Exhibit No.:	
Issues:	Nuclear Fuel Costs
Witness:	Randall J. Irwin
Sponsoring Party:	Union Electric Company
Type of Exhibit:	Direct Testimony
Case No.:	ER-2008-____
Date Testimony Prepared:	April 4, 2008

MISSOURI PUBLIC SERVICE COMMISSION

CASE NO. ER-2008-____

DIRECT TESTIMONY

OF

RANDALL J. IRWIN

ON

BEHALF OF

UNION ELECTRIC COMPANY
d/b/a AmerenUE

St. Louis, Missouri
April, 2008

**** <u>DENOTES HIGHLY CONFIDENTIAL INFORMATION</u> ****

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DIRECT TESTIMONY

OF

RANDALL J. IRWIN

CASE NO. ER-2008-____

Q. Please state your name and business address.

A. My name is Randall J. Irwin. My business address is One Ameren Plaza, 1901 Chouteau Avenue, St. Louis, Missouri 63103.

Q. By whom are you employed and in what capacity?

A. I am employed by Union Electric Company d/b/a AmerenUE ("AmerenUE" or the "Company") as Supervising Engineer, Fuel Cycle Management in the Nuclear Division.

Q. Please describe your educational background.

A. I graduated from the University of Oklahoma in 1972, receiving a Bachelor of Science Degree in Engineering Physics. I have also taken graduate courses in nuclear engineering from the University of Missouri – Rolla.

I am a registered professional engineer in the State of Missouri.

Q. What has been the nature of your duties while in the employ of AmerenUE?

A. I was employed by Union Electric Company in January, 1973. In July 1973, I was assigned to the nuclear group. My primary duties since that time have involved nuclear fuel.

Q. Please describe your current duties and responsibilities regarding nuclear fuel.

A. I am responsible for the procurement of nuclear fuel goods and services to support the operation of the Callaway Nuclear Plant. In this regard, I am responsible for the determination of nuclear fuel requirements, development of nuclear fuel procurement strategies, negotiation and administration of the various nuclear fuel-related contracts, monitoring the nuclear fuel markets, and maintaining business relations with the numerous suppliers in the nuclear fuel industry. In addition, I am responsible for the preparation of fuel cycle economic studies and projections of nuclear fuel costs. I previously also had the responsibility for reactor core fuel management activities necessary to support reload design, licensing and plant operation.

Q. Have you previously filed written testimony concerning nuclear fuel costs before this Commission?

A. Yes, I have submitted testimony in prior AmerenUE rate cases which involved the Callaway Nuclear Plant and nuclear fuel costs. Most recently, I submitted testimony in Case No. ER-2007-0002.

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

A. The purpose of my direct testimony is to discuss nuclear fuel costs for the Callaway Plant. In particular, I will: a) present the nuclear fuel cost for the test year (April 1, 2007 to March 31, 2008), b) provide a historical perspective on actual nuclear fuel costs for Callaway, c) discuss recent changes in the nuclear fuel markets, d) provide expected nuclear fuel costs going forward, and e) discuss volatility in the nuclear fuel market and how it can impact future nuclear fuel costs for the Callaway Plant.

Attachment A is an Executive Summary of my testimony.

Q. What is the nuclear fuel cost for the test year?

A. The total nuclear fuel cost for that period is $47.3 million.

Q. What does that value represent?

A. Nuclear fuel costs are based on the amortization of the initial costs of the 193 fuel assemblies contained in the Callaway reactor. In addition, fees required to be paid to the Department of Energy ("DOE") for both spent fuel disposal and decommissioning and dismantling ("D&D") of certain DOE facilities are included. The fuel cost of $47.3 million represents the amortization of the fuel assemblies during the 12 month period from April 1, 2007 to March 31, 2008 and the DOE fees incurred during that time. The total fuel cost is based on actual costs incurred through February 2008, and a forecast for March 2008.

Q. What comprises the initial costs of a fuel assembly?

A. The cost of a fuel assembly consists of those expenses necessary to: i) obtain the raw natural uranium, ii) convert that uranium into uranium hexafluoride (conversion services), iii) enrich the uranium hexafluoride in the isotope of U235 (enrichment services), and iv) fabricate the enriched uranium into a nuclear fuel assembly (fabrication services). Each of the components described above is represented by a separate and distinct market, with different suppliers in each market.

