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June 19, 2006

VIA E-MAIL & FEDERAL EXPRESS

Patricia Van Gerpen
Executive Director
South Dakota Public Utilities Commission
Capitol Building, 1st Floor
500 East Capitol Avenue
Pierre, South Dakota 57501-5070

Re: ***In the Matter of the Application by Otter Tail Power Company on Behalf of the Big Stone II Co-Owners for an Energy Conversion Facility Siting Permit for the Construction of the Big Stone II Project***
Case No. EL05-022

Executive Director Van Gerpen:

Enclosed for filing please find corrected versions of Applicants' Pre-filed Rebuttal Testimony, marked as Applicants' Exhibits 31 and 51.

Paper copies of the testimony are being served on those persons on the Legal Service List and electronic copies on those persons on the Electronic Service List. The testimony, along with exhibits, will also be placed on the project's website at https://extranet.lindquist.com/bigstone.

Please direct any questions to the undersigned at the number above or to Mr. Thomas J. Welk. Mr. Thomas J. Welk may be reached at (605) 336-2424.

Very truly yours,

LINDQUIST & VENNUM P.L.L.P.

Todd J. Guerrero /s/
Todd J. Guerrero

TJG/dmd
Enclosures

c: Attached Service Lists

Doc# 2154804\1

APPLICANTS' EXHIBIT 31

SOUTH DAKOTA PUBLIC UTILITIES COMMISSION

CASE NO. EL05-022

IN THE MATTER OF THE APPLICATION BY OTTER TAIL POWER COMPANY

ON BEHALF OF THE BIG STONE II CO-OWNERS

FOR AN ENERGY CONVERSION FACILITY SITING PERMIT FOR THE

CONSTRUCTION OF THE BIG STONE II PROJECT

PREFILED REBUTTAL TESTIMONY

OF

DANIEL E. KLEIN

PRESIDENT

TWENTY-FIRST STRATEGIES, LLC

JUNE 9, 2006

BIG STONE II

PARTNERS IN GENERATION

PREFILED REBUTTAL TESTIMONY OF DANIEL E. KLEIN

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BEFORE THE SOUTH DAKOTA PUBLIC UTILITES COMMISSION

PREFILED REBUTTAL TESTIMONY OF DANIEL E. KLEIN

I. INTRODUCTION AND SUMMARY

Q: Please state your name and business address for the record.

A: My name is Daniel E. Klein, and my business address is Twenty-First Strategies, LLC, 6595 Terri Knoll Court, McLean, VA 22101.

Q: Briefly describe your present occupation and responsibilities.

A: I am President of Twenty-First Strategies, LLC, a consulting firm founded in 1995 to offer energy and environmental consulting services to electric power companies, industry associations, government agencies, NGOs, and others.

Q: Briefly describe your educational and professional background.

A: In 1973, I received a bachelor's degree in Urban Studies from the Massachusetts Institute of Technology. In 1975, I received a Masters of Business Administration from the Stanford University Graduate School of Business. Since that time, I have been a consultant specializing in energy, environmental, and economic analysis. Beginning in 1975, I was employed for over twenty years by the consulting firm ICF Resources Incorporated (originally ICF Inc.), where for several years I was a Senior Vice President and Director. I founded Twenty-First Strategies in 1995 to offer energy and environmental consulting services to electric power companies, industry associations, government agencies, NGOs, and others.

Applicants' Exhibit 31O to this Testimony presents my resume, qualifications, and experience in greater detail.

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Q: What is the purpose of your testimony in this proceeding?

A: The purpose of my testimony is to address the concept of risk in the context of selecting the proper type of electric generation resource to meet the future needs of the Big Stone Unit II participants. Opponents of the Big Stone Unit II project have argued that construction of a new baseload generating station may not be justified in light of what they perceive as the significant risk of future greenhouse gas regulation. I understand other witnesses will address the possibility that such regulations will be adopted. My testimony addresses the significant risk that would result from not constructing the Big Stone Unit II station and relying on other forms of electric generation.

Q: Please summarize the findings made in your analysis.

A: As I understand it, the Big Stone Unit II owners have determined there is a need for baseload resources.

To meet this increasing demand, seven electric utilities have proposed building Big Stone Unit II, a 600-megawatt, coal-fired electric generation plant. The plant's dispatchable, baseload power would increase reliability in the region, as well as add diversity and reduce single-outage risks for the participants.

If Big Stone Unit II is not built, an alternative means of acquiring baseload resources will be required. Likely alternatives to supply 600 MW of baseload power are few, and would entail dependence upon expensive and risky supplies of natural gas and/or petroleum fuels. In most parts of the U.S., the primary alternative to a new coal-fired plant would be construction of a 600 MW combined cycle natural gas plant. Nuclear energy is edging closer to again becoming a viable option for new capacity, but cannot yet be considered dependable with respect to licensing, timing, and costs. The other primary source of baseload power, large hydroelectric plants, offers no reasonable opportunities for large-scale additions.

Renewable resources such as wind power could substitute for some of the generation that Big Stone Unit II would produce. But because these resources are intermittent and not dispatchable, they make only a limited contribution to meeting peak load capacity needs. These intermittent renewable resources would require back-up capabilities such as natural gas-fired turbines before most of the capacity could be considered dependable.

Accordingly, capacity alternatives to Big Stone Unit II entail utilization of natural gas (or petroleum fuels), either as a primary or backup fuel supply. Natural gas (and petroleum) prices are much more volatile than coal prices. Because of this, regions with more coal-fired power in their generation mix have more stable power rates.

The volatility of natural gas prices creates a highly significant risk factor for an electric generation resource that relies on natural gas. As shown below, if Big Stone Unit II were gas-fired instead of coal-fired, an increase in gas prices of only $1/MMBtu would increase generation costs by about $30,000,000 in a single year. As also shown below, natural gas prices to electric power generators have often changed by over $1/MMBtu in a single year. Forecasts of future natural gas markets show similar price unpredictability. For instance, for the last ten years Energy Information Administration forecasts have consistently projected 2005 natural gas prices at $4/MMBTU and below, whereas actual 2005 gas prices reached three times that level.

In contrast, coal prices tend to be much more stable than natural gas prices, and, in any event, coal prices can be locked in long-term through coal supply agreements. As a result, coal plants are likely to involve far less generation cost risk than an alternative that relies on natural gas for fuel.

Q: Is the risk advantage of coal increasing as compared to natural gas?

A: Yes. The outlook for natural gas supplies is worsening for consumers. The supply disruptions and high prices of the 1970s and early 1980s was followed by a period of generally ample supplies and lower prices lasting through the mid-1980s and most of the 1990s. But in the last few years, available supplies for both natural gas and petroleum fuels have been much tighter, resulting in sharply higher market prices and rapidly increasing expectations for higher prices well into the future.

Coal prices, on the other hand, are based much more on domestic mining and transportation costs, and are influenced heavily by trends in labor costs and mining productivity. Price forecasts for coal have generally trended downward since the 1980s, as improvements in labor productivity and rail rates have exceeded earlier expectations.

Because of these trends, the forecasted price differential between coal and natural gas is widening, weakening natural gas's ability to be a competitive long-run fuel for power generation.

Q: How do these risk factors affect South Dakota consumers?

A: For South Dakota consumers, higher energy prices can have many effects. One of the most direct effects is that the income diverted into higher power bills is no longer available to meet other household uses. With less disposable income, other activities must be curtailed, including some that promote better health and safety. This is particularly true in lower income households, where just meeting the basic necessities can consume most, if not all, available income. Reductions in disposable income result in higher health and safety risks.

There is also research that has been conducted that has explored the relationship between energy price shocks and unemployment. Apart from the average long-term effects of higher energy prices, the volatility of those prices can further perturb the economy and heighten unemployment.

Residential energy consumption data shows that households in South Dakota and other West North Central states consume greater-than-average quantities of energy relative to other states and regions, possibly due to greater heating requirements. In addition, these households generally have a higher fraction of their energy needs met by natural gas and petroleum fuels, with the result that the per-household consumption of these fuels is substantially higher than in most other states. Accordingly, South Dakota households could be doubly sensitive to gas price volatility – both in the direct gas consumption for households and for the higher costs of gas-fired generation. Hence, coal use would not only be less volatile as a power generation source, but would also help to moderate price spikes in other parts of a family's energy budget.

Q: How is your testimony organized?

A: My testimony is divided into two sections. The first section examines the volatility of natural gas prices as compared with coal prices. This section shows that investment in a generation resource utilizing natural gas as a fuel poses far greater generation cost risks than the same investment in a generation resource utilizing coal. The second section examines the consequences to South Dakota households if a riskier form of electric generation is chosen and such risk results in higher energy prices. This section shows that the higher energy prices will have detrimental effects on both the economic well-being and the health of South Dakota households.

II. VOLATILITY IN FOSSIL FUEL PRICES

II(A). OVERVIEW OF VOLATILITY AND FUEL PRICE ISSUES

Q: What does "*volatility*" mean in the context of energy prices?

A: "Volatility" refers to the degree to which prices may rise or fall over a period of time. In an efficient market, prices will normally incorporate known and anticipated present and future circumstances of supply and demand. Similarly, changes in market prices will tend to reflect changes in what we collectively know or anticipate.

When market prices tend to change a lot over relatively short time periods, the market is described as having a high degree of volatility. Conversely, relatively stable prices are associated with low volatility.

In electric power markets, generation assets represent huge investments, typically hundreds of millions if not billions of dollars. The ability of those investments to return, and earn a return on, capital depends upon the ability of the generation to produce power and sell it at a viable price. With fossil fuel costs representing a substantial portion of the total cost of producing power, and with economic dispatch principles exposing high-cost generators to idle operations, electric power companies are extremely sensitive to fluctuations in fossil fuel prices.

Hence, volatility in prices creates uncertainty and risk. Generally, firms and individuals are risk-averse, in that there is a willingness to give up a portion of the expected benefits in order to achieve greater certainty that those benefits will be achieved. This is a basic principle of insurance and risk management, and is a cornerstone underlying modern portfolio theory.

Electric power producers will typically make serious efforts to mitigate the financial risk of volatile fuel prices. Such steps may include long-term supply contracts, and financial options and futures. However, these types of actions do not eliminate the inherent risk of price volatility;

they merely transfer the risk to other parties. This transference of risk is achieved at a cost, and the electric power producer will consider such risk mitigation costs as part of making fuel choices.

Further, it is not possible to transfer all of the financial risk of volatile fuel prices. Power generation assets are extremely long-lived, typically expected to be productive for several decades. Most options and futures markets provide hedging opportunities for no more than a few years. Even long-term fuel supply contracts will tend to contain provisions for price adjustments over time. Hence, the electric power producer will not be able to mitigate completely all fuel price risks, and fuels with more volatile prices will continue to pose greater financial risks.

Q: Why is price volatility important?

A: We live in a market economy, where prices move up and down in response to changes in supply and demand. Some amount of price volatility is, therefore, an inevitable consequence of a market-based economy.

But price volatility carries a cost. Volatility matters for all consumers and producers in the economy. Just as a car gets worse mileage when driven in stop-and-go conditions, price volatility induces actions that collectively cause a weaker-performing economy. Volatility in prices creates market uncertainties. Since consumers and companies make purchase and investment decisions based on expectations about prices, higher volatility increases the likelihood of making decisions that turn out poorly. Risk premiums increase to compensate for higher volatility. Volatile prices can also affect labor markets, increasing temporary layoffs or prompting surge hiring.

The U.S. Department of Energy's Energy Information Administration (EIA) is a statistical agency created by Congress in 1977 to provide policy-independent data, forecasts, and analyses. EIA recently undertook an analysis of the effect of energy price volatility vis-à-vis steady energy prices. Their findings were published as "Energy Price Impacts on the U.S. Economy" (April 2001, at http://www.eia.doe.gov/oiaf/economy/energy_price.pdf). This analysis was undertaken in response to the two years of rapidly falling oil prices in 1997 and 1998, followed by two years of rapidly rising prices. To assess the economic impacts of these rapidly changing energy prices, EIA compared two cases: (1) The "Volatile Energy Price" case mimicked the energy price percent changes seen from the period between 1997:1 to 2001:1, including the prices movements for petroleum, natural gas, coal and electricity and (2) The "Steady Energy Price" case assumed steady energy prices throughout the four-year period.

EIA's analysis examined what the impact would be on the growth of the economy if energy prices had remained steady throughout the four-year period from 1997:1 to 2001:1, compared to the roller coaster path they actually took. As hypothesized, the falling energy prices boosted economic growth, while the subsequent price jumps dampened growth. Less expected was the finding that this was not a zero-sum game. The falling energy prices in 1997-1998 boosted the economy by about 0.3 percentage points. However, rising prices in 1999-2000 dampened GDP growth by as much as 0.7 percentage points. Over the entire four-year period, a steady energy price path could have potentially boosted GDP growth by 0.2 percentage points compared to the volatile price path. EIA concluded that all other things equal, the economy would most likely perform better with stable or predictable energy prices than when the price of energy fluctuates greatly.

Several other studies have also examined relationships between price volatility and broader economic impacts. Ben S. Bernanke, now Chairman of the Federal Reserve Board, in a 1980 paper titled "Irreversibility, Uncertainty, and Cyclical Investment" (NBER Working Paper

No. 502, July 1980), examined the optimal timing of real investment when those investments were irreversible and when new information about the future returns would be arriving over time. Bernanke concluded that uncertainty retards the current rate of investment because it increased the value of waiting for new information. In a 1996 analysis titled "Oil Price Volatility and the Macroeconomy" (Journal of Macroeconomics, Winter 1996, Vol. 18, No. 1, pp. 1-26), J. Peter Ferderer found that both oil price changes and oil price volatility have different and negative impact on output growth, and that price changes up and down have asymmetric effects.

Q: How is volatility measured?

A: "Volatility" and "risk" mean different things to different people, and different approaches have been developed to express this. For some, volatility is best understood by visual comparisons, charting prices and price changes over time. For others, volatility can be represented by the occasional "big event" – a maximum one-day loss, or the biggest year-to-year change.

A useful and common way of measuring price volatility is the use of the statistical function known as the "standard deviation." The standard deviation is a measure of how widely numbers are spread out from the average value (the mean) of a population. The standard deviation is calculated as the square root of the "variance," which in turn is computed as the average squared deviation of each number from its mean.

The standard deviation is always a positive number and is always measured in the same units as the original data. A relatively large value indicates that the data points tend to be dispersed far from the mean, while a small value indicates that they are clustered closely around the mean. When the data are normally distributed (a "bell curve" distribution), the standard deviation helps describe the likelihood and magnitude of outliers. In a normally distributed population, a little over two-thirds (about 68.26%) of the values will fall within one standard deviation away from the mean, and about 95 percent (95.46%) of the values are within two standard deviations. The range of two standard deviations about the mean is a commonly-used benchmark for statistical significance, and is often referred to as the "95-percent confidence interval."

Many people – particularly those in the financial community – prefer a more quantitative formulation of "volatility" that can then be used in various option pricing models and portfolio analyses. Most commonly, volatility is measured as the standard deviation of an asset's rate of return relative to "the market" rate of return. Over some time frame (e.g., days, months, or hours), the returns of the asset relative to the market are measured and used in the statistical calculation of standard deviation. The greater the standard deviation, the higher the volatility.

Even within this frequently-used approach of calculating standard deviations, there are several variations. As noted above, the frequency of the measurement period (e.g., days, months, or hours) and the length of time over which observations are made can vary. Volatility can also be measured historically by examining past data, or prospectively by looking at futures markets and forecasts.

Ultimately, there is no single "right" approach; the appropriate method depends upon the questions being considered. Some questions may call for an understanding of the average variability within the data, and others may be focused on the extreme outliers. For my purposes here, the set of questions posed and the variety of tools used to answer them collectively build to my findings that coal prices are much less volatile than other fossil fuels, and that this is turn confers benefits for its use. Accordingly, highly quantitative calculations of fuel price volatility may be informative, but are not necessarily required.

Q: What factors drive changes in energy prices?

A: Like other commodities, prices for fuels are set largely by forces of supply and demand. But the factors affecting coal prices are very different from those affecting oil and gas, and this has important implications for fuel price volatility.

The U.S. has vast reserves of coal. Its major market is the U.S. electric power sector. High transportation costs limit international traffic, while environmental concerns and ease-of-use considerations limit coal's role in other sectors. Relatively abundant supply and predictable growth tend to make for a steady market, especially in the longer-term. Longer-term prices tend to be set by mining and transportation costs, which tend to change slowly over time in response to changes in productivity, labor costs, technology, and other factors.

Petroleum prices are set in a world market. The U.S. is a relatively high-cost oil producer with a gradually diminishing share of world production. World reserves and production are concentrated in relatively few regions, often with state-controlled production and other limits to a full and free market. For the past few years, world demand has been growing faster than new productive capacity, with the result that there is now very little if any excess capacity globally. With relatively inelastic supply and demand, world oil prices are highly volatile, responding to changes in international economic growth, weather, infrastructure, world politics and much more.

Natural gas was once seen as a regional or national fuel, but increasingly trades on a world market. To some extent, oil and gas prices have long been linked by market competition and contract pricing provisions. However, more recently the global market for liquefied natural gas (LNG) has begun to expand at a rapid rate. As this global market evolves and grows, we should expect gas and oil prices to become more tightly linked, with regional differences in gas prices mainly reflecting transportation cost differences.

II(b). ANALYSIS OF FUEL PRICE VOLATILITY

Q: What types of energy prices did you examine?

