than a decade ago.

LDCs purchase natural gas for resale to customers and, through the regulatory process, are permitted to pass through all such prudent costs incurred. Bills of residential natural gas consumers are a function of gas price and weather. Higher prices for natural gas, other things being equal, cause higher bills for customers. Higher bills cause economic hardship, particularly for low-to middle-income customers. Such customers may face choices between paying the utility service, food, or medical services. Price spikes also makes budgeting for timely payment for utility services more difficult for such customers.

Q. Are there other reasons to manage customers' exposure to price risk?

A. High bills also have a negative impact on LDCs themselves. When customers cannot pay bills in a timely manner, LDCs face increases in arrearages and bad debt, as well as cash flow strains from payment to suppliers for the gas consumed by customers unable to pay. This may require the company to make special requests to the Commission, which can upset the ordinary flow of business between Commission Staff and the Company, and with limited resources often results in a reduction in the timeliness, quality and orderliness of ordinary activity.

Most importantly, a LDC must consider hedging in light of its obligation to act prudently in purchasing gas for its customers. After the price spike in the 1996/1997 heating season, the Missouri Commission supported hedging programs at three LDCs, including MGE, to mitigate the impact of price spikes on customers. This history is discussed in the testimony of David Sommerer.

TOOLS FOR MANAGING UTILITY CUSTOMER PRICE RISK EXPOSURE BY UTILITIES

Q. Please describe the tools a LDC can use to manage its customers' exposure to price risk.

A. LDCs have three general means to manage price risk: fixed price contracts; physical storage of gas for future delivery; and financial instruments, all of which can be matched to expected future needs for and during the heating season.

Fixed price contracts are agreements with suppliers at a firm, fixed price for delivery of specified volumes at a specified future time. The price paid for gas at the time of delivery is known in advance.

Most LDCs, including MGE, purchase and take delivery of gas in the April through October period, and inject the gas into storage facilities. The gas is withdrawn from storage for delivery to customers in periods of peak usage, typically November through March.

Buying gas for storage fixes the cost (including the cost of storage) at the time of delivery, thus serving as a hedge. MGE's storage gas as a way to reduce price risk exposure is addressed in both Lesa Jenkins and Anne Allee testimony.

Financial instruments used to hedge the price risk for natural gas requirements of utility customers are principally futures contracts and call options.

Q. Please describe the use of futures contracts.

A. A futures contract requires a holder to buy or sell a commodity at a predetermined delivery price for a specified future delivery period if the company with the futures contract position does not close out the position prior to the close of the futures contract market for the delivery month. Closing out a position means entering into a transaction opposite from the original transaction for the same delivery month. If the utility opened or 'bought' a natural gas futures contract for November delivery in a prior April, it could close out the position by 'selling' a November contract prior to the end of October when the futures contract market for November delivery terminates; that is there is no more trading of contracts for November delivery after that date.

The company would probably close out the position near or during bid week for November in late October when it expects to purchase a volume on the cash bid week market. The volume purchased on the cash market is expected to correspond to the volumes associated with the futures contract position. The company expects the price on the futures market to be very close to the price on the cash market. Thus, if the price of natural gas for the November futures position was $2.50 and the price in late October for November delivery was $4.00, the Company in closing the futures market position would gain $1.50 by selling at $4.00 what it bought at $2.50. The company would apply this $1.50 gain to the

$4.00 purchase of gas on the cash market. In this way the effective cost of the gas to the company would be fixed at $2.50.

Q. Please describe "options."

A. A contract that gives the utility the right but not the obligation to buy a commodity at a set price (usually called a strike price or cap) is known as a call option. Such contracts, when purchased on the NYMEX market, reference the terms of NYMEX futures contract. Financial instruments can be used in combination to achieve specific hedging goals. Definitions are provided in the glossary of the report attached as Schedule 2 to this testimony.

Q. How can a LDC reduce its customers' exposure to price risk?

A. It is relatively easy for a utility wanting to fix the forward cost of natural gas for the heating season months to do this by injecting gas into storage and/or by entering into either fixed price forward contracts or futures contract positions for each of the heating season months. In this way the Company effectively reduces the exposure of its customers to price risk for each month of the heating season – the company knows prior to the heating season by how much it has reduced its customers price risk exposure for each month of the heating season. This is a hallmark of a well-managed plan.

Each month is treated separately because it is standard business practice in the gas industry and on the futures contract market to make decisions about acquiring gas on a monthly basis for a forward delivery month.

It is worth noting that futures contract prices work particularly well as an estimate of the cost of gas. This is because the futures price at the Henry Hub on the final day of trading of the futures contract is usually very highly correlated with bid week prices for monthly deliveries at most other pricing locations in Louisiana, Texas and in the Mid-continent producing area.

VOLUMES THAT SHOULD BE HEDGED

Q. How much gas should be hedged?

A. As part of an effective hedging program, it is necessary for a utility to determine the volumes of natural gas it would necessarily be purchasing during each of the heating season months. These are the volumes that can be effectively hedged. In the report *"The General Report on Analysis of Gas Supply and Hedging Practice by Regulated Natural Gas Utilities in Missouri"* March 2002 prepared for the Staff of the Missouri Commission these amounts were discussed and designated as minimum purchase requirements or monthly requirements during warmest heating season months. These monthly requirements for many distribution companies are approximately 70% of normal requirements or requirements under normal heating degree-days. That report is attached as Schedule 2 to this testimony.

As part of an effective hedging program a utility is also expected not to increase its price risk exposure of its customers by decisions made for and especially during the heating season. It is crucial that utilities particular plans for storage for each heating season month and its decisions during heating season months do not combine in such a way to create large and unreasonable amounts of price risk exposure for its customers during the heating season.

Q. Are there limits to the volumes that an LDC can hedge?

A. It is possible that hedging the previously mentioned 70% values would be too large for a distribution company that had absolutely no flexibility in its contracting practices and operating environment. These companies don't have flexible swing contracts, don't have storage into which they can inject during the heating season and also have strict daily balancing requirements on their pipeline system. Of course, there are few, if any, distribution companies that are this inflexible in their operating environment and contracting practices. Nonetheless, a very conservative estimate of 30% of normal requirements was chosen as the minimal volume to hedge. This percentage was viewed as being near the lower range of feasible percentages to account for any inflexibility across companies in Missouri and to account for the fact that utility companies are new to hedging and consequently may want to proceed cautiously in the volumes they hedge.

Q. Does this conclude your direct testimony?

A. Yes, it does.

JOHN H. HERBERT
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Falls Church, Virginia 22042
jhh1@msn.com **phone: 703-532-4544 fax: 703-940-0400**

CONSULTING EXPERIENCE:

- **1998 - Present – Consultant and Adjunct Professor of Statistics, Virginia Polytechnic Institute & State University (Virginia Tech) Graduate Center and of Finance, Johns Hopkins University.** Regularly provides expert advice and testimony on price risk and supply management and market analysis using common sense and financial, economic and statistical tools for clients (see list below).

1. SAIC, Inc.
2. Lehman Brothers.
3. Foster Associates.
4. U.S. Postal Service.
5. Sempra Corporation.
6. Questar Corporation.
7. Thompson Learning.
8. Reliant Minnegasco.
9. Market Hub Partners.
10. PG&E Energy Trading.
11. Merklein & Associates.
12. Johns Hopkins University.
13. Energy Intelligence Group.
14. Louis Dreyfus Natural Gas.
15. Falcon Natural Gas Storage.
16. Public Utilities Reports, Inc.
17. First Economic Analysis, Inc.
18. Decision Analysis Corporation.
19. Law Firm of D'Arcy & Deacon.
20. Natural Gas Supply Association.
21. City of Chicago Law Department.
22. Electric Power Research Institute.
23. Resource Data International (RDI).
24. Louis Dreyfus Plastics Corporation.
25. Missouri Public Service Commission.
26. Energy Security Analysis, Inc. (ESAI).
27. Department of Commerce, Minnesota.
28. FT Energy, a division of Pearson, PLC.
29. Virginia State corporation Commission.
30. Resource Dynamics Corporation (RDC).
31. Office of the Consumer Advocate of Ohio.
32. Public Utilities Board of Manitoba, Canada.
33. Institute of Public Utilities, Michigan State.

34. Pennsylvania Office of the Consumer Advocate.
35. State of New York, Department of Public Service.
36. Haddington Ventures (developers of Lodi Gas Storage).
37. Interstate Natural Gas Association of America (INGAA).
38. Brent Friedenberg & Associates Calgary, Alberta Canada.
39. Inventory Management & Distribution Company Inc. (IMDC).
40. Energy Information Administration, US Department of Energy.
41. Wharton Econometric Forecasting Associates (WEFA), London.
42. Statistics Department, Virginia Polytechnic Institute & State University.
43. Systems Performance Laboratory, Virginia Polytechnic Institute & State University.

EXAMPLES OF PRODUCTS AND SERVICES PROVIDED CONSULTING CLIENTS.

- ✓ **Evaluate hedging and supply management programs.**
- ✓ **Expert testimony** in a case, which established that a utility was ***trading***, and not ***hedging*** with ***derivatives***. As a consequence company had to absorb a multi-million dollar cost. Provided expert advice at other hearings on cost of service and price risk management issues.
- ✓ **Provide advice to trading company on expected future price behavior.**
- ✓ **Provide fee seminars** on *"Price Risk and Supply Management for Utilities and their Regulators."*
- ✓ **Provide graduate course on derivatives** for Johns Hopkins University MBA programs.
- ✓ **Evaluate utility price and supply risk management programs** for a State Regulatory Commission.
- ✓ **Prepare a methodology for determining damage** caused by a company not hedging price risk.
- ✓ **Present expert testimony** on the damage caused by a company because it did not follow its own price risk management plan.
- ✓ **Provide fee presentations** on the ***current and future state of the gas industry*** for Wall Street analysts and senior staff at companies.
- ✓ **Provide statistical/econometric support** for ***cost analyses***, ***rate setting***, ***price*** and ***load analyses*** and ***forecasting*** for a variety of clients
- ✓ **Wrote report demonstrating that changes in natural gas prices were not causing changes in wholesale power prices in California.**
- ✓ **Provide expert testimony at a hearing**, which resulted in a cost of service reduction from a re-specification of the company's equation for peak day load.
- ✓ **Provide expert testimony** for a hearing and advice on ***value of a company's rights to storage assets.***
- ✓ **Provide expert advice** to senior management on determining the ***strategic value of proposed investments*** using the behavior of spot prices.
- ✓ **Provide fee presentations** on ***price risk management***, ***price volatility and opportunities*** provided by spark spreads to fuel managers at electric utilities. .
- ✓ **Provide expert testimony at** a hearing and advice on the value of a company **capacity release program**.

- ✓ **Provide expert advice on the possibility of using *forward curves*** from futures markets as an alternative to using ***forecasts from econometric models***.
- ✓ **Provide technical support** on using ***energy price volatility*** to determine ***value of operationally flexible storage and generation assets*** for several clients.
- ✓ **Wrote report** for a company on ***market clearing prices*** for the services from a proposed storage investment, which supported the company moving forward on the investment.
- ✓ **Provide expert testimony and advice** to utilities and commission staff in several states on price risk, supply and ***arbitrage management*** and benefits from such management.
- ✓ **Develop methods for estimating** production of natural gas in producing regions of the United States from such variables as drilling, industry employment and price.
- ✓ **Wrote material for a chapter** on recent ***mergers and acquisitions in power and natural gas industries*** for a report published in 1999 by Wharton Econometric Forecasting Associates, London.
- ✓ **Wrote** *"ABCs of Trading BTUs – A Guide to the Convergence of Prices and Services in the North American Natural Gas and Electricity Markets"* published by Energy Intelligence Group, publishers of Natural Gas Week, Petroleum Intelligence Weekly, World Gas Intelligence and Oil Daily.
- ✓ **Designed and wrote sections of a study** for the Electric Power Research Institute (EPRI) Fuel *and Power Price Volatility and Convergence."* Contributed to other EPRI reports on new market developments.
- ✓ **Evaluate** Energy Information Administration (EIA) ***short-term natural gas forecasting capability***.
- ✓ **Develop methods** for evaluating the reliability of ***power sales*** information of industrial customers for the EIA.
- ✓ **Develop methods for determining *value of distributed generation*** technologies for EPRI.
- ✓ **Develop approach** to evaluate the ***financial performance and market power*** of ***strategically significant companies*** in the domestic energy industry.
- ✓ **<u>Wrote articles for fee on a wide variety of topics (see below)</u>**.

<u>EXAMPLES</u> OF FEE ARTICLES WRITTEN SINCE LEAVING GOVERNMENT SERVICE

FT Energy

"Southwest boasts appealing but volatile gas market", Regional Report, March 19, 1999.
"Futures, release markets guide auction proposal", Special Report, June 11, 1999.
"Gas to help eastern Canada, Northeast picture", Regional Report, July 16, 1999.
"TCPL, Westcoast dominate despite weaknesses", Special Report, August 25, 1999.
"Chicago prices stabilize under Alberta's influence", Analysis, November 19, 1999.
"Henry Hub spike could mark new price trend", Regional Report, May 26, 2000.
"California prices track higher relative to supply basins", Regional Report, September 1, 2000.

"Chicago-area power generators encounter gas cost dilemma", Regional Report, October 6, 2000.
"Price Gyrations play havoc with hedging", Special Report, December 1, 2000.
"Gas, oil price behavior unrelated to competition", Special Report, April 6, 2001.
"El Paso San Juan prices behave like no others", In Focus, April 12, 2001.
"Calif. Gas and power prices: Joined at the hip?", In Focus, May 2, 2001.
"Traders try to cope with Calif Price disconnect", In Focus, May 16, 2001.
"Premium spark spread points to value of Rockies", June 1, 2001.
"Calif. Prices exceed transport, wellhead costs", June 7, 2001.
"Prices at Calif. Trading hubs reveal inefficiency", June 19, 2001.
"Uncertainty throws Henry, Chicago for a loop", In Focus, July 11, 2001.

Brent Friedenberg's Canadian Natural Gas Focus

"The Times They are A Changin", June 1999.
"Northeast Natural Gas Market", August 1999.
"U.S. Rockies, Nevada and U.S. Northwest – Worth Watching", December 1999.

Public Utilities Fortnightly

"The Gas Merchant Business: Still a Place for LDCs?", July 1, 1999.
"Northeast Energy Markets: Windfall or Washout", Jan 1, 2000.
"Alliance Gas Pipeline: Early, Late, or Just in Time?", November 15, 2000.
"Gas Fired Future: Boom or Bust?", April 1, 2001
"Natural Gas Hedging: A Primer for Utilities and Regulators. *What commissions need to learn. What LDCs should know already*", October 1, 2001.
"Utility Risk Management – Success or Failure", May 1, 2002.
"Power Prices Today: Growing More Unpredictable", October 1, 2002.
"Energy Technology Special Column", January 1.2003.

EPRI (Electric Power Research Institute) Energy Markets & Generation Responses Series

"$4.00 Gas! Are Forward Price Curves from Futures Markets Substitutes for Forecasts from Models?" June 2000.
"Lower Demand at Higher Prices – A Helpful Factor in Today's Very Tight Natural Gas Market", January 2001.
"Gas Price Volatility – A Practitioner's Perspective", February 2002.

Energy Security Analysis Inc (ESAI) Subscription Service

Natural Gas Stockwatch. April-September 2000, a fee publication of analysis and forecasting for selected industry clients.

EXAMPLES OF PAST PROFESSIONAL EXPERIENCE BEFORE PRIVATE PRACTICE

***1979 - 1997*: Energy Information Administration, U.S. Department of Energy**
At the EIA, I initially worked in the Office of Analysis Oversight which office provided statistical and economic consulting services to other offices in the EIA. In the early 1980s I switched to the Natural Gas Division and worked on **estimating natural gas demand and on the economic implications of the deregulation of the natural gas industry**. During the 1990s I began to specialize in **new contracting practices in the natural gas industry, the natural gas futures and related derivative markets and the economics of natural gas storage**. I also regularly made **invited presentations** to the industry and to the statistics and economic professions. I was also an **advisor on the economics of natural gas industry** to the Commodity Futures Trading Commission and to other government organizations both national and international. I also provided **expert advice at public meetings** at the Illinois Commerce Commission and at other Commissions and at strategic planning meetings of natural gas companies. During my tenure at the EIA I wrote more than **50 refereed journal articles**, contributed to more than 20 government reports to include **seminal contributions to EIA's Natural Gas Issues & Trends,** which addressed all new issues and industry trends. **Wrote "The Value of Underground Storage in Today's Natural Gas Industry", an industry standard publication.**

- **1989 - 1997: Office of Oil and Gas.** I addressed all aspects of the natural gas industry from the production at the wellhead in the south central United States to consuming markets in Northeastern United States. Regularly quoted in Public Utilities Fortnightly, trade press, Bloomberg, the Wall Street Journal, and other newspapers. Involved in explaining the use of futures options and swaps for hedging energy price risk since inception of NYMEX natural gas futures market in 1990.

