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Issue(s): Production Cost Model
Witness: *Tom Y. Lin*
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Sponsoring Party: MoPSC Staff
Case No.: EM-2000-292

ON BEHALF OF THE

MISSOURI PUBLIC SERVICE COMMISSION

UTILITY OPERATIONS DIVISION

REBUTTAL TESTIMONY

OF

TOM Y. LIN

UTILICORP UNITED INC. AND
ST. JOSEPH LIGHT & POWER COMPANY

CASE NO. EM-2000-292

Jefferson City, Missouri

May, 2000

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Date 7-13-00 Case No. EM-2000-292
Reporter MO

REBUTTAL TESTIMONY

OF

TOM Y. LIN

UTILICORP UNITED INC. AND ST. JOSEPH LIGHT & POWER COMPANY

CASE NO. EM-2000-292

Q. Please state your name and business address.

A. My name is Tom Y. Lin and my business address is 301 West High Street, Jefferson City, Missouri 65101.

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

A. I am employed by the Missouri Public Service Commission (Commission) as a Staff Engineer in the Engineering Section of the Utility Operations Division's Electric Department.

Q. Please describe your educational and professional background.

A. I received a Bachelor of Engineering degree in Mechanical Engineering from Nanjing Institute of Technology (now Southeast University), China, in July 1983. After graduation in 1983, I worked for seven years as a mechanical engineer at the Fujian Testing and Research Institute for Electric Power, a division of Fujian Provincial Electric Power Industry Bureau.

During that time, I was responsible for developing, designing, modifying, testing, and performing computer simulation programs, boiler efficiency and heat rate tests, and various projects in Fujian power plants. In January 1991, I pursued an advanced degree in the United States and graduated from the University of Oklahoma with a Master of Science degree in Mechanical Engineering in 1993. I began my employment with the Commission in 1994. I am a professional engineer (PE) under the laws of the State of Missouri and a member of both the National and the Missouri Society of Professional Engineers.

Q. Have you filed testimony previously before this Commission?

A. Yes, I have filed testimony in Case Nos. ER-95-279, EM-96-149, ER-97-81, EO-97-144, EC-97-362, ER-97-394, EC-98-573, HR-99-245 and ER-99-247.

Q. What is the purpose of your rebuttal testimony?

A. The purpose of my rebuttal testimony is, first, to estimate the annual electric production cost, including generation and net purchased power, for St. Joseph Light & Power Company (SJLP) as shown in my testimony in Section I. This cost

figure was calculated by the production cost model used by the Staff, and this cost figure was used by the Commission's Accounting Staff to determine SJLP's current revenue requirement.

Second, I will respond to the testimony of UtiliCorp United, Inc. (UCU) witness Robert W. Holzwarth regarding joint dispatch savings associated with coordination of generation dispatch between Missouri Public Service (MPS), a division of UCU, and SJLP. The savings were calculated by a production cost model simulation and the calculation is discussed in Section II of this testimony.

Q. What is a production cost model?

A. A production cost model is a computer program that performs an hour-by-hour chronological economic dispatch simulation of a utility's generation and net power purchases, as a means of determining energy costs, fuel consumption, and/or emissions outputs required to serve the company's net system load.

Q. What production cost model did UCU use to calculate the merger savings for this case?

A. UCU used REAL TIME, a model developed by the

EMELAR Group.

Q. What production cost model did you use?

A. REAL TIME, the same model as UCU used.

SECTION I - ELECTRIC PRODUCTION COSTS FOR SJLP REVENUE REQUIREMENT

Q. What is your responsibility with respect to determining electric production cost for calculation of SJLP's revenue requirement in this case?

A. Using the REAL TIME production cost model, I am responsible for calculating the total electric production cost to be used by the Staff in the revenue requirement calculation. The input data to the model for which I am responsible includes each generating unit's heat rates, maintenance outage schedules, and forced outage rates, as well as prices and quantities for purchased power for SJLP's system. The normalized hourly system loads and fuel price data that I used were provided by other Commission Staff (Staff) members: Ms. Lena M. Mantle of the Electric Department provided normalized hourly system loads and Mr. V. William Harris of the Accounting Department provided normalized fuel prices.