A: I examined three types of data: historical price data, futures market data, and price forecast data. Each of the data sets confirms the greater volatility of natural gas prices, and therefore their greater price risk relative to coal. I will discuss each of these in turn.

II(b)(1). HISTORICAL PRICE DATA

Q: Please describe your analysis of historical price data.

A: I first examined annual data on electric utility fuel purchases and average residential rates over the time period 1973-2005. These data are collected and reported by the Energy Information Administration (EIA) of the U.S. Department of Energy.

For fossil fuels, the data series of primary interest were the average annual cost of coal, natural gas, and oil received at electric generating plants. These averages are expressed in dollars per million Btu ($/MMBtu), including taxes. By quantity, coal is by far the largest fossil fuel input for electricity, followed by natural gas. Petroleum is presently a distant third, although previously it had a larger market share. To remove the effects of general price inflation over this period, I have adjusted these price series by the Gross Domestic Product (GDP) Implicit Price Deflator, so that all prices can be compared on a basis of constant year 2000 dollars.

For the same 1973-2005 time period, I then tabulated EIA data for the average retail price of electricity for the residential sector. These averages are presented in units of cents per kilowatt-hour (kWh), including taxes. Here, too, the GDP Implicit Price Deflator was used to adjust the price series so that all prices can be compared on a constant 2000$ basis.

Q: What patterns did you see concerning fossil fuel costs and electric rates?

A: Table 1 presents the data developed for this comparison. The key time series are charted in Figure 1, graphing the average fossil fuel prices and residential electricity prices (in real 2000$) over the 1973-2005 time period. Several important points can be seen in Table 1 and Figure 1:

- The real (inflation-adjusted) price of coal shows a relatively steady pattern, with small year-to-year changes and a general downward trend over time.
- The real (inflation-adjusted) prices for oil and gas show much greater year-to-year fluctuations, with average prices in some years being more than $1.00/MMBtu higher or lower than the previous year's average price.
- The real price trend for average residential electric rates generally tends to parallel that seen for coal prices, with modest year-to-year price changes. The primary departures from the coal price trend appear to be in the form of moderate upward bumps in average residential electric rates in the mid-1970s, early 1980s, and early 2000s. (Note that while the trend for residential electric rates may appear "bumpier" and therefore more volatile than coal, the absolute levels are higher and this makes the annual changes smaller on a percentage basis.)
- The upward bumps seen in average residential electric rates appear to coincide with price spikes seen for oil and/or gas during those periods.

Q: How much volatility can be seen in the historic energy price data?

A: The relatively greater volatility seen in natural gas and oil prices can also be quantified using standard statistical approaches, particularly the standard deviation. However, since the data are in a time series, the observations are not independent, in that the price at the beginning of a year is the ending price of the previous year. Because of this autocorrelation, a commonly-used approach is to analyze the price changes from one period to the next, rather than the absolute price level. These changes can be expressed either as the absolute price change in each period or as the percentage change over the last period.

Table 2 calculates the year-by-year changes from the price and cost levels seen in Table 1, and calculates the standard deviations of these changes. These calculations were made in real terms (inflation-adjusted 2000 dollars), and clearly show the higher volatility of oil and gas prices relative to coal, both on an absolute and percentage basis:

- The average residential electric price showed relatively small year-to-year changes. The annual changes over the 1973-2005 period indicated a standard deviation of only 3.7 percent, and 0.32 cents per kWh. The 95 percent confidence interval for these annual changes would be plus-or-minus 0.64 cents per kWh.
- Coal prices showed the smallest year-to-year changes among the fossil fuels. The annual changes over the 1973-2005 period indicated a standard deviation of only 11.6 percent, and $0.16 per MMBtu. The 95 percent confidence interval for these annual changes would be plus-or-minus $0.32 per MMBtu.
- Petroleum prices showed the largest year-to-year changes among the fossil fuels. The annual changes over the 1973-2005 period indicated a standard deviation of 30.0 percent, and $1.08 per MMBtu. The 95 percent confidence interval for these annual changes would be plus-or-minus $2.16 per MMBtu, substantially more than the entire average cost of coal.
- Natural gas prices also showed large year-to-year changes. The annual changes over the 1973-2005 period indicated a standard deviation of 20.6 percent, and $0.67 per MMBtu.

The 95 percent confidence interval for these annual changes would be plus-or-minus $1.34 per MMBtu, about equal to the entire average cost of coal.

From this analysis we can easily conclude that the historical prices for natural gas have been far more volatile than the prices for coal, both on an absolute as well as a percentage basis.

II(b)(2). FUTURES MARKET DATA

Q: Please describe your analysis with respect to futures markets.

A: Data from futures markets confirm that oil and gas prices are highly volatile and unpredictable as compared with coal prices. As part of my analysis, I examined data from the New York Mercantile Exchange, Inc. (NYMEX), the world's largest physical commodity futures exchange. NYMEX pioneered the development of energy futures and options contracts over 25 years ago, bringing price transparency and risk management to these markets. Hedgers use the futures to help stabilize the revenues or costs of their business operations because they have an offsetting position in the physical market. Other investors seek to profit from market movement because they do not have offsetting physical positions, and in doing so provide the liquidity hedgers need to take positions.

NYMEX trades several energy commodity futures, including light sweet crude oil, natural gas, electricity, and coal. Crude oil and natural gas markets are particularly active, and allow investors at any time to speculate or hedge on the prices, by month, up to five or six years into the future. If one looks at the futures price for natural gas, as an example, one sees in essence the marketplace's consensus forecast for monthly prices over the futures period, taking into account the various expectations of supply, demand, seasonal factors, and other considerations.

For my purposes here, it is more instructive to examine futures contracts near the end of their lifetime. For example, Figure 2 presents the price histories for futures contracts for natural gas and light sweet crude oil expiring May 6, 2006. The histories show not only the general rise in prices over the past couple of years, but also the extreme volatility seen in rapidly changing expectations in turbulent market times.

- For natural gas, futures contracts expiring in May 2006 could have been purchased for under $4.00 per MMBtu in early 2003. But these futures contracts turned out not to be an accurate forecast of the actual future price of natural gas. Prices have generally soared since 2003, peaking at over $14 per MMBtu during the last half of 2005. Mild winter weather and other factors have acted to bring prices down sharply since then, but at recent prices still over $6 per MMBtu, this futures contract is still far above its price of just a few years ago.
- For light sweet crude oil – the world's most actively traded commodity – futures contracts expiring in May 2006 could have been purchased for under $40 per barrel in late 2004. By about August 2005, prices had climbed to about $70 per barrel, then fell to below $60 per barrel, and has since been up and down in the $60-$70 per barrel range. With crude oil having an energy content of about 5.8 MMBtu per barrel, a $10 per barrel change is price is equivalent to about $1.72 per MMBtu price change.

As was seen in Table 1, the average price of coal for electric generating plants has remained under $2.00 per MMBtu since before 1990. Hence, just the changes in prices for oil and natural gas futures in the past couple of years have been greater than the entire price of delivered coal.

II(b)(3). FUEL PRICE FORECASTS

Q: Please describe your analysis with respect to recent forecasts of fossil fuel prices?

A: A review of current and historical price forecasts also confirms the highly volatile nature of natural gas and oil prices as compared with coal prices.

Among the most widely known and read forecasts of energy markets is the Annual Energy Outlook, published annually by the Energy Information Administration. The Annual Energy Outlook (AEO) develops detailed year-by-year projections of U.S. energy markets. EIA's most recent set of forecasts – AEO 2006 – includes energy projections out to the year 2030.

The Reference Case projections of AEO 2006 are based on Federal, State, and local laws and regulations in effect on or before October 31, 2005. As such, they may best be thought of as a "business-as-usual" scenario, and not necessarily a prediction that includes a best guess on future policies. AEO 2006 also develops other scenarios to test the sensitivity of key parameters.

Table 3 shows the Reference Case price forecasts from AEO 2006. These prices show year-by-year forecasts through the year 2030 for fossil fuels (petroleum, natural gas, and coal) delivered to the electric power sector. The AEO 2006 prices were published in units of 2004 dollars per MMBtu, and so I have converted them into year 2000 dollars (using the GDP Implicit Price Deflator) in order to facilitate comparability with other information presented herein. Figure 3 presents some of the key AEO 2006 forecasts in graphical form. From Figure 3 and Table 3, several important aspects of the AEO 2006 forecasts can be observed:

- For both natural gas and oil, EIA is forecasting price declines from the sharp spikes experienced in 2005. Forecast prices are seen as declining $1 to $3 per MMBtu through the period 2010-2015, and then resuming a gradual yet steady upward climb through the year 2030.

- Throughout most of this period, oil and gas prices move roughly in parallel. The oil price is seen as higher, as the power sector's average includes both distillate and residual fuel. Prices for residual fuel and natural gas are forecast as usually being within 10 percent of each other on a national average.
- Steam coal prices show very little price movement over this forecast period. Over the entire 2003-2030 period, coal prices fluctuate by less than $0.20 per MMBtu, and rarely more than $0.03 per MMBtu in any given year. By comparison, annual fluctuations in prices for oil and gas are often 10 times more than those for coal.
- EIA's report notes that the prices in the AEO 2006 reference case reflect a shift in their thinking about long-term trends in oil markets. World oil markets have been extremely volatile for the past several years, and EIA now believes that their previous price forecasts did not fully reflect the causes of that volatility and the implications for long-term average oil prices. Gas prices also reflect updated thinking on growing demands, gas production potential from domestic sources and unconventional sources, and new imports of LNG. The rapid growth of LNG imports is particularly significant, as these supplies compete on the world market and are often tied directly to crude oil prices.

EIA also develops alternative projections from its Reference Case forecasts in AEO 2006, using scenarios named "High Price" and "Low Price." The scenarios vary mainly by incorporating different assumptions about the size of the world and U.S. resource bases for oil and gas, usually plus or minus 15 percent from the Reference Case. Figure 4 summarizes the key price projections for the electric power sector fossil fuel prices:

- Petroleum prices are extremely uncertain, and modest changes (15%) in resource assumptions have a dramatic effect on long-term prices. By 2030, the high petroleum prices for the electric power sector are nearly triple those of the low price case, and vary by nearly $8 per MMBtu.
- Natural gas prices also span a substantial range, but less than those for petroleum. By 2030, the high natural gas prices for the electric power sector are almost half again as high as in the low price case, a difference amounting to more than $2.00 per MMBtu.
- Coal prices show little change in prices. While the higher oil and natural gas prices serve to boost demand for coal and increase its costs for production and transportation, these effects on the vast U.S. coal resource base are modest. By 2030, the high coal prices for the electric power sector are less than 20 percent higher than in the low price case, a difference amounting to only $0.21 per MMBtu. Here, too, the price sensitivity of coal is less than one-tenth that of petroleum and natural gas.

Q: What can we learn by comparing past forecasts to more recent ones?

A: Forecasts are only predictions of the future, not guarantees. Forecasts are made by imperfect humans using imperfect data and an imperfect understanding of how they all connect. Unexpected events, changes in laws and regulations, and new interactions within the economy will all act to steer the future in different directions from our earlier predictions. Even the largest, most impartial, and most experienced efforts at forecasting energy markets, such as EIA's Annual Energy Outlook, will in hindsight be seen to have "missed" in various ways.

EIA first published the Annual Energy Outlook in 1982, and the AEO 2006 marked the 25th annual edition. In early 1982, the world was facing near-record high oil prices, high inflation, and a stumbling economy. The 25 years since then have seen dramatic and often unexpected changes in technologies, economic structure, world politics and trade, and much more. The set of AEOs published over this period serve as an archive of then-contemporaneous expert thinking as to how all of these factors would shape the future of energy supply, demand, and prices. This archive shows that the expert predictions often missed dramatic shifts in oil and gas prices.

For my analysis here, I compiled information from each of the 25 AEOs published over the 1982-2006 period. Specifically, I recorded from each AEO the price forecasts for petroleum, natural gas, and coal delivered to electric generators over the forecast period. AEO generally publishes its forecasts in 5-year increments; for example, the AEO 1982 published forecasts for 1985 and 1990, while the AEO 2006 publishes for 2010, 2015, 2020, 2025, and 2030. (I note that some of the AEOs also publish forecasts for some of the intervening years, but this is not consistent over the publication's history.) Also, because each AEO published prices in varying year dollars (e.g., the AEO 1982 expressed prices in 1982 $/MMBtu, while the AEO 2006 expresses prices in 2004 $/MMBtu), it was necessary to convert each price series into year 2000 dollars, using the GDP Implicit Price Deflator.

Table 4 presents this 25-year set of AEO forecasts for (A) petroleum, (B) natural gas, and (C) coal prices delivered to electric power generators. While the tables are dense with information, they reveal a wealth of insight regarding a quarter-century's worth of expectations regarding future fossil fuel markets. First, let us take each fuel in turn:

- Petroleum prices (Table 4a) in the early 1980s were at record highs, and expectations were widespread that prices would continue rising into the future. However, that did not happen. As the 1980s progressed, oil shortages eased, and prices and price projections moved lower. By the late 1980s and early 1990s, talk of an "oil glut" continued to push

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forecasts increasingly lower. After 2000, this trend began to reverse itself, and since then forecasts have been trending increasingly upwards, but none of EIA's forecasts captured the very high prices being experienced today. Most recently, the AEO 2006 forecasts project a future petroleum price path that is about 30 to 40 percent higher than forecasts made just a year ago.

- Natural gas price forecasts (Table 4b) made over the past 25 years generally parallel those made concurrently for petroleum. Significantly, none of EIA's Annual Energy Outlooks made over the years have been able to foresee the recent dramatic escalation in natural gas prices. Indeed, in AEO 1995 through AEO 2003, natural gas price forecasts to electric generators for 2005 all came in at under $4.00 per MMBtu (in year 2000 $), and usually substantially less. Actual data for 2005 (EIA Monthly Energy Review, April 2006, Table 9.11, page 137) now show that the actual price averaged $8.45 per MMBtu, equal to $7.59 per MMBtu in year 2000 $. In other words, natural gas prices are so volatile that for the past decade, the nation's leading energy forecasting agency underestimated current natural gas prices by half.
- Coal price forecasts (Table 4c) have generally declined for the past 25 years. Whereas petroleum and natural gas price forecasts have always been more volatile and driven by various world events, coal price forecasts have always tended to be dominated by the enormous domestic coal reserves and relatively elastic, or "flat," coal supply curves. And unlike petroleum and natural gas price forecasts that almost always show higher prices in the out-years, coal price forecasts will sometimes show declining long-term prices, depending upon the assumptions made regarding future labor costs, mining productivity, and other costs.

These compilations of AEO forecasts can also be examined from another angle by looking at the volatility of the forecasts themselves from year-to-year. This can be done by charting year-over-year changes in price forecasts for a single year. For the year 2010, for example, we can see how expectations shifted as the long term grew closer. The EIA first began making projections to the year 2010 in its AEO 1990, and they continue to include that as one of its target years. By charting 2010 fuel price forecasts from the various AEO publications made 1990 to 2006, we can in effect simulate NYMEX commodity futures, but in this case over a much longer period of time.

Figure 5 presents four charts showing fuel price forecasts for the years 2000, 2005, 2010, and 2020. Each chart uses all of the available AEO publications, and simultaneously shows petroleum, natural gas, and coal price forecasts to electric generators. Like the charts of the NYMEX commodity futures, we can see how expectations of prices at a specific end-date changed as that end-date drew closer:

- For petroleum and natural gas for the forecast target years 2000 and 2005, end-year price projections generally fell over the periods spanned by the AEOs. These forecasts were made over a period of generally falling or stable market prices, and each year the forecasters incorporated more of that pattern into their future projections.
- For petroleum and natural gas for the forecast target years 2010 and 2020, we can observe end-year price projections generally falling through the early and mid-1990s. By the late 1990s and continuing today, AEO projections began showing gradually higher price forecasts for 2010 and 2020, with substantially higher estimates made in the past couple of years.

- Coal prices show a very stable set of price projections for all four of the forecast target years shown. During much of the 1990s, actual coal mining productivity continued to exceed expectations, and forecasts increasingly reflected these mining cost reductions.
- Over the "commodity futures" period, both petroleum and natural gas show very high volatility. The highest price points are two to three times that of the lowest, with the future price for each fluctuating by several dollars per MMBtu.
- Coal prices, in contrast, show relatively little volatility over the "commodity futures" period. The highest price points are about twice those of the lowest, reflecting a more pessimistic view of coal mining costs in the earlier years of the AEO. But because coal prices are so much lower than petroleum and natural gas, the future price for coal fluctuates by no more than about $1.50 per MMBtu over the forecast period.

Q: What do you conclude from your review of fuel price forecasts?

A: Historically, oil and gas prices are far more subject to market vicissitudes than coal prices. Thus, the 1970s and early 1980s were a turbulent time for petroleum and natural gas supplies, characterized by expectations of high prices well into the future. Through the mid-1980s and most of the 1990s, the market outlook brightened for consumers, and petroleum and natural gas price forecasts trended progressively lower. In the last few years, however, available supplies for both fuels have been much tighter, resulting in sharply higher market prices and rapidly increasing expectations for higher prices well into the future.

Coal price expectations, on the other hand, are based much more on domestic mining and transportation costs, and are influenced heavily by trends in labor costs and mining productivity. Price forecasts for coal have generally trended downward since the 1980s, as improvements in labor productivity and rail rates have exceeded earlier expectations. Because of these trends, the forecasted price differential between coal and natural gas is widening, weakening natural gas's ability to be a competitive long-run fuel for power generation.