Q. How have the nuclear fuel costs for Callaway changed over the past few years?

A. Please refer to the Table 1 below:

Table 1

Year	Fuel Cost $ millions	Fuel Cost $/MWHr	Generation MMWHr
2004	35.3	4.48	7.874
2005	35.3	4.39	8.045
2006	45.8	4.53	10.110
2007	45.9	4.89	9.38

Q. What is your assessment of this data?

A. Two obvious conclusions can be made. First, fuel costs, on a $/MWHr basis, did not vary much over the period, although a general increase is evident. Second, the higher total fuel expenses in 2006 and 2007 can be partially attributed to increased generation in those years. As more fuel is burned, the expense will increase.

Q. Are there other factors to be considered?

A. Substantial changes were taking place in the nuclear fuel markets during this time. Market prices for uranium increased from $15.50/lb. at the beginning of 2004 to a peak of $136/lb. in mid-2007. Similarly, market prices for enrichment services increased from $108/SWU (SWU is a unit of measure for enrichment services) at the beginning of 2004 to $143/SWU by the end of 2007.

Q. Why didn't the nuclear fuel costs increase as a result of these market changes?

A. In fact, they were increasing. This is more clearly represented by examining the cost of fuel that was reloaded into the Callaway Plant during the period. Table 2 below provides more details.

Table 2

Reload Date (Year – Month)	04 - May	05 - Nov	07 - May
Total Reload Cost ($M)	46.2	51.4	67.9
Avg. Uranium Cost ($/lb.)	17.4	18.6	25.3
Avg. Enrichment Cost ($/SWU)	94.1	111.5	121.5

During this period, the costs for uranium and enrichment services each comprise about 30% of total nuclear fuel costs, or 60% in total. AmerenUE procured minimal uranium during the 2004 – 2006 period, as it was utilizing a pre-existing stockpile. Thus, the Company was

temporarily immune to the market changes. Uranium procurements were resumed in the 2007 timeframe, and the average costs of uranium began to increase. This is reflected by the increase in the average uranium cost for the May 2007 reload. In addition, the mechanism for pricing uranium under new contracts had changed. In earlier years, uranium could be obtained under a contract with a base (fixed) price that was subject only to increase due to escalation (i.e. a base escalated contract). Now, uranium procurements are more typically market priced contracts, where the contract price is based on the then current market price shortly before actual delivery. Similar changes were also occurring in the enrichment market. As existing base escalated enrichment contracts ended and new market related procurements were made, the Company's costs for enrichment also began to increase. Again, the average cost of enrichment for the 2007 reload reflects this situation.

Q. Even with these increases, the Table 1 total fuel costs for 2007 are not much higher than those for 2006. Please explain.

A. The key point where a major change in fuel costs can occur is after new assemblies have been loaded into the reactor. The Callaway Plant resumed operation in May 2007 following a refueling. As indicated in Table 1, 2007 fuel costs, on a $/MWHr basis, are 8% higher than those in 2006. This reflects the higher costs of procurement that are now being experienced.

Q. Do you expect nuclear fuel costs to continue to increase?

A. Yes. The nuclear fuel markets have experienced years of depressed prices, with little or no expansion of production facilities. Uranium is a prime example. From 1994 to 2004, the price of uranium never exceeded $20/lb. Inventories were being drawn down, with little production expansion. Worldwide demand for uranium has begun to increase, and

is expected to continue to increase for several years. Significant global growth in nuclear power is occurring in such countries as China, Russia and India. Today's uranium prices of $80-90/lb. are sufficient to support investment in new production. Production is expanding, but is still unable to keep up with demand. Upward pressure on uranium pricing will remain for the foreseeable future. Production problems have occurred, and will continue. With limited supplies of uranium and demand increasing, price volatility is the expected norm. Although current spot prices are approximately $80/lb., prices have been as high as $136/lb.

The enrichment services market is another example. Demand for enrichment is increasing, just like demand for uranium. Building new enrichment facilities is a highly technical, very proprietary, and expensive venture. Enrichment costs in the range of $150-160/SWU are necessary to support the expansion of this critical portion of the industry.

Q. What are the expected nuclear fuel costs for the period 2009 – 2012?

A. During the four year period beginning with 2009, the Company's total nuclear fuel costs are expected to be as follows:

Table 3

Year	Fuel Cost $ millions	Fuel Cost $/MWHr
2009	** [redacted] **	** [redacted] **
2010	** [redacted] **	** [redacted] **
2011	** [redacted] **	** [redacted] **
2012	** [redacted] **	** [redacted] **

Q. What are the costs of reloads anticipated to be during this same period?

A. Table 4 below provides reload cost details.

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Table 4

Reload Date (Year – Month)	08 - Nov	10 - Apr	11 – Oct
Total Reload Cost ($M)	** [redacted] **	** [redacted] **	** [redacted] **
Avg. Uranium Cost ($/lb.)	** [redacted] **	** [redacted] **	** [redacted] **
Avg. Enrichment Cost ($/SWU)	** [redacted] **	** [redacted] **	** [redacted] **

Q. Compared to both the total annual costs of $47.3 million for the period April 1, 2007 to March 31, 2008 and the May 2007 Reload cost of $67.9 million, significant increases are expected. Please explain the reasons for the increase in costs.