- **1982 - 1989: Office of Oil and Gas.** Responsible for all analyses of natural gas demand within the Office Of Oil and Gas. Principal reviewer of both governmental and non-governmental analyses of natural gas demand for the EIA. Developed procedures for estimating the current price of residential natural gas. Supervised computer programmers in the development of natural gas sales data system that integrated data files with statistical/graphical procedures. Directed the implementation of telecommunication technologies to update and maintain files and also to efficiently produce publication quality graphs of current data. Developed forecasting equations for natural gas demand by sector, which were used by EIA to produce short-term forecasts.

- **1981 - 1982: Office of Energy Markets and End Use.** Wrote and edited chapters of EIA's principle forecasting volume - The 1982 Annual Report to Congress.

- **1979 - 1981: Office of Analysis Oversight and Access.** Senior Analyst in data, model and forecast documentation, verification, and assessment. Technical project officer for evaluations of major models used for forecasting and analyses of energy demand, coal supplies and nuclear generation. Organized assessment projects at MIT and at the

National Bureau of Standards to establish acceptance guidelines for forecasting models. Coordinated data and model documentation and assessment activities with the Offices of Coal and Electrical Power Analysis, Nuclear Energy Analysis, and Energy Use Analysis. Prepared testimony for Congressional Subcommittee Hearings.

1977- 1979: Transportation and Economic Research Associates. Directed and reviewed assessments of energy data and models by staff members. Conducted in-house seminar on data analysis techniques. **Planning Research Corporation.** Directed staff in the development of an internal Department of Energy documents 'A Strategy for Solar Energy'. As a consultant to the Solar Energy Domestic Policy Review, advised on the statistical and economic basis of forecasted changes in fuel shares by sector of the economy. Planned and directed economists, engineers, and operations researchers in the analysis of a wide variety of energy policy issues. Evaluated the economic and statistical characteristics of many of the larger energy models for PRC professionals.

EXAMPLES OF MORE THAN 50 REFEREED JOURNAL PUBLICATIONS

"Hidden Messages in Some Key North American Energy Prices", Energy Economics, 21, 1999, 471-483.

"US Natural Gas Markets - How Efficient are They?", Energy Policy, 1996, 24, 1, 1-5.

"Trading Volume, Maturity and Natural Gas Futures Price Volatility," Energy Economics, 17, 1995, 293-299.

"Measurement Errors in Introductory Econometric Courses," Eastern Economic Journal, 15, 1995, 97-108.

"An empirical note on regressions with and without a poorly measured variable"; co-authored, The Statistician, 37, 1988, 293-298.

"Robust variance estimation in linear regression", co-authored, Journal of Applied Statistics, 15, 1988, 341-345.

"A data analysis of sales of natural gas to households in the U.S.A.", Journal of Applied Statistics, 13, 1986, 199-211.

"A Data Analysis of Residential Demand for Natural Gas Using Step-down Multiple Comparison Tests", Applied Stochastic Models and Data Analysis, 4, 1988, 149-157.

"Regression Diagnostics - a review", Statistica Neerlandica, 34, 1980, 161-164.

"Data matters - specification and estimation of natural gas demand per customer in the Northeastern United States", Computational Statistics and Data Analysis", 5, 1987, 67-78.

"Demand for natural gas at the state level - twenty years of effort", Review of Regional Studies, 17, 1987, 79-87.

"Noisy Data and Uncertain Coefficients", Energy Journal, 8, 1988, 167-169.

"Institutional and economic factors in residential gas markets in the Northeastern United States between 1960-1984", Energy, 13, 1988, 211-216.

"A review of some commonly used methods of estimating petroleum resource availability", Energy Sources, 6, 1982, 293-320.

"Energy forecasting - the science of the art", Energy Economics, 4, 1982, 208-210.

"Frameworks for modeling learning on the supply side of solar technology market penetration studies", Energy, 6, 1981, 159-166.

"Some comments on market penetration, innovation, and learning - the case for solar", Technological Forecasting and Social Change, 13, 1979, 259-266.

EXAMPLES OF THE MORE THAN 70 ARTICLES/REPORTS/PROCEEDING PUBLICATIONS DURING GOVERNMENT SERVICE

"Gas Storage - What moves the Market & what doesn't?", Public Utilities Fortnightly, December 1, 1997, 46-51.

"US Markets Ponder a Decade of Hubs, Market Centers and Trading of Gas", Gas Matters, July 1997, 26-31.

"Gas Price Behavior: Gauging Links Between Hubs and Markets", Public Utilities Fortnightly, April 1, 1996, 27-30.

"Spot and Futures Markets - Will Britain follow the US?", Gas Matters, January 1996, 13-21.

"Of Vital and Strategic Importance - Underground Natural Gas Storage", Public Utilities Fortnightly, October 15, 1995, 32-35.

"Recent Trends in Natural Gas Prices", Natural Gas Monthly, co-authored, December, 1997, 7-21.

"Contracting for Natural Gas Supplies", Natural Gas Monthly, co-authored, February 1994, 1-17.

"The Expanding Role of Underground Storage", Natural Gas Monthly, co-authored, October, 1993, 1-14.

"Natural Gas Futures Contract Market--The First 2 Years", Natural Gas Monthly, November, 1992, 1-11.

"An Overview of Recent Developments in the Underground Storage Market", Natural Gas Monthly, co-authored, April 1991, 1-9.

"Recent Trends and Regional Variability in Underground Natural Gas Storage", Natural Gas Monthly, co-authored, February, 1991, 1-10.

"Underground storage of natural gas", Natural Gas Monthly, co-authored, July, 1987, 9-22.

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THE GENERAL REPORT ON

ANALYSIS OF GAS SUPPLY AND HEDGING PRACTICE

BY REGULATED NATURAL GAS UTILITIES IN MISSOURI

BY

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TABLE OF CONTENTS

EXECUTIVE SUMMARY 5

Utilities Do Not Have Well-Organized Price Risk Management Plans 5

Utility Price Risk Management Has Unique Problems 6

Reliable Price Volatility Estimates Are Very Useful Numbers For Evaluating Price Risk Management Decisions 6

It Is Reasonable To Expect That Utilities Should Have Made Price Risk Management Decisions For Heating Season 2000/2001 To Reduce Utility Customer Price Risk Exposure 7

Volume Risk Is A Challenging Problem For A Utility Price Risk Management Program 8

The Value Of Available Storage Service As A Hedge Needs To Be Evaluated 9

There Is A Need For Consumer Surveys Regarding Price Risk Management Services 10

Reporting Requirements Are Crucial For Determining The Prudency Of Price Risk Management Decisions 10

Improvements In Approaches Going Forward Are Clearly Possible 12

Reasonable Steps That Could Have Been Undertaken By All Utilities In Missouri That Could Have Resulted In Price Mitigation During Heating Season 2000/2001 13

I. INTRODUCTION 14

1.1 Natural Gas Companies And The Hedging Of Price Risk 15

1.2 Large Users Of Natural Gas Hedge Price Risk 16

1.3 Special Price Risk Management Problems Facing Utilities 17

1.4 Overview Of Report 18

II. HISTORY OF RECENT NATURAL PRICE BEHAVIOR 20

2.1 Introduction 20

2.3 Price Behavior And Storage Levels Prior To Heating Season

2000/2001 21

2.4 More On Price Behavior In Year 2000 During The Injection/Contracting Season 22

III. MISSOURI UTILITY PRICE RISK MANAGEMENT PROGRAMS AND THEIR ABILITY TO RESPONDTO PRICE RISK AND MARKET CONDITIONS DURING YEAR 2000 24

3.1 Overview 24

3.2 Recording And Reporting Information On Price Risk Transactions And Plans 27

3.3 Price Risk Management Steps Taken By Companies 28

3.4 Some Price Risk Management Programs Yielded Profits To Companies 30

IV. APPROACHES TO HEDGING BY NON-MISSOURI UTILITIES 33

4.1 Overview 33

4.2 The Passing On Of Gas Costs And Risks To Consumers And Other Issues 34

4.3 Approaches To Price Risk Management By Non-Missouri Utilities Prior To Year 2000 35

4.4 Steps For A Hedging Program 40

4.5 Steps Taken By Non-Missouri Utilities In Hedging Programs 41

4.6 Steps Taken By Non-Utilities In Hedging Programs With An Emphasis On Industries Relevant To The Gas Utility Industry 43

V. CONTRACTING AND STORAGE PRACTICES AT MISSOURI UTILITIES RELATED TO HEDGING 48

VI. HEDGING GUIDELINES 52

6.1 Introduction 52

6.2 Price Volatility Analysis 52

6.3 Storage And Market Analysis 55

6.4 Options Markets Provide Market Intelligence ....

6.5 Futures Contracts And Fixed Price Forward Contracts 59

6.6 Bookkeeping 59

6.7 Statistical Analysis 60

6.8 Volumes To Hedge 63

6.9 Storage As An Economic Hedge 66

6.10 The Need For Consumer Surveys 69

VII. PRUDENCE ISSUES 70

VIII. IMPROVEMENTS IN APPROACHES GOING FORWARD 84

8.1 Introduction 84

8.2 Measuring Price Risk 84

8.3 Measuring Price Risk Exposure 86

8.4 Storage As A Hedge 89

8.5 Material On Price Risk Management 90

8.6 Market Analysis 90

8.7 Hedging Effectiveness 91

8.8 Reporting Requirements 96

IX. REASONABLE STEPS THAT COULD HAVE BEEN UNDERTAKEN BY ALL UTILITIES IN MISSOURI THAT COULD HAVE RESULTED IN PRICE MITIGATION DURING HEATING SEASON 2000/2001 98

X. CONCLUSIONS 100

GLOSSARY 101

Price And Bill Risk Management Glossary For Natural Gas Utilities And Regulatory Commissions 101

EXECUTIVE SUMMARY

Price risk in the natural gas industry is greater than in any other commodity business except for power. Accordingly the number of companies using the market for price risk management contracts and addressing price risk management has flourished within the last 10 years.

Effective price risk management by companies has also paved the way for them to better plan the use of assets and to do a better all around job of purchasing natural gas to assure a reliable supply at reasonable rates. These benefits already obtained by natural gas producing and marketing companies are major reasons for utility companies to support an effective price risk management program.

UTILITIES DO NOT HAVE WELL-ORGANIZED PRICE RISK MANAGEMENT PLANS

Yet, utilities generally have not developed well-organized, comprehensive plans to effectively control the risk from volatile prices faced by consumers. The lack of comprehensive plans and effective control of price risk is, in part, explained by the difficulty of implementing effective programs because the utility must address not only price risk or volatility but also volume risk or volatility. Hence, they cannot directly adopt many of the approaches used by natural gas producers and marketing companies and non-utility companies because there are important differences in their risk exposure and business practices.

Nonetheless, it is increasingly clear to legislatures, commissions and utility customers that more of a cure is necessary. In other words, the price risk needs to get reduced in a well-managed way.

UTILITY PRICE RISK MANAGEMENT HAS UNIQUE PROBLEMS

Today, utility companies and the commissions regulating them need to come to terms with managing price risk. Yet, commission staff not only need to understand price and volume risk but they also need to be on their guard for agency problems.

Agency issues are particularly important when the utility is part of a corporation with a significant non-regulated arm and when the utility is, in effect, the buying agent for many customers. There is always the chance that the arms length regulated customer paying the cost of the business, and ultimately bearing the price risk, is not the focus of attention in a price risk management decision.

RELIABLE PRICE VOLATILITY ESTIMATES ARE VERY USEFUL NUMBERS FOR EVALUATING PRICE RISK MANAGEMENT DECISIONS

Large price movements include difficult to predict movements in the overall level of price. They also include ordinary price volatility or price risk.

Volatility numbers are usually expressed as percentages and are convenient to have available. For example, if the current price is $3.00/MMBtu and the monthly price volatility is 10% this should indicate that the chance is large that the price over the next month is likely to be 10% greater or 10% less than $3.00 or $2.70 to $3.30. On the other hand if the price level is $6.00/MMBtu, the relevant range is $5.40 to $6.60/MMBtu.

IT IS REASONABLE TO EXPECT THAT UTILITIES SHOULD HAVE MADE PRICE RISK MANAGEMENT DECISIONS FOR HEATING SEASON 2000/2001 TO REDUCE UTILITY CUSTOMER PRICE RISK EXPOSURE

Leading up to heating season 2000/2001 natural gas supplies were tight and price volatility was at least as large as in the previous year. Thus, it would have been prudent for Missouri utilities to have sufficient (TO DO WHAT???) storage, fixed price contracts, futures contract positions or call options in place during the heating season. Moreover, if the risk exposure of their customers, as measured by the expected volumes exposed to price risk, increased during the heating season they should have addressed this, as well.

It is reasonable to expect that utilities could have sought outside advice, altered plans or taken additional steps before and during the heating season.

Some companies did not do much to reduce their customers' price risk prior to and during the early heating season 2000/2001 for several reasons. Some did not think prices would go higher. Other companies considered the premium associated with locking in prices to be too high. Hence their customers were left completely exposed to price risk.

Some companies had fixed price contracts, which provided their customers with some price risk protection, but the volume of fixed price contracts seemed small when compared to expected purchases of gas during the heating season.

For example, a company's customers' requirements even during a warmest January are equal to 400,000 MMBtu. If the company has fixed price contracts amounting to 50,000 MMBtu, expected storage withdrawals amounting to 50,000 MMBtu and no other hedging instruments then the company's customers had 300,000 MMBtu of price risk exposure that could have been readily brought under control with a well-organized plan.

Although most companies seemed well aware of the changing market conditions especially the low levels of aggregate national storage, few responded to this as the heating season unfolded even when they had the capability to respond.

VOLUME RISK IS A CHALLENGING PROBLEM FOR A UTILITY PRICE RISK MANAGEMENT PROGRAM

It is also difficult to obtain specific lessons from other industries to guide utilities in the development of hedging programs. This is primarily because volume risk in these other industries is much smaller.

Owners of orange groves in some ways share a problem with gas utilities. They also find it difficult to forecast the relevant volumes to hedge because frost and other difficult to measure weather events may significantly influence the size of their crop.

The bright side for the utility when compared to the orange grove owner is that the utility owner has an easier time figuring out minimal requirements (equivalent to minimal yields to orange grove owners). This is possible because the relationship between use and weather is well understood and useful historical data is readily available for the type of weather data relevant to the natural gas utility industry. Thus, the utilities can at least plan to hedge volumes required during warmest heating season months.

On the other hand for most business the volume to hedge is easy. Most businesses have a very good idea of their future purchases or sales. This is because for most businesses the level of activity is not regularly dependent on a factor that is as difficult to predict 9, 6, 3 or 1 month in advance as the weather.

A food company manager knows with some certainty much how many loaves of bread the company expects to sell in December. Therefore, the company also knows how many futures market wheat positions to open to hedge this future purchase.

A Company such as Kraft also knows pretty well in September how much Maxwell House coffee it can expect to sell in December. Hence, it is relatively easy for it to hedge the cost of coffee using the futures market.

Information about minimal volumes or requirements that will necessarily be purchased by a utility during a month is important for a hedging program and should be known and reported by the utility.

During the heating season minimal purchase requirements or expected purchases of gas that will be required to satisfy customer demands by purchase rather than from storage should be tracked at all times.

THE VALUE OF AVAILABLE STORAGE SERVICE AS A HEDGE NEEDS TO BE EVALUATED

Most companies assume that the storage services they have access to provide them with a good hedge. The common belief is that storing gas in the off season necessarily puts a utility in the position of being able to avoid the assumed high cost of gas during the heating season. This, however, needs to be evaluated.

One aspect of storage requires special attention in a price risk management plan. The more operationally flexible and the higher the daily injection and withdrawal rates the greater the ability of a company to avoid price spikes or to take advantage of price drops during the month.

THERE IS A NEED FOR CONSUMER SURVEYS REGARDING PRICE RISK MANAGEMENT SERVICES

An easily overlooked question is whether a utility would want to have a price risk management program for all of its regulated customers. For example, the company may have regulated fuel-switching customers. Because these customers have the capability to switch fuels, which is a type of physical hedge, they may not want or require hedging services.

There is a way to address the question of which customers want price risk management services. There is also a way to address the question of the degree to which customers want price and bill risk management and are willing to pay for the reduction in price risk exposure through a price risk management program. The way is through a consumer survey.

REPORTING REQUIREMENTS ARE CRUCIAL FOR DETERMINING THE PRUDENCY OF PRICE RISK MANAGEMENT DECISIONS

Reporting requirements are paramount for effective management and oversight. Overall a company should specify an entrance and exit strategy for opening hedging positions, identify accounting rules being used to record such transactions and identify internal controls for maintaining the integrity of the program. At a more general level there should be a clear reporting of:

1. the company view of market supply and demand conditions;
2. the volume exposure under different weather conditions;
3. the company view of overall market price volatility;
4. hedging effectiveness of the hedging instruments used by the company;
5. credit analysis of counter-party risk especially for longer term contracts obtained from marketing companies;
6. an evaluation of storage as an economic hedge.

As part of a prudence review commission staff might evaluate how a particular utility is stacking up in terms of a hedging program by comparing utility:

1. Consideration of price risk exposure;
2. Price risk management plans;
3. Consideration of alternative approaches to hedging price risk;
4. Estimates of price volatility
5. Documentation of price risk management transactions; and
6. Evaluation of hedging tools.