Q: Please summarize your conclusions on the overall volatility of fossil fuel prices.

A: In addition to the trends in fuel prices – both historic and forecast – the greater price volatility of natural gas and petroleum should be taken into account. Using several quantitative and qualitative measures of volatility, it is clear that both natural gas and petroleum have a very volatile price path, whereas coal shows a much lower volatility. This difference in volatility is evident not only as a percentage of price, but given coal's much lower price to begin with, volatility as measured by changes in $ per MMBtu shows a dramatic advantage for coal.

III. EFFECTS ON THE PUBLIC OF FUEL PRICE VOLATILITY LEADING TO HIGHER COSTS

Q: What issues do you address in this section of your testimony?

A: This part of my analysis examines some of the consequences that would result from fuel selection choices that increase exposure to volatility and high prices. I examine both the economic consequences of higher energy prices and, because wealth is directly correlated with health, the health consequences of higher energy prices. These economic and health consequences are both risks that must be considered in determining whether Big Stone Unit II should be built or replaced by an alternative type of power supply.

III(a). ECONOMIC CONSEQUENCES

Q: Why are higher prices for fossil fuel a matter of concern?

A: For an electric power company, higher fuel prices means higher costs for generating power. Ultimately, these costs are recovered from the customers in the form of higher rates. Money now spent on higher power prices is no longer available for households to spend on food, housing, education and other purposes. As discussed below, for many, this drop in household disposable income will affect health, safety, and mortality.

Q: How significant is this likely to be in the context of Big Stone Unit II?

A: Quite significant. Since a 600 MW unit consumes such large quantities of fuel, even small changes in fuel prices amount to very large changes in annual costs. For illustration, assume that if instead of coal, a natural gas combined cycle (NGCC) plant was proposed. If the NGCC plant was 600 MW, had a 7200 Btu/kWh heat rate, and operated at an 80 capacity factor, then each year it would generate about 4.2 million MWh and consume about 30 million MMBtu of gas. For this single unit, then, a change in gas prices of only $0.01 per MMBtu over the course of a year would change total costs by about $300,000. If future natural gas prices are uncertain by $1.00 per MMBtu (or more), then total annual costs for a gas-fueled alternative to Big Stone Unit II may vary by tens of millions of dollars per year.

Q: What impact do higher fuel prices have on the economy?

A: Higher energy prices can become a drag on the economy, boosting inflation rates and slowing overall economic activity. Energy expenditures are a large part of our economic activity, and higher prices quickly show up in national inflation indices. When energy prices are sustained at high levels, they begin to affect the core inflation rate (the rate that excludes energy and food) through their continued pressure on the prices of other commodities, transportation, and other energy-intensive goods.

Historically, high energy prices have had adverse effects on the economy. Looking from the 1970s forward, there are observable and dramatic changes in GDP growth as the world oil price has undergone dramatic change. The price shocks of 1973-74, the late 1970s/early 1980s, and early 1990s were all followed by recessions, which were then followed by a rebound in economic growth. The pressure of energy prices on aggregate prices in the economy created adjustment problems for the economy as a whole. As shown in Figure 6, these relationships among energy prices, inflation, and GDP growth have been explored by the Energy Information Administration and others. As can be seen, energy prices have correlated closely with inflation, and are inversely correlated with growth in Gross Domestic Product (GDP).

These relationships to economic growth can also be observed in forecasts. Each year, as part of the Annual Energy Outlook forecasts, the Energy Information Administration develops alternative scenarios with higher and lower world oil prices. In the Low Price scenario, for example imported crude oil prices are $37.00 per barrel in the year 2010, compared to a $43.99 per barrel reference case price. The effect on GDP in 2010 is about $60 billion, where the lower oil price leads to an extra 0.5 percent in GDP (AEO 2006, Tables C-1, C-2).

To some, these effects of higher fuel costs may seem minor and certainly manageable. But to those households with lower income, energy prices can constitute a crushing burden. A recent paper titled "Energy Cost Burdens on American Families" (Eugene M. Trisko, for Americans for Balanced Energy Choices, October 2005, http://www.ceednet.org/docs/ABEC%20Member%20Documents/Energy%20Price%20Impact%20Study.pdf) used federal government data to analyze the effects of 2005 prices for residential and transportation energy. Trisko found that overall, the 56 percent of American families with incomes of $50,000 or less (totaling 63 million families) will spend 20 percent of their pre-tax income on energy in 2005. In contrast, households with family incomes greater than $50,000 will spend only five percent of their gross incomes for residential and transportation energy.

Q: Are Big Stone Unit II customers at greater than average risk for fuel price volatility?

A: Yes. In addition to electricity, we use substantial amounts of natural gas and petroleum in the residential sector, plus modest amounts of wood and other renewables. Nationally, this direct consumption of natural gas and petroleum in the residential sector is substantially greater than the electrical energy consumed. It follows that if this non-electric residential energy consumption is weighted heavily toward price-volatile energy sources, then the reliance upon those same energy sources for Big Stone Unit II could exacerbate the overall volatility risks for South Dakotans.

Households in South Dakota and other West North Central states have higher than average consumption of natural gas and petroleum. This greater consumption is largely related to higher winter heating needs that largely utilize natural gas and petroleum fuels. Using data on heating and cooling degree-days, as reported by the Energy Information Administration, we can see that the West North Central region (comprised of Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, and South Dakota) is substantially colder than average in the winter, and somewhat warmer on average in the summer (DOE/EIA Annual Energy Review 2004, Tables 1.9 and 1.10, at http://www.eia.doe.gov/emeu/aer/). For heating degree-days over the 1971-2000 period, the West North Central region averaged more heating degree-days than any other Census region, 49.2 percent higher than the U.S. average. Conversely, the somewhat cooler-than-average summers led to the West North Central having 23.6 percent fewer cooling degree-days than the U.S. average.

Whereas summer cooling needs are typically met using electricity-driven air conditioners and fans, winter heating needs are more often met by direct household use of natural gas and petroleum fuels. It would tend to follow that the colder regions of the country would have greater household consumption of natural gas and petroleum fuels.

The Energy Information Administration, in its periodic Residential Energy Consumption Survey (RECS), develops state-wide estimates of energy consumption by type of fuel. EIA's most recent published estimates are for calendar year 2001. By dividing these estimates by the number of housing units in these states for 2001 (using Census Bureau data), we can attain per-household estimates of energy consumption, by state and by type of fuel.

Table 5 summarizes these per-household calculations of residential energy use. As can be seen, South Dakota had both a higher-than-average consumption of non-electrical residential energy consumption and a greater proportion of that as natural gas and petroleum fuels. For non-electric energy consumption, the average South Dakota household in 2001 consumed 62.6 MMBtu, compared to the national average of about 58.5 MMBtu per household. For natural gas and petroleum fuels, the average South Dakota household in 2001 consumed 59.0 MMBtu, also higher than the national average of 54.7 MMBtu.

The heavy reliance on natural gas and petroleum fuels in the residential sector brings with it another risk of natural gas as a power plant fuel for South Dakotans. If natural gas is used as an energy source instead of coal at Big Stone Unit II, there is an overall loss of fuel supply diversity. If natural gas supplies are constrained in supply and/or subjected to price spikes, residences can be hit twice – once in their direct consumption of fuel, and again in their use of natural gas-fueled electricity.

III(b). HEALTH CONSEQUENCES

Q: Is there a relationship between higher energy costs and health?

A: Yes. One of the most widespread and strongest research findings in the field of medical population statistics is that the higher the social and economic status (holding age and sex constant), the lower the probability of illness and mortality. This theory has been well documented over decades of research. The World Health Organization, the World Bank, and other noted institutions agree with this fact.

For energy costs, this relationship is demonstrated and developed in the report titled Mortality Reductions from Use of Low-Cost Coal-Fueled Power: An Analytical Framework, dated December 2002. I was the lead author of that report. My co-author was Ralph L. Keeney, presently a Research Professor at Duke University's Fuqua School of Business. The report was peer-reviewed by James K. Hammitt (Associate Professor of Economics and Decision Sciences, Department of Health Policy and Management, Harvard School of Public Health) and Detlof von Winterfeldt (Associate Dean for Faculty Affairs and Research of the School of Policy, Planning, and Development at the University of Southern California, and Professor of Public Policy and Management). This report can be downloaded in full as a PDF document at http://ceednet.org/docs/Mortality%20Reductions.pdf.

Q: What is the basis for asserting that reduced income is related to lesser health and higher mortality?

A: In the 1980s, the noted political scientist Aaron Wildavsky formulated the concept of the "richer is safer" (also referred to as "wealthier is healthier"). In essence, this link between wealth and health relies on two facts. First, when individuals incur higher costs of regulatory actions - such as higher prices for their energy use - less of their income is available for other purposes.

Second, individuals tend to use additional disposable income in ways that on average reduce their health and safety risks and therefore reduce deaths. Accordingly, when higher energy costs reduce the disposable income available for other purposes, they can increase other health and safety risks to individuals.

Q: What are the ways in which energy costs affect health and mortality?

A: Money spent on energy costs is not available to meet other household needs. With more income, individuals tend to spend more on health care for themselves and their children, purchase more safety equipment, eat a more nutritious diet, and take other actions that decrease the likelihood of premature death by illness or accident. Conversely, individual reductions in disposable income tend to increase health and safety risks and the resulting deaths. Similarly, higher unemployment has been shown to have an adverse effect on safety, health, and longevity.

There are many mechanisms that support the richer-is-safer and wealthier-is-healthier concepts. Some are directly due to individuals' actions and others are due to societal action. Here are a few examples:

- When individuals have less disposable income, on average the following occur: nutrition is typically poorer, babies will have less prenatal health care, adults may forgo physical exams and preventative medical expenses (e.g. pap smears) and postpone safety purchases (e.g. home fire alarms), and individuals are less likely to attend smoking clinics to stop smoking or spend as much to reduce stress.
- A general increase in the standard of living influences societal structure. Health and safety are improved via social mechanisms such as education. With more disposable income, students from poor families will more likely complete high school and attend college. Better education changes both one's knowledge about what is safe and healthy

and one's practice to pursue them. For example, sanitary procedures are improved, homes are "child-proofed" to reduce accidents, and more people start wearing seat belts.

- A wealthier society leads to the development of a better and more diverse medical research establishment, to larger markets to stimulate creation of safer products, to an infrastructure of health clubs and many opportunities for exercise, and to the societal resilience to rapidly and efficiently attack new unforeseen problems threatening our collective health and safety.

The fact that additional disposable income is used in ways that on average improve health and reduce the mortality risks of individuals applies to statistical averages and not necessarily to any specific individual whose behavior and risks contribute to those averages. For some individuals, additional income facilitates riskier and/or unhealthier activities. However, over broad populations the pattern is clear.

Q: How does this relationship apply within relatively wealthy countries such as the U.S.?

A: Much of the literature developing the relationship between income and mortality has examined the differences among countries, particularly the stark differences in average life spans between developing nations and impoverished ones. But this relationship is applicable within a country as well as across countries. Even in countries where the average household income is at a high level, the poorer segments of society will face disadvantages that collectively reduce average life spans.

Figure 7 presents a scatter chart of household income vs. average life expectancy in the United States. Each of the 50 states is a data point on this chart. The x-coordinate for each data point is that state's average household income, and the y-coordinate is average life expectancy.

While the relationship is not perfect, there is a clear upward trend among the state averages. Higher-income states tend to have higher life expectancies than the lower-income states, often 3-4 years more on average.

Q: What are the implications of this relationship for Big Stone Unit II?

A: If Big Stone Unit II is not built, and a higher-cost alternative power source used instead, there would be higher costs for electricity to the consumers, and this in turn would lead to less disposable income available for those consumers to meet other household needs.

Q: How would families be impacted by these economic dislocations?

A: In most cases, reduced household income will mean cutting back on expenditures, including some that may have a direct impact on health and longevity. This is particularly true for lower-incomes homes with fewer surplus resources. For example, less disposable income may necessitate dropping insurance coverage, forgoing or delaying medical care, or denying children access to better schools or advanced education. In some cases, reduced household incomes may lead to poor nutrition or the family having to live in unsafe conditions. These are just a few of the factors that can lead to lesser health and increased mortality. Collectively, there are measurable health and mortality risks associated with significant reductions in household incomes and higher unemployment that can result from increased power costs.

Q: Where within the population are these additional income-driven health and mortality consequences most likely to occur?

A: These estimates of lesser health and increased mortality are not spread evenly across the population; the most vulnerable in our society are often the hardest hit. Increases in energy costs are regressive because, as data and research by the U.S. Department of Energy show, low-income families must spend a greater percentage of their household earnings to cover energy-related expenditures. Further, lower-income families incur a greater mortality risk than do higher-income families when income is reduced. As a result, the health and mortality impacts are highly concentrated in lower income groups. These disproportionate effects would disadvantage certain minority communities where the average household incomes may be lower.

Q: How does volatility in fuel prices affect your conclusions in this regard?

A: As developed above, my conclusions are based on the loss of disposable household income resulting from having to pay higher prices for electricity. This linkage can be considered a first-order impact, in that the higher fuel prices directly translate into lower disposable income for other purposes.

But as I discussed, volatility in fuel prices creates additional negative impacts, disrupting labor markets and dampening overall GDP growth. Thus, even if fuel prices over time average the same, reliance on a energy source having higher volatility will have additional second-order impacts in the form of higher unemployment and lower household income. Both of these outcomes are linked to lesser health and higher rates of mortality.

Q: How applicable are your conclusions specifically to the ratepayers for Big Stone Unit II power?

A: There is evidence to suggest that the sensitivity to household income changes would be greater for the population affected by Big Stone Unit II than the national average, and as such the benefits to health, safety, and longevity of Big Stone Unit II (relative to higher-cost generating options) would be higher than use of the national averages alone would suggest. I say this because most of the counties to be served by the Big Stone Unit II plant on average have a lower average household income than the national average. Since lower-income families incur a greater health and mortality risk than do higher-income families when income is reduced, the health and mortality impacts to households served by Big Stone Unit II would likely be greater than U.S.-wide avareages would suggest.

Table 6 shows data from the U.S. Census Bureau on median household incomes for the U.S. and the counties to be served by Big Stone Unit II. The Census Bureau data consists of model-based estimates of poverty and income for states and counties, and is developed from its Small Area Income and Poverty Estimates (SAIPE) program. The latest estimates are for calendar year 2003, and can be referenced at http://www.census.gov/hhes/www/saipe/county.html.

The six companies that would share the output of Big Stone Unit II serve communities throughout large parts of western Minnesota and portions of North Dakota, South Dakota, and Iowa. The staff at Otter Tail Power Company helped me to match these communities to their respective counties. In all, the Big Stone Unit II project would serve portions of 48 of Minnesota's 87 counties, 12 of North Dakota's 53 counties, 9 of South Dakota's 66 counties, and one of Iowa's 99 counties. For each of these counties, I compared the median household income in 2003 to the U.S. average.

As seen in Table 6, U.S. median household income was $43,318 in 2003. South Dakota ranked 40th among states (including the District of Columbia), at $38,008 per household. North Dakota ranked 39th, at $38,223 per household. Minnesota, at $50,750 median household income, actually ranked seventh among states in 2003, well above the national average. However, a county-by-county examination indicates that Minnesota's high state average is driven mainly by wealthier counties in the Minneapolis-St. Paul area, whereas the Big Stone Unit II plant would service communities primarily in the western part of the state. These western Minnesota counties are generally far below the Minnesota average income, and significantly below the U.S. average.

- In South Dakota, all 9 of the counties to be served by Big Stone Unit II had a 2003 median household income below the U.S. average.
- In North Dakota, 11 of the 12 counties to be served by Big Stone Unit II had a 2003 median household income below the U.S. average.
- In Minnesota, 35 of the 48 counties to be served by Big Stone Unit II had a 2003 median household income below the U.S. average.
- The single county in Iowa to be served by Big Stone Unit II had a 2003 median household income above the U.S. average.
- In aggregate, 86 of the 118 counties in the four-state region that would be served by Big Stone Unit II had a 2003 median household income below the U.S. average.

Q: What are the implications of Big Stone Unit II's service territory having a median household income lower than the U.S. average?

A: It means that they are relatively more sensitive to the income effects on health and mortality. With a higher fraction of the households being more sensitive to the health and mortality effects of changes in household income, these counties would likely gain (or lose) more from Big Stone Unit II's presence (or absence) than national averages would suggest. Because of this, the average national vulnerability to higher energy costs may be less than that for the population economically affected by Big Stone Unit II. If so, then the health and mortality impacts for the Big Stone Unit II impacts would likely be greater than our use of national averages would suggest.

IV. CONCLUSION

Q: Was this material prepared by you or under your supervision?

A: I prepared the material in this testimony.

Q: Insofar as this material is in the nature of opinion or judgment, does it represent your best judgment?