A. Contrary to the situation prior to the 12 month period beginning April 1, 2007 where increases in market prices were mitigated by uranium inventories and pre-existing base escalated priced contracts, this is no longer the case. The nuclear fuel markets have transitioned from a buyer's market in the pre-2004 timeframe to today's seller's market. Supplies remain limited, yet demand is increasing. Pricing for uranium contracts is now primarily market-based. Enrichment contracts reflect higher prices needed to support new facilities, with some also containing market price provisions. AmerenUE is now more exposed to the volatility of the nuclear fuel markets than in the past.

Q. The next reload for the Callaway Plant is scheduled for November 2008. What is the current status of that reload?

A. The fuel assemblies for the November 2008 reload are currently scheduled to be fabricated during the June-July timeframe, with all assemblies delivered to the Callaway Plant by mid-July, 2008.

Q. When will the costs for that reload be certain?

A. AmerenUE uses an average inventory cost accounting methodology. All purchases of nuclear fuel which are delivered and paid for prior to the average cost date for a reload will factor into that calculation. The majority of the uranium, conversion and

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enrichment services purchases (i.e. cost inputs) for the November 2008 reload have already been finalized. Fabrication will be completed in July. The cost for the November 2008 reload will be known and final by September 30, 2008.

Q. Given these market conditions, what efforts has AmerenUE undertaken regarding long-term supplies of nuclear fuel?

A. AmerenUE has focused on two key markets, uranium and enrichment services. The long-term balance of supply and demand in the uranium market remains under pressure. Security of supply is a key concern. AmerenUE has contracted for substantial supplies of uranium to meet future needs. **[redacted]**. Price hedging for uranium is a newly evolving market. Activity is limited, but slowly increasing. **[redacted]**.

AmerenUE has also obtained long-term supplies of enrichment services. This product is typically contracted under base escalated pricing provisions, thus it is price hedged other than for the unknown effects of escalation. However, a portion of these future committed supplies remain **[redacted]**.

Q. Of the two components, uranium and enrichment services, which one exposes AmerenUE fuel costs to the most volatility?

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A. Uranium, for the following reasons. Unlike the period 2004 - 2007 where uranium and enrichment each comprised about 30% of total nuclear fuel costs, the contribution of uranium has increased. During the period 2009 -2012, uranium is now forecast to comprise approximately 50% of total fuel costs. Enrichment costs will represent less than 30% of total fuel costs. In addition, the contracts for uranium supplies in the ** [redacted] ** are all based on ** [redacted] **. The uranium market is the one nuclear fuel market that has exhibited, and is expected to continue to exhibit, the most volatility. In 2007 alone, spot uranium prices went from $75/lb. in January, peaked at $136/lb. in June, and ended the year at $90/lb.

Q. Have you evaluated the potential impact of uranium price volatility on nuclear fuel costs?

A. Yes. AmerenUE uses the Ux Consulting Company LLC ("UxC") for much of its market supply/demand and price forecast information. UxC has been in business for over 20 years and is well recognized and respected in the nuclear fuel industry. UxC routinely updates its forecast of market dynamics, including price forecasts. As part of its service, UxC develops uranium price forecasts for base or mid level, low and high cases. Key factors taken into consideration by UxC in these forecasts include: projected requirements, inventory demand, production response, exchange rates, investor activity, and other secondary supply sources. Varying assumptions for these factors result in the different price forecasts.

Q. For the fuel costs that have currently been presented in this testimony, what uranium price forecast was used?

A. The base, or mid level, uranium price forecast.

Q. Has an evaluation been performed using the low and high forecasts?

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A. Yes. The results from that analysis are provided in the Table 5 below.