Another important consideration for a Utility Commission to consider is the resources available to a company to establish and maintain a utility risk management program. The size and type of resources available to a company would influence the size and type of the price risk management program a company might be expected to have.

IMPROVEMENTS IN APPROACHES GOING FORWARD ARE CLEARLY POSSIBLE

The response of most Missouri utilities to the price risk faced by their customers varied greatly during year 2000. Some set up supply planning/purchasing programs for the markets where they purchase natural gas that included a consideration of price risk mitigation, at least to the extent that they choose contracts that were designed for such purposes.

Some companies had staff attend price risk management seminars. However, the majority of companies have not had staff attend seminars, did not include price risk consideration as part of their purchase decisions or did not enter into contracts with price mitigation features in a well organized way.

Since all companies have staff that are familiar with Excel and also track price information from Gas Daily and/or Inside FERC and/or use these prices in contracts, they can measure price risk in a standardized way on a regular basis. They can also report this information and other risk management related information in semi-annual reports – one at the end of the season and the other prior to the heating season following the reporting standard previously discussed.

In addition it is important for all utilities to:

Report Customer Price Risk Exposures;

Evaluate the Value of Storage as a Hedge;

Develop a Price Risk Management Capability;

Prepare Market Analyses on a Regular Basis;

Evaluating Hedging Effectiveness Using Standardized Methods.

REASONABLE STEPS THAT COULD HAVE BEEN UNDERTAKEN BY ALL UTILITIES IN MISSOURI THAT COULD HAVE RESULTED IN PRICE MITIGATION DURING HEATING SEASON 2000/2001

In general, there were many measures and steps that Missouri Utilities could have undertaken but didn't and that could have resulted in better job of price risk management during heating season 2000/2001. Three steps that could have been taken by all utilities, which would have been reasonable, are:

1. Utilities could have entered into futures contract positions or fixed price forward contracts for minimal purchase requirements. These are purchases that would have been required even if each heating season month had turned out to be especially warm.

2. Utilities could have investigated purchasing call options to guard against peak prices near the beginning of the heating season when it became increasingly clear that the price level was likely to rise during the heating season or price spikes were likely to occur and to recur or persist during the heating season. Thus, there was little chance utilities would be able to avoid these price increases by increased use of storage or by other means. An explanation that options weren't used because they became increasingly expensive must be carefully scrutinized. As with any insurance premiums are large when the risk is great. High premiums do not preclude the use of call options.

3. Finally, as the heating season evolves, the company may have to put in place additional hedging positions. If the company withdraws unexpectedly large amounts of gas from storage in November and/or December, which leaves its customers exposed to significant price risk in January, the company may need to take additional hedging positions in November and December to reduce this exposure. It must be understood that hedging for a utility is first of all about volumes and these volumes need to be addressed one month at a time and as each heating season month passes the future heating season months need to be reconsidered.

I. INTRODUCTION

Price risk in the natural gas industry is greater than for any other commodity business except for power. Yet, the futures markets for power have failed while the futures market for natural gas has been a great success. In fact, the number of natural gas futures market contracts (open interest) in 2000 and 2001 grew significantly and is now as large as crude oil and corn, the two other largest commodities markets in terms of number of contracts.

The futures markets for power in the United States have failed, in part, because it is difficult to devise standardized contracts that support the development of hedging instruments in power. Yet, the variety of hedging instruments that have surfaced within the natural gas industry is enormous.

The great success of hedging instruments in the natural gas industry confirms the capability of the industry to produce a variety of standardized risk management contracts that are acceptable to a large number and variety of companies. Accordingly the number of companies using the market for price risk management contracts and addressing price risk management has flourished within the last 10 years. Effective price risk management by companies has also paved the way for them to obtain risk free returns or arbitrage gains and to better plan the use of assets. Some consider these several additional benefits to be the major reason for a utility to support an effective price risk management program.

1.1 Natural Gas Companies And The Hedging Of Price Risk

Many natural gas producing companies have learned how to hedge price risk. They expect to produce a certain amount of gas in a forward month, and they fix the price for this forward month by using a futures market contract or a forward contract. This allows them to lock in a return.

Yet pipeline companies from whom utilities receive transportation and often storage services do not have to hedge this risk because their possessory interest does not expose them to price risk. They do not take title to the commodity.

On the other hand, marketing companies' transactions in the commodity regularly expose them to risk. They use price risk management contracts and techniques extensively since if they are to continue to operate smoothly they need to identify and limit the price risk in the large number of commodity positions they regularly take. They often want to effectively reduce their price risk exposure as soon as they complete a negotiation, and thus receive a target return. Oftentimes they receive a fee for providing hedging services by simply matching a creditworthy future buyer or a buy position with an equally credit worthy seller, or a sell position.

Yet, the utility takes positions in the gas commodity, on behalf of customers leaving their customers with enormous price risk. The utility has the responsibility as the agent of the consumer to reduce this price risk. But, utilities have done little to directly and effectively control the risk faced by consumers from volatile prices. The lack of direct and effective control is, in part, explained by the difficulty of implementing effective programs because the utility must address not only price risk or volatility but also volume risk or volatility. As a result, utilities cannot use many of the approaches used by producers, industrial consumers, and marketing companies because their risk exposure and business practices are so much different.

Often, utility responses to reducing the price risk borne by the consumers of gas service are piecemeal. The time spent on designing and implementing specific measures is expensive, and the possible damage from price risk exposure remains. Thus, it is increasingly clear to legislatures, commissions and utility customers that more of a cure is necessary. In other words, the price risk needs to get reduced in a well-managed way.

1.2 Large Users Of Natural Gas Hedge Price Risk

Price volatility is also a problem for companies using significant amounts of gas service. Hence, during the 1990s an increasing number of large off-system industrial and commercial customers either hired companies to help them control this risk or they obtained this service indirectly through a marketing company that was selling them gas or managing their gas acquisitions.

Companies hedging price risk were provided with greater cost stability, which enabled them to better calculate expected returns for the primary products or services they sold.

This also improved their ability to plan, freeing up time and other resources for focusing better on their core business. It also may have improved their credit rating. Such benefits could also accrue to utilities with effective price risk management programs.

1.3 Special Price Risk Management Problems Facing Utilities

Today, utility companies and the commissions regulating them need to come to terms with the new environment of larger price risk. Yet, commission staff not only need to understand price volatility or risk and effective programs to control this risk but they also need to be on their guard for agency problems. This is particularly important when the utility is part of a corporation with a significant non-regulated arm and when the utility is, in effect, the buying agent for many captive customers. There is always the chance that the regulated customer who is paying the cost of the business and ultimately bearing the price risk is not the focus of attention in a price risk management decision.

Price risk management or hedging is also much easier for businesses with a predictable demand for the services or goods provided. The variability in demand, or volume volatility, is much greater for utilities than it is for most other businesses. This problem is addressed in several sections of this report. This problem cannot be ignored any more than large price movements.

Large price movements include difficult-to-predict movements in the overall level of price. They also include ordinary price volatility or price risk, which is the uncertainty around an overall price level.

Price level movements are especially important because they represent the recurring boom and bust cycles that seem endemic to the natural gas industry. Current supplies often sometimes suddenly seem much tighter or much more robust than previously estimated or anticipated. Hence there is a large leap or decline in the price level over a relatively short time period. This is precisely what occurred in 2000.

Standard industry statistics in 2000 indicated that supplies were tight. But supplies stayed tighter longer than most expected given the consistent rise in price during early 2000 and the sustained jump in price after May 2000. The sustained jump in price was supported in part by increases in demand for gas during the summer and then in November and December that were surprisingly strong.

Uncertain weather is always a wild card. In September 2000 weather forecasts began to appear indicating that the weather in November and December 2000 was to be significantly colder than the previous November and December. Then, the coldest November and December occurred and prices were lifted even higher. The sudden rise in price was not followed by a sudden fall in price to previous levels.

1.4 Overview Of Report

Accordingly, we will begin this report by reviewing past price history in the natural gas industry in Section II with an emphasis on the last several years especially heating season 2000/2001.

Section III will summarize in general terms price risk management programs in place at Missouri utilities and Missouri utilities' response to the tight supply situation and the uncertain and higher prices in 2000. In particular, we will examine what, if any, price risk management efforts they undertook.

Section IV will discuss approaches to price risk management by non-Missouri utilities and also by non-utilities.

Section V will examine the degree to which utility companies purchasing natural gas in different markets relied on fixed price contracts and storage to hedge their price risk and whether the different approaches are likely to be effective in the future under different market conditions.

Section VI will lay out guidelines for hedging by utilities. It will build on material presented in Section III.

Section VII will address prudence issues related to utilities engaging or not engaging in price risk management programs.

Section VIII will discuss improvements in approaches going forward.

Section IX will address reasonable steps that could have been taken by utilities to mitigate price risk prior to heating season 2000/2001.

Section X lists benefits to the consumer, to the Commission and to the company from an effective price risk management program.

A glossary is included at the end of the report.

II. HISTORY OF RECENT NATURAL PRICE BEHAVIOR

2.1 Introduction

The natural gas market is a market with unstable prices. In fact, since 1991 the average price of natural gas appears to have changed several times (see Figure 1).

Up until November 1995, the natural gas price was usually below \$2.00/MMBtu. After November 1995 the natural gas price was usually above \$2.00/MMBtu but in the second half of 1998 and first half of 1999 a short-term supply bubble surfaced. This bubble was a consequence of a strong increase in storage levels, productive capacity and warm weather. The bubble lasted for about a year and by mid-1999 prices had again risen to their previous level.

Price consistently trended slowly upwards in the first four months of 2000. Then, prices shifted significantly upwards in May 2000. Between May 2000 and early summer 2001 the natural gas price was generally above \$4.00/MMBtu.

The exact amount of any shift in the price level between years is, of course, difficult to forecast. Important factors underlying the most recent price fly-up between May 2000 and June 2001 included tight supplies, the increased cost of producing and marketing natural gas, increased demand for natural gas by power generators, market power and an increase in normal profits.

2.2 Importance Of Storage In Determining Price Behavior

Although predicting the exact amount of the possible shift in price level is almost impossible, the likelihood of either a rise or decline in price from year earlier levels during the heating season is less difficult to forecast.

As storage levels decline relative to year earlier levels, especially in the producing region, the chance of an increase above year earlier levels in the price of natural gas during the heating season increases. Not too surprisingly, storage levels in the producing region relative to year earlier levels in injection season in year 2000 were as low as they have ever been for that time of the injection season. (See figure 2).

On the other hand as storage amounts increase relative to year earlier levels especially in the producing regions, then the chance of a decline in the price of natural gas during the heating season increases. This occurred in heating season 1998/1999.

Storage levels during an injection season prior to the heating season are, of course, in part a consequence of the weather during the previous heating season.

2.3 Price Behavior And Storage Levels Prior To Heating Season 2000/2001

Storage levels were low at the end of heating season 1995/1996 primarily because of cold weather in the latter part of the winter. Subsequently, storage levels were not built up in the non-heating season to planned levels for the next heating season. Hence storage levels were low in the early part of heating season 1996/1997. When temperatures dropped below normal levels in December 1996 price increased and the increase in price was sustained by tight supply conditions after December 1996.

The fall season of 1997 was different from the previous two fall seasons. Storage levels were built up during the non-heating season to planned levels for the heating season. When temperatures dropped below normal in October 1997 prices jumped, but quickly dropped when temperatures rose and storage levels remained robust.

During non-heating season 1998 storage levels were once more very robust and when temperatures were very high in November and early December prices plummeted. The consistent drop in price during 1998 and, especially, the drop in prices to near $1.00 in early December motivated the producing part of the industry to change their plans. The current market price of natural gas in December was less than the marginal cost of producing gas for market for some producers, so many producers began to make plans to significantly cut back on drilling of both development and exploratory wells.

2.4 More On Price Behavior In Year 2000 During The Injection/Contracting Season

Eventually productive capacity began to decline in 1999 and the price level rose. Although a very mild winter kept prices in check in heating season 1999/2000, prices began to rise consistently in early 2000 despite relatively mild weather. This seemed a sure sign that supplies were tight.

Then the situation changed dramatically in May 2000.

Demand for natural gas from natural gas generators increased significantly and relatively small amounts of natural gas were being injected into storage. Storage levels in producing regions were much below levels in the previous year. In fact, the change in storage during the injection season in the AGA producing area between years was as low as it has ever been and was a significant sign that prices were likely to stay above their year earlier levels. Simply stated the supply situation had gotten much worse.

During 2000, an increase in available supplies did not follow from the consistent increase in price, in rig count, in development wells and in pipe capacity that was occurring at the time. There was much uncertainty in the market and when temperatures dropped to historically low levels in November and in December 2000, spot prices were at high levels never sustained previously.

Given this historical context, we will next examine the types of price risk management efforts Missouri utilities had initiated prior to the heating season 2000/2001, and their response to the particular market conditions at that time.

III. MISSOURI UTILITY PRICE RISK MANAGEMENT PROGRAMS AND THEIR ABILITY TO RESPONDTO PRICE RISK AND MARKET CONDITIONS DURING YEAR 2000

3.1 Overview

The enormous natural gas price risk that has been sustained over the last ten years has been borne by consumers, while the utility is the agent for the consumer. Thus, it is reasonable to expect that most utilities would have taken steps to understand and manage this price risk prior to the year 2000.

It is also reasonable to expect that during 2000 these utilities would have responded to the environment of higher prices, sustained price volatility and tight supplies. They could have sought outside advice and either altered plans or taken steps such as opening NYMEX futures market positions or purchasing call options to cap the price of gas as the year unfolded. NYMEX options are particularly attractive because they are much like any insurance and delivery is generally not associated with these options. The company pays for the insurance and gets the cap.

As the heating season 2000/2001 approached, forecasts of a significant reduction in temperatures from year earlier levels suggested a possible rise in price. Moreover, the price risk during the upcoming heating season as represented by readily available measures of price volatility was expected to be at least as large as in the previous year. Thus, it would have been prudent for Missouri utilities to evaluate the purchase of call options from NYMEX and possibly open futures contract positions as long as price changes from the basins where they purchased gas were strongly correlated with changes in Henry Hub prices.

Because many of the smaller utilities are affiliates of much larger companies it is somewhat surprising that they had few plans for addressing price risk and took few or no steps to respond to the market environment prior to heating season 2000/2001. The larger parent probably had resources to address the development of a price risk management framework to use for developing price risk management plans for their utilities in several states.

In fact, some smaller companies had no formal plans to manage price risk even though they did not have storage and thus they were totally exposed to price risk.

Some companies did not take steps to reduce price risk prior to the heating season 2000/2001 because they did not think prices would go higher. Not too surprisingly, these same companies had limited knowledge of the market for price risk management instruments.

Other companies did not undertake price risk management efforts because they considered the premium associated with locking in prices to be too high. This exposed their customers completely to price risk.

Smaller utilities generally did not seek out consultants for advice. Their response to readily available, non-proprietary market analysis was often limited to concern about the low levels of storage within the industry during the year.

Some smaller companies had fixed price contracts that provided them with some price risk protection, but the volume of fixed price contracts seemed small when compared to flows under normal weather conditions.

Some utilities did seek out some informal advice from companies knowledgeable of price risk management tools. But they still did not have a price risk management plan as part of their supply plan nor did they take steps during the year to respond to changing conditions in the market.

Although most companies seemed well aware of the changing market conditions especially the low levels of storage, few managed to change their plan and contract mix.

Companies, whether small or large that had access to natural gas storage generally did not evaluate the effectiveness of storage as a price risk management tool. They also did not generally have anything like an operational risk management plan where guidelines for the use of price risk management instruments were stated and by which the effectiveness of hedging instruments could be evaluated.

Some of the smaller companies that were part of a larger company did have supply plans but the plans generally did not include price risk management.

Some that did not originally plan to have fixed price contracts obtained fixed price contracts during the injection/contracting season. Yet the volumes acquired under the fixed price contracts seemed small when compared to the volume of gas that would necessarily be purchased during a warm winter.

Most companies did some market analysis to support their contract decisions and not too surprisingly the larger the company the more they relied on extensive market analysis.

Nonetheless, several companies in Missouri had been engaged in the development of price risk management programs for more than 6 years. These companies had a much more considered approach to price risk management. Initiatives were even undertaken prior to heating season 1995/1996 and heating season 1996/1997 when prices rose significantly. Only after 1996 did utilities and Commissions in most other states begin to take a more focused look at price risk management. Yet, even these companies had a difficult time responding effectively to the changing circumstances in year 2000.

Early on in Missouri there was an emphasis on conventional call options obtainable from the New York Mercantile Exchange and the over the counter market to set price caps. Later on there was an emphasis on embedded hedges in 'physical' gas supply contracts.

Reports on programs sometimes demonstrated an understanding of price volatility and how it relates to the price of a call option and other aspects of natural gas price risk management. There was also some awareness of the difficulty of receiving the same quality of hedging effectiveness at all receipt points. Yet, no company had a price risk management plan that could be used as a model for other utilities and no company kept transaction records that lent themselves to a complete review and evaluation. Important information supporting decisions to take positions was not routinely recorded.