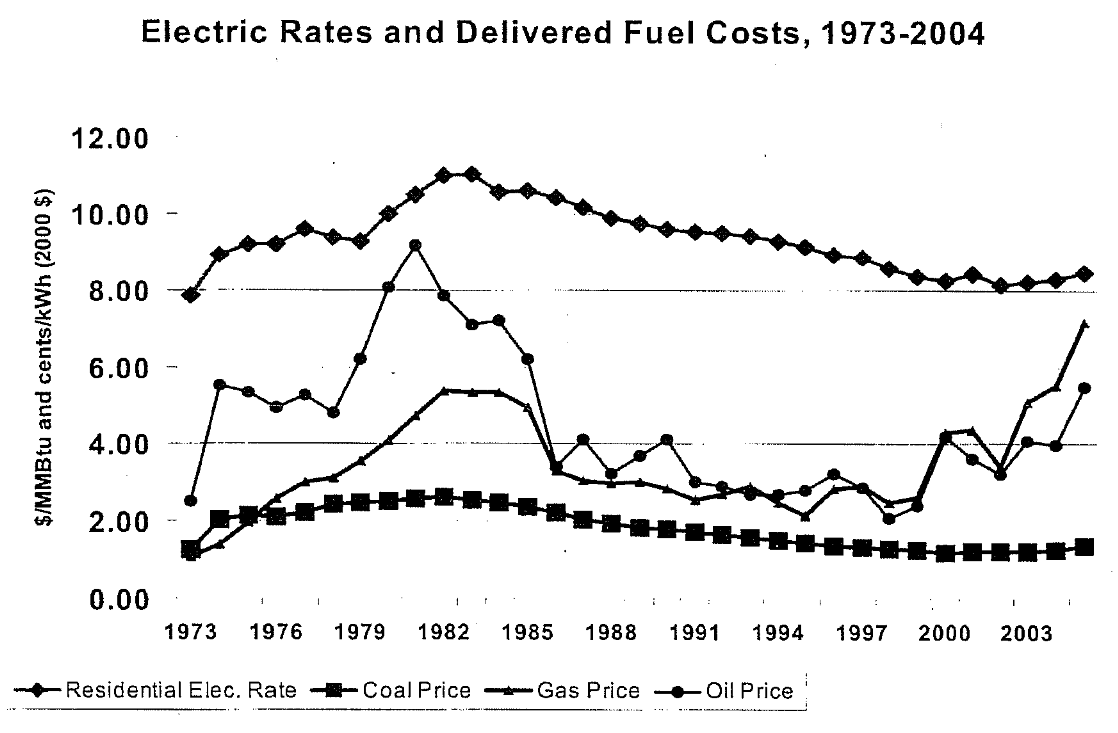
A: Yes, it does.

Q: Does this conclude your qualifications and prepared testimony?

A: Yes, it does.

FIGURE 1

RESIDENTIAL ELECTRIC AND DELIVERED FUEL COSTS TO ELECTRIC POWER COMPANIES, 1973-2005



Source: U.S. Dept. of Energy, Energy Information Administration, *Monthly Energy Review March 2006*, Table 9.9, http://www.eia.doe.gov/emeu/mer/prices.html. GDP Implicit Price Deflator based on U.S. Dept. of Commerce data, as reported in U.S. Department of Energy, Energy Information Administration, *Annual Energy Review 2004*, DOE/EIA-0384(2004), Appendix D, Table D-1, page 373, "Population and U.S. Gross Domestic Product, Selected Years, 1949-2004", August 2005, http://www.eia.doe.gov/emeu/aer/pdf/aer.pdf.

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EXHIBIT
APPLICANTS' EXHIBIT 31-A

TABLE 2

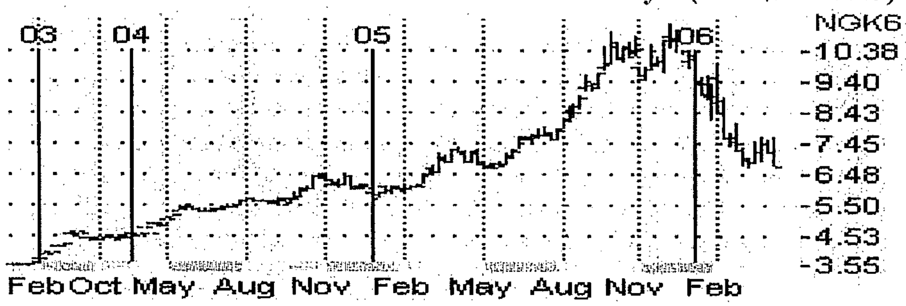
CHANGES IN RESIDENTIAL ELECTRIC AND FOSSIL FUEL PRICES, 1973-2(

	Annual Changes (2000$, cents/kWh or $/MMBtu)				Annual Percentage Ch	
	Ave. Residential	Cost at Electric Generating Plants			Ave. Residential	Cost a
Year	Electric Price	Coal	Petroleum	Natural Gas	Electric Price	Coal
1973	--	--	--	--	--	--
1974	1.08	0.770	2.989	0.327	0.14	0.606
1975	0.28	0.100	-0.177	0.591	0.03	0.049
1976	-0.01	-0.032	-0.373	0.594	0.00	-0.015
1977	0.39	0.105	0.310	0.447	0.04	0.050
1978	-0.19	0.224	-0.472	0.088	-0.02	0.101
1979	-0.11	0.031	1.412	0.422	-0.01	0.013
1980	0.71	0.030	1.851	0.539	0.08	0.012
1981	0.50	0.092	1.125	0.676	0.05	0.037
1982	0.51	0.034	-1.330	0.637	0.05	0.013
1983	0.04	-0.086	-0.749	-0.054	0.00	-0.033
1984	-0.47	-0.080	0.091	-0.002	-0.04	-0.032
1985	0.03	-0.096	-0.995	-0.385	0.00	-0.039
1986	-0.19	-0.148	-2.772	-1.641	-0.02	-0.063
1987	-0.24	-0.159	0.693	-0.239	-0.02	-0.072
1988	-0.30	-0.121	-0.891	-0.071	-0.03	-0.059
1989	-0.14	-0.097	0.461	0.008	-0.01	-0.050
1990	-0.14	-0.056	0.427	-0.153	-0.01	-0.031
1991	-0.08	-0.070	-1.117	-0.295	-0.01	-0.039
1992	-0.02	-0.079	-0.082	0.145	0.00	-0.046
1993	-0.09	-0.067	-0.225	0.202	-0.01	-0.041
1994	-0.13	-0.066	0.000	-0.426	-0.01	-0.042
1995	-0.16	-0.070	0.101	-0.317	-0.02	-0.047
1996	-0.21	-0.058	0.438	0.660	-0.02	-0.040
1997	-0.07	-0.039	-0.363	0.079	-0.01	-0.029
1998	-0.27	-0.036	-0.766	-0.425	-0.03	-0.027
1999	-0.22	-0.055	0.315	0.162	-0.03	-0.043
2000	-0.10	-0.042	1.769	1.672	-0.01	-0.034
2001	0.19	0.003	-0.573	0.079	0.02	0.003
2002	-0.30	-0.002	-0.398	-0.961	-0.04	-0.002
2003	0.08	0.007	0.876	1.665	0.01	0.006
2004	0.08	0.049	-0.121	0.421	0.01	0.041
2005	0.18	0.119	1.533	1.640	0.02	0.095
Standard Deviation:	**0.32**	**0.16**	**1.08**	**0.67**	**3.7%**	**11.6%**

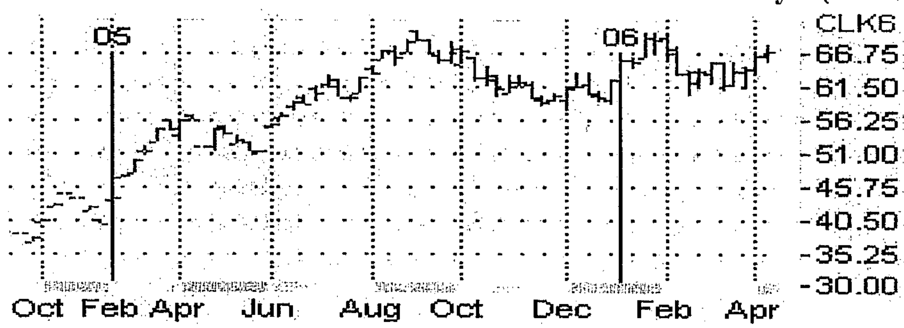
Source: Developed from Table 1, preceding, using data from U.S. Dept. of Energy, Energy Information Administration, *Monthly Energy Review March 2006* http://www.eia.doe.gov/emeu/mer/prices.html. GDP Implicit Price Deflator based on U.S. Dept. of Commerce data, as reported in U.S. Department of Energ Administration, *Annual Energy Review 2004*, DOE/EIA-0384(2004), Appendix D, Table D-1, page 373, "Population and U.S. Gross Domestic Product, Sele 2005, http://www.eia.doe.gov/emeu/aer/pdf/aer.pdf.

FIGURE 2
FLUCTUATIONS IN OIL AND NATURAL GAS FUTURES PRICES

Natural Gas Futures: 4/13/2006 Session Contract Detail for May 6 (U.S. $/MMBtu)



Light Sweet Crude Oil Futures: 4/13/2006 Session Contract Detail for May 6 (U.S. $/barrel)



Source: Data and charts from New York Mercantile Exchange, April 14, 2006, http://www.nymex.com/.

TABLE 3

AEO 2006 FORECAST OF ELECTRIC POWER SECTOR FOSSIL FUEL COSTS, 20

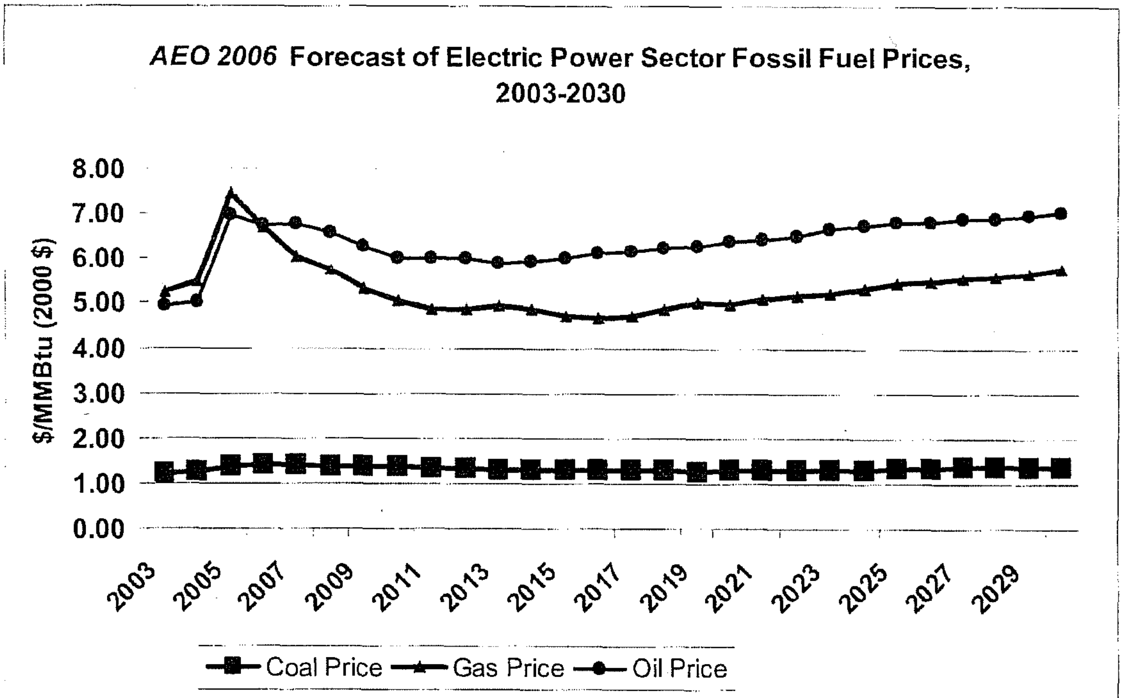
Forecast Year	Reference Case Forecasts, 2004 Dollars per MMBtu: Distillate Fuel	Residual Fuel	Petroleum Total, Ave.	Natural Gas	Steam Coal	Fossil Fuel Ave.	Ref. Case Forecasts, Conve: Distillate Fuel	Residual Fuel	Petroleum Total, Ave.	Natu
2003	6.65	4.90	5.35	5.66	1.33	2.35	6.14	4.53	4.94	
2004	9.23	4.76	5.43	5.92	1.36	2.46	8.52	4.39	5.02	
2005	9.71	6.98	7.53	8.09	1.50	3.05	8.97	6.45	6.96	
2006	10.61	6.55	7.29	7.24	1.53	2.85	9.81	6.05	6.73	
2007	10.06	6.57	7.33	6.54	1.51	2.67	9.30	6.07	6.77	
2008	9.80	6.35	7.11	6.22	1.50	2.60	9.06	5.86	6.56	
2009	9.38	5.99	6.78	5.77	1.47	2.46	8.66	5.53	6.26	
2010	9.04	5.70	6.50	5.46	1.48	2.41	8.35	5.27	6.01	
2011	9.04	5.72	6.51	5.26	1.45	2.37	8.35	5.29	6.02	
2012	9.16	5.71	6.51	5.24	1.44	2.39	8.47	5.28	6.01	
2013	8.85	5.65	6.39	5.36	1.43	2.44	8.18	5.22	5.90	
2014	8.98	5.67	6.43	5.28	1.41	2.44	8.30	5.23	5.94	
2015	9.02	5.72	6.52	5.08	1.40	2.41	8.34	5.28	6.02	
2016	9.23	5.78	6.64	5.06	1.40	2.41	8.53	5.34	6.13	
2017	9.23	5.83	6.69	5.10	1.39	2.41	8.53	5.39	6.18	
2018	9.43	5.86	6.76	5.26	1.39	2.44	8.72	5.41	6.24	
2019	9.48	5.90	6.79	5.41	1.39	2.48	8.76	5.45	6.27	
2020	9.62	6.02	6.91	5.40	1.39	2.46	8.89	5.56	6.38	
2021	9.67	6.06	6.95	5.52	1.40	2.48	8.94	5.60	6.42	
2022	9.85	6.14	7.06	5.59	1.40	2.48	9.10	5.68	6.53	
2023	9.92	6.27	7.21	5.65	1.41	2.48	9.17	5.80	6.66	
2024	9.99	6.36	7.30	5.76	1.43	2.49	9.23	5.87	6.74	
2025	10.05	6.43	7.37	5.87	1.44	2.50	9.29	5.94	6.81	
2026	10.12	6.47	7.39	5.93	1.46	2.51	9.35	5.98	6.83	
2027	10.14	6.54	7.44	6.02	1.47	2.50	9.37	6.04	6.87	
2028	10.19	6.56	7.47	6.06	1.49	2.49	9.42	6.06	6.90	
2029	10.21	6.63	7.52	6.12	1.50	2.47	9.44	6.12	6.95	
2030	10.28	6.73	7.61	6.26	1.51	2.49	9.50	6.22	7.03	
Annual Growth, 2004-2030	0.4%	1.3%	1.3%	0.2%	0.4%	0.0%	0.4%	1.3%	1.3%	

Source: U.S. Dept. of Energy, Energy Information Administration, *Annual Energy Outlook 2006*, DOE/EIA-0383(2006), February 20
Case Tables, Table 3, http://www.eia.doe.gov/oiaf/aeo/aeoref_tab.html. Prices converted from 2004 dollars to 2000 dollars by dividi
Deflator of 1.08237, based on U.S. Dept. of Commerce data, as reported in U.S. Department of Energy, Energy Information Adminis
Review 2004, DOE/EIA-0384(2004), Appendix D, Table D-1, page 373, "Population and U.S. Gross Domestic Product, Selected Ye
2005, http://www.eia.doe.gov/emeu/aer/pdf/aer.pdf.