RECOMMENDATION

Q. What is the level of electric production cost that you are sponsoring in this case?

A. I recommend that the annual electric production cost, including generation and net purchased power, for SJLP be set at $21,361,250. This amount was used by the Accounting Staff to determine SJLP's revenue requirement. The purpose of the Staff's revenue requirement calculation is discussed in the rebuttal testimony of Staff witness Steve M. Traxler of the Accounting Department.

PARAMETERS OF ANALYSIS

Q. What is the test year for the Staff's revenue requirement calculation?

A. The test year used is from January 1, 1998 to December 31, 1998, updated for known and measurable changes through December 31, 1999.

Q. Did you review and analyze the heat rates, maintenance outage hours and forced outage rates for each generating unit of SJLP?

A. Yes. In response to Staff Date Request (DR) Nos. 4101 and 4134, UCU and/or SJLP provided the actual heat rates,

maintenance outage hours and forced outage rates for each unit from 1990 through 1999.

Q. What heat rates, maintenance outage hours and forced outage rates data did you use for this case?

A. The heat rates, maintenance outage hours and forced outage rates data for each generating unit were the same as those Staff used in SJLP's last electric rate case, Case No ER-99-247.

PURCHASED POWER

Q. What is purchased power?

A. It is energy purchased in the wholesale market to meet the hourly net system load of the electric utility company. Purchased power prices are measured in dollars per megawatt-hour ($/MWh).

Q. How did you determine the appropriate purchased power prices to use as inputs in this case?

A. Purchased power prices were determined on the basis of historical capacity and spot market price data, which are obtained from SJLP monthly, under Commission Rule 4 CSR 240-20.080 (20.080 data). The purchased power prices were calculated in this case by the same method Staff has used in previous

cases.

Q. How many types of purchased power were considered in the expense calculation?

A. Three types of purchased power were considered: capacity purchases; spot market purchases; and hypothetical peaking purchases.

Q. How many capacity purchase contracts did SJLP have during the test year?

A. SJLP had capacity purchase contracts with two suppliers during the test year; namely, Kansas City Power & Light Company (KCPL) and Nebraska Public Power District (NPPD).

Q. How did you calculate the hourly energy prices for each capacity contract?

A. For NPPD purchases, I used the monthly weighted average price for each month's hourly energy prices, because the hourly purchased prices by month were essentially the same. The yearly weighted average price was used to determine the hourly energy prices for KCPL since the total purchases from KCPL were less than 2,500 MWh in the test year.

Q. What was the amount of energy (MWh) for each capacity contract?

A. SJLP provided the maximum amount of energy that can be used for each capacity contract in its 20.080 data.

Q. In computing the appropriate spot market energy prices, did you use the same procedure you used to arrive at capacity purchased prices?

A. No.

Q. What procedure did you use to determine spot market energy prices?

A. Spot market energy prices were calculated based on SJLP's actual hourly spot market transaction prices, obtained from 20.080 data, by using a procedure developed and adopted by Staff's Electric-Engineering Section. The procedure is set forth in A Methodology to Calculate Representative Prices for Purchased Energy in the Spot Market (March 18, 1996). In particular, a statistical calculation based on a truncated normal distribution was used to represent the hourly purchased power prices in the spot market.

Q. Has Staff used this method in previous cases?

A. Yes, this method was used most recently in Case Nos. ER-95-279, ER-97-81, EO-97-144, EC-97-362 EC-98-573 and ER-99-247.

Q. How did you determine the amount of spot purchased energy available in each hour?

A. The amount of spot energy available in each hour used in this case was the same as that used by SJLP in the last SJLP electric rate case, Case No. ER-99-247.