3.2 Recording And Reporting Information On Price Risk Transactions And Plans

Recording and reporting information on price risk transactions and plans at Missouri utilities were not well organized and never complete. For example, companies reporting information on call options did not necessarily document and report:

a) the cap or strike price,

b) the price volatility at the time the contract was completed,

c) the cost of the option,

d) volume hedged by the option,

e) the seller of the option and whether it was a NYMEX option,

f) the implied and/or historical price volatility associated with the option,

g) the date the option contract was signed, and

h) the forward price for the delivery month from the futures market at the time the option contract was completed.

Companies generally did not document whether the price of an option was evaluated before completing a position and how the size of the option position was determined. Reporting such factors is important for reviewing the reasonableness of an option position. In general, there was no evidence of even a tacit acceptance of reporting standards.

3.3 Price Risk Management Steps Taken By Companies

Companies generally did not have a separate Risk Management Policy document as part of a Gas Supply Plan. Nonetheless, the larger companies had staff attend conferences where price risk management approaches and tools were discussed.

Some companies had significant physical hedging tools such as rights to no-notice storage service to avoid price spikes and to swing contracts for operational flexibility. Some even had a capability to inject natural gas into storage throughout the year and took actions such as minimizing their withdrawals in early 2000 and maximizing injections in the early heating season 2000 in response to the changing market conditions.

Some informally addressed evolving market conditions with their suppliers and made price risk management decisions based on this analysis. None, however, made separate and special analysis of the price risk management opportunities in the different markets from which they were capable of purchasing natural gas. Such analysis would be expected to contain sections on bid design, usage forecasts, bid selection, general market analysis and any special market analysis used in making price risk management and related supply contracting decisions.

Some companies evaluated the effectiveness of storage as a hedge through model runs based on different scenarios. Yet, no studies were based on a comparison of commodity costs when the gas was withdrawn compared to commodity costs when the gas was injected.

Most companies did not record and report the forward price from the NYMEX futures contract for the month in which a volume of gas being injected for the month it was expected to be withdrawn. This analysis provides an indication of the value of the gas being injected. This evaluation also provides information on whether it made economic sense to store more or less natural gas.

Since the latter half of the 1990s some companies worked in consultation with Commission staff to develop programs for using derivatives such as call options. Over time the programs evolved with the companies being afforded increased discretion in determining the details of the position such as the volumes to hedge. As a consequence they began to treat hedging positions as ordinary business decisions.

Several companies considered using the NYMEX to help fix the price for a series of forward months. Yet companies did not seem to appreciate that the contracts might be best used for different purposes, the futures contract as a substitute for a conventional fixed price forward contract, and the option contract as a cap on peak prices for peak demand volumes. Even though combinations of options contract positions can be used to create derivative instruments that perform like a futures contract, utilities would generally not be expected to use the contracts in this way.

3.4 Some Price Risk Management Programs Yielded Profits To Companies

Surprisingly enough some approaches to price risk management had evolved into a profit-making program for the utility where it wasn't clear that reducing systems customers exposure to price risk was the primary purpose of the program.

Expected returns were built into the program. A target strike price was established for the program. The company was authorized to spend a certain amount of money on the program which amount was used in calculating the actual strike price. The company then had 90 days to put on positions for the upcoming heating season. Of course, the cost or value of the insurance depended on the term – the shorter the term the less the cost. Each day the company held off purchasing the insurance the less the expected cost. The less the expected cost the greater the potential profit.

Three things could occur.

One, the market could remain stable in which case the company could receive a return equal to the difference between the amount of moneys allocated to the program less the actual cost when they opened the position.

Second, the market could improve for the company relative to the cost of establishing a position. For example the expected cost of gas or expected volatility could decline. In this case the return is even greater than in the previous example. There is the return from the term of the insurance policy being less. There is also the return from the fact that the risk has declined over time.

The importance of the term is not to be underestimated. The term of the contract is at most one year. Thus, if they hold off putting any option contract in place for 3 months, the term of the contract is reduced by at least 25%. If they hold off putting a November option contract in place for 3 months from a start date in April the term of the contract is reduced by 3/7th or 43% since the November contract terminates in late October.

Third, if the market gets worse relative to the cost of establishing a position by the company the company could exit the market. For example, the expected price of gas increases or the expected volatility increases. Thus the company had the option of not signing up for price risk insurance for customers.

Most probably the company would not sign up for the insurance because this would represent a cost to the company. The amount of money required to purchase the insurance at the agreed strike price would exceed the agreed program funds. This would results in an unappealing situation for the customer. The customer would be fully exposed to price risk when price risk was known to have increased. The customer would only receive insurance if the company received a return which return could be a byproduct of a decline in risk over time.

If the company purchased the insurance it had an opportunity for an additional return. If it closed out the position prior to the last three days of the contract it received a portion of any gains associated with the contract.

If price volatility increased in the last month of the contracts' life the value of the insurance would increase and the company would gain from selling the insurance. When the company received a gain by selling the insurance prior to its maturity, however, the consumers would necessarily be exposed to price risk unless a physical deal was coupled with the financial deal at the time the financial deal was completed.

IV. APPROACHES TO HEDGING BY NON-MISSOURI UTILITIES

4.1 Overview

Increased interest in hedging and price risk management programs for both power and natural gas utility services occurred during the years 2000 and 2001 as both power and, especially natural gas prices shifted upwards. Since end of May 2000, the price of natural gas has been as high as $10.50 at the Henry Hub. The median value of the price at Henry Hub for May 2000 to October 2001 was about $4.50. This is about twice median values for the previous 5 years.

Following the price spikes during heating seasons 1995/1996 and the price rise during heating season 1996/1997 an increasing number of utilities were diversifying their contract portfolios as a way of possibly reducing their price risk exposure. Other utilities were entering into contracts with marketing companies for supplies that had options-like and futures contract like features. However, prior to the new millennium few utilities were engaged actively and directly in the futures and derivatives market. Nonetheless, several utilities had used the options and futures market during the 1990s and one utility had proposed using the options market extensively to not just cap their cost of gas but to fix their cost of gas. They were purchasing both call and put options.

Of course, a major reason for the lack of interest by utilities was that they were not driven by a profit motive in their gas acquisition. Some natural gas producers, on the other hand, were regularly evaluating whether it was possible to lock in a return for a portion of their gas production using the natural gas futures market. They often locked in a return equal to the forward price less their cost of production. The amount of hedging would depend on the size of the return, the amount of debt on their books (in general the more debt they had on their books the more likely they were to hedge) and available investment opportunities. During the first six months of 2001 many independent producers were able to lock in significant returns using the futures market and they did.

4.2 The Passing On Of Gas Costs And Risks To Consumers And Other Issues

In most states gas costs are almost automatically passed onto consumers as long as costs are considered as prudently incurred or incurred in good faith. Thus, the cost of not having a price risk program is borne by consumers.

Moreover, arbitrage gains surface from actively engaging in the cash, derivatives and storage markets. For example, at times companies with gas in storage can obtain risk free or arbitrage returns. They can sell the gas on the cash market and at the same time replace the gas by going long a futures contract or buying forward and lock in the profit as long as they do not expose their customers to any additional price risk by taking this action. The main goals of storage are supply reliability and hedging services, therefore arbitrage returns are best viewed as incidental. Arbitrage returns are ordinarily only captured by companies that are actively engaged in cash, derivative and storage markets. Even though the gains may be significant at times and investors might view such returns as representing a capability that few utilities have, few utilities appear to even consider these returns.

The heating season 2000/2001 brought into sharp focus the size of the price risk passed onto consumers. Consumers expressed clearly the need for price risk protection.

4.3 Approaches To Price Risk Management By Non-Missouri Utilities Prior To Year 2000

Already by year 2000, many utilities were obtaining NYMEX futures and option-like features in mid-term contracts with marketing companies. The marketing company would sign a contract with a utility where the utility could lock in a forward price at a point in time it chose. Personnel at a utility would track NYMEX futures market information. When a futures price or an average of futures prices for the heating season satisfied some criterion as to reasonableness, they would contact the marketing company and lock in the price.

The price criterion used to make a decision was based on historical price information. For example if the average of forward prices for a delivery month were less than a target price they would lock in the price for a certain amount of gas.

Some companies would also cap the price rather than lock it in. If the price were less than but near some upper bound price they would put a cap on price near this upper bound price. Alternatively they could establish a cost-less collar. In the cost-less collar they put a cap on price for a certain amount of gas. But they also agreed to take gas at a floor price if the price of gas in the cash market fell below this forward price in the forward month.

To repeat, the nearer the average of the forward prices was to the upper value of the range, the more likely the company was to put a cap on price instead of fixing the cost. Thus, with a high price they were less likely to enter into an arrangement like a futures market position but more likely to enter into a relationship like a call option.

As the average of the forward price declined they would lock in increasing amounts of forward purchases. Thus, if prices were high by an historical standard they did little hedging, merely putting a cap on the price for a relatively small portion of their requirements. They did nothing to reduce the price risk exposure because their criterion for hedging was based on a comparison of current forward price levels with historical price levels, and not a consideration of the volume of expected requirements that might be exposed to price risk.

When an average of forward prices is reached that is considered low by historical standards they often discontinue hedging. Companies seemed to realize that if they continued to increase the size of their hedge they would be hedging an amount of gas that exceeded the amount of gas they were likely to require.

First, companies used a variety of methods for establishing price criterion or target prices. In principle they required some estimate of an expected or long term average price. In some instances they might combine historical spot prices for past heating seasons with historical futures prices for an upcoming heating season.

To obtain a long term or expected average price for heating season 2001/2002 a company might access historical spot prices for heating seasons 1995/1996 through heating seasons 2000/2001, compute an average for each heating season and then compute an overall average spot price for all heating seasons.

Next they would access futures prices for heating season 2001/2002. For every day they would take an average of the forward prices for the months of November through March.

Then they would take an average of these daily prices to get an average futures price for the heating season.

The company might also compute a weighted average where the weights would be equal to the expected volumes of gas purchased on the cash market at different times during the year. Again, they compute an overall average. This is the simple average of the average spot price and the average futures price. This overall average is what they use as a basis for making hedging decisions.

Second, companies construct ranges around this overall average. The upper bound on this range is considered an exceptionally high price and the lower bound on this range is considered an exceptionally low price. They might expect this range to cover 95% to 99% of all possible prices.

Third, they might divide the range into 4 parts. For example, if the overall range was $3.00 to $5.00, they might compute four ranges:

i) $3.00 up to (but not including) $3.50;

j) $3.50 up to (but not including) $4.00;

k) $4.00 up to (but not including) $4.50;

l) $4.50 up to (but not including) $5.00.

Generally as the average of the forward price falls within a lower and lower range they hedge a larger proportion of their expected future requirements for gas.

As previously stated the marketing company fixes the actual price for the utility company. The utility company decides when and how much it wants to hedge within the limitations of the contract with the marketing company.

There are several problems with this procedure.

The notion of a long-term average price for a natural gas market that applied at all times may be misplaced. Between 1990 and 2001 there were at least 3 regimes for natural gas markets represented by different average price levels representing different market conditions. There were also heating seasons where supply conditions heading into the heating season were much different. The different supply conditions, of course, also had implications for the acceptance of a particular price risk management strategy.

Between 1990 and 1995 there was still an excess supply of natural gas and pipe space (the remains of the gas bubble) from the high wellhead price of the mid-1980s. This was largely a byproduct of price setting for different categories of gas in the Natural Gas Policy Act of 1978 and because of a willingness of utilities to enter into long term fixed price contracts. These high prices increased supply, and reduced demand. The end result was a disconnect between spot market contracts where prices reflected robust supplies and high prices in fixed price contracts where price often reflected expected market conditions that had not materialized. The disconnect inspired the restructuring of the industry by the FERC and the industry in the second half of the 1980s and the first half of the 1990s.

Much of the natural gas excess supply capacity was whittled away by 1995. The heating season of 1995/1996 was cold and storage levels were drawn down to very low levels. Supplies were tight and storage operators were slow in building storage in the non-heating season of 1996. Hence, when the weather turned cold in heating season 1996/1997 prices rose in response to the tight supplies at production and at storage sites.

The increase in price in 1996/1997 heating season inspired an increase in productive capacity, which reduced price pressure. Thus, between September 1998 and December 1998 the weather was mild and supplies were robust especially in December 1998. Hence price collapsed. After June 1999 until May 2000 prices were, once again, at their former level. Then prices were pushed to a new higher level starting in May 2000 when tight supplies and robust demand from natural gas power generators and storage operators combined.

In summary, the approach of using price levels to determine volumes to hedge puts the cart before the horse. Volumes to be hedged need to be decided first. Then, expected price levels may be useful in choosing the hedging strategy. For example, if the chance of a sharp rise in price is viewed as highly likely then a company might buy call options for peak prices. On the other hand if the chance of a sharp rise in price is not viewed as all that great then a company might still want to use the futures market to fix the cost of some expected purchases of natural gas for each month, but it may not wish to purchase call options.

4.4 Steps For A Hedging Program

The first step in a hedging program is to decide on the amount of future requirements the company will definitely hedge such as some expected amounts of natural gas the company necessarily expected to purchase during the heating season and non-heating season months.

The second step is to obtain estimates of price volatility or price risk. Generally speaking the greater the price risk, the greater the need to consider hedges.

The third step is to determine some peak requirements.

The fourth step is to consider the likelihood of a significant increase or decrease in price during the heating season. This would follow from an analysis of supply conditions heading into the heating season. This is part of the market analysis.

The fifth step is to draw some conclusions about whether price spikes were very likely during the heating season based on supply analysis and also some consideration of expected weather. The consideration of weather becomes more important the closer to the heating season.

Some companies provide evidence to their management that they have superior market intelligence or are in an advantageous position relative to others in the market. This may influence the hedging strategy since arbitrage returns are always a possibility with a well-managed price risk management program.

4.5 Steps Taken By Non-Missouri Utilities In Hedging Programs

Many companies employ fundamental analyses in setting a hedging strategy and some employ technical analyses, which is a tool initially developed for the trading community as an aid to identify expected persistence in price behavior. It is the author's view that technical analysis is not appropriate for a utility hedging program but that fundamental analysis coupled with statistical analysis is.

Technical analysis, like most time series analysis, is best suited for short-term decision making such as a trading company opening and closing a large number of derivative positions. A trading company has no choice here. It needs some tool to summarize the likely persistence of a price trend since persistence is often a property of price series. Price series are generally not independent. Therefore, it tries through experience to find those tools that seem to help it in identifying price persistence in making contracting decisions.

Fundamental analysis is better suited for the mid-term decisions a utility has to make such as locking in prices in October for November-and December of the same year. Moreover, the utility intends to keep the position and not trade in and out of positions unless arbitrage profits surface.

Oddly enough some utility companies have attempted to use the futures market in a way consistent with the way a seller of soybeans or wheat might use the futures market. But in its ordinary role as a supplier of gas to consumers and as an agent for these consumers who don't purchase the gas directly, it contributes to higher prices and the price volatility faced by the end use customer by behaving in this way.

A producer of soybeans might lock in a return for a forward delivery month by opening a short position on the futures market (in effect, selling the soybeans forward). If the price of soybeans on the forward (futures) market exceeds the cost of producing and storing the soybeans until the forward month, the producer can lock in a return equal to the forward price less the cost of the producing the commodity and storing it until the forward month.

If the price of the commodity rises in the forward month the producer closes out its futures position at a loss (it, in effect, buys back the position at the higher price). However, it receives a gain on the sale of the commodity on the commodity market that should be approximately equal to the loss experienced in closing out its futures position. As a consequence the producer still receives the return calculated when it opened the position. Similar results are obtained if the forward price declines except that a gain on the closing out of the futures position is approximately equal to the loss in selling the product at a lower price on the cash market.

Now let's see what happens if a utility follows the example of the soybean producer. A utility could open a short position on the futures market and could also store gas for delivery to consumers in the forward month. But current business practice indicates that the utility would plan to charge the consumer the initial cost of the commodity plus the fixed and variable cost of storing the gas no matter what happens on the cash market. Thus, if price rises in the forward month it closes out its futures position at a loss at the same time that it is paying more for any additional spot or index gas that might be required at this time. In fact, the higher price is likely to be a consequence of increased demand by customers, which suggests that the company would, in fact, be purchasing increased amounts of gas on the spot market. Thus, the loss on the futures position contributes to a higher cost to customers because prices are rising and the customers' requirements are rising as well.

On the other hand if price falls on the cash market in the forward month it incurs a gain on its futures positions. But customers also experience a reduction in cost either because of a reduction in requirement or/and a reduction in the price the company is paying for spot purchases.

Thus, the above strategy would contribute to price volatility because customers' cost would be still higher at a time when cost was already high and their cost would be still lower at a time when cost was already low.

4.6 Steps Taken By Non-Utilities In Hedging Programs With An Emphasis On Industries Relevant To The Gas Utility Industry

It is difficult to obtain specific lessons from other industries to guide utilities in the development of hedging programs. This is primarily because volume risk in these other industries is much smaller. Nonetheless, some general guidance is possible.