FIGURE 3

AEO 2006 FORECAST OF ELECTRIC POWER SECTOR FOSSIL FUEL COSTS, 2003-2030

($/MMBtu, real 2000$)



Source: Developed from data in Table 3. Data from U.S. Dept. of Energy, Energy Information Administration, *Annual Energy Outlook 2006*, DOE/EIA-0383(2006), February 2006, Year-by-Year Reference Case Tables, Table 3, http://www.eia.doe.gov/oiaf/aeo/aeoref_tab.html. Prices converted from 2004 dollars to 2000 dollars by dividing by a GDP Implicit Price Deflator of 1.08237, based on U.S. Dept. of Commerce data, as reported in U.S. Department of Energy, Energy Information

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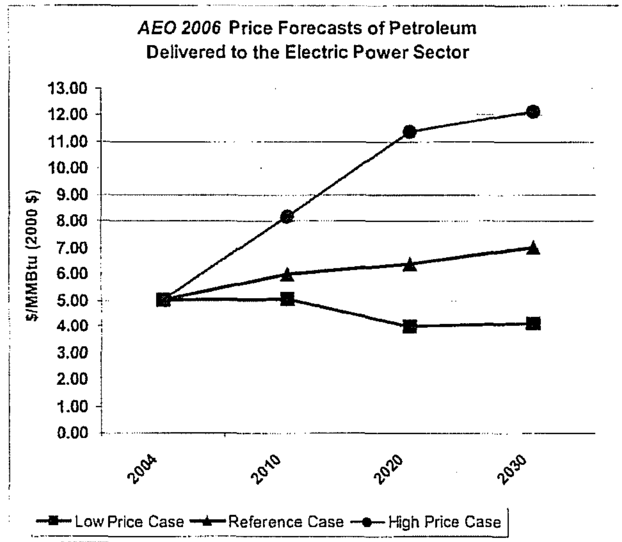
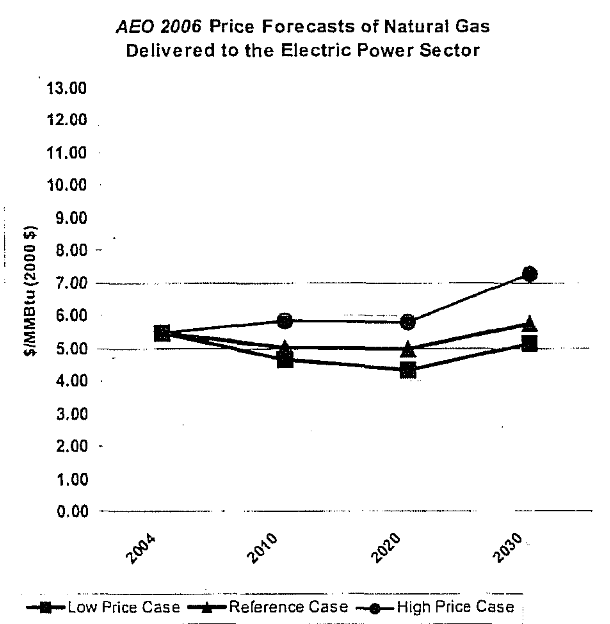
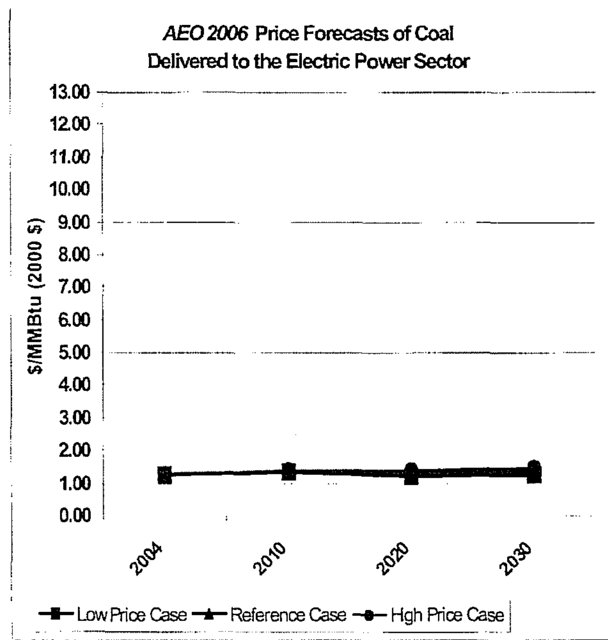
FIGURE 4
AEO 2006 RANGE OF PRICE FORECASTS FOR FOSSIL FUEL DELIVERED TO THE ELECTRIC POWER SECTOR (2000 $/MMBtu)

***AEO 2006* Price Case Forecasts for the Electric Power Sector**

		Price (2000$/MMBtu)			
	Scenario	2004	2010	2020	2030
Petroleum	Low	$ 5.02	$ 5.05	$ 4.00	$ 4.13
	Reference	$ 5.02	$ 6.01	$ 6.38	$ 7.03
	High	$ 5.02	$ 8.19	$ 11.38	$ 12.16
Natural Gas	Low	$ 5.47	$ 4.67	$ 4.32	$ 5.14
	Reference	$ 5.47	$ 5.04	$ 4.99	$ 5.78
	High	$ 5.47	$ 5.85	$ 5.80	$ 7.29
Coal	Low	$ 1.26	$ 1.35	$ 1.23	$ 1.28
	Reference	$ 1.26	$ 1.37	$ 1.28	$ 1.40
	High	$ 1.26	$ 1.39	$ 1.38	$ 1.49







Source: U.S. Dept. of Energy, Energy Information Administration, *Annual Energy Outlook 2006*, DOE/EIA-0383(2006), February 2006, Table C-3, http://www.eia.doc.gov/oiaf/aeo/pdf/0383(2006).pdf. Prices converted from 2004 dollars to 2000 dollars by dividing by a GDP Implicit Price Deflator of 1.08237

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TABLE 4(A)
PETROLEUM PRICE FORECASTS TO ELECTRIC GENERATORS FROM *ANNUAL ENERGY OUTLOOK*, 1982-2006 (2000 $/MMBTU)

1. Petroleum forecast prices in real $ per MMBtu, using $ base year as given in that year's *AEO*

Source	Table/Page	Year $	1985	1990	1995	2000	2005	2010	2015	2020	2025	2030
AEO 1982	Table A.5.1, Page 141	1982	$ 4.55	$ 6.75								
AEO 1983	Table A5, Page 194	1983	$ 4.05	$ 5.53	$ 7.59							
AEO 1984	Table A5, Page 209	1984	$ 4.48	$ 5.15	$ 6.58							
AEO 1985	Table A3, Page 49	1985	$ 4.61	$ 4.85	$ 5.30							
AEO 1986	Table A3, Page 33	1986		$ 2.79	$ 4.33	$ 5.48						
AEO 1987	Table A3, Page 35	1987		$ 3.02	$ 3.72	$ 5.00						
AEO 1988	*not published (see note)*	1988		$ 2.87	$ 3.77	$ 5.01						
AEO 1989	Table A3, Page 47	1988		$ 2.62	$ 3.70	$ 4.84						
AEO 1990	Table A2, Page 41	1989		$ 2.75	$ 3.48	$ 4.70	$ 5.54	$ 6.21				
AEO 1991	Table A3, Page 46	1990			$ 4.36	$ 4.62	$ 5.43	$ 6.00				
AEO 1992	Table A3, Page 66	1990			$ 3.84	$ 4.76	$ 5.43	$ 6.17				
AEO 1993	Table A3, Page 84	1991			$ 3.58	$ 4.05	$ 4.61	$ 5.36				
AEO 1994	Table A3, Page 58	1992				$ 3.58	$ 4.39	$ 4.94				
AEO 1995	Table A3, Page 76	1993				$ 2.91	$ 3.33	$ 3.78				
AEO 1996	Table A3, Pages 78-79	1994				$ 3.27	$ 3.68	$ 4.04	$ 4.38			
AEO 1997	Table A3, Page 100	1995				$ 3.09	$ 3.35	$ 3.59	$ 3.52			
AEO 1998	Table A3, Page 104	1996				$ 3.21	$ 3.57	$ 3.84	$ 4.00	$ 4.21		
AEO 1999	Table A3, Page 116	1997				$ 2.32	$ 3.29	$ 3.89	$ 4.05	$ 4.33		
AEO 2000	Table A3, Page 121	1998					$ 3.23	$ 3.28	$ 3.40	$ 3.54		
AEO 2001	Table A3, Page 131	1999					$ 3.70	$ 4.11	$ 4.27	$ 4.35		
AEO 2002	Table A3, Page 129	2000					$ 3.80	$ 3.97	$ 4.14	$ 4.27		
AEO 2003	Table A3, Page 123	2001					$ 4.13	$ 4.27	$ 4.43	$ 4.60	$ 4.98	
AEO 2004	Table A3, Page 137	2002						$ 4.21	$ 4.54	$ 4.67	$ 4.88	
AEO 2005	Table A3 , Page 143	2003						$ 4.55	$ 4.77	$ 5.10	$ 5.42	
AEO 2006	Table A3, Page 137	2004						$ 6.50	$ 6.52	$ 6.91	$ 7.37	$ 7.61

2. Petroleum forecast prices in real $ per MMBtu, using year 2000 dollars

Source	Table/Page	Implicit Price Deflator	1985	1990	1995	2000	2005	2010	2015	2020	2025	2030
AEO 1982	Table A.5.1, Page 141	0.6273	$ 7.25	$ 10.76								
AEO 1983	Table A5, Page 194	0.6521	$ 6.21	$ 8.48	$ 11.64							
AEO 1984	Table A5, Page 209	0.6766	$ 6.62	$ 7.61	$ 9.73							
AEO 1985	Table A3, Page 49	0.6971	$ 6.61	$ 6.96	$ 7.60							
AEO 1986	Table A3, Page 33	0.7125		$ 3.92	$ 6.08	$ 7.69						
AEO 1987	Table A3, Page 35	0.7320		$ 4.13	$ 5.08	$ 6.83						
AEO 1988	not published (see note)	0.7569		$ 3.79	$ 4.99	$ 6.61						
AEO 1989	Table A3, Page 47	0.7569		$ 3.46	$ 4.89	$ 6.39						
AEO 1990	Table A2, Page 41	0.7856		$ 3.50	$ 4.43	$ 5.98	$ 7.05	$ 7.91				
AEO 1991	Table A3, Page 46	0.8159			$ 5.34	$ 5.66	$ 6.66	$ 7.35				
AEO 1992	Table A3, Page 66	0.8159			$ 4.71	$ 5.83	$ 6.66	$ 7.56				
AEO 1993	Table A3, Page 84	0.8444			$ 4.24	$ 4.80	$ 5.46	$ 6.35				
AEO 1994	Table A3, Page 58	0.8639				$ 4.14	$ 5.08	$ 5.72				
AEO 1995	Table A3, Page 76	0.8838				$ 3.29	$ 3.77	$ 4.28				
AEO 1996	Table A3, Pages 78-79	0.9026				$ 3.62	$ 4.08	$ 4.48	$ 4.85			
AEO 1997	Table A3, Page 100	0.9211				$ 3.35	$ 3.64	$ 3.90	$ 3.82			
AEO 1998	Table A3, Page 104	0.9385				$ 3.42	$ 3.80	$ 4.09	$ 4.26	$ 4.49		
AEO 1999	Table A3, Page 116	0.9541				$ 2.43	$ 3.45	$ 4.08	$ 4.24	$ 4.54		
AEO 2000	Table A3, Page 121	0.9647					$ 3.35	$ 3.40	$ 3.52	$ 3.67		
AEO 2001	Table A3, Page 131	0.9787					$ 3.78	$ 4.20	$ 4.36	$ 4.44		
AEO 2002	Table A3, Page 129	1.0000					$ 3.80	$ 3.97	$ 4.14	$ 4.27		
AEO 2003	Table A3, Page 123	1.0240					$ 4.03	$ 4.17	$ 4.33	$ 4.49	$ 4.86	
AEO 2004	Table A3, Page 137	1.0409						$ 4.04	$ 4.36	$ 4.49	$ 4.69	
AEO 2005	Table A3 , Page 143	1.0600						$ 4.29	$ 4.50	$ 4.81	$ 5.11	
AEO 2006	Table A3, Page 137	1.0824						$ 6.01	$ 6.02	$ 6.38	$ 6.81	$ 7.03

Source: U.S. Dept. of Energy, Energy Information Administration, *Annual Energy Outlook* , yearly publications, 1982 through 2006. Reference Case Tables' prices converted from various year dollars to 2000 dollars by dividing by a GDP Implicit Price Deflator, based on U.S. Dept. of Commerce data, as reported in U.S. Department of Energy, Energy Information Administration, *Annual Energy Review 2004* , DOE/EIA-0384(2004), Appendix D, Table D-1, page 373, "Population and U.S. Gross Domestic Product, Selected Years, 1949-2004," August 2005, http://www.eia.doe.gov/emeu/aer/pdf/aer.pdf. *AEO 1988* was not published; values shown here are the averages (real) of the 1987 and 1989 *AEO.* 1982 Petroleum prices calculated as volume-weighted averages of distillate, low-sulfur resid, and high-sulfur resid. for 1990, only heavy oil prices were forecast for electric power.

EXHIBIT
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Applicants' Exhibit 31-G

TABLE 4(B)
NATURAL GAS PRICE FORECASTS TO ELECTRIC GENERATORS FROM *ANNUAL ENERGY OUTLOOK*, 1982-2006 (2000 $/MMBTU)

1. Natural gas forecast prices in real $ per MMBtu, using $ base year as given in that year's *AEO*

Source	Table/Page	Year $	1985	1990	1995	2000	2005	2010	2015	2020	2025	2030
AEO 1982	Table A.5.1, Page 141	1982	$ 5.54	$ 7.19								
AEO 1983	Table A5, Page 194	1983	$ 3.44	$ 4.49	$ 7.05							
AEO 1984	Table A5, Page 209	1984	$ 3.59	$ 4.35	$ 5.89							
AEO 1985	Table A3, Page 49	1985	$ 3.87	$ 3.85	$ 4.96							
AEO 1986	Table A3, Page 33	1986		$ 2.75	$ 4.43	$ 5.71						
AEO 1987	Table A3, Page 35	1987		$ 2.45	$ 3.30	$ 4.54						
AEO 1988	not published (see note)	1988		$ 2.39	$ 3.26	$ 4.43						
AEO 1989	Table A3, Page 47	1988		$ 2.25	$ 3.10	$ 4.16						
AEO 1990	Table A2, Page 41	1989		$ 2.39	$ 2.90	$ 3.83	$ 4.92	$ 6.00				
AEO 1991	Table A3, Page 46	1990			$ 2.72	$ 3.17	$ 4.59	$ 5.48				
AEO 1992	Table A3, Page 66	1990			$ 2.51	$ 3.27	$ 4.39	$ 5.44				
AEO 1993	Table A3, Page 84	1991			$ 2.60	$ 3.18	$ 4.13	$ 4.47				
AEO 1994	Table A3, Page 58	1992				$ 2.92	$ 3.51	$ 4.08				
AEO 1995	Table A3, Page 76	1993				$ 2.59	$ 3.38	$ 3.73				
AEO 1996	Table A3, Pages 78-79	1994				$ 2.19	$ 2.26	$ 2.44	$ 2.95			
AEO 1997	Table A3, Page 100	1995				$ 2.19	$ 2.28	$ 2.32	$ 2.47			
AEO 1998	Table A3, Page 104	1996				$ 2.48	$ 2.63	$ 2.84	$ 2.98	$ 3.15		
AEO 1999	Table A3, Page 116	1997				$ 2.62	$ 2.94	$ 3.08	$ 3.17	$ 3.24		
AEO 2000	Table A3, Page 121	1998					$ 2.79	$ 3.08	$ 3.21	$ 3.33		
AEO 2001	Table A3, Page 131	1999					$ 2.88	$ 3.03	$ 3.24	$ 3.59		
AEO 2002	Table A3, Page 129	2000					$ 3.19	$ 3.38	$ 3.65	$ 3.87		
AEO 2003	Table A3, Page 123	2001					$ 3.27	$ 3.79	$ 4.14	$ 4.30	$ 4.60	
AEO 2004	Table A3, Page 137	2002						$ 4.04	$ 4.78	$ 4.85	$ 4.92	
AEO 2005	Table A3 , Page 143	2003						$ 4.27	$ 4.81	$ 5.20	$ 5.44	
AEO 2006	Table A3, Page 137	2004						$ 5.46	$ 5.08	$ 5.40	$ 5.87	$ 6.26

2. Natural gas forecast prices in real $ per MMBtu, using year 2000 dollars

Source	Table/Page	Implicit Price Deflator	1985	1990	1995	2000	2005	2010	2015	2020	2025	2030
AEO 1982	Table A.5.1, Page 141	0.6273	$ 8.83	$ 11.46								
AEO 1983	Table A5, Page 194	0.6521	$ 5.28	$ 6.89	$ 10.81							
AEO 1984	Table A5, Page 209	0.6766	$ 5.31	$ 6.43	$ 8.71							
AEO 1985	Table A3, Page 49	0.6971	$ 5.55	$ 5.52	$ 7.11							
AEO 1986	Table A3, Page 33	0.7125		$ 3.86	$ 6.22	$ 8.01						
AEO 1987	Table A3, Page 35	0.7320		$ 3.35	$ 4.51	$ 6.20						
AEO 1988	not published (see note)	0.7569		$ 3.16	$ 4.30	$ 5.85						
AEO 1989	Table A3, Page 47	0.7569		$ 2.97	$ 4.10	$ 5.50						
AEO 1990	Table A2, Page 41	0.7856		$ 3.04	$ 3.69	$ 4.88	$ 6.26	$ 7.64				
AEO 1991	Table A3, Page 46	0.8159			$ 3.33	$ 3.89	$ 5.63	$ 6.72				
AEO 1992	Table A3, Page 66	0.8159			$ 3.08	$ 4.01	$ 5.38	$ 6.67				
AEO 1993	Table A3, Page 84	0.8444			$ 3.08	$ 3.77	$ 4.89	$ 5.29				
AEO 1994	Table A3, Page 58	0.8639				$ 3.38	$ 4.06	$ 4.72				
AEO 1995	Table A3, Page 76	0.8838				$ 2.93	$ 3.82	$ 4.22				
AEO 1996	Table A3, Pages 78-79	0.9026				$ 2.43	$ 2.50	$ 2.70	$ 3.27			
AEO 1997	Table A3, Page 100	0.9211				$ 2.38	$ 2.48	$ 2.52	$ 2.68			
AEO 1998	Table A3, Page 104	0.9385				$ 2.64	$ 2.80	$ 3.03	$ 3.18	$ 3.36		
AEO 1999	Table A3, Page 116	0.9541				$ 2.75	$ 3.08	$ 3.23	$ 3.32	$ 3.40		
AEO 2000	Table A3, Page 121	0.9647					$ 2.89	$ 3.19	$ 3.33	$ 3.45		
AEO 2001	Table A3, Page 131	0.9787					$ 2.94	$ 3.10	$ 3.31	$ 3.67		
AEO 2002	Table A3, Page 129	1.0000					$ 3.19	$ 3.38	$ 3.65	$ 3.87		
AEO 2003	Table A3, Page 123	1.0240					$ 3.19	$ 3.70	$ 4.04	$ 4.20	$ 4.49	
AEO 2004	Table A3, Page 137	1.0409						$ 3.88	$ 4.59	$ 4.66	$ 4.73	
AEO 2005	Table A3 , Page 143	1.0600						$ 4.03	$ 4.54	$ 4.91	$ 5.13	
AEO 2006	Table A3, Page 137	1.0824						$ 5.04	$ 4.69	$ 4.99	$ 5.42	$ 5.78

Source: U.S. Dept. of Energy, Energy Information Administration, *Annual Energy Outlook* , yearly publications, 1982 through 2006. Reference Case Tables' prices converted from various year dollars to 2000 dollars by dividing by a GDP Implicit Price Deflator, based on U.S. Dept. of Commerce data, as reported in U.S. Department of Energy, Energy Information Administration, *Annual Energy Review 2004* , DOE/EIA-0384(2004), Appendix D, Table D-1, page 373, "Population and U.S. Gross Domestic Product, Selected Years, 1949-2004," August 2005, http://www.eia.doe.gov/emeu/aer/pdf/aer.pdf. *AEO 1988* was not published; values shown here are the averages (real) of the 1987 and 1989 *AEO*.