Table 5
Annual Fuel Costs ($ million)

Price Forecast	2009	2010	2011	2012
Low	** [redacted] **	** [redacted] **	** [redacted] **	** [redacted] **
High	** [redacted] **	** [redacted] **	** [redacted] **	** [redacted] **
Variance (high-low)	** [redacted] **	** [redacted] **	** [redacted] **	** [redacted] **

Q. What conclusions can be drawn from this data?

A. First, whether the low or high case is considered, total annual nuclear fuel costs are increasing. Fuel costs increase by ** [redacted] ** from 2009 to 2012 in the Low case, and by ** [redacted] ** during that same time for the High case. In addition, fluctuations in the price of uranium can impose additional uncertainty in fuel costs of several million dollars per year.

Q. Are nuclear fuel experts, such as the Ux Consulting Company, able to accurately forecast uranium prices?

A. In general, no. The market for uranium is global, and affected by changes in such areas as worldwide supply and demand, exchange rates, investor/hedge fund actions, and government disposition of inventories. UxC continually revises its price forecasts as uranium market conditions change. Table 6 provides the UxC base case uranium forecast for July of each year during the period 2009 – 2012, as forecast in each of 2005, 2006 and 2007.

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Table 6
UxC Uranium Price Forecasts – Base Case
$/lb. Uranium

Forecast Date	7/2009	7/2010	7/2011	7/2012
October 2005	** [redacted] **	** [redacted] **	** [redacted] **	** [redacted] **
October 2006	** [redacted] **	** [redacted] **	** [redacted] **	** [redacted] **
October 2007	** [redacted] **	** [redacted] **	** [redacted] **	** [redacted] **

As Table 6 shows, forecasts of future uranium prices have more than doubled in 2 years. In addition to the base case forecasts, UxC also develops a high and low price case by varying key input parameters. Taking all into consideration, this illustrates that industry experts cannot forecast long-term uranium prices with any real degree of certainty. However, recognizing key developments in the industry, such as the forecasted expansion of worldwide nuclear generation, general trends in price movements can be forecast. Volatility in the uranium market, not only for the near term but also from a long-term perspective, contributes to the continued uncertainty in predicting nuclear fuel costs.

Q. Are there other sources of uncertainty in fuel costs in addition to those discussed above?

A. A substantial portion of pricing for other components of the fuel cycle – enrichment and fabrication services for example – is typically subject to a base escalated price mechanism. Those prices are subject to conditions of the overall economy. In addition, for the past 15 years, AmerenUE has been required to pay D&D fees annually to the Department of Energy. For the fiscal year ending September 2007, the total paid to DOE was almost $1.9 million.

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Q. What conclusions result from your testimony?

A. Most importantly, during the period 2009 – 2012, nuclear fuel costs are expected to not only increase, but also be subject to significant volatility in the marketplace. Fuel cost increases during this time may be as high as ** [redacted] **, due to uranium prices alone. Unanticipated increases in the cost of other components, and escalation parameters, will only further exacerbate this concern.

Q. Does this conclude your direct testimony?

A. Yes, it does.

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BEFORE THE PUBLIC SERVICE COMMISSION
OF THE STATE OF MISSOURI

In the Matter of Union Electric Company d/b/a AmerenUE for Authority to File Tariffs Increasing Rates for Electric Service Provided to Customers in the Company's Missouri Service Area.	)))))	Case No. ER-2008-____

AFFIDAVIT OF RANDALL J. IRWIN

STATE OF MISSOURI)
) **ss**
CITY OF ST. LOUIS)

Randall J. Irwin, being first duly sworn on his oath, states:

1. My name is Randall J. Irwin. I work in St. Louis, Missouri and I am employed by AmerenUE as Supervising Engineer, Fuel Cycle Management in the Nuclear Division.

2. Attached hereto and made a part hereof for all purposes is my Direct Testimony on behalf of Union Electric Company d/b/a AmerenUE consisting of 12 pages and Attachment A which have been prepared in written form for introduction into evidence in the above-referenced docket.

3. I hereby swear and affirm that my answers contained in the attached testimony to the questions therein propounded are true and correct.

Randall J. Irwin

Subscribed and sworn to before me this 4th day of April, 2008.

Danielle R. Moskop
Notary Public

My commission expires:

Danielle R. Moskop
Notary Public - Notary Seal
STATE OF MISSOURI
St. Louis County
My Commission Expires: July 21, 2009
Commission # 05745027

EXECUTIVE SUMMARY

Randall J. Irwin

Supervising Engineer, Fuel Cycle Management for AmerenUE

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The purpose of my direct testimony is to discuss nuclear fuel costs for the Callaway Plant. In particular, I: a) present the nuclear fuel cost for the test year, April 1, 2007 to March 31, 2008, b) provide an historical perspective on actual nuclear fuel costs for Callaway, c) discuss recent changes in the nuclear fuel markets, d) provide expected nuclear fuel costs going forward, and e) discuss volatility in the nuclear fuel market and how it can impact future nuclear fuel costs for the Callaway Plant.