Q. How did you determine the amount of hypothetical peaking purchased energy and the associated prices?

A. I used the figures provided by SJLP in its last electric rate case, Case No. ER-99-247.

SUMMARY FOR SECTION I

Q. Would you summarize the content of Section I of your rebuttal testimony?

A. Section I of my testimony presents my methodology and underlying rationale for determining the appropriate level of electric production cost, including generation and purchased power, for the Staff's calculation of the SJLP revenue requirement in this case. The annual electric production cost was determined with the aid of a production cost model simulation.

I reviewed and analyzed the following parameters associated with the generating units: heat rates, maintenance

outage schedules, and forced outage rates. I updated and calculated appropriate purchased power prices through December 1999. I also used updated fuel prices and system load data, obtained from other Staff members (V. William Harris and Lena M. Mantle, respectively), in the production cost model.

Q. Based on your calculations, what is your recommendation for electric production cost to be included in determining SJLP's revenue requirement in this case?

A. $21,361,250.

SECTION II - JOINT DISPATCH SAVINGS AFTER THE MERGER

Q. What is your responsibility in the Staff's analysis of estimated joint dispatch savings resulting from the merger in this case?

A. I am responsible for calculating joint dispatch savings resulting from the merger, through economic dispatch simulation.

Q. What are the joint dispatch savings associated with the merger?

A. The joint dispatch savings are those savings in electric production costs attributable to jointly dispatching MPS's and SJLP's generation on a single or combined system basis

after the merger, compared to the total electric production costs of MPS and SJLP on a stand alone basis as if there were no merger. Total electric production costs include fuel costs, costs associated with net purchases and sales, and variable operation and maintenance (O&M) costs for this case.

Q. What level of joint dispatch savings did UCU estimate for this case?

A. UCU estimated that the joint dispatch savings based on a combined cycle expansion plan over the ten-year period from 2001 to 2010 would be approximately $104 million associated with the UCU and SJLP merger. The savings, as shown in Schedule 1, were calculated by UCU's updated production cost model simulation that was sent to Staff on February 2, 2000.

Q. What is your responsibility in this case with regard to the determination of the joint dispatch savings?

A. I am responsible for: 1) evaluating the joint dispatch savings, which were calculated by UCU by a computerized production cost model simulation; and 2) reviewing and assessing the reasonableness of the input data used in Staff's model. The input data include each generating unit's fuel prices, heat rates, variable O&M, maintenance outage schedules, forced outage

rates, energy sales and purchases with their associated prices and system loads projected for a ten-year period from 2001 through 2010. In addition, I also calculated the joint dispatch savings for the UCU and The Empire District Electric Company (EDE) merger as well as a UCU/SJLP/EDE three-way merger combined system, respectively, because the proposed UCU/SJLP and UCU/EDE mergers will affect each other in the joint dispatch area.

Q. How did you calculate the joint dispatch savings?

A. I ran the production cost model for three different scenarios. The first two scenarios assumed that the UCU and SJLP generating systems would be operated as stand alone systems. The third scenarios assumed that the combined generation resources of the two systems would be operated as a single or combined system. The total electric production costs for the three simulations were collected. The MPS and SJLP stand alone system simulation results were added together and compared to the results for the MPS and SJLP combined system simulation. The difference in the two results was identified as joint dispatch savings. The same method was used to calculate the savings for the UCU/EDE merger and a UCU/SJLP/EDE combined system.

Q. Did you consider the same scenario with off system sales in the model UCU used for this case in estimating joint dispatch saving?

A. Yes.

Q. What is the method and basis UCU used to adjust the amount of energy for off system sales?

A. UCU adjusted the amount of energy sales using forced outage rates and upper bound limits on off system energy sales in the model to approximate the level of historical off system sales for the MPS, SJLP and EDE stand alone systems as shown in Table 1.

Table 1. Upper Bound for Off System Sales: MW/hour and Forced Outage Rates (FOR)

Model input	Upper Bound for Off System Sales: MW/hour	FOR (%)
MPS stand alone	3,000	25%
SJLP stand alone	25	35%
EDE stand alone	3 before 6/1/01 – 60 after 6/1/01	18%
MPS and SJLP joint dispatch	3,000	15%
MPS and EDE joint dispatch	3,000	0%
MPS, SJLP and EDE joint dispatch	3,000	0%

UCU eliminated limits on off system energy sales and decreased forced outage rates for off system energy sales in the

MPS/SJLP and MPS/EDE joint dispatch models because UCU is projecting an increase in the opportunity for off system energy sales after the UCU/SJLP and/or UCU/EDE mergers.