EXHIBIT
tabbies
APPLICANTS'
EXHIBIT 31-H

TABLE 4(C)
COAL PRICE FORECASTS TO ELECTRIC GENERATORS FROM *ANNUAL ENERGY OUTLOOK*, 1982-2006 (2000 $/MMBTU)

1. Coal forecast prices in real $ per MMBtu, using $ base year as given in that year's *AEO*

Source	Table/Page	Year $	1985	1990	1995	2000	2005	2010	2015	2020	2025	2030
AEO 1982	Table A.5.1, Page 141	1982	$ 1.74	$ 1.86								
AEO 1983	Table A5, Page 194	1983	$ 1.82	$ 1.90	$ 2.13							
AEO 1984	Table A5, Page 209	1984	$ 1.83	$ 1.92	$ 2.05							
AEO 1985	Table A3, Page 49	1985	$ 1.68	$ 1.75	$ 1.83							
AEO 1986	Table A3, Page 33	1986		$ 1.67	$ 1.82	$ 1.88						
AEO 1987	Table A3, Page 35	1987		$ 1.56	$ 1.71	$ 1.89						
AEO 1988	not published (see note)	1988		$ 1.58	$ 1.69	$ 1.82						
AEO 1989	Table A3, Page 47	1988		$ 1.54	$ 1.61	$ 1.68						
AEO 1990	Table A2, Page 41	1989		$ 1.47	$ 1.59	$ 1.66	$ 1.76	$ 1.86				
AEO 1991	Table A3, Page 46	1990			$ 1.66	$ 1.79	$ 1.94	$ 2.09				
AEO 1992	Table A3, Page 66	1990			$ 1.59	$ 1.74	$ 1.86	$ 2.00				
AEO 1993	Table A3, Page 84	1991			$ 1.51	$ 1.64	$ 1.73	$ 1.89				
AEO 1994	Table A3, Page 58	1992				$ 1.63	$ 1.70	$ 1.92				
AEO 1995	Table A3, Page 76	1993				$ 1.39	$ 1.45	$ 1.50				
AEO 1996	Table A3, Pages 78-79	1994				$ 1.26	$ 1.29	$ 1.26	$ 1.28			
AEO 1997	Table A3, Page 100	1995				$ 1.29	$ 1.24	$ 1.20	$ 1.11			
AEO 1998	Table A3, Page 104	1996				$ 1.20	$ 1.14	$ 1.09	$ 1.03	$ 0.97		
AEO 1999	Table A3, Page 116	1997				$ 1.19	$ 1.14	$ 1.06	$ 0.99	$ 0.93		
AEO 2000	Table A3, Page 121	1998					$ 1.11	$ 1.07	$ 1.03	$ 0.98		
AEO 2001	Table A3, Page 131	1999					$ 1.13	$ 1.05	$ 1.01	$ 0.98		
AEO 2002	Table A3, Page 129	2000					$ 1.13	$ 1.05	$ 1.01	$ 0.97		
AEO 2003	Table A3, Page 123	2001					$ 1.22	$ 1.17	$ 1.15	$ 1.12	$ 1.10	
AEO 2004	Table A3, Page 137	2002						$ 1.22	$ 1.20	$ 1.17	$ 1.18	
AEO 2005	Table A3 , Page 143	2003						$ 1.25	$ 1.23	$ 1.25	$ 1.31	
AEO 2006	Table A3, Page 137	2004						$ 1.48	$ 1.40	$ 1.39	$ 1.44	$ 1.51

2. Coal forecast prices in real $ per MMBtu, using year 2000 dollars

Source	Table/Page	Implicit Price Deflator	1985	1990	1995	2000	2005	2010	2015	2020	2025	2030
AEO 1982	Table A.5.1, Page 141	0.6273	$ 2.77	$ 2.97								
AEO 1983	Table A5, Page 194	0.6521	$ 2.79	$ 2.91	$ 3.27							
AEO 1984	Table A5, Page 209	0.6766	$ 2.70	$ 2.84	$ 3.03							
AEO 1985	Table A3, Page 49	0.6971	$ 2.41	$ 2.51	$ 2.63							
AEO 1986	Table A3, Page 33	0.7125		$ 2.34	$ 2.55	$ 2.64						
AEO 1987	Table A3, Page 35	0.7320		$ 2.13	$ 2.34	$ 2.58						
AEO 1988	not published (see note)	0.7569		$ 2.08	$ 2.23	$ 2.40						
AEO 1989	Table A3, Page 47	0.7569		$ 2.03	$ 2.13	$ 2.22						
AEO 1990	Table A2, Page 41	0.7856		$ 1.87	$ 2.02	$ 2.11	$ 2.24	$ 2.37				
AEO 1991	Table A3, Page 46	0.8159			$ 2.03	$ 2.19	$ 2.38	$ 2.56				
AEO 1992	Table A3, Page 66	0.8159			$ 1.95	$ 2.13	$ 2.28	$ 2.45				
AEO 1993	Table A3, Page 84	0.8444			$ 1.79	$ 1.94	$ 2.05	$ 2.24				
AEO 1994	Table A3, Page 58	0.8639				$ 1.89	$ 1.97	$ 2.22				
AEO 1995	Table A3, Page 76	0.8838				$ 1.57	$ 1.64	$ 1.70				
AEO 1996	Table A3, Pages 78-79	0.9026				$ 1.40	$ 1.43	$ 1.40	$ 1.42			
AEO 1997	Table A3, Page 100	0.9211				$ 1.40	$ 1.35	$ 1.30	$ 1.21			
AEO 1998	Table A3, Page 104	0.9385				$ 1.28	$ 1.21	$ 1.16	$ 1.10	$ 1.03		
AEO 1999	Table A3, Page 116	0.9541				$ 1.25	$ 1.19	$ 1.11	$ 1.04	$ 0.97		
AEO 2000	Table A3, Page 121	0.9647					$ 1.15	$ 1.11	$ 1.07	$ 1.02		
AEO 2001	Table A3, Page 131	0.9787					$ 1.15	$ 1.07	$ 1.03	$ 1.00		
AEO 2002	Table A3, Page 129	1.0000					$ 1.13	$ 1.05	$ 1.01	$ 0.97		
AEO 2003	Table A3, Page 123	1.0240					$ 1.19	$ 1.14	$ 1.12	$ 1.09	$ 1.07	
AEO 2004	Table A3, Page 137	1.0409						$ 1.17	$ 1.15	$ 1.12	$ 1.13	
AEO 2005	Table A3 , Page 143	1.0600						$ 1.18	$ 1.16	$ 1.18	$ 1.24	
AEO 2006	Table A3, Page 137	1.0824						$ 1.37	$ 1.29	$ 1.28	$ 1.33	$ 1.40

Source: U.S. Dept. of Energy, Energy Information Administration, *Annual Energy Outlook* , yearly publications, 1982 through 2006. Reference Case Tables' prices converted from various year dollars to 2000 dollars by dividing by a GDP Implicit Price Deflator, based on U.S. Dept. of Commerce data, as reported in U.S. Department of Energy, Energy Information Administration, *Annual Energy Review 2004* , DOE/EIA-0384(2004), Appendix D, Table D-1, page 373, "Population and U.S. Gross Domestic Product, Selected Years, 1949-2004," August 2005, http://www.eia.doe.gov/emeu/aer/pdf/aer.pdf. *AEO 1988* was not published; values shown here are the averages (real) of the 1987 and 1989 *AEO* .

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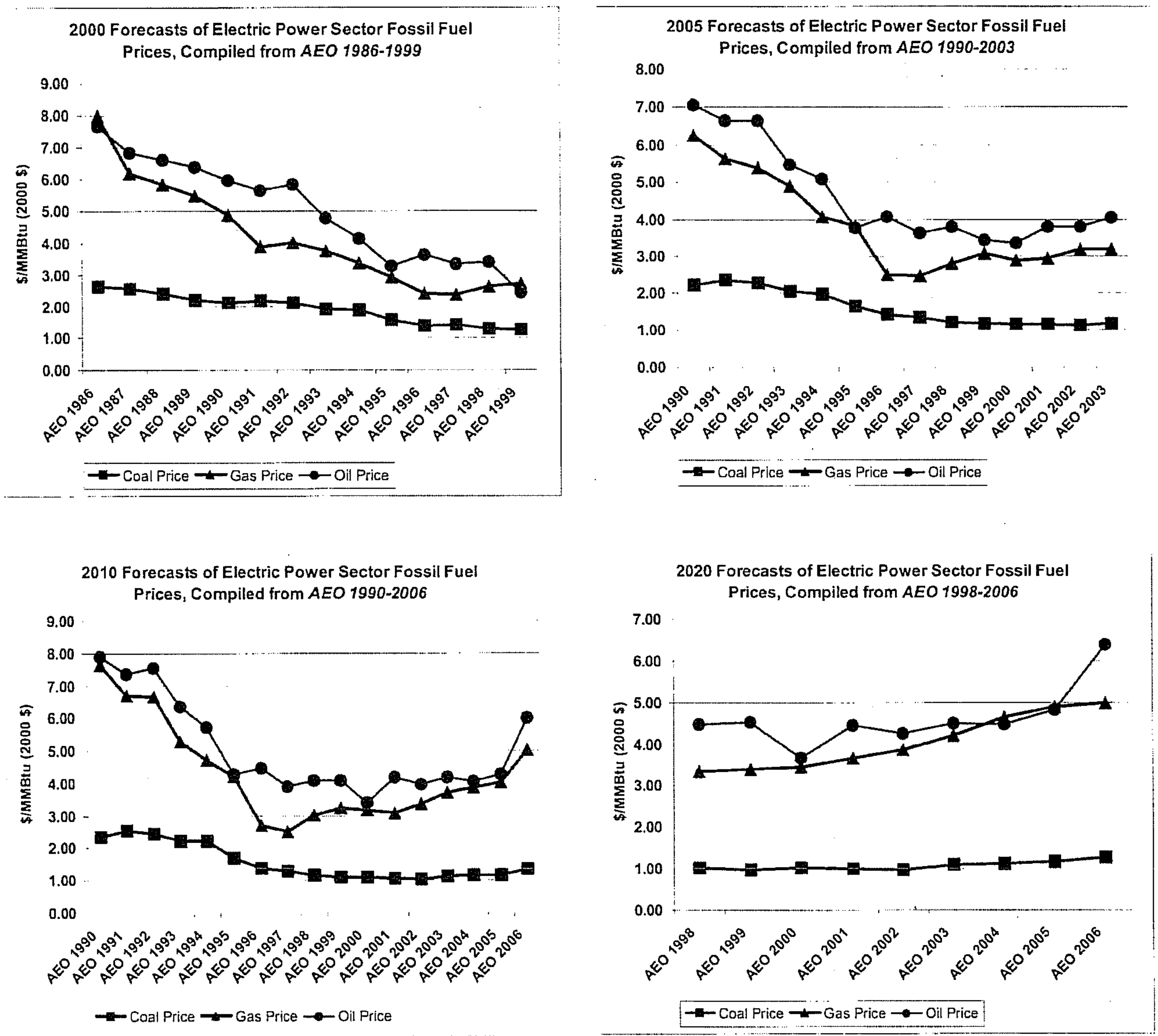
FIGURE 5
FLUCTUATIONS IN OIL AND NATURAL GAS FUTURES PRICES



Source: U.S. Dept. of Energy, Energy Information Administration, *Annual Energy Outlook* , yearly publications, 1982 through 2006. Reference Case Tables' prices converted from various year dollars to 2000 dollars by dividing by a GDP Implicit Price Deflator, based on U.S. Dept. of Commerce data, as reported in U.S. Department of Energy, Energy Information Administration, *Annual Energy Review 2004*, DOE/EIA-0384(2004), Appendix D, Table D-1, page 373, "Population and U.S. Gross Domestic Product, Selected Years, 1949-2004," August 2005, http://www.eia.doe.gov/emeu/aer/pdf/aer.pdf. *AEO 1988* was not published; values shown here are the averages (real) of the 1987 and 1989 *AEO*. 1982 Petroleum prices calculated as volume-weighted averages of distillate, low-sulfur resid, and high-sulfur resid. For 1990, only heavy oil prices were forecast for electric power.

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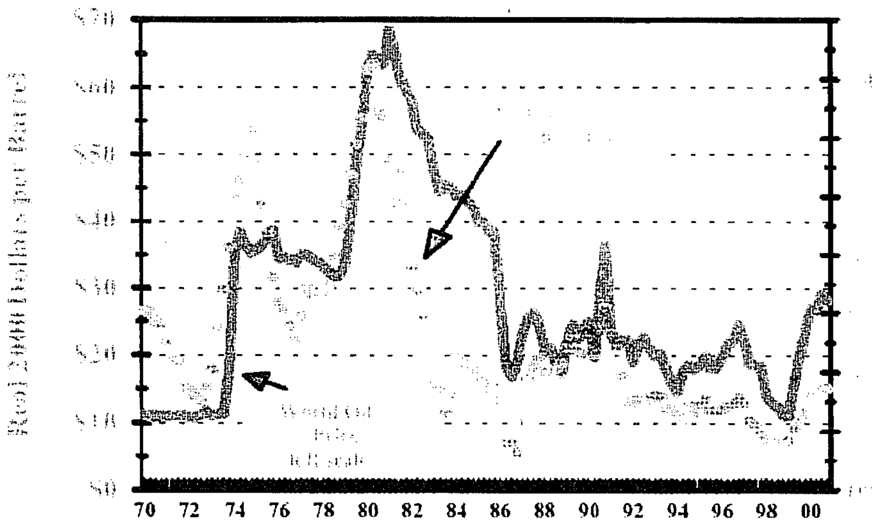
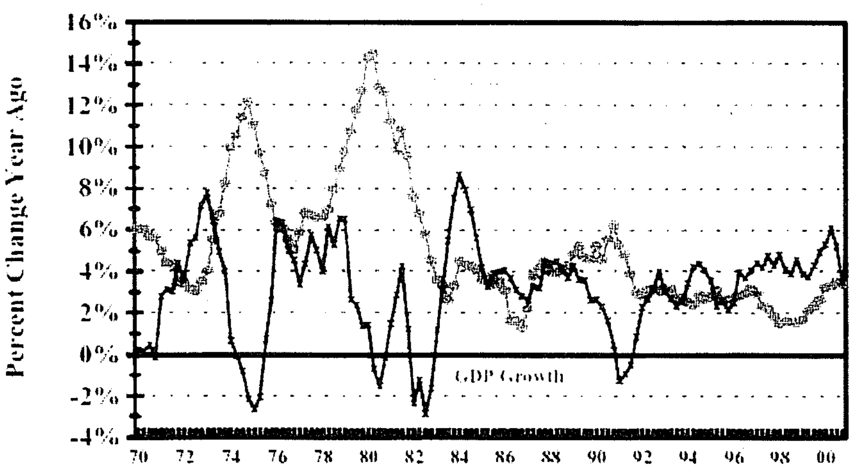
FIGURE 6
RELATIONSHIPS AMONG HISTORICAL WORLD OIL PRICES, INFLATION RATES, AND GDP GROWTH

MOVEMENTS IN WORLD OIL PRICE AND INFLATION:



Sources:
CPI: Bureau of Labor Statistics at http://stats.bls.gov/cpihome.htm
World Oil Price: Refiner Acquisition Cost for Imported Oil: Energy Information Administration, Monthly Energy Review at http://www.eia.doe.gov/mer/contents.html

MOVEMENTS IN INFLATION AND GDP GROWTH:



Sources
CPI: Bureau of Labor Statistics at http://stats.bls.gov/cpihome.htm
GDP: Bureau of Economic Analysis at http://www.bea.doc.gov/bea/dn/st-tabs.htm

Source: U.S. Department of Energy, Energy Information Administration, "*Energy Price Impacts on the U.S. Economy*," April 2001, Figures 4 and 5, http://www.eia.doe.gov/oiaf/economy/energy_price.pdf.