Most companies that use derivatives to hedge price risk such as companies that purchase large amounts of coffee beans, wheat or corn rely on the fundamentals of their line of business and their ability to forecast their requirements accurately. Many will put off hedging until they have a good idea of what their requirements will be.

A buyer of coffee beans and sugar such as Starbucks if it does not have particularly advantageous contracts with its suppliers, will most likely want to hedge a significant portion of its expected purchases. In this way it will be able to set a price for its coffee that will not have to be changed suddenly because of sudden increase in the cost of coffee. The company knows the price at which it is able to sell its products. It also knows that its product has good brand identification. It is also very capable of forecasting incremental demand based on the growth of its outlets. Hence it will tend to open long futures positions when the price under the futures contract enables it to achieve its target return. The hedge is just one part of a price risk management program that spans inventory management as well as losses associated with buying and processing the coffee commodity.

Although a broad scope for a price risk management program is suitable for a utility, the specific approach is different because utility demands are impossible to predict accurately in large part because of the uncertainty in long-term weather forecasts.

Owners of orange groves share a similar problem with gas utilities. Orange growers find it difficult to forecast the size and quality of their harvest because of the danger of frost and other difficult to measure weather events that may significantly damage the crop, while the utility also finds it difficult to forecast its demand because forward weather is so uncertain. For example, orange growers open a short futures position on oranges or gas on the futures market for a large crop, but the crop yield turns out to be poor not only for them but for other grove owners because of a significant freeze. The price of oranges will rise because of the scarcity of supplies following the freeze. Thus, grove owners would be closing out their position at a much higher price than the price they sold forward under the futures market. Moreover, this increase in cost on the futures market would not be balanced by a gain on the cash market because the size of their actual crop was much smaller than their hedged position. This could be financially disastrous for grove owners.

The situation would be similar for a utility if it had hedged a large amount of forward purchases and requirements turned out to be modest because it turned out to be a warm winter. They would, in effect, be closing out their position on the futures market at a very low price for volumes that were not required on the cash market. Hence, the additional cost on the futures side of the ledger would not be offset with cash savings on the current cash side of the business. Hence, the cost of gas to the consumer would be much greater than if the utility had done nothing.

There is a risk that utilities will hedge more than they need to with fixed price contracts and futures contracts because they can usually pass the cost onto the consumer. The bright side for the utility when compared to the orange grove owner is that the utility owner has an easier time figuring out minimal requirements (equivalent to minimal yields to orange grove owners). This is possible because the relationship between use and weather is well understood and useful historical data is readily available for the type of weather data relevant to the utility industry.

Other types of commodity businesses also often have difficult price risk management problem but these problems are not experienced by natural gas utilities. For holders of soybean and wheat in grain elevators the problem sometimes is a difference in the quality characteristics of the purchase commitment and quality characteristics under the futures contract. This, however, is not a problem for natural gas.

Sometimes the price of the commodity the company would like to hedge such as flour is not highly correlated with the price of a commodity for which there is a hedging instrument. While this might be true for utilities operating in the Rockies it is not true for utility companies operating in Missouri where changes in the price in the wholesale markets where they purchase gas are highly correlated with price changes on the futures market (see Figure 3).

Moreover, the level of the gas price available to Missouri utilities from the mid-continent is often less expensive than natural gas at the Henry Hub. Thus, many Missouri utilities can use the futures market to hedge their price risk yet still receive the savings from purchasing the gas in the mid-continent.

Many companies that hedge have analysts who keep tab of the market when trying to decide when to put on a hedge position. For such decisions market and price analyses, forecasts, judgment and years of experience determine when to sign a contract for forward delivery and when to hedge an expected purchase. Of course, business and price risk exposure vary by industry and are distinct for the utility business. Utilities will need to craft approaches to price risk management that also depend on market analysis, price analysis and, finally, judgement.

In conclusion, the crafting of price risk management programs for utilities may be more difficult than for some other commodity businesses that have been involved in the derivatives market for a long time. This is because the problem of the possible volume(s) to hedge as a first step is easier to solve for these other industries.

Schedule 2-47

V. CONTRACTING AND STORAGE PRACTICES AT MISSOURI UTILITIES RELATED TO HEDGING

Nonetheless, the most difficult problem facing utilities going forward is to decide on the proportion of their expected requirements to hedge using fixed price forward or futures contracts during the heating season. The important related problem is to decide on how much and what type of storage rights to have. In this section we only report summary information on fixed price contracts and storage service that Missouri gas utilities have in the different markets from which they purchase natural gas and near which they also obtain pipeline transportation/balancing, storage and other services.

The problem of the right proportion of fixed price forward contracts and storage service to have under contract prior to the heating season is, at first glance, a difficult one. If supplies relative to demand appear robust prior to the heating season then companies with too large a proportion of fixed price contracts relative to flowing gas will experience many lost opportunities for lowering the cost of gas for their customers.

On the other hand, if supplies are tight relative to expected demand heading into the heating season, then companies with too small a proportion of fixed price contracts relative to expected requirements would leave their customers exposed to possibly large spikes in their bills during the heating season. The degree of exposure will depend on whether they also have call options, which guard against price spikes. Also, the use of operationally flexible storage and/or swing contracts with first-of-month index prices, can also reduce costs at times of peak prices.

The topic of estimating expected requirements to hedge with fixed price contracts and storage was treated in previous sections and will be treated in the next section as well. In this section we provide summary information on the proportion of flowing supplies from fixed price contracts and from storage for the separate purchasing markets where gas utilities in Missouri obtained their natural gas.

In all instances bear in mind that utilities face hard choices implementing market analyses and an assessment of contractual and asset opportunities available to them. For example, if a company has operationally flexible storage it may not only reduce the amount of its fixed price gas, but may also attempt to take advantage of pricing opportunities as they surface during the heating season.

A company with sufficient supplies in operationally flexible storage at end of a January when supplies appear robust will most likely nominate minimal amounts of near-term fixed price index contracts for monthly flows. It will satisfy variable loads either from storage or from the spot market whichever is cheaper. Fully addressing such issues goes beyond the scope of this report but an examination of the proportion of flowing gas and use obtained from fixed price contracts (which can include contracts with call option features) and storage service will provide us with a most useful lay of the land. These proportions are reported in figures 4, 5 and 6.

Figure 4 results indicate that, in almost 50% of the markets where Missouri companies received natural gas, fixed price forward contracts were used in December 2000 to acquire natural gas. Yet, in some markets companies acquired more than 40% of their flowing supplies with a fixed price contract. Having no fixed price contracts is probably poor practice, but having 40% fixed price contracts is probably too large under ordinary weather condition, especially if the company has rights or access to significant amounts of natural gas in storage sites.

Having a large proportion of its expected purchases under fixed price contracts may be a major problem if the company does not have a uniform load that is a load that is not very weather sensitive. If a utility has a very weather sensitive load, then in a mild December it may have rights to much more natural gas than it needs. If the weather turns out to be especially mild it may even have to resell some of its fixed priced natural gas at distress prices onto the cash market.

In the evaluation of storage over several years, all costs should be considered in the evaluation of a storage capability and cost should be considered on cost per unit of gas service. Such an analysis of storage service would include the weighted-average cost of the stored gas plus all fixed and variable cost of storage service. This calculated cost may be much greater than the average spot market price of natural gas for the period at the times when the gas was being withdrawn from storage. Such analyses will reveal whether customers are, at times, exposed to huge opportunity costs because of the amount of gas the company has in storage.

Companies generally rely much more on storage for hedging purposes than on fixed price contracts (see figure 5). This, in part, is explained by the fact that companies have been engaged in using natural gas storage for a large number of years. They have used storage for hedging, reliability and other services while the use of heating season fixed price contracts and other derivative instruments for hedging services is of more recent origin. Nonetheless, natural gas storage service was not used in 20% of the Missouri markets examined in December 2000.

On the other hand when we combine storage and fixed price contracts (see figure 6) we find that for several companies more than 70% of their needs were acquired with either fixed price contracts or storage or both. Thus, less than 30% of their needs were obtained from index contracts, spot contracts or imbalance arrangements.

VI. HEDGING GUIDELINES

6.1 Introduction

In section II we identified the significant price shifts that occurred in natural gas markets in the 1990s. Although figuring out in the non-heating season the chance of an increase in the level of natural gas price for the heating season is important for a price risk management program, it is more important to have a measure of the variability around any level. This measure is price volatility or in statistical terms a standard deviation of percentage changes in price.

Price volatility is most often expressed in percentage terms and is usually annualized. Thus, if the annualized volatility is 30% and the price level is $3.00/MMBtu prices are generally expected to fall within a range of $1.20 and $4.80. This is because twice the standard deviation is equal to 60% and 60% of $3.00 is $1.80. Thus, adding and subtracting $1.80 from the average level provides the range of $1.20 to $4.80.

In this section the importance of both shifts in price levels and sustained price volatility for a utilities supply planning is addressed. It is also shown how such information could be used to design a utility price risk management program and also discuss reporting requirements for such price risk management tools of utilities as fixed price contracts, futures contracts, natural gas storage and options contracts.

6.2 Price Volatility Analysis

A useful way to begin reporting price volatility information is by heating and non-heating season because this is the way the natural gas industry first begins to plan its business year. Figure 7 reports estimates of monthly price volatility by non-heating and heating season for the last 5 years. Although the reported price volatilities are based on daily values and represent average values over a heating season, they can be easily transformed to monthly values for ease of understanding and use. Many relevant utility variables such as first of month index prices, storage volumes and fixed price forward contracts are monthly. Also listed in the figure are values for price volatility for the heating and non-heating seasons for the time period.

One item to address is whether there seems to have been any overall reduction in unadjusted price volatility over the last five years. The overall conclusion from the numbers reported here is there has not. In addition there is at times not a great difference in volatility during the heating and the non-heating season.

Another item to address is which past heating season is most like an upcoming heating season. This information is useful for obtaining a volatility estimate to use for an upcoming heating season. It is possibly advisable to use a volatility estimate from a previous heating season to obtain an estimate for a current heating season when conditions are similar for the two heating seasons. For example, market conditions, in particular storage in the AGA producing region and nationally, were similar in the non-heating seasons 1996/1997 and 2000/2001. Readily available supplies were tight heading into and during the heating season. Accordingly, price volatility estimates were large during both heating seasons.

The alternatives to using a specific volatility from a past heating season is to use a weighted average of past heating seasons or to estimate price volatilities for each month of the heating season since utilities make their hedging decisions on a month by month basis. Remember the greater the volumes of fixed price forward contracts and natural gas storage a company has, the less the amount of natural gas it is likely to acquire through first of the month index contracts.

It is also useful to treat expected shifts in price level separate from price volatility. If supplies appear to be very robust especially as indicated by storage levels between years then there is also likely to be a downward shift in the price level between years.

When supplies are robust, price volatility is likely to be less than average volatility as long as a cold spell does not occur severe enough to alter the underlying supply/demand conditions of the market. However, if the variability associated with the price shift is included in the estimation of the price volatility, the price volatility will be overstated.

Under ordinary weather conditions with robust supplies prices may increase significantly when especially cold weather occurs but the price is expected to decline significantly when the severe weather passes. Again, the short-lived price spikes may better reflect a skew in price towards high values when temperatures drop significantly and suddenly. Thus, there is always the question of whether the large price movements on these few days should be included in the estimation of price volatility because the ordinary movements up and down in price or price volatility may be overstated if they are included.

6.3 Storage And Market Analysis

It is clear that in analyzing price behavior it is necessary to pay special attention to storage since it is the most current, non-price information on the state of the market and because it provides information on both current and future supplies available to the market. In the analyses of storage information it is also necessary to separate out consuming area storage from producing area storage because storage in these two areas has a different meaning.

Producing area storage often represents supplies in excess of those required by the market. When supply capability grows at a rate that exceeds the growth in current demand then producing companies need to place increasing amounts of gas in storage. Thus, these storage amounts represent excess supplies for future use. They are supplies on the shelf.

On the other hand, growth in consuming area storage above year earlier levels indicates that utilities will have less need to obtain incremental supplies from the producing area. In other words, other things being equal they will be demanding less natural gas from producers during an upcoming heating season.

The combination of an increase in storage supplies above year earlier levels in both the consuming and in the producing markets indicates that there will be downward pressure on price during an upcoming heating season. In addition, under normal weather conditions the price distribution will be less spread out even after account is taken of any downward shift in price.

Figure 2 provides a numeric view of aggregate working gas levels over the last five years. Viewing this figure reveals that storage levels were low at the end of heating season 1995/1996 in April 1996, which was a heating season that experienced cold weather and high prices. Storage levels were also low at the end of heating season 1999/2000 in April 2000 but not as low as in April 1996.

During the non-heating season from mid April 2000 to beginning of November 2000 injections of gas into storage were also generally much less than during a like period in 1996. This is shown in Figure 8. Hence, by the beginning of heating season 1996/1997 and 2000/2001, there was little difference in storage levels between these years (see Figure 2).

Figure 2 also depicted the difference between years in storage levels in the AGA producing region.

To repeat: the difference between years in storage levels in the AGA producing region is a very good indicator of overall market supply conditions. Simply stated, when supplies are robust, storage levels consistently increase above year earlier levels in the producing region. When demand is not great enough to take all the gas producers are capable of flowing to market. Some of the gas needs to be put in storage. This often represents supplies that could not find a market and hence represent supplies that producers or marketing companies would like to sell. These amounts represent an inventory hangover and price is more likely to be lower than previously considered and possibly lower than in the previous year.

The market analyses hopefully would reveal the basis for expectations about both changes in price levels and changes in price volatility for an upcoming heating season or year.

Some consideration by a company of a possible shift in price level is also useful for both price risk and supply management program. This consideration will affect such business decisions as planned injections of gas into storage and deviations from plan and the need for such price risk management instruments as call options. In short, the greater the chance of a shift upward in price levels the greater the need for call options. On the other hand, the lower the price level the greater the consideration given to longer term (beyond one year) fixed price contracts.

The method for gauging whether the price level is indeed low is to determine whether the price level is near the marginal cost of production, including exploration and production costs, processing costs, shipping the gas to a wholesale market and normal profits. Of course these costs vary by market and by company. Nonetheless, special contract opportunities may surface when supplies are robust and demand is weak. Thus, the consideration of long-term contracts is to be expected at these times.

Yet, special considerations must also be given to the possible illiquidity of long-term fixed price contracts and any additional credit risk that might be associated with them. The longer the term, the greater the chance that the utility will be required to renegotiate the contract and the greater the chance that the counter-party will experience bankruptcy or other corporate problems that may result in non-performance. It may be best to treat the longer-term contract a bit differently from the contract positions that form the core of positions undertaken to hedge price risk for an upcoming heating season.

6.4 Options Markets Provide Market Intelligence

A utility should also be tracking basic statistics on the call options market for an upcoming heating season. This would include tracking the cost of call and put options for different strike prices (the price at which the option is executed) and also the current market value of forward delivery under a futures contract.

Keeping tab on the options market is also useful for obtaining market assessments of what price volatility is for a forward month. Since the utility knows: 1) the amount of time until the option contract terminates, 2) current and expected forward or strike prices, 3) the current interest rate and 4) price of the option; price volatility can be readily calculated for forward months using a Black-Scholes or other options model. These models are readily available. There are also many financial news services that provide this information.

Price volatilities from the options market are designated implied price volatilities because they can be derived from the price of the option and other known information. These are market values because they relate directly to the cost of the option, everything else held constant. The option value represents the price that buyers are willing to pay and sellers are willing to receive for the option and thus they also reflect buyers and sellers perception of price risk in the market since options are price insurance. The greater the price volatility or risk the greater the cost of the option. These price volatilities can also be graphed and compared to the company's expectations about volatilities during a forward month based on analyses of historical price information.

6.5 Futures Contracts And Fixed Price Forward Contracts

Futures contracts for a forward delivery month are similar to fixed price contracts for a forward delivery month. If a company fully intends to take delivery under a futures contract for a forward month there is little difference between fixed price contracts and futures contracts. Futures contracts, however, have distinct prices associated with each month while some conventional fixed price contracts have only one price for the entire heating season. Nonetheless, the two types of contract can easily be compared by taking a volume weighted average of the futures contract prices.

The possible superiority of the futures contract is that it has a very liquid market, which allows companies to get in and out of a position at any time they so desire. Futures contract positions can also be readily completed for different volumes for each heating season forward month while the fixed price contract may have a fixed volume for all months. Since the volumes to be hedged are likely to be required during the heating season, a futures contract has definite advantages since expected purchase needs are likely to vary by heating season month. If volumes hedged are different from volumes expected to be required this creates problems for the hedging accounting.

6.6 Bookkeeping

Hedging contracts need to be recorded in some standard way to clearly show the performance of the contract positions over time.

According to FAS 133/138 a company needs to show the degree to which changes in the price on the cash market where the utility intends to purchase its gas is related to changes in the price on the futures market. The company needs to show this prior to the use of the futures market, and on an ongoing basis.

There are many interesting examples of hedge accounting in "Accounting for Derivative Instruments and Hedging Activities, FASB Statement No. 133 as amended and interpreted Incorporating FASB Statements No. 137 and 138 and certain Statement No. 133 implementation issues as of September 25, 2000."