Q. Does the data given above indicate that UCU considered the opportunities for off system sales to be limited in the energy market for the stand alone cases, but that the merger would result in expanded opportunities in the off system energy market?

A. Yes. Table 1 shows that UCU assumes that SJLP and EDE cases have limited opportunities to make off system sales as stand alone companies. Staff witness Dr. Michael S. Proctor of Electric Department has a detailed discussion in his rebuttal testimony regarding the relationship between the merger and expanded sales opportunities in the off system energy market.

Q. Did you consider additional scenarios for off system sales opportunities beyond the UCU scenarios provided?

A. Yes, I considered not only the UCU assumptions/ scenarios, but also others, which Dr. Proctor requested that I run.

The differences among these scenarios take into account not only the combinations of utilities jointly dispatching generation resources (MPS/SJLP, MPS/EDE, MPS/SJLP/EDE) but also assumptions about the ability of the utilities either as stand alone (MPS, SJLP, EDE) or jointly dispatched to make off system sales (no off system sales, limited off system sales, "unlimited" off system sales). Dr. Proctor has a detailed discussion of the reasons for considering these additional scenarios in his testimony.

Q. Please describe the scenarios that you have run and the joint dispatch savings calculation.

A. The detailed results for all scenarios are shown at Schedule 1, and summarized below:

1) The joint dispatch savings with UCU's assumption for limited off system sales opportunities would be approximately $99.5 million for the MPS and SJLP combined system.

2) The joint dispatch savings without any off system sales opportunities would be approximately $47.9 million for the MPS and SJLP combined system.

3) The joint dispatch savings with the same off system sales opportunities ("unlimited" off system sales) for the stand alone and joint dispatch models would be approximately $6.8 million for the MPS and SJLP combined system.

4) The joint dispatch savings with UCU's assumption for limited off system sales opportunities would be approximately $164 million for the MPS and EDE combined system.

5) The joint dispatch savings without any off system sales opportunities would be approximately $43.6 million for the MPS and EDE combined system.

6) The joint dispatch savings with UCU's assumption for limited off system sales opportunities would be approximately $246.1 million for a MPS, SJLP and EDE combined system.

7) The joint dispatch savings without any off system sales opportunities would be approximately $89.0 million for a MPS, SJLP and EDE combined system.

8) The joint dispatch savings with the same off system sales opportunities ("unlimited" off

system sales) for the stand alone and joint dispatch models would be approximately $12.1 million for a MPS, SJLP and EDE combined system.

Q. What caused the differences in joint dispatch savings between the Staff and UCU model results?

A. Several changes that I made to the input data in the model and/or model version differences caused the different results. These differences are discussed in the next section of my analysis.

PARAMETERS OF ANALYSIS

Q. What input changes and adjustments did you make for the Staff's SJLP stand alone model compared to UCU's model?

A. I changed the SJLP Lake Road (LR) units #1, #2, and #3 fuel inputs to blends of coal and gas, based on their actual operating experience, instead of using the UCU assumption of LR #1 using only coal, and LR #2 and #3 using only gas. In addition, I adjusted the heat rate factors for LR #1, #2, and #3 because the heat rates input for those units by UCU did not consider the boilers' efficiency.

Q. What inputs did you change and adjust for the Staff's EDE stand alone model compared to UCU's model?

A. I increased the capacities for the EDE units Asbury #2, Energy Center #1 and #2, and Riverton #7 and #8 to their peak capacities as stated in response to Staff DR No.4105. In addition, Riverton #7 and #8 were modeled using natural gas as the fuel for the last block of capacity; that is, I considered Riverton #7 and #8 would burn natural gas when the level of generation for these units exceeded the capacities indicated in response to Staff DR No.4105 (In DR No.4105, maximum capacities were underreported because the last block of capacity was omitted).