EXHIBIT
Applicants' Exhibit 31-K

TABLE 5
AVERAGE PER-HOUSEHOLD ENERGY CONSUMPTION, 2001
(MMBtu per household)

State	Census Region	Net Energy	Electricity	Non-electric Energy: Total Non-electric	Non-electric Energy: Nat.Gas & Petroleum	Non-electric Energy: Other
Alabama	ESC	83.2	47.5	35.7	32.8	2.9
Alaska	PAC	141.4	24.7	116.7	108.3	8.4
Arizona	MTN	63.0	39.5	23.5	18.4	5.2
Arkansas	WSC	86.0	43.2	42.8	40.3	2.4
California	PAC	68.9	21.3	47.5	43.5	4.1
Colorado	MTN	102.2	26.3	75.8	71.5	4.4
Connecticut	NE	125.3	29.3	96.0	90.9	5.0
Delaware	SA	95.7	36.4	59.3	55.6	3.7
District of Columbia	SA	77.5	20.7	56.7	52.7	4.0
Florida	SA	55.3	46.2	9.1	4.2	4.9
Georgia	SA	88.5	44.5	44.0	40.4	3.6
Hawaii	PAC	28.1	20.6	7.5	4.7	2.8
Idaho	MTN	95.5	43.6	51.9	48.0	4.1
Illinois	ENC	122.8	28.9	94.0	91.7	2.3
Indiana	ENC	107.7	38.9	68.8	66.2	2.6
Iowa	WNC	107.3	34.0	73.3	69.2	4.1
Kansas	WNC	107.0	35.9	71.1	67.7	3.4
Kentucky	ESC	88.0	45.4	42.6	39.2	3.4
Louisiana	WSC	80.1	47.1	33.0	31.0	2.0
Maine	NE	113.1	24.6	88.5	83.6	4.9
Maryland	SA	94.9	37.6	57.2	53.4	3.8
Massachusetts	NE	122.4	23.2	99.1	94.3	4.9
Michigan	ENC	126.0	25.7	100.4	98.0	2.3
Minnesota	WNC	110.1	31.4	78.6	75.0	3.6
Mississippi	ESC	88.3	48.5	39.8	36.9	2.9
Missouri	WNC	106.6	41.5	65.1	61.4	3.6
Montana	MTN	96.0	32.0	64.0	60.2	4.1
Nebraska	WNC	117.1	40.2	76.9	73.4	3.5
Nevada	MTN	84.6	37.9	46.8	42.3	4.5
New Hampshire	NE	103.8	23.3	80.6	75.5	4.7
New Jersey	MA	112.8	25.9	86.8	84.4	2.4
New Mexico	MTN	86.5	21.5	65.0	60.5	4.4
New York	MA	110.8	19.5	91.4	81.8	9.5
North Carolina	SA	78.6	43.4	35.2	31.6	3.7
North Dakota	WNC	117.0	40.7	76.3	71.9	4.4
Ohio	ENC	109.2	33.4	75.8	73.5	2.3
Oklahoma	WSC	95.1	44.1	51.0	49.2	1.8
Oregon	PAC	79.5	40.4	39.0	33.2	5.8
Pennsylvania	MA	108.8	29.9	78.9	76.1	2.8
Rhode Island	NE	117.2	20.8	96.4	91.7	4.8
South Carolina	SA	72.6	47.2	25.4	21.8	3.6
South Dakota	WNC	99.7	37.1	62.6	59.0	3.6
Tennessee	ESC	86.9	50.6	36.3	33.2	3.1
Texas	WSC	80.0	47.9	32.1	30.9	1.2
Utah	MTN	111.6	28.9	82.8	78.6	4.1
Vermont	NE	108.7	23.2	85.4	81.1	4.7
Virginia	SA	88.7	42.9	45.8	41.9	3.9
Washington	PAC	91.4	43.2	48.3	42.9	5.4
West Virginia	SA	95.2	39.3	55.9	52.0	3.6
Wisconsin	ENC	103.3	29.5	73.8	71.4	2.4
Wyoming	MTN	100.9	32.3	68.6	63.3	5.3
United States		**93.3**	**34.8**	**58.5**	**54.7**	**3.8**

Source: Residential energy consumption data from Energy Information Administration, "*State Data: Table S4: Residential Sector Energy Consumption Estimates, 2001*, http://www.eia.doe.gov/emeu/states/sep_sum/html/sum_btu_res.html. Household data from U.S. Bureau of the Census, "*Annual Estimates of Housing Units for the United States and States: April 1, 2000 to July 1, 2004*," Publication HU-EST2004-01, at http://www.census.gov/popest/housing/tables/HU-EST2004-01.xls.

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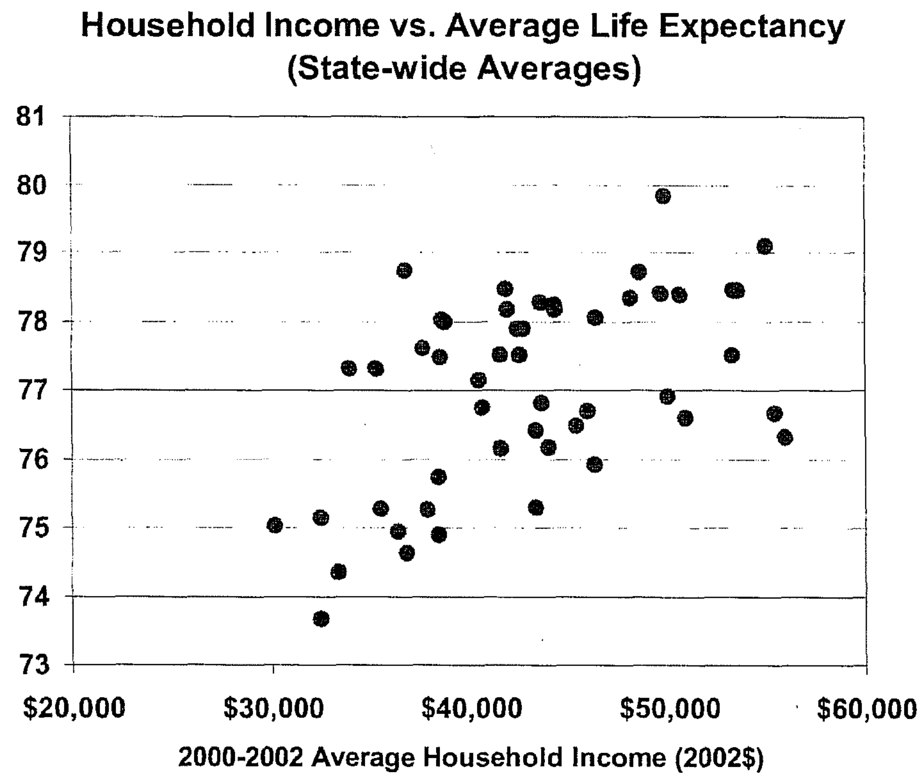
FIGURE 7
HOUSEHOLD INCOME VS. AVERAGE LIFE EXPECTANCY
(STATE-WIDE AVERAGES)



Sources:

Median Household Income: U.S. Census Bureau, *Current Population Survey, 2001, 2002, and 2003 Annual Social and Economic Supplements,* Last Revised: May 13, 2004, http://www.census.gov/hhes/income/income02/statemhi.html. (Income in 2002 dollars.)

Life Expectancy: U.S. Census Bureau, Population Division, *Interim State Population Projections, 2005,* "Table 2: Average Life Expectancy at Birth by State for 2000 and Ratio of Estimates and Projections of Deaths: 2001 to 2003," Internet Release Date: April 21, 2005,

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APPLICANTS'
EXHIBIT 31-M

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TABLE 6 (part 1 of 2)

MEDIAN 2003 HOUSEHOLD INCOME FOR COUNTIES SERVED BY BIG STONE II

State	County	Companies Serving	Median Household Income (2003$)	% of U.S. Income
United States			**$43,318**	**100.00%**
Minnesota *(ranked #7 among states)*			**$50,750**	**117.16%**
	Becker	GRE, MRE, OTPC	$38,766	89.49%
	Beltrami	GRE, OTPC	$35,108	81.05%
	Big Stone	GRE, OTPC, MRE	$33,003	76.19%
	Brown	CMMP, GRE	$42,997	99.26%
	Cass	GRE, OTPC	$37,800	87.26%
	Chippewa	CMMP, GRE, OTPC	$38,296	88.41%
	Chisago	GRE, SMMP	$58,543	135.15%
	Clay	GRE, MRE, OTPC	$41,285	95.31%
	Clearwater	GRE, OTPC	$32,504	75.04%
	Cook	GRE, SMMP	$38,633	89.18%
	Cottonwood	CMMP, GRE, MRE	$35,967	83.03%
	Dodge	CMMP, GRE, SMMP	$54,603	126.05%
	Douglas	GRE, MRE, OTPC	$41,908	96.75%
	Faribault	CMMP, GRE, SMMP	$37,467	86.49%
	Goodhue	CMMP, GRE	$50,356	116.25%
	Grant	GRE, MRE, OTPC	$37,199	85.87%
	Jackson	CMMP, GRE, MRE	$39,102	90.27%
	Kanabec	GRE, SMMP	$40,974	94.59%
	Kandiyohi	CMMP, GRE, OTPC	$41,726	96.32%
	Lac qui Parle	GRE, MRE, OTPC	$34,271	79.11%
	Le Sueur	GRE, SMMP	$48,139	111.13%
	Lincoln	GRE, HCP, OTPC	$33,418	77.15%
	Lyon	GRE, HCP, MRE, OTPC	$41,155	95.01%
	Martin	GRE, HCP, SMMP	$38,632	89.18%
	McLeod	CMMP, GRE, MRE	$47,633	109.96%
	Meeker	GRE, SMMP	$43,308	99.98%
	Mille Lacs	GRE, SMMP	$39,532	91.26%
	Nicollet	GRE, SMMP	$46,307	106.90%
	Nobles	GRE, MRE	$38,237	88.27%
	Olmsted	GRE, SMMP	$56,721	130.94%
	Otter Tail	GRE, MRE, OTPC	$37,420	86.38%
	Pope	GRE, OTPC	$38,563	89.02%
	Redwood	GRE, OTPC, SMMP	$38,288	88.39%
	Renville	CMMP, GRE	$39,304	90.73%
	Rock	GRE, MRE	$40,025	92.40%
	Scott	GRE, SMMP	$74,001	170.83%
	Stearns	GRE, MRE	$45,644	105.37%
	Steele	GRE, SMMP	$48,614	112.23%
	Stevens	GRE, OTPC	$39,422	91.01%
	Swift	GRE, MRE, OTPC	$35,543	82.05%
	Todd	GRE, MRE	$33,659	77.70%
	Wabasha	GRE, SMMP	$45,028	103.95%
	Wadena	GRE, MRE	$32,188	74.31%
	Waseca	CMMP, GRE, SMMP	$43,567	100.57%
	Watonwan	GRE, HCP, MRE	$37,014	85.45%
	Wilkin	GRE, MRE, OTPC	$41,702	96.27%
	Wright	CMMP, GRE	$60,253	139.09%
	Yellow Medicine	GRE, OTPC	$36,200	83.57%

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TABLE 6 (part 2 of 2)
MEDIAN 2003 HOUSEHOLD INCOME FOR COUNTIES SERVED BY BIG STONE II

State	County	Companies Serving	Median Household Income (2003$)	% of U.S. Income
United States			**$43,318**	**100.00%**
Iowa *(ranked #29 among states)*			**$42,278**	**97.60%**
	Plymouth	HCP, MRE	$45,349	104.69%
North Dakota *(ranked #39 among states)*			**$38,223**	**88.24%**
	Barnes	MRE, OTPC	$36,372	83.97%
	Burleigh	MDU, OTPC	$45,634	105.35%
	Dickey	MDU, OTPC	$33,951	78.38%
	Grand Forks	MRE, OTPC	$38,686	89.31%
	Kidder	MDU, OTPC	$28,562	65.94%
	Logan	MDU, OTPC	$30,857	71.23%
	McLean	MRE, OTPC	$36,744	84.82%
	Mountrail	MDU, OTPC	$32,138	74.19%
	Nelson	MRE, OTPC	$32,365	74.71%
	Pembina	MRE, OTPC	$39,001	90.03%
	Renville	MDU, OTPC	$40,359	93.17%
	Traill	MRE, OTPC	$40,902	94.42%
South Dakota *(ranked #40 among states)*			**$38,008**	**87.74%**
	Brookings	HCP, MRE, OTPC	$37,835	87.34%
	Clay	HCP, MRE	$30,168	69.64%
	Codington	MRE, OTPC	$39,577	91.36%
	Corson	HCP, OTPC	$22,683	52.36%
	Grant	MRE, OTPC	$36,656	84.62%
	Hamlin	HCP, OTPC	$36,838	85.04%
	Lake	HCP, OTPC	$38,349	88.53%
	Marshall	HCP, OTPC	$32,393	74.78%
	Moody	HCP, MRE, OTPC	$38,055	87.85%

Source: Tabulated from U.S. Census Bureau, *Small Area Income & Poverty Estimates (SAIPE): Median household income, in dollars, 2003*, http://www.census.gov/hhes/www/saipe/county.html. Staff of Otter Tail Power Company identified the counties with communities to be served by Big Stone II.

Code to Company names: CMMP=Central Minnesota Municipal Power, GRE=Great River Energy, HCP=Heartland Consumers Power, MRE=Missouri River Energy, MDU=Montana-Dakota Utilities, OTPC=Otter Tail Power Company, SMMP=Southern Minnesota Municipal Power.

ANNEX B

RESUME OF DANIEL E. KLEIN

Twenty-First Strategies

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6595 Terri Knoll Court
McLean, VA 22101

phone (703) 893-8333
fax (703) 893-8813
dklein@21st-strategies.com

RESUME

DANIEL E. KLEIN

EDUCATION

1975	M.B.A., Graduate School of Business, Stanford University
1973	S.B., Urban Studies, Massachusetts Institute of Technology

EXPERIENCE

Daniel E. Klein, President of Twenty-First Strategies, has over 30 years of consulting experience in energy, environmental, and economic analysis. For many years a Senior Vice President and Director of ICF Resources Incorporated, he founded Twenty-First Strategies in 1995 to offer energy and environmental consulting services to energy companies, government agencies, and others.

Over the course of his consulting career, Mr. Klein has conducted hundreds of projects related to energy and environmental concerns, energy markets, electric utility fuel use, coal supply, transportation, and antitrust issues. His work in recent years has focused primarily on climate change, electric power, and related issues, both on policy issues from the government side as well as strategies for the private sector. Mr. Klein earned a Bachelor's degree from MIT and an MBA from the Stanford Graduate School of Business. Selected examples of his recent work include the following:

Environmental Policy and Analysis

- ***Global Climate Change and Electric Utilities.*** Mr. Klein has directed efforts with electric utilities and government agencies to develop data and methods for assessing and planning for potential climate change initiatives. These efforts include developing new analytic frameworks for estimating potential impacts on electric power systems, and evaluating risk mitigation strategies. He directed efforts to assist the Administration develop and implement portions of the Climate Change Action Plan in the 1990s, and is continuing a variety of analytic efforts related to the Global Climate Change Initiative. In the electric utility/DOE Climate Challenge program, he was responsible for recruiting new member utilities and for helping measure and report on progress made. He is presently working with electric utilities and others to identify and implement voluntary programs to reduce greenhouse gas emissions as part of their efforts under the Power Partners^{SM} program.
- ***Environmental Externalities.*** Mr. Klein has directed several efforts supporting the U.S. Department of Energy in matters related to the use of environmental externalities. For DOE's Fossil Energy office, he directed an assessment of the socioeconomic impacts associated with potential rate increases that may result from the inclusion of externalities in electric power resource planning. He has provided internal critiques and analytic support to efforts to use the damage function approach for quantifying externalities. Working with private sector groups, he has developed a framework for evaluating mortality implications stemming from income effects of changes in power costs, and has used this framework in testimony.
- ***Carbon Sequestration.*** Mr. Klein has provided numerous support efforts to DOE's Carbon Sequestration Program since its inception. He has co-authored over 20 papers and conference presentations communicating the potential for carbon sequestration and DOE's activities in this area. He has additionally co-authored several book chapters and industry journal articles on the

topic. He assisted DOE in its review of the recent draft IPCC Special Report on Carbon Dioxide Capture and Storage. He developed, compiled, and maintains what has become the most comprehensive database of carbon sequestration R&D activities available, and made this available via the Internet at http://carbonsequestration.us.

- ***Clean Air Act Analyses.*** In numerous studies for public and private sector clients, Mr. Klein has analyzed the impacts of acid rain mitigation proposals, New Source Performance Standards, NO_x restrictions, and several other Clean Air Act issues on the electricity, coal, transportation, and labor markets. He developed state-of-the-art approaches for estimating impacts on electric utilities, coal mining, and transportation industries.
- ***Climate Change Mitigation Strategy in Eastern Europe.*** Mr. Klein led the U.S. portion of a multinational team to create a climate change strategy for the city of Donetsk, Ukraine. Under funding provided by U.S. Agency for International Development, Twenty-First Strategies partnered with the Ecology and Environment Department of the Donetsk City Council and the U.S.-based Center for Clean Air Policy. The project developed a GHG inventory for the city of Donetsk, and identified potential GHG mitigation activities and the associated cost and effectiveness.
- ***Utility Coal Combustion By-Products.*** Mr. Klein has analyzed issues related to disposal practices and potential standards for electric utility ash and sludge wastes. These efforts have included estimating past and future waste disposal volumes, identifying current regulatory requirements, and evaluating the costs and other potential impacts of alternative waste management practices. Working with the American Coal Ash Association, Utility Solid Waste Action Group, and others, he has directed studies and made conference presentations concerning beneficial use of coal combustion by-products and associated reductions in greenhouse gas emissions.
- ***Environmental Aspects of Coal Mining and Transportation.*** Mr. Klein has led numerous studies of the impacts of strip mining regulations, fugitive dust limits for surface coal mining, federal coal leasing policies, environmental impacts of rail deregulation, and related issues.
- ***Oil Spill Environmental Impacts.*** On behalf of several Alaskan Native Corporations, Mr. Klein directed litigation support efforts related to the Exxon VALDEZ oil spill. These efforts have included field and technical studies, economic impacts, and impacts on land values.