6.7 Statistical Analysis

Statistical analysis is used to determine how well changes in price on the cash market correlate with changes in price on the derivatives market and thus to demonstrate the effectiveness of the hedge according to FASB 133/138 using a futures contract. In elementary examples of futures market transactions, the hedge is perfect. The volumes are the same on the derivatives and cash markets and the changes in the price on the cash and derivatives market are also the same.

Doing the necessary statistical analysis is much easier than it might seem for someone not familiar with statistics. It is actually very similar to examining two columns of differences. One column of differences lists the change in the futures price between periods the second column lists the change in the cash price between periods. A third column would list the difference in the futures and cash price differences for the same period. The analysis then proceeds to determine how many times the difference between the change in the cash price and the change in the futures price is, for example, 15%

above or 15% below the change in the spot price. Simply stated you would want the third column differences to be small in percentage terms.

Doing the regression analysis is more straightforward, and provides a good summary of the information in standard output form. With experience, a comfort level develops especially when it is realized that the analysis is similar to the accounting framework for examining the difference in changes in price on cash and futures markets between time periods. Moreover, the analyses are readily accomplished by using common spreadsheet software available at utilities such as Excel.

Although the volumes associated with the cash position and with the futures position are expected to match and should be planned for, we don't expect the changes in price to match perfectly. All that we expect is that over time differences in the price changes are expected to average out to zero and that a difference is relatively small at most points in time.

The expectation with an effective hedge is that an increase in cost on the cash market will be offset with a gain on the derivatives market of about the same magnitude when the position is closed out.

The statistical analysis also provides us with information on the number of derivative contract positions we need to open in order to hedge a certain volume of purchases on the cash market.

For the statistical analyses we first graph changes in the price from the two markets as in Figure 9 (also refer back to Figure 3). The changes in price on the two markets are plotted on the graph. For example, point A on the figure represents a \$0.64 change on the cash price coupled with a \$0.68 change in the derivative price. The difference is equal to \$0.04. This is the amount by which the observed change in price on the cash market falls below the change in the cash market. In fact, the expectation is that over time small positive differences will tend to cancel out small negative differences. In fact this is what an effective hedge amounts to.

The equation for the line is actually equal to:

Change in cash price = estimated slope*change in derivatives price.

Change in cash price = 1*change in derivatives price.

The slope of the line (equal to 1 here) indicates the number of derivative positions required to hedge a certain volume of gas on the cash market.

Since the slope is equal to one this indicates that for each volume of gas on the cash market to be hedged, futures market positions equivalent to the same volume would be required.

If the slope is equal to 0.5 this would mean that for each volume of purchased gas to be hedged futures market contract positions representing half as many volumes of gas would need to be opened.

Thus, if we wanted to hedge purchases amounting to 20,000 MMBtu on the cash market we would only need to open a 10,000MMBtu position on the derivatives market if the slope coefficient were equal to 0.5.

6.8 Volumes To Hedge

For most business the volume to hedge is easy. Most businesses have a very good idea of their future purchases. This is because for most businesses the level of activity is not regularly dependent on a factor that is as difficult to predict 9, 6, 3 or 1 month in advance as the weather. A food company manager knows pretty much how many loaves of bread the company expects to sell in December. Therefore, the company also knows how many futures market wheat positions to open to hedge this future purchase.

A Company such as Kraft also knows pretty well in September how much Maxwell House coffee it can expect to sell in December. Hence, it is relatively easy for it to hedge the cost of coffee using the futures market. Over time Maxwell House may lose market share and this will influence the number of futures contract positions it opens but the change in market share is expected to be small between September and November.

Now let us assume that on a mild December a utility has 50,000 MMBtu of gas requirements not covered by storage. On the other hand in a cold December these requirement may amount to 100,000 MMBtu.

Now if a utility had hedged 50,000 MMBtu and it turned out to be a mild winter, it most probably would be able to purchase the gas at a price that was lower than the price on the derivative contract. Let us say that the price of the gas for the derivative position was $4.00 and the current price of gas end of November for December delivery was $3.50. Under these conditions the utility would, in effect, be selling the gas at $3.50, a loss of $0.50 when it closed out its futures position. However, the utility would also be purchasing the gas at $0.50 less than what it had expected to pay on the cash market. The end result is that it fixed the cost at $4.00, which is what the company planned to do. But that calculation is based on just the price information. What if the utility had hedged 75,000 MMBtu instead of 50,000 MMBtu? When the utility closed out its position on the futures market the utility would, in effect, be selling the gas on the futures market and receiving revenues of 75,000MMBtu*$3.50/MMBtu = $262,500. However, the utility would, in effect, have paid 75,000MMBtu*$4.00/MMBtu = $300,000 when it opened the futures contract position. The above transaction results in a net cost on the futures market of 75,000MMBtu*$0.50/MMBtu ($4.00 - $3.50) = $37,500. Now on the cash market the utility would be purchasing 50,000MMBtu*$3.50 =$175,000. Therefore, the total cost would be $175,000 + $37,500 = $212,500 for 50,000MMBtu, and the unit cost would be $4.25/MMBtu ($212,500/50,000MMBtu).

To repeat if the utility had hedged the 50,000 MMBtu it actually needed, then the unit cost would have been $4.00. If the utility had hedged 75,000 MMBtu, 25,000 more than it actually needed, then the unit cost would have been $4.25.

If a major utility had hedged the excess volumes with a fixed price contract, the above situation would be much the same except that selling the gas on a local market might drive the price down if other buyers found themselves in the same position. This would make the situation worse.

First the utility would have agreed to purchase 75,000MMBtu at $4.00 for a total cost of $300,000. Then, they would have used 50,000 MMBtu, leaving an excess of 25,000MMBtu they needed to sell.

However, if this utility and other utilities had taken similar positions then when they began to sell the gas that wasn't required they might drive the price down to \$3.25. If this occurred then they would be selling the excess 25,000 MMBtu at \$3.25/MMBtu = \$81,250.

Their total cost would be (\$300,000 – 81,250) for 50,000 MMBtu for a unit cost of \$4.375.

Therefore, information about minimal volumes or requirements that will necessarily be purchased by a company during a month is important for a hedging program and should be known and reported by the company.

During the heating season minimal purchase requirements or expected purchases of gas that will be required to satisfy customer demands through purchase rather than from storage is crucial.

The value for the minimum amount of natural gas hedged would depend on how variable the company's loads are within a month, how operationally flexible its storage operations are and the imbalance tolerances and penalties on the pipeline systems it uses. The more variable the companies loads within a month, the less flexible its storage operations, the lower its imbalance tolerances and the higher the penalties, the lower it's minimum purchase requirements are likely to be.

The less variable the company's loads within a month, the more flexible its storage operations, the higher its imbalance tolerances and the lower the penalties, the higher it's minimum purchase requirements are likely to be. Of course, if the company had swing contracts they would also have to be taken into consideration. In general the greater the volume of gas under swing contract the less the amount of gas under fixed price forward contracts.

6.9 Storage As An Economic Hedge

Most utilities assume that underground natural gas storage is necessarily a good hedge against an expected rise in price. Putting natural gas into storage necessarily fixes the cost. The cost is the commodity cost when the natural gas is stored plus the fixed costs associated with the storage property and the variable costs associated with injecting the gas into storage and withdrawing the gas.

The common belief is that storing gas in the off season puts a utility in the position of being able to avoid the assumed high cost of gas during the heating season. This assumption, however, needs to be evaluated.

The company needs to perform the following calculation. The amount of gas withdrawn from storage needs to be multiplied by the difference between the market cost of gas when the gas is withdrawn less the volume-weighted cost of the gas in storage. Then these products need to be summed for the heating season. A negative number indicates that there are opportunity costs associated with storage. Negative values indicate that the company could have done better by purchasing gas on the cash market during the heating season instead of withdrawing the gas from storage.

An additional calculation would be the difference between the forward price for a future delivery month (Forward) on a day when natural gas is injected. Then take the sum of the commodity cost (Cash) of the injected gas and all costs associated with storing the gas until the delivery month and also withdrawing the gas in the delivery month (Cost).

The company would then calculate Forward less (Cash plus Cost) and then take the sum of these numbers over the heating season. Again if the calculated number is negative it suggests that the company would save money by hedging forward purchases with future contract positions.

In performing the above calculation the price to use for the forward supplies would require knowledge of planned withdrawals of gas from storage during the heating season months. For example, if the utility planned to withdraw 150,000 MMBtu of gas from storage in November then the November price would be used for the first 150,000 MMBtu of injected gas. After 150,000 MMBtu of gas was injected into storage the December forward price would be used, and so forth.

To make the above evaluation more complete, it is necessary to consider any transportation savings that occur because of storage. The major transportation savings is the reduction in demand charges that occur because less gas is required to be transported long distance in the heating season.

When both storage cost and savings in transportation (TSaving) are taken into consideration a more complete calculation is obtained and is simply:

FP less (Cash plus Cost less TSaving).

Again if the calculated numbers tend to be consistently negative and the sum over the heating season is negative then the company should investigate reducing the amount of natural gas it holds in storage.

The results of the above evaluations need to be considered carefully because it assumes that all the natural gas the company would ever need would be available on the local market. Thus, it would not increase its volume risk exposure (the inability to obtain needed gas for customers) by reducing the amount of natural gas it stored. Finally, since there is a larger capacity release market for transportation than for storage it would probably be useful to take this into consideration for a complete evaluation. The more storage capacity and the less transportation capacity, the less are potential capacity release revenues.

Another important aspect of storage requires some attention. The more operationally flexible and the higher the daily injection and withdrawal rates the greater the ability of the company either to avoid price spikes or to take advantage of price drops during the month.

An often overlooked part of a utility price risk management program is for a utility to consider the need for separate price risk management plans if it purchases natural gas from several markets. This is especially pertinent when the assets and purchasing and hedging opportunities are different in the different markets.

6.10 The Need For Consumer Surveys

Another easily overlooked question is whether a utility would want to have a price risk management program for all of its regulated customers. For example, the company may have regulated fuel-switching customers. Since these customers have the capability to switch fuels which is a type of physical hedge, they may not want or require hedging services.

There is a way to address the question of which customers want price risk management services and to address the question of the degree to which customers want price and bill risk management and are willing to pay for the reduction in price risk exposure through a price risk management program. The way is through a consumer survey.

VII. PRUDENCE ISSUES

FASB in its publications provides examples of what might be considered as effective hedges or how to go about determining whether a hedge is effective or not, based on an examination of historical data. FASB also provides some indications of the difficulty inherent in trying to hedge some commodity positions. The FASB, however, stops short of indicating exactly what a company should do. This is probably the best tack for a Commission to take as well.

It would probably be useful to provide some general examples of prudent hedging decisions but stop short of telling a utility exactly what to do. Some guidance is advisable because supply and price risk management programs are not only new to the Missouri natural gas utility industry but such management decisions involve factors not previously considered such as the estimation of price risk or price volatility.

If we use as an example the hedging of purchases for a forward month using a fixed price contract, the monthly volumes to be hedged might at first be limited to those requirements that a company will necessarily be purchasing during the heating season. These volumes are viewed as required purchases during a warm winter and are designated minimum purchase requirements.

As a first step it might be considered most reasonable if minimum purchase requirements were hedged with a fixed price contract. The same consideration would apply to a futures market position. Yet the company needs to show for the futures position that the futures contract provides an effective hedge along the lines indicated in FAS 133/138. This involves showing that the changes in the price in the cash market where the company will be purchasing an expected purchase for a forward month is highly correlated with changes in the Henry Hub futures contract price. This was discussed in the statistical analysis subsection of Section VI and, of course, is not an issue with the fixed price contract.

Reporting requirements are also important for effective management and oversight. Moreover, the reporting requirements for a futures contract are very straightforward. They are:

a) the volumes to be hedged,
b) the matching volumes to be purchased when the futures contract position is closed out,
c) the forward delivery price in the futures contract,
d) the price when the matching volumes are purchased and the futures position terminated,
e) the dates when the forward or futures contract position is opened and closed.

If the Commission does not stipulate reporting requirements information may not be available for a prudence review. Moreover, reporting requirements should make it clear that futures contracts and options contracts are probably best viewed for utilities as compliments.

Standard reporting for options positions would be the volatility associated with the options contract, a historical volatility for the period covered by the options contract and the full cost of the options position. The volatility information is particularly important.

Other things being equal the greater the volatility the greater the cost of the option. Comparing an implied volatility with price volatility obtained from past market information could serve as a check on whether the current market price of the option is relatively expensive or inexpensive. Nonetheless, estimating representative price volatility numbers is not always straightforward.

Information on price volatility would also not be reported for a futures position. This is because the cost of the futures position is not fixed perfectly at the time the futures position is opened and the cost of the position is not tied directly to price volatility as it is for an option contract. This makes clear that the options contract is similar to an insurance policy and probably it's best use is to put a price cap on peak requirements.

On the other hand the futures contract is best suited as a substitute for a fixed price contract for forward delivery. Both contracts can be viewed as substitutes for first of month index gas. Both types of contract are also best viewed as hedging instruments for some expected purchases of requirements as discussed previously. Thus, when price rises or falls in a particular month the price is always fixed for some portion of expected purchases of gas.

A detailed and interesting example of a transaction that involves derivatives like features within a contract is next examined.

A company receives the right to purchase gas (10,000 MMBtu) between June through October at a $0.10/MMBtu discount to an Inside FERC bid week price for the month. The Value of the Discount is equal to the discount multiplied by 10,000 multiplied by the number of purchasing days under the contract – 153 days if the contract covered the period June through October of a year.

The company expects to require all the gas acquired under this contract, that is it would have been purchasing the gas under a monthly index contract anyway. In return for the discount, the seller receives the right to sell to the utility on any day during the period November through March 10,000MMBtu at the monthly index instead of the daily index. This natural gas clearly represents discretionary gas because of the flexibility of the contractual relationship. It is also similar to a put option, which gives the company the right to put natural gas to the utility during the heating season when the monthly index is above the spot price for natural gas.

One reason that the seller is willing to sell the gas in the non-heating season at a discount is that it expects the daily index during the heating season to be significantly below the monthly index especially for the months January through March from its analysis of historical data. Of course the utility company could have obtained these savings represented by the difference between the daily price and the monthly index price if it had not entered into this contract.

If the utility company had not undertaken a historical analysis of market price behavior then it could be subject to a disallowance if the contract results in a lost opportunity for savings on its gas acquisition. A lost opportunity index is defined in the following way. First, we take the sum, designated SUM, of the differences between the index price and the cash price during the heating season on those days when the index price is above the cash price. We take the difference between the Value of the Discount and the SUM divided by the total number of days during the heating season. If this amount is negative it represents the expected daily gain provided to the seller under the put arrangement. If the amount is negative there is a possible disallowance.

It is easy to compute the total savings to the company from the discount or the value of the discount – it is the discount times the total amount of discounted gas purchased during the year under review.

It is also easy to compute the total gains provided to the seller – it is the sum of the daily amounts of gas sold to the utility under the put arrangement times the difference between the index price and the spot price on those days.

For example, assume it was found that on 605 days during heating season 1996/1997 to 1999/2000 the company would have been putting gas to the company and the sum of the difference between the first of the month and the spot gas was $50.14. If we divide this amount by the 420 trading days over the historical period we get $0.12/MMBtu as the daily gain. The company's discount was $0.10/MMBtu. If the $0.02/MMBtu difference between the daily gain and the discount is statistically or practically significant there is reason for a possible disallowance. The practical significance is just the product of $0.02/MMBtu multiplied by 10,000 MMBtu/day and 153 days or $30,600. Therefore, a $0.02/MMBtu difference is not practically and materially significant but a $0.20/MMBtu difference would be.

It would have been good business practice for the utility company to have evaluated the contract using historical data. It would do this to determine whether the possible savings it was giving up were greater than the savings it was receiving with the discount.

The possible savings the utility is gaining in the above situation may, in fact, be greater than the expected gain the seller is receiving because the selling company had other alternatives that the utility company did not have. For example, if the marketing company had access to operationally flexible storage and was also adept at using the futures market in conjunction with storage operations it could sell gas out of storage in a month such as January. It might then plan to buy replacement gas via a futures contract for February delivery at an expected discount to January gas that was large enough to more than cover the full cost of the transaction. The point is that some marketing companies have more opportunities for such gains than utilities, which places them in a position to provide utilities with good deals.

Now the utility might claim that, even if the apparent gains provided to the seller from entering into the arrangement were significant, the contract position was still justified because price behavior can always change. The argument, however, must be supported. If the utility makes decisions that are not based on cost history, it must indicate clearly, at the time of contracting, why it is ignoring these business facts.

In addition the company might state that it is entering into the contract for reason of diversification. By this the utility company means that by entering into a variety of contracts it is reducing its overall risk. Yet, this needs to be shown as well and there is standard formula for measuring this. In fact, by adding a contract the overall expected cost of the portfolio may increase and the portfolio risk relative to the overall cost may not get reduced.