The total nuclear fuel cost for the 12 month period April 1, 2007 to March 31, 2008 is $47.3 million. Nuclear fuel costs are based on the amortization of the initial costs of the 193 fuel assemblies contained in the Callaway reactor. In addition, fees required to be paid to the Department of Energy ("DOE") for both spent fuel disposal and decommissioning and dismantling ("D&D") of certain DOE facilities are included. The fuel cost of $47.3 million represents the amortization of the fuel assemblies during the 12 month period beginning April 1, 2007 and the DOE fees incurred during that time.

Nuclear fuel costs for Callaway have changed over the past few years. The changes are provided in Tables 1 and 2.

Table 1

Year	Fuel Cost $ millions	Fuel Cost $/MWHr	Generation MMWHr
2004	35.3	4.48	7.874
2005	35.3	4.39	8.045
2006	45.8	4.53	10.110
2007	45.9	4.89	9.38

Table 2

Reload Date (Year – Month)	04 - May	05 - Nov	07 - May
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The nuclear fuel markets have experienced years of depressed prices, with little or no expansion of production facilities. Uranium is a prime example. From 1994 to 2004, the price of uranium never exceeded $20/lb. Inventories were being drawn down, with little production expansion. Worldwide demand for uranium has begun to increase, and is expected to continue to increase for several years. Significant global growth in nuclear power is occurring in such countries as China, Russia and India. Today's uranium prices of $80-90/lb. are sufficient to support investment in new production. Production is expanding, but is still unable to keep up with demand. Upward pressure on uranium pricing will remain for the foreseeable future. Production problems have occurred, and will continue. With limited supplies of uranium and demand increasing, price volatility is the expected norm. Although current spot prices are approximately $80/lb., prices have been as high as $136/lb. The enrichment services market is another example. Demand for enrichment is increasing, just like demand for uranium. Building new enrichment facilities is a highly technical, very

proprietary, and expensive venture. Enrichment costs in the range of $150-160/SWU are necessary to support the expansion of this critical portion of the industry.

During the four year period following the test year, the Company's total nuclear fuel costs, and costs of reloads, are expected to be as follows:

Table 3

Year	Fuel Cost $ millions	Fuel Cost $/MWHr
2009	** [redacted] **	** [redacted] **
2010	** [redacted] **	** [redacted] **
2011	** [redacted] **	** [redacted] **
2012	** [redacted] **	** [redacted] **

Table 4

Reload Date (Year – Month)	08 - Nov	10 - Apr	11 – Oct
Total Reload Cost ($M)	** [redacted] **	** [redacted] **	** [redacted] **
Avg. Uranium Cost ($/lb.)	** [redacted] **	** [redacted] **	** [redacted] **
Avg. Enrichment Cost ($/SWU)	** [redacted] **	** [redacted] **	** [redacted] **

Of the two components, uranium and enrichment services, the uranium component exposes AmerenUE fuel costs to the most volatility. Unlike the period 2004 - 2007 where uranium and enrichment each comprised about 30% of total nuclear fuel costs, the contribution of uranium has increased. During the period 2009 - 2012, uranium is now forecast to comprise approximately 50% of total fuel costs. Enrichment costs will represent less than 30% of total fuel costs. In addition, the contracts for uranium supplies in the ** [redacted] **. The uranium market is the one nuclear fuel market that has exhibited, and is expected to continue to exhibit, the most volatility. In 2007 alone, spot uranium prices went from $75/lb. in January, peaked at $136/lb. in June,

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and ended the year at $90/lb. The potential impact of uranium price volatility on nuclear fuel costs is presented in Table 5.

Table 5

Annual Fuel Costs ($ million)

Price Forecast	2009	2010	2011	2012
Low	** [redacted] **	** [redacted] **	** [redacted] **	** [redacted] **
High	** [redacted] **	** [redacted] **	** [redacted] **	** [redacted] **
Variance (high-low)	** [redacted] **	** [redacted] **	** [redacted] **	** [redacted] **

During the period 2009 – 2012, nuclear fuel costs are expected to not only increase, but also be subject to significant volatility in the marketplace. Fuel cost increases during this time may be as high as ** [redacted] **, due to uranium prices alone. Unanticipated increases in the cost of other components, and escalation parameters, will only further exacerbate this concern.