Economic and Market Analysis and Forecasting

- ***Energy Market Forecasting.*** For 20 years, Mr. Klein directed major portions of ICF Resources' extensive efforts in forecasting short- and long-term conditions in the fuel and power markets. He developed forecasting methodologies and related data bases, developed and enhanced ICF's Coal and Electric Utilities Model, and designed its successor models. These models and methodologies were used in dozens of market and strategic studies for private clients and policy analyses for the public sector.
- ***Antitrust Market Analysis.*** In major antitrust cases, Mr. Klein has served as an expert witness in the identification of relevant coal and transportation markets. In work with the Department of Justice and major coal companies, he tested and implemented new market delineation techniques based upon demand cross-elasticities; this work currently serves as the basis for Department of Justice policy. Mr. Klein has also testified as a witness before the ICC on issues regarding railroad transportation markets, and in private antitrust cases.
- ***Energy and Mineral Appraisals.*** Rapid swings in energy and minerals markets over the past two decades have led to sharp changes in the value of reserves and producing operations. Appraisals have often been needed to set property values at different points in time for tax basis determination, prudence of procurement decisions, losses resulting from federal takings, property tax assessments,

and other purposes. Mr. Klein has led numerous projects relating to reconstructing appraisals appropriate to past market conditions and knowledge. These efforts have included oil, gas, coal, geothermal, and various metals and mineral properties.

Energy and Transportation Issues

- ***Adequacy of Energy Data.*** Mr. Klein is a recognized expert on the use and misuse of coal and other energy data, particularly as they apply to modeling and forecasting efforts. He has developed new approaches toward incorporating disparate sources of information, and has been published at length on the pitfalls of using public data. For the Department of Justice, Mr. Klein directed the development of the coal reserve data base now used in DOJ's competition review procedures.
- ***Federal Coal Leasing Policies.*** In several studies for public and private sector clients, Mr. Klein has evaluated impacts of leasing moratoriums, approaches to determining levels of leasing, concepts of fair market value, impacts of diligence and royalty requirements, and many other aspects of this complex regulatory program. He testified as an expert witness before the Commission on Fair Market Value Policy for Federal Coal Leasing.
- ***Transportation Policy.*** Mr. Klein has led studies evaluating impacts of rail rate deregulation, economic and energy impacts of coal slurry pipelines, railroad leasing of federal coal, coal transportation costs for different modes, and many others. In efforts with DOE, he conducted studies of the effects of the Staggers Rail Act on coal and electricity markets. He has testified before the Interstate Commerce Commission on market dominance issues.
- ***Transportation Strategies.*** Mr. Klein has worked with shippers to formulate strategies for enhancing their competitive alternatives and improving their bargaining position. Working with carriers, law firms, investment bankers, and others, he has developed market forecasts of rail traffic and revenues, analyzed impacts of economic and legislative uncertainties, and helped to develop approaches for enhancing market share and contribution.

SELECTED PUBLICATIONS AND PRESENTATIONS

"Climate Vision, Power Partners^SM, & GHG Activities for Public Power," presented to the American Public Power Association seminar on "Climate Change: Making Community-Based Decisions in a Carbon-Constrained World," Washington DC, Feb. 28, 2006.

"New Developments in Carbon Capture and Storage" (co-authored with Sean Playsynski, DOE/NETL), presented at the 9th Electric Utilities Environmental Conference: Air Quality & Global Climate Change, Tucson, Arizona, January 23-25, 2006.

"Prospects for Participation of Methane Sectors in Emissions Trading Programs in California," prepared for the Center for Clean Air Policy, October 2005, http://www.climatechange.ca.gov/documents/2005-10-14_CCAP_REPORTS/CCAP_REPORT_METHANE.PDF

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U.S. District Court for the District of Columbia, Joseph P. Connors, Sr. et al. v. Island Creek Corp, Drummond Coal Co., et al., C.A. Nos. 87-1210-SSH and 87-1973-SSH, March 16, 1994.

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Declaration and Deposition on behalf of the UMWA Health and Retirement Funds regarding past trends and forecasts of coal production, productivity, and labor-hours for specific companies and for all UMWA mines, in the U.S. District Court for the District of Columbia, In Re: United Mine Workers of America Employee Benefit Plans Litigation, Multidistrict Litigation No. 886 CA. No. 88-0969-TH, February-March 1992.

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Testimony and Verified Statements before the Interstate Commerce Commission on behalf of Consolidated Rail Corporation, relating to railroad market dominance issues, I.C.C. No. 37931S, August-November 1987.

Testimony before the Commission on Fair Market Value Policy for Federal Coal Leasing, regarding valuation concepts for federal coal leasing, September 7, 1983.

Testimony and Verified Statement of behalf of Consolidated Edison Company of New York, Inc. before the State of New York Department of Environmental Conservation, regarding low sulfur coal reserves and production, UPA #20-81-0020 (Ravenswood Coal Conversion) and UPA #20-81-0009 (Arthur Kill Coal Conversion), January-February 1983.

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Testimony before the U.S. Subcommittee on Public Lands and Resources of the Committee on Energy and Natural Resources, related to energy and economic impacts of the Surface Mining Control and Reclamation Act of 1976, May 11, 1977.

EMPLOYMENT HISTORY

Twenty-First Strategies, LLC	President	1995-present
ICF Resources Incorporated	Senior Consultant	1995-1997
	Senior VP & Director	1988-1995
ICF Incorporated	Vice President	1980-1988

	Associate—Project Manager	1975-1980
City of Palo Alto, California	Operations Analyst	1974-1975
Federal Energy Administration, Office of Data Policy	Data Analyst	1974
Atlanta (GA) Board of Education	Systems Programmer	1970-1973

APPLICANTS' EXHIBIT 51

SOUTH DAKOTA PUBLIC UTILITIES COMMISSION

CASE NO. EL05-022

IN THE MATTER OF THE APPLICATION BY OTTER TAIL POWER COMPANY

ON BEHALF OF THE BIG STONE II CO-OWNERS

FOR AN ENERGY CONVERSION FACILITY SITING PERMIT FOR THE

CONSTRUCTION OF THE BIG STONE II PROJECT

PREFILED REBUTTAL TESTIMONY

OF

JEFFREY J. GREIG

VICE PRESIDENT AND GENERAL MANAGER
BUSINESS & TECHNOLOGY SERVICES DIVISION

BURNS & MCDONNELL ENGINEERING COMPANY

JUNE 16, 2006

BIG STONE II
PARTNERS IN GENERATION

BEFORE THE SOUTH DAKOTA PUBLIC UTILITIES COMMISSION

PREFILED REBUTTAL TESTIMONY OF JEFFREY J. GREIG

Q: Please state your name and occupation.

A: My name is Jeffrey J. Greig, Vice President and General Manager of Burns & McDonnell's Business & Technology Services Division.

Q: Did you provide direct testimony in this proceeding?

A: Yes, Applicants' Exhibit 23.

Q: In rebuttal, to whose direct testimony are you responding?

A: I am responding to the May 26 testimony of Mr. David Schlissel and Ms. Anna Sommer of Synapse Energy Economics, Inc.

Q: What issues do you address in your rebuttal testimony?

A: The purpose of my testimony is to clarify the record regarding the report I prepared entitled *Analysis of Baseload Generation Alternatives* Applicants' Exhibit 23-A, and to respond to the misperceptions reported by Mr. David Schlissel and Ms. Anna Sommer.

Q: What was the purpose of the Analysis of Baseload Generation Alternatives study?

A: The purpose of study was to compare alternative baseload generation technologies capable of providing up to 600 MW of reliable, dispatchable capacity and energy to meet baseload requirements. Mr. Schlissel and Ms. Sommer seem to imply that the Applicants relied on the study as justification for participating in the Big Stone Unit II plant in the absence of prudent and appropriate utility resource planning. Neither the Applicants nor Burns & McDonnell have ever portrayed the evaluations presented in the *Analysis of Baseload*

Generation Alternatives as a comprehensive assessment of need or an integrated evaluation of supply and demand-side alternatives.

The evaluation compares baseload generation alternatives only and demonstrates that a 600 MW supercritical pulverized coal (PC) plant is a least-cost generation alternative for the Big Stone station site on a life-cycle basis considering capital and operating costs compared to numerous other baseload generation alternatives. This conclusion did not change when a carbon tax of \$3.64/ton of CO_2 (2005\$) was assumed, which is the high-end CO_2 externality value the Minnesota Public Utilities Commission requires utilities to use in assessing resources located within the state of Minnesota.

Q: Mr. Schlissel and Ms. Sommer claim that the economic analysis presented in the *Analysis of Baseload Generation Alternatives* is critically flawed. How do you respond?

A: Schlissel and Sommer's main criticism of our study is that, in their view, Burns & McDonnell assumes that wind requires 100 percent backup. They claim that wind should be assigned a capacity value and that, by doing so, the amount of natural gas-fired power "backing up" the wind resource can be reduced. See their May 26 testimony, pages 11-14.

However, the study never claimed that wind requires 100 percent backup. For the 600 MW combined cycle gas turbine (CCGT) project plus 600 MW wind case set forth in the study, the 600 MW CCGT plant is the baseload alternative being compared to the 600 MW PC plant. Both are reliable, dispatchable generation resources that can be operated to meet baseload capacity and energy requirements. The wind component was added to the CCGT project alternative to enhance its economic performance by displacing higher cost gas-fired energy production with non-firm wind energy when available. The evaluation was focused on comparing baseload project alternatives, not developing combinations of resources on a system basis as a substitute for utility resource planning efforts. This was previously explained in the Applicant's response to Question 69 of the Sixth Set of Interrogatories and is explained further in Bryan Morlock's Rebuttal Testimony, Applicants' Exhibit 42.

Q: What are the results of the *Analysis of Baseload Generation Alternatives* if the CCGT project size is decreased to reflect an assumed capacity value for a 600 MW wind plant?

A: For the reasons just stated, and as further discussed in the rebuttal testimony of Bryan Morlock, I do not think it is appropriate, for purposes of the *Analysis of Baseload Generation Alternatives* study, to reduce the size of the assumed 600 MW gas plant to reflect the fact that wind has a capacity value. Wind is not a baseload resource. Gas is generally not a baseload resource, but can be operated in that fashion and we assumed in our comparison of a wind-gas alternative to Big Stone Unit II that a gas-fired CCGT was the baseload resource. Accordingly, if we were to reduce the size of the CCGT to something under 600 MW, we no longer have 600 MW of baseload power.

However, even if we were to modify the analysis to reduce the size of the natural gas plant, there is no change in our overall conclusion that Big Stone Unit II is the Applicant's lowest cost baseload resource by a wide margin. I modified our analysis by reducing the size of the CCGT project from 600 MW to 510 MW. This reflects the assumption that a dedicated 600 wind farm would have a 15% capacity value, or 90 MW. As stated in Bryan Morlock's testimony, Schlissel and Sommer's statement that a wind development might receive a 25% capacity value is not supported. All other assumptions remained the same. Table 1 presents the net present value by which the wind-gas alternative exceeds Big Stone Unit II.

Table 1
Net Present Value Busbar Cost (millions)

Resource Alternative	Combined[2] B&McD Cases No CO_2	Combined[2] B&McD Cases PUC High CO_2[1]
Coal 600 MW	**$2,452**	**$2,686**
600 MW Wind + 600 MW CCGT - NO PTC	**$3,425**	**$3,483**
600 MW Wind + 510 MW CCGT - NO PTC	**$3,357**	**$3,414**
600 MW Wind + 600 MW CCGT - WITH PTC	**$3,163**	**$3,221**
600 MW Wind + 510 MW CCGT - WITH PTC	**$3,095**	**$3,153**

Notes:
[1] PUC High CO_2 Case is based on a $3.64/ton carbon tax in 2005 and escalated at 2.5%. Results in a 2005 levelized cost of $4.50/ton in 2005$.
[2] Investor owned and public power NPV results combined 38.67%/61.33% based on respective ownership shares.

If the PTC is not extended, forcing the Applicants to implement a gas-fired CCGT project with wind resources for baseload capacity and energy could result in a direct cost impact of approximately $905 million to $973 million for the ratepayers, plus further expose them to volatile natural gas prices, in order to mitigate the possibility of a future carbon tax on Big Stone Unit II. Even assuming the high end of the approved Minnesota PUC CO_2 externality value of $3.64/ton (2005$) was established by 2011 at the federal or state level as a direct cost and applied to every ton of CO_2 emitted from Big Stone Unit II, an additional direct cost impact of approximately $728 million to $797 million could apply to the ratepayers if the Applicants are forced to implement a gas-fired CCGT project with wind resources for baseload capacity and energy. Even further assuming that the PTC is extended, the direct cost impacts could still total in the hundreds of millions of dollars.

Q: What is your response to the claim by Mr. Schlissel and Ms. Sommer that the value of the PTC is understated at $12/MWh?

A: Actually, we agree with this statement. In our internal pro forma analyses, we estimate a value of approximately $22/MWh, which is consistent with the studies referenced by Mr. Schlissel and Ms. Sommer. We had reflected a cost of wind of $50/MWh in the absence of the PTC in an effort to be more than fair in our assumptions regarding how the wind energy market may react in the future to the expiration of the tax credit. However, if Mr. Schlissel and Ms. Sommer were trying to create the impression that $22/MWh (or something higher) should be subtracted from the $50/MWh estimate to arrive at a cost of $28/MWh (or something lower) for wind energy in 2011 assuming the PTC is extended in current form, that would be a misleading position. A more realistic assumption is that the expiration of the PTC will result in an additional cost of $22/MWh (or something higher) to our current estimate of wind cost with the PTC of $38/MWh for a resulting cost of $60/MWh. This would further decrease the economics of a CCGT plus wind case.

Q: Do you think that Mr. Schlissel and Ms. Sommer have adequately justified the amount of wind resource they use in their wind-gas scenarios?

A: Tables 1 and 2 on page 17 of their May 26, 2006 testimony assume wind-gas scenarios including 800 MW and 1200 MW of wind capacity. These scenarios also include concomitantly large amounts of wind energy. For instance, in their 1200 MW wind scenario, 91% of the energy from the combined wind-gas alternative would be produced by wind. See their May 26 testimony, page 14, line 3.

Mr. Morlock addresses this issue in detail in his rebuttal testimony, but I also have several issues with these amounts of wind energy and capacity. First, as noted, the *Analysis of Baseload Generation Alternatives* was not developed to be a substitute for each Applicant's resource planning efforts to evaluate different mixes of supply and demand-side alternatives.

Second, the *Analysis of Baseload Generation Alternatives* was prepared on a busbar cost basis. This is a reasonable approach if transmission impacts between the alternatives under consideration are relatively similar. Each of the baseload generation alternatives considered by the Burns & McDonnell study was developed to supply up to 600 MW of baseload capacity and energy. For the 600 MW CCGT plus wind case, the wind component was assumed to be non-firm purchases. Thus, the Burns & McDonnell wind-gas scenario, like the other baseload scenarios we considered, requires 600 MW of transmission. In contrast, it is not appropriate for Mr. Schlissel and Ms. Sommer to argue that 800 MW or 1200 MW of wind should be combined with 300 MW to 480 MW of CCGT while not addressing the transmission system impacts to accommodate up to 1620 MW of resources compared to 600 MW of resources.

Third, if Mr. Schlissel and Ms. Sommer believe that greater and greater amounts of wind can be added to the system, relied on every day as accredited capacity to meet the load serving needs of utilities including critical loads, and can be integrated with relatively no incremental operating or additional transmission cost impacts other than busbar costs, then I am not sure why they propose adding any gas-fired CCGT capacity. In the case entitled alternative four consisting of 1200 MW of wind and 300 MW of CCGT, the CCGT is only used for 402,000

MWh of energy per year at a very high cost. The logical extension of this proposal is that a lower cost case could have been developed if all capacity and energy needs were met with increasing amounts of wind. I do not believe this represents a prudent approach to meeting baseload capacity requirements.

Q: Does this complete your rebuttal testimony?

A: Yes.

In the Matter of the Application by Otter Tail Power Company on Behalf of the Big Stone II Co-Owners for an Energy Conversion Facility Siting Permit for the Construction of the Big Stone II Project
Case No. EL05-022

AFFIDAVIT OF SERVICE

STATE OF MINNESOTA)
) ss.
COUNTY OF HENNEPIN)

Kathryn A. Soucek of the City of Minneapolis, County of Hennepin, in the State of Minnesota, being duly sworn on oath says that on the 19th day of June, 2006 she e-served:

Corrected versions of Applicants' Pre-filed Rebuttal Testimony, marked as Applicants' Exhibits 31 and 51.

Paper copies of the testimony are being served on those persons on the Legal Service List via Federal Express and electronic copies on those persons on the Electronic Service List.

Kathryn A Soucek

Subscribed and sworn to before me
on June 19, 2006.

Cheryl A Long
Notary Public

CHERYL A. LONG
Notary Public
Minnesota
My Commission Expires January 31, 2010

Doc# 2149335\4

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Notary Public

CHERYL A. LONG
Notary Public
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My Commission Expires January 31, 2010

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