It also needs to be pointed out that the above contract represents a speculative position not a hedging position even though it is based on puts and calls because the cost of the gas is not fixed as it is with a standard option contract. The cost and value of the position depends on how prices turn out. Thus, it should be classified as an ordinary contract since most of these contracts have some speculative element as to expected price, expected requirements or an expected benefit associated with being provided with the services from the contract. Such positions are part of ordinary business and they should be viewed accordingly.

In the options contracts previously considered the cost is a certainty. The option has an explicit cost associated with it. If the market price is above the cap price then the revenues or savings that can be applied against the overall cost of gas is the market price less the cap less the cost of the option times the volume of gas associated with the option contract position. Moreover, the cost is fixed in the futures contract position as long as the volumes hedged match the volumes purchased on the cash market and the derivative can be shown to provide an effective hedge using historical data.

There are other prudence issues that relate to whether a utility is necessarily increasing the cost to the consumer by entering into a derivative position. A utility sells a put to a producing company and receives a fee for doing this. The seller, in turn, receives the right to sell natural gas on a daily basis to the utility anytime during the heating season at an index price. In this instance if the utility retains the premium and it is not allocated to general system customers then these customers are incurring a cost that would not be incurred if the contract had not been entered into. This cost is the Index less the daily cost of gas times 10,000MMBtu (if the contract was for 10,000MMBtu/day) times the number of days that the daily cost of gas was less than the index. In this instance it is clear that the customer of the utility would have received gas at the daily price and not the index.

For reasons of management control and Commission review the hedging program should be well defined. When, for example, call options are purchased to cover a specified volume of gas the positions should be held to termination or until the physical deal and matching derivative position is completed. An exception to this rule might be when arbitrage returns surface in the conduct of the program.

A utility has a derivative plan. In this plan expected purchases are matched with derivative positions in terms of volumes at a specified cost. During the course of the heating season situations may arise where the utility is able to capture risk free arbitrage returns. It might be decided that the utility take advantage of the arbitrage as long as these returns are recorded and it is well documented that these returns were arbitrage returns and no additional risk exposure occurred as a consequence of completing the transaction. Such returns would be evidence of the company's ability to function effectively in financial and in physical markets. Such gains along with the effective hedging program could increase the credit rating of the company and its overall cost of capital and thus yield benefits to consumers in the longer term.

As part of a prudence review commission staff might evaluate how a particular utility is stacking up in terms of a hedging program. This is provided in the tabular check sheet below.

CHECKLIST FOR EVALUATING UTILITY PRICE RISK MANAGEMENT EFFORTS

Criterion	Regularly and Completely	Sometimes and Incompletely	Never
1. Considers price risk exposure			
2. Has a price risk management plan			
3. Considers alternative approaches to hedging price risk			
4. Estimates price volatility			
5. Documents price risk management transactions			
6. Evaluates Hedging Tools			

1. Considers price risk exposure explicitly in planning, contracting and storage activity decisions. The purpose is to show how customers would be exposed to the influence of price spikes and price level increases in their bills before a hedging program is put in place. This evaluation would include the consideration of volumes hedged and volumes left exposed.

2. The plan includes a market and a price volatility analysis, which is integrated with an analysis of exposure.

3. This is documented evidence that alternatives were considered. For example a company decided to use fixed price contracts for the entire heating season because price changes where it purchased its gas were not highly correlated with price changes at the Henry Hub.

4. Price volatility should be estimated using standard formula for price volatility and critically evaluated. The company should not rely solely on graphical presentations of price information. However, attention should be given to the fact that estimating price volatility to represent ordinary up and down movement in price is a goal that is not automatically achieved.

5. This includes all the important details of a contract position in standardized reports as indicated in Section III and elsewhere in this report and as required by FAS 133/138.

6. This could include an evaluation of whether the weighted average cost of gas put in storage for a heating season is expected to exceed the avoided cost of not having gas in storage during the heating season. It would also include the hedging effectiveness of futures contracts and other derivatives as specified in FAS 133/138.

Another important consideration for a Utility Commission to consider is the resources available to a company to establish and maintain a utility risk management program. The size and type of resources available to a company would influence the size and type of the price risk management program a company might be expected to have. The checklist can also be used to identify whether a utility might have to augment its current capability to put in place an effective price risk management program.

RESOURCES AVAILABLE FOR EFFECTIVE IMPLEMENTATION OF PRICE RISKMANAGEMENT PROGRAM BY A UTILITY

Level of Resources Available

	Good	Fair	Poor
1. Ability to Take Advantage of Price Risk Management Alternatives			
2. Ability to Implement Price Risk Management Programs			
3. Ability to Respond to Changing Environment			

1. Some companies have more alternatives. They can effectively use derivatives for hedging price risk because their size is such that the fixed cost of putting in place a price risk management program and team can be spread over a large number of transactions or a large volume of gas. They can also better track and take advantage of arbitrage opportunities. Some companies have storage that has better price risk management capability. Some companies don't have storage.

2. This ability will be based on the resources available to the company and how the company is organized. Some companies have more human resources available for implementing a price risk management program. Some companies are an affiliate of a much larger company such as Atmos, UtiliCorp, MCN, Ameren, Southern Union or are large in their own right – Laclede. Other companies have corporate affiliates or divisions that have historically been involved in price risk management programs.

3. This is dependent on the operational and contracting flexibility a company has built into its business practices.

It is often useful to provide information in the form of a to do list as an aid to a consideration of the prudence of decisions taken and not taken. Such a list should be of use to both company and Commission staff and a similar list should be used by each.

A TO DO LIST

1. Does the company determine the amount of expected or possible volumes exposed to price risk?
2. Does the company establish what proportion of volumes exposed to price risk to hedge and what instruments, assets and contracts to use to effect a hedge?
3. Did the company hedge minimal purchase requirements or some other requirement standard generally considered reasonable?
4. Does the company calculate the percentage of expected requirements not hedged?
5. Does the company clearly identify the types of instruments, assets and contracts to be used in its price risk management activity?
6. Does the company maintain a list of companies to be used to obtain guidance or to enter into contracts for price risk exposure reduction?
7. Does the company have standard reporting requirements for the hedging program and standard reports to be provided to the Commission?
8. Does the company document when arbitrage opportunities were gained as a consequence of a hedging program.
9. Does the company evaluate the cost of using different derivative instruments?
10. Does the company employ regression analyses to address hedging effectiveness or else use very detailed arithmetic analyses using real data?

11. Is the Commission made aware of what groups within the company is responsible for execution of hedge transactions, monitoring the price risk management program and administering the program?

12. Does the company establish what group within the company or outside the company will be responsible for timely market analysis.

13. Does the company document when, how and what market analysis influenced purchasing and hedging decisions.

14. Does the company establish conditions under which hedging will be undertaken.

15. Does the company establish conditions under which hedging will not be undertaken.

16. Does the company have a separate individual or program responsible for managing price risk for its regulated customers as distinct from it unregulated customers.

VIII. IMPROVEMENTS IN APPROACHES GOING FORWARD

8.1 Introduction

The response of most Missouri utilities to the price risk faced by their customers varies greatly. Some have set up supply planning/purchasing programs for the markets where they purchase natural gas that includes a consideration of price risk mitigation at least to the extent that they choose contracts that are designed for such purposes.

Some companies have had staff attend price risk management seminars and have purchased futures contract or options contract positions. However, the majority of companies have not had staff attend seminars, do not include price risk consideration as part of their purchase decisions or have not entered into contracts with price mitigation features in a well organized way.

8.2 Measuring Price Risk

Since all companies have staff that are familiar with Excel and also track price information from Gas Daily and/or Inside Ferc and/or use these prices in contracts they can measure price risk in a standardized way on a regular basis. They can also report this information and other risk management related information in semi-annual reports – one at the end of the season and the other prior to the heating season.

It is important to measure price risk for both daily and monthly index prices.

Daily price risk is, of course, the ordinary price risk that they face when they purchase natural gas in the daily spot market. Monthly price risk is the risk they face when they purchase gas at first of month index prices. Companies will tend to rely more on monthly and/or daily index gas the fewer rights they have to gas in storage, the less the volume of gas under fixed price contracts and the more variable their customer loads.

The calculation of a first cut measure of volatility is relatively easy using Excel. First, compute the proportionate change in daily or monthly prices by taking the difference between the price on a day or month less the price on the previous day or month and then dividing the difference by the price on the previous day or month.

Second, take the standard deviation of these numbers. This is calculated by taking the standard deviation of the proportionate changes in price which in Excel is simply STDEV(a1:a21) where a1:a21 are, for example 21 proportionate price changes in column a of an Excel spread sheet, a1 would be the very first entry in the spreadsheet. If the prices are daily, the standard deviations are then further standardized by multiplying them by 100 to express them as percentage and by 15.88 which is the square root of 252, the number of trading days in a year. Alternatively the daily prices would be standardized to monthly values by multiplying by 4.69 which is the square root of 22, the number of trading days in a month. This is how the numbers in Figure 7 were created.

The standardization, where you multiply by 4.69 or 15.88, is just to express all computed volatilities (standard deviations of percentage price changes) on the same time interval. The monthly numbers in general terms represent the amount of variability you can expect in percentage terms over a month. Annualized values are generally used by the financial community and allow that community to compare volatilities for a variety of commodities. The annualization is similar to expressing interest rates on an annualized basis rather than a daily or monthly basis, all of which are readily possible, once you have a daily rate.

The above estimate is a first cut volatility. In many instances this will work well. But during a period of a significant shift in the price level, the influence of the shift in price level or a few outlying prices on the price volatility calculation needs to be considered.

The price volatility should represent the percentage variability in price that can generally be expected. It is a general measure of risk that can be applied to any price. For example, if the price volatility is expected to be 20% in one market and 40% in another market there is a much greater need for price risk management tools in the second market. The goal here is to get a measure of the price risk before the company does anything about controlling it.

8.3 Measuring Price Risk Exposure

Earlier it was indicated that a company should address the issue of exposure by examining its historical requirements. Alternatively, a company could obtain a range for requirements under different weather conditions such as warm, normal and cold weather conditions and use this as an indicator of exposure.

First, the company would need to obtain relevant heating degree-day information for its service area. Most utilities, of course, have such information for recent years but they need to get access to such information for at least thirty years. This, however, is not difficult since the National Oceanic and Atmospheric Administration and other organizations maintain extensive information on temperatures, heating degree-days and other weather variables. Companies should as part of their ordinary business maintain this information.

After obtaining this information, the company next identifies the value of heating degree-days for the warmest month for each of the months during the heating season. They also identify the average or normal heating degree-days for each month and the value of heating degree-days for the coldest month for each of the months during the heating season.

The most important number to consider here is the minimal number of heating degree-days or the heating degree-days associated with the warmest historical month during the heating season. The utility takes this number and then uses it in conjunction with the equation or relationship it uses to estimate peak day requirements or ordinary send-out or a similar equation or estimate. The company then uses the heating degree-days to calculate requirements or send-out under these weather conditions.

The calculated number for a warmest heating season month is the most important number to consider since it represents the amount of gas a utility will necessarily require for its customers. This number is referred to as the minimal exposure number or minimal expected purchases. This number represents the amount it could hedge with a futures contract and not have a problem with matching volumes purchased with volumes hedged so that it could guarantee that it would fix the cost of the gas.

As a first cut measure a utility should use minimal heating degree-days for each month during a historical period. When it understand better the dependency in heating degree days between these months it can attempt to use these findings to adjust the monthly values.

If the company has storage service it needs to also subtract from the minimal exposure number the minimal amount of gas it expects to withdraw from storage during the heating season months, even if the weather is very mild. The result of this subtraction represents the minimal expected purchases per month. This represent the amount it could hedge with a futures contract and not have a problem with matching volumes purchased with volumes hedged so that it guarantees that it will fix the cost of the gas.

If hedged volumes were greater than purchased volumes and the price of natural gas declines then the utility would be incurring a cost that could be avoided. In this instance when the company is closing out its futures position the utility is, in effect, selling the hedged volumes at a price that is less than the price it paid for the gas. Since the volumes under the futures contract are greater than the volumes purchased on the cash markets the additional cost in the closing out of the futures market would exceed the savings on the cash market.

Similar considerations are relevant for fixed price contracts as for futures contracts.

In the case of a fixed price contract where a company purchases under a fixed price contract an amount of natural gas that it doesn't need there could be a problem. It could eventually be in a position where it was selling the gas on the cash market and receiving a price for the gas that was lower than what it had originally paid. Hence, its cost of gas service is not fixed for the amount of gas volumes purchased and hedged.

The company next calculates requirements under cold weather conditions for each of the heating season months. It then subtracts from this amount its minimal expected purchases and also subtracts the maximal amount of gas service it would expect to get from storage service for that month consistent with its targets for planned levels of storage at the end of the month. This number represents the maximal amount of exposure the company has.

The examination of the volumes just described relates to the critical part of the utility business that distinguishes it from most other businesses that have the capability to hedge.

The above analysis should also be reported to the Commission in a semi-annual and annual report.

8.4 Storage As A Hedge

A company that has rights to storage should plan to evaluate the value of the storage as a hedge in its annual purchasing plan. The company might compute the difference between market value of the gas as it is withdrawing the gas and the average weighted cost of gas or some other cost it uses to track the value of the gas in storage. It could also perform this calculation on an ongoing basis during the year.

The utility could easily graph the difference between the market value of the gas and the weighted average cost of stored gas on a daily basis and a monthly basis for each month of the heating season. The company should also compute the sum of these differences for the heating season.

The above results should be reported to the Commission in the semiannual and annual report.

8.5 Material On Price Risk Management

Staff at Commission and at Utilities should obtain material on risk management and the futures and other derivatives markets. Excellent free material is put together by the New York Mercantile Exchange (NYMEX) and the Chicago Board of Trade (CBOT). They should be contacted about free seminars that might be available.

Materials and seminars are useful. But it is crucial for the company to understand how to apply risk management tools and principles to the utility business. This understanding will improve with practice, and in submitting the semiannual and annual report to the Commission.

8.6 Market Analysis

Another step for a utility to take is to prepare a market analysis on a regular basis. Since this analysis should relate to the purchase/contracting decision, it should contain information on storage separated out by the AGA producing and east consuming regions. These are the bare bones statistics to consider. It should also consider additional statistics as it deems appropriate. Other than price, storage statistics are, however, the most useful and current market statistics.

The reliability of the AGA storage statistics is generally good. When the weekly numbers are summed and adjusted to make them correspond well to monthly amounts they can be compared to the much less current but much more comprehensive EIA monthly storage figures. When this comparison is undertaken, the difference between the two series is not that great and the difference tends to be least near the beginning of the heating season. The difference between the two series tends to be similar across years for the same month. However, there is always the possibility that numbers for a specific week contain significant error.

The market analysis should be useful for the company's gas purchasing decisions and its overall gas supply plan. Depending on whether currently available supplies as measured by storage appear robust, a utility would tend to look more or less at certain price risk management instruments. It would also look harder at long-term fixed price contracts. If supplies appear tight relative to demand it would also tend to look harder at locking in a cap on price with a call option. Moreover, the Commission would look hard at whether the company hedged volumes did not fall below minimum expected purchases. If supplies appeared robust the company might decide not to purchase call options. In its risk management decisions the company is allowed discretion, the bottom line is whether the utility has a documented and separate price risk management plan. The rationale for the decision will serve as the basis for the prudence of the decision.

The market analysis should also be included in the semiannual and annual report.

8.7 Hedging Effectiveness

The company should also evaluate and report on the effectiveness of the hedge it would obtain by using the NYMEX futures contract to hedge the price risk in the wholesale market from which it obtains its gas.

First, the company needs to obtain monthly indices from the wholesale markets where it conventionally purchases its gas.

Second, the company needs to obtain matching indices for the same delivery months from the futures market. These latter numbers would be the settlement price for the delivery month from the futures market and/or the average of the settlement price on the last 3 days. The company would need to acquire several years of price information.

After arranging the data in a spreadsheet the company would want to compute the changes in price between days for the market where it purchases gas and for the futures market. Such information is shown in Table 1 for a West Oklahoma index, a series relevant to several Missouri utilities. These numbers were also plotted in a scatter plot (see figure 3).

Such a scatter-plot should be provided in any report to the commission and should be regularly updated. A regression line readily obtainable with Excel is also included on such figures. If the prices line up along the regression line the company should be able to use the futures market to effectively hedge its price risk. The correlation number, which is standard output, can be used as a key indicator of hedging effectiveness. The correlation number for the data in Figure 3 is equal to 0.98, which suggests that the company would most likely get an effective hedge by using the natural gas futures contract. However, it would still be necessary to look hard at the price information and determine whether there are particular times when the difference between the spot and the futures price is particularly large.

Table 1. The Settlement price for Henry Hub futures contract on the expiration date of the contract and Inside FERC first of Month Index price at Williams Natural – TX, OK, KS.