Q. Were the above modifications that you made used in both the Staff and the EDE models in the previous EDE rate cases, Case Nos. ER-95-279 and ER-97-81?

A. Yes.

Q. Did you review projected system load data for MPS, SJLP and EDE over a ten-year period?

A. Yes, for the period 2001 through 2010.

Q. Did you modify MPS, SJLP and EDE projected system load data?

A. No, the projected system load data over a ten-year period from 2001 through 2010 which I used in this analysis

are the same data as that furnished by UCU in response to Staff DR No.4901.

Q. What else did you review?

A. I reviewed the projected fuel prices, heat rates, variable O&M, maintenance outage schedules, and forced outage rates of each generating unit as well as energy purchases and sales data.

Q. Did you change any projected fuel prices, heat rates, variable O&M, maintenance outage schedules, or forced outage rates of any generating units or energy purchases and sales data provided by UCU, SJLP, or EDE in response to Staff DRs?

A. No. In response to Staff DR Nos. 4901 and 4902, UCU, SJLP and EDE provided the projected fuel prices, heat rates, variable O&M, maintenance outage schedules, and forced outage rates of each generating unit as well as purchase power and energy sales projected over the ten-year period 2001 through 2010 used in this analysis.

Q. Do you think UCU can make the Lake Road Operating Enhancements as shown in Mr. Holzwarth's Schedule RWH-7?

A. I am not aware that either UCU or SJLP has made any decisions to perform specific heat rate improvement projects for Lake Road #4 as they indicated they would, in their response to Staff DR No.4104. However, in order to compare the results between the Staff and UCU models used in this case, I am assuming that UCU can achieve its goals for Lake Road operating enhancements after the merger.

STAFF RECOMMENDED CONDITIONS FOR APPROVAL OF THE MERGER

Q. What merger conditions, in your opinion, should the Commission require of UCU/SJLP so that the Electric Engineering Section can continue to perform appropriate fuel and energy cost simulations after the merger?

A. The following conditions should be ordered:

1. MPS and SJLP must continue to provide the historical actual hourly generation, energy purchases and sales data, and other information for the MPS and SJLP divisions of UCU required under Commission Rule 4 CSR 240-20.080 in electronic format accessible by a spreadsheet program.

2. In order for the Staff to be able to analyze fuel and energy costs, acknowledgment and agreement that the Commission may access and require without the necessity of

subpoena the production of all accounts, books, contracts, records, documents, memoranda, papers, and employees of UtiliCorp United, Inc. and any affiliate, division or subsidiary.

It would be detrimental to Missouri ratepayers if the Commission did not receive or have access of the above information because the Commission's ability to set just and reasonable rates would be impaired.

SUMMARY FOR SECTION II

Q. Would you summarize the contents of Section II of your rebuttal testimony?

A. Yes. Projected fuel prices, heat rates, variable O&M costs, maintenance outage schedules, and forced outage rates for all MPS, SJLP and EDE generating units, system loads and all purchases and sales data were included in the production cost model run to estimate joint dispatch savings scenarios by the Staff. The joint dispatch savings of the MPS and SJLP generating units resulting from the mergers and for other scenarios (no off system sales, limited off system sales, and "unlimited" off system sales) are calculated by the production cost model simulation and are shown in Schedule 1.

Q. Does this conclude your rebuttal testimony?

A. Yes, it does.

BEFORE THE PUBLIC SERVICE COMMISSION

OF THE STATE OF MISSOURI

In the Matter of the Joint Application of UtiliCorp United Inc. and St. Joseph Light & Power Company for Authority to Merge St. Joseph Light & Power Company With and into UtiliCorp United Inc., and, In Connection Therewith, Certain Other Related Transactions.	)))))))	CASE NO. EM-2000-292

AFFIDAVIT OF TOM Y. LIN

STATE OF MISSOURI)
) ss
COUNTY OF COLE)

Tom Y. Lin, of lawful age, on his oath states: that he has participated in the preparation of the foregoing written testimony in question and answer form, consisting of 22 pages of testimony to be presented in the above case, that the answers in the attached written testimony were given by him; that he has knowledge of the matters set forth in such answers; and that such matters are true to the best of his knowledge and belief.