	Henry Hub	Williams	Henry Hub Change	Williams Change
Mar-97	1.780	1.630		
Apr-97	1.807	1.700	0.027	0.07
May-97	2.122	1.920	0.315	0.22
June-97	2.346	2.110	0.224	0.19
July-97	2.145	2.040	-0.201	-0.07
Aug-97	2.161	2.060	0.016	0.02
Sept-97	2.515	2.380	0.354	0.32
Oct-97	3.346	2.980	0.831	0.6
Nov-97	3.266	3.150	-0.08	0.17
Dec-97	2.577	2.370	-0.689	-0.78
Jan-98	2.309	2.150	-0.268	-0.22
Feb-98	2.001	1.920	-0.308	-0.23
Mar-98	2.286	2.150	0.285	0.23
Apr-98	2.300	2.180	0.014	0.03
May-98	2.262	2.160	-0.038	-0.02
June-98	2.017	1.930	-0.245	-0.23
July-98	2.358	2.270	0.341	0.34
Aug-98	1.942	1.850	-0.416	-0.42
Sept-98	1.672	1.560	-0.27	-0.29
Oct-98	2.031	1.900	0.359	0.34
Nov-98	1.972	1.940	-0.059	0.04
Dec-98	2.149	2.050	0.177	0.11
Jan-99	1.765	1.780	-0.384	-0.27
Feb-99	1.810	1.750	0.045	-0.03
Mar-99	1.666	1.570	-0.144	-0.18
Apr-99	1.852	1.740	0.186	0.17
May-99	2.348	2.220	0.496	0.48
Jun-99	2.226	2.120	-0.122	-0.1
July-99	2.262	2.170	0.036	0.05
Aug-99	2.601	2.500	0.339	0.33
Sep-99	2.912	2.770	0.311	0.27
Oct-99	2.560	2.430	-0.352	-0.34
Nov-99	3.092	2.940	0.532	0.51
Dec-99	2.120	2.060	-0.972	-0.88
Jan-00	2.344	2.250	0.224	0.19
Feb-00	2.610	2.490	0.266	0.24
Mar-00	2.603	2.470	-0.007	-0.02

Apr-00	2.610	2.790	0.007	0.32

In addition to the plot and the correlation numbers the company might examine the residuals from the regression equation in detail.

On the plot the residuals are the perpendicular distance from the line to a point which point represents the change in price on a day for the two price series. These numbers should be small relative to the average value of the price change and they should be distributed around the line in a nonsystematic way. The average value of the absolute value of the price change for the period was equal to \$0.25. The average value of the absolute value of the residuals can be usefully compared to these numbers. The smaller the ratio of the absolute value of the residuals to the average of the absolute value of the price changes, the more effective the hedge.

The residuals are easily and usefully examined. If a residual is positive or above the regression line this indicates that the change in price on the cash market was greater than the change in the futures market price.

The estimated slope for the line is also known as the hedge ratio. If the slope were equal to 1 then for each volume of purchases in Oklahoma the company wanted to hedge it would have a volume of gas covered by a futures position. The smallest volume able to be hedged is 10,000 MMBtu, which is the size of the NYMEX natural gas futures contract. Since the hedge ratio is equal to 0.89 for the situation examined here this means that each future contract can hedge 11,236 MMBtu, that is 10,000/0.89 = 11,231 MMBtu.

8.8 Reporting Requirements

Reporting requirements are paramount for effective management and oversight. Overall a company should specify an entrance and exit strategy for opening hedging positions, identify accounting rules being used to record such transactions and identify internal controls for maintaining the integrity of the program. At an even more general level there should be a clear reporting of:

1) the company view of market supply and demand conditions;
2) the volume exposure under different weather conditions;
3) the company view of overall market price volatility;
4) hedging effectiveness of the hedging instruments used by the company;
5) credit analysis of counter-party risk especially for longer term contracts obtained from marketing companies;
6) an evaluation of storage as an economic hedge.

More specifically the reporting requirements for an options contract transaction are:

1) the cap or strike price;
2) the price volatility at the time the contract was made;
3) the cost of the option;
4) volume hedged by the option;
5) the seller of the option and whether it was a NYMEX option;
6) the implied and historical price volatility associated with the option at the time of decision;
7) the date the option contract was made;

8) the forward price for the delivery month from the futures market at the time the option contract was made.

Reporting requirements for a futures contract transaction are:

1) the volumes hedged,

2) the matching volumes purchased when the futures contract position is closed out,

3) the forward delivery price in the futures contract,

4) the price when the matching volumes are purchased and the futures position terminated,

5) the dates when the forward or futures contract position is opened and closed.

The information reported for the options and futures contract is different. This is because the cost of the futures position is not fixed perfectly at the time the futures position is opened and the cost of the position is not tied directly to price volatility as it is for an option contract. This makes clear that the options contract is similar to an insurance policy and probably its best use is to put a price cap on peak requirements.

On the other hand, the futures contract is best suited as a substitute for a fixed price contract for forward delivery. Both types of contracts are also best viewed as hedging instruments for some expected purchases of requirements as discussed previously. Thus when price rises for a particular month the price is always fixed for some portion of expected purchases of gas.

IX. REASONABLE STEPS THAT COULD HAVE BEEN UNDERTAKEN BY ALL UTILITIES IN MISSOURI THAT COULD HAVE RESULTED IN PRICE MITIGATION DURING HEATING SEASON 2000/2001

In general, there were many measures and steps that Missouri Utilities could have undertaken, but didn't, that could have resulted in their doing a better job of price risk management during heating season 2000/2001. These measures and steps were treated in detail throughout this report but are not emphasized here. Instead, three steps that could have been taken by all utilities which would have been reasonable are listed here.

1. Utilities could have entered into futures contract positions or fixed price forward contracts for minimal purchase requirements. These are purchases that would have been required even if the winter had turned out to be especially warm. These amounts are obtained in the following way.

First the company needs to establish a NOAA weather station that represents the heating degree-days experienced by its system or regulated customers. The utility wants to acquire about 30 years of data. Identify the lowest value of heating degree-days for each heating season month during this time period. Next the utility takes these monthly values and estimates what monthly customer requirements would be. Designate these calculated values as minimal requirements.

Then, if the company doesn't have any storage these are the amounts that could be hedged with a fixed price contract or with a futures contract.

If these amounts are hedged with a futures contract then the volumes hedged are very likely to match the volumes required. As discussed previously this needs to occur for effective hedging with a futures contract. If these amounts are hedged with a fixed price contract then the opportunity cost associated with not being able to purchase inexpensive gas if the weather turns out to be warm are minimized.

If the company has storage then storage withdrawals that are expected to occur even under warm weather conditions are subtracted from the minimal requirements. These residual volumes could be designated as minimal purchase requirements. These amounts are generally the volumes to hedge.

2. Utilities could have investigated purchasing call options for peak prices near the beginning of the heating season when it became increasingly clear that the price level was likely to rise during the heating season or price spikes were likely to occur and recur or persist during the heating season. Thus, there was little chance it would be able to avoid these price increases by using storage more or by other means. If the reason given by the company for not using call options is that the options became increasingly expensive, this may be considered unreasonable. As with any insurance premiums are large when the risk is great. High premiums do not preclude the use of call options.

3. Finally, as the heating season evolves the company may have to put in place additional hedging positions. If the company withdraws unexpectedly large amounts of gas from storage in November and/or December which leaves its customers exposed to significant price risk in January, the company may need to take additional hedging positions in November and December to reduce this exposure. It must be understood that hedging for a utility is first of all about volumes and these volumes need

to be addressed one month at a time and as each heating season month passes the future heating season months need to be reconsidered. In short, the dynamic aspect of utility hedging is also first of all about volumes.

X. CONCLUSIONS

In closing out this report it is perhaps useful to identify benefits from price risk management programs that will accrue to utilities (U), customers (P) and the Commission (C). These benefits along with the principal beneficiary(ies) are listed below.

Obtain arbitrage returns (U,P).

Promote better forward planning (U).

Improve estimates of the value of assets (U).

Improve credit rating (less risk in the business) (U,C,P).

Reduce costs associated with under/over collection (U,P,C).

Meet customer demands for protection from price risk (U, P,C).

Develop needed skills for market-oriented utility businesses (U).

Concentrate more staff time on improving operating efficiency, customer service, etc.(C,P,U).

Reduce number of hearings at commissions – to include special hearings to consider the steps the utility company did or did not take to reduce the damage caused by severe periods of price volatility on the economic welfare of their customers (U,C).

GLOSSARY

PRICE AND BILL RISK MANAGEMENT GLOSSARY FOR NATURAL GAS UTILITIES AND REGULATORY COMMISSIONS

Arbitrage. A risk free return most often obtained by entering into transactions on several markets. For example, if a company has rights to operationally flexible storage and the commodity price rises significantly above the futures market price then the company can sell the natural gas from storage onto the wholesale market and open a long or buy position on the futures contract market. This forward contract can be viewed as providing substitute gas for the gas sold from storage. This works as long as the company does not need the natural gas for its own customers between the time period covered by the selling of the gas from storage and the closing out of the futures market position.

Basis risk. This is the variability in the price relationship between natural gas on two markets. For example, if the difference between the price of natural gas on a wholesale market in Oklahoma varies greatly over time this is considered a basis risk. If the difference is relatively constant there is a basis but there is no basis risk. In its simplest form basis risk is equal to the difference between the Henry Hub cash and futures price at the time the derivative position is closed out.

Black-Scholes model. Readily available formula or software for computing and evaluating the price of an option or the value for price volatility.

Call option contract. A contract that, in effect, provides a utility with the right to receive natural gas at a specified price called a strike or cap price.

Carrying charges. Storage costs (fixed and variable) to include any insurance costs, lost commodity costs and other incidental costs associated with holding the commodity over a period of time.

Collar. A derivative instrument that is equivalent to a utility buying a call option to receive natural gas at a cap price while selling a put option which requires it to take gas at a floor price. A common form of a collar in the natural gas industry is a costless collar which has no direct current out-of-pocket costs associated with it. However, these instruments have to be carefully evaluated as to the possible implied opportunity costs that might be associated with them. Collars are one of many instruments called combinations, which involve puts and calls. Often, available collars appear to provide sellers or holders of the put part of the collar or the marketing company acting as the intermediary with a large net benefit. This is indicated by the fact the chance they receive payment under the contract is greater than the buyers receive a payment.

Commodity Futures Trading Commission (CFTC). The federal regulatory agency that oversees the orderliness of the futures market.

Contango market. A market where the forward prices are above the current spot price. Thus the forward price for December delivery is usually above the August forward price in July of a year. This is an example of a contango market. This price structure is usually associated with storage costs.

Convenience yield. A return that is received by a holder of the commodity, for example a utility that holds natural gas in storage, that is not received by a utility if, instead, it has a fixed price forward contract. The size of the convenience can be roughly measured by the magnitude and relative frequency of price spikes on one market when compared to another market. For example, large positive differences between the spot price at the Henry Hub and the Henry Hub nearby futures contract price provide a measure of the convenience yield

Counter-party risk. The risk that one of two parties in a derivative position will not perform. For example in a swap contract one party (a producer) will be expected to pay, in effect, the other party (a utility) an amount if the price rises above some level while the utility will be expected to pay an amount if the price declines. The chance that the producer will not be able or unwilling to sustain this arrangement over time is the counter-party risk for the utility.

Credit Risk. The risk that a loss will be experienced because of a default by a counter-party in a derivative transaction.

Delivery month. The calendar month during which delivery of the gas occurs under a fixed price forward contract or a futures contract.

Embedded hedges. Terms in fixed price contracts that act as hedges

Exposure. The volume that is at risk as distinct from the price risk which represents the risk associated with buying or selling a unit of the commodity.

Fair Value. The amount at which the commodity or derivative instrument could be bought or sold between willing parties. The fair value is usually the product of the market price times the number of tradable units.

FASB. Financial Accounting Standards Board.

Firm commitment. A legally binding agreement, which specifies the quantity, price, time and term of the transaction. Performance is highly probable.

Forecasted transaction. A transaction that is expected to occur for which there is no firm commitment.

Forward price. The delivery price in a fixed price forward or futures contract.

Fundamental analysis. The analyses of the quantitative factors that influence or represent the supply and demand for natural gas.

Futures contract. A contract that requires a holder to buy or sell a commodity or an asset at a predetermined delivery price for a specified future delivery period. Most frequently delivery is not required instead the holder closes out the position. If a utility "bought" a contract for future delivery of natural gas it would, in effect, close out the futures market position by, in effect, "selling" the commodity on the futures market when it took delivery of the natural gas by purchasing it on the cash wholesale market.

Futures market. A market where futures contract positions are established.

Hedge ratio. This ratio indicates the number of futures contract positions that need to be opened in order to hedge a certain volume of expected purchases on the cash market.

Hedging. An activity that reduces price risk exposure or stabilizes expenditures via a contract or an asset. For example, a futures contract for natural gas supplies an effective hedge when an increase in the cost of natural gas on the cash or wholesale market is balanced by a similar gain when it terminates the futures position. Thus an increased cost in one market is offset with a gain on the other market

Hedging Instrument. A contract such as a futures or fixed price forward contract or an asset such as rights to stored natural gas that provides a utility with hedging services.

Historic volatility. A price volatility computed from historical data

Implied price volatility. A price volatility obtained from a traded option contract. Price volatility is directly related to the cost of the option. The greater the price volatility or risk the greater the cost or value. The Black-Scholes model can be used to obtain estimates of price volatility.

Inverted market or backwardation. A market where forward price is below the current spot price or nearby futures price. Thus, the forward price for July delivery is usually below the January forward price for the same delivery year. This is an example of an inverted market. This price structure is usually associated with the fact that the demand for gas in July is usually expected to be less than the demand for gas in January. Thus, the chance of tight supplies is usually also usually greater in January then in July.

Liquidity. Ease of buying and selling a contract. The smaller difference between a bid and offer price the greater the liquidity.

Margin. The amount of collateral associated with maintaining a futures position or with selling an option. There is no margin associated with buying an option just a fixed cost. Margin amounts will vary with price volatility, credit worthiness and the current market price.

Marking to Market. The processes of valuing a hedging instrument or asset in terms of its current market value. Every day a futures contract for a forward delivery month has a price associated with it.

Minimum heating season month purchase requirements. A volume of natural gas that a utility will purchase during a warmest heating season month. Depending on operational flexibility with the pipeline or flexibility of some storage contracts/facilities, the minimum heating season monthly purchase requirement may be based on a minimum daily quantity or a minimum monthly quantity. Nonetheless, a monthly number will be used because these numbers are, in general, viewed as a substitute for monthly index gas. This amount should not include withdrawals from storage that are expected to be made during a warmest heating season month.

Nearby or prompt month futures contract. This is the futures contract that is next to finish trading on the futures contract market.

New York Mercantile Exchange. A self-regulating commodity exchange where the natural gas futures contract and futures option contracts are traded in open outcry. This exchange is also regulated by the Commodity Futures Trading Commission.

Notional amount. Number of units of the commodity specified in the derivative instrument.

Option price. The price at which the option is bought and sold. For example a call option for February delivery at a strike price of $3.50/MMBtu may have a cost of $0.15 which effectively increases the cost of gas for the volume of gas associated with the option contract. For example, if a company had five option contracts for 10,000 MMBtu and if the option contract were executed this would effectively lead to a cost of natural gas of $3.65/MMBtu for 50,000 MMBtu.

Portfolio Diversification. Portfolio diversification refers to the reduction in risk that occurs when different types of contracts to include contracts for gas at different locations are included in a company's list of contracts. Risk reduction is obtained if the correlation of price changes on the different markets is negatively correlated. Price risk reduction is not necessarily obtained by simply adding a type of contract to an existing set of contracts. Both the inherent price risk associated with the contract (price volatility) and the relationship between price changes for different contracts (price correlation) needs to be evaluated.

Premium. The price of an option.

Price risk management. The management of price risk exposure by first identifying the amount of price risk and then identifying the instruments used to reduce this price risk exposure.

Price volatility. Is a measure of price risk or average price variability that is used in derivatives markets. Formally it is the standard deviation of percentage price changes. It is a convenient number. For example, a monthly price volatility of 10% when the price of natural gas is $3.00 indicates that we expect price to vary between $2.40/MMBtu and $3.60/MMBtu during the month. Two standard deviation units of course are equal to the $0.60, which is viewed as a likely range for prices. Highly reliable estimates of price volatilities for a future time period are of major interest in price risk management. Yet, they are often difficult to obtain.

Put option contract. A contract that, in effect, provides a seller with the right to sell natural gas to a utility at a specified price often called a strike or floor price.

Settlement price. The price associated with the futures contract near the close of trading on a day

Spot price. The price for immediate delivery.

Speculation. A position entered into for the purpose of making a profit or a return either for the company or for its customers. The gain is associated with the end user expecting to pay less than the long run market price for a certain volume of gas or with the seller expecting to receive a price less than the long run market price for a certain volume of gas. Because volumes are as difficult to predict as prices in natural gas markets a company may be speculating in terms of prices as well as volumes.

Strike Price. The price at which the commodity can be bought and sold in an options contract.

Technical analysis. The use of a wide variety of informal techniques to identify the likely persistence of price trends.

Underlying Variable. The variable that the price of the option depends on, the natural gas commodity.

Underlying. In FASB the price of the commodity not the commodity itself as in underlying variable which is ordinary derivative usage.

Volume volatility. The standard deviation of percentage changes in volume. A statistical measure to represent average load variability.