Tom Y. Lin

Subscribed and sworn to before me this 2nd day of May, 2000.

Notary Public

My commission expires_____

SHARON S WILES
NOTARY PUBLIC STATE OF MISSOURI
COLE COUNTY
MY COMMISSION EXP. AUG. 23,2002

Total fuel cost from production cost model simulation from 2001 to 2010

1. UCU assumption of limited sales opportunities for the MPS and SJLP combined system

	UtiliCorp	Staff
MPS Stand Alone	$1,072,131,398	$1,069,983,615
SJLP Stand Alone	$252,047,078	$256,291,685
MPS + SJLP Joint Dispatch	$1,219,834,417	$1,226,732,322
Savings (Joint Dispatch - Stand Alone)	($104,344,059)	($99,542,978)

2. No sales opportunities for the MPS and SJLP combined system

	UtiliCorp	Staff
MPS Stand Alone	$1,227,261,779	$1,229,832,957
SJLP Stand Alone	$255,964,724	$260,476,572
MPS + SJLP Joint Dispatch	$1,433,570,333	$1,442,401,101
Savings (Joint Dispatch - Stand Alone)	($49,656,170)	($47,908,428)

3. The same sale opportunities (FOR=15%) for stand alone and joint dispatch for the MPS and SJLP combined system

	Staff (1)
MPS Stand Alone	$1,041,896,362
SJLP Stand Alone	$191,594,390
MPS + SJLP Joint Dispatch	$1,226,732,322
Savings (Joint Dispatch - Stand Alone)	($6,758,430)

4. UCU assumption of limited sales opportunities for the MPS and EDE combined system

	UtiliCorp	Staff
MPS Stand Alone	$1,072,131,398	$1,069,983,615
EDE Stand Alone	$969,809,358	$967,496,569
MPS + EDE Joint Dispatch	$1,880,941,459	$1,873,460,495
Savings (Joint Dispatch - Stand Alone)	($160,999,297)	($164,019,689)

5. No sales opportunities for the MPS and EDE combined system

	UtiliCorp	Staff
MPS Stand Alone	$1,227,261,779	$1,229,832,957
EDE Stand Alone	$983,606,279	$982,286,854
MPS + EDE Joint Dispatch	$2,170,981,903	$2,168,529,215
Savings (Joint Dispatch - Stand Alone)	($39,886,155)	($43,590,596)

6. UCU assumption of limited sales opportunities for a MPS, SJLP and EDE combined system

	UtiliCorp	Staff
MPS Stand Alone	$1,072,131,398	$1,069,983,615
SJLP Stand Alone	$252,047,078	$256,291,685
EDE Stand Alone	$969,809,358	$967,496,569
MPS + SJLP + EDE Joint Dispatch	$2,052,933,483	$2,047,656,909
Savings (Joint Dispatch - Stand Alone)	($241,054,351)	($246,114,960)

7. No sales opportunities for a MPS, SJLP and EDE combined system

	UtiliCorp	Staff
MPS Stand Alone	$1,227,261,779	$1,229,832,957
SJLP Stand Alone	$255,964,724	$260,476,572
EDE Stand Alone	$983,606,280	$982,286,854
MPS + SJLP + EDE Joint Dispatch	$2,388,309,709	$2,383,643,901
Savings (Joint Dispatch - Stand Alone)	($78,523,074)	($88,952,482)

8. The same sale opportunities (FOR=0%) for stand alone and joint dispatch for a MPS, SJLP and EDE combined system

	Staff
MPS Stand Alone	$993,095,564
SJLP Stand Alone	$179,394,561
EDE Stand Alone	$887,314,061
MPS + SJLP + EDE Joint Dispatch	$2,047,656,909
Savings (Joint Dispatch - Stand Alone)	($12,147,277)

Schedule 1