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|---|---|
| Exhibit No.: | |
| Issues: | System Energy Losses |
| Witness: | Alan J. Bax |
| Sponsoring Party: | MO PSC Staff |
| Type of Exhibit: | Direct Testimony |
| Case No.: | ER-2005-0436 |
| Date Testimony Prepared: | October 14, 2005 |

# MISSOURI PUBLIC SERVICE COMMISSION

## UTILITY OPERATIONS DIVISION

## DIRECT TESTIMONY

## OF

## ALAN J. BAX

## AQUILA, INC.
## D/B/A AQUILA NETWORKS-MPS
## AND AQUILA NETWORKS-L&P

## CASE NO. ER-2005-0436

**Jefferson City, Missouri**
**October 2005**

**BEFORE THE PUBLIC SERVICE COMMISSION**

**OF THE STATE OF MISSOURI**

| | | |
|---|---|---|
| In the Matter of Aquila, Inc. d/b/a Aquila Networks-MPS and Aquila Networks-L&P, for Authority to File Increasing Electric Rates For the Service Provided to Customers in the Aquila Networks-MPS and Aquila Networks-L&P Area. | ) ) ) | Case No. ER-2005-0436 |

**AFFIDAVIT OF ALAN J. BAX**

**STATE OF MISSOURI** )
) ss
**COUNTY OF COLE** )

Alan J. Bax, of lawful age, on his oath states: that he has participated in the preparation of the following Direct Testimony in question and answer form, consisting of 9 pages of Direct Testimony to be presented in the above case, that the answers in the following Direct 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.

Alan J. Bax
**Alan J. Bax**

Subscribed and sworn to before me this 12th day of October, 2005.

ROSEMARIE RIEDL
MY COMMISSION EXPIRES
June 1, 2009
NOTARY SEAL
#05509636
COLE COUNTY
NOTARY PUBLIC, STATE OF MISSOURI

Rosemarie Riedl
**Notary Public**

My commission expires June 1, 2009

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**DIRECT TESTIMONY**

**OF**

**ALAN J. BAX**

**AQUILA, INC.**
**D/B/A AQUILA NETWORKS-MPS**
**AND AQUILA NETWORKS-L&P**

**CASE NO. ER-2005-0436**

Q. Please state your name and business address?

A. Alan J. Bax, P.O. Box 360, Jefferson City, Missouri, 65102.

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

A. I am employed by the Missouri Public Service Commission (Commission) as a Utility Engineering Specialist III in the Energy Department of the Utility Operations Division.

Q. Please describe your educational and work background.

A. I graduated from the University of Missouri - Columbia with a Bachelor of Science degree in Electrical Engineering in December 1995. Concurrent with my studies, I was employed as an Engineering Assistant in the Energy Management Department of the University of Missouri – Columbia from the Fall of 1992 to the Fall of 1995. Prior to this, I completed a tour of duty in the United States Navy, completing a program of study at the Navy Nuclear Power School and a Navy Nuclear Propulsion Plant. Following my graduation from the University of Missouri - Columbia, I was employed by The Empire District Electric Company (Empire) as a Staff Engineer until August 1999, at which time, I began my employment with the Staff of the Missouri Public Service Commission (Staff).

Q. Are you a member of any professional organizations?

A. Yes, I am a member of the Institute of Electrical and Electronic Engineers (IEEE).

Q. Have you previously filed testimony before the Commission?

A. Yes, a list of the cases in which I have filed reports or testimony is attached as Schedule 1 to this Direct Testimony. In particular, I have filed testimony on jurisdictional allocations and system energy losses in electric rate cases involving Aquila, Inc, d/b/a Aquila Networks – MPS and Aquila Networks – L&P (Case No. ER-2004-0034) as well as for Missouri Public Service, at the time a division of Utilicorp United, Inc. (Case No. ER-2001-672), and Empire, (Case Nos. ER-2002-424 and ER-2004-0570). In addition, I filed testimony on losses and jurisdictional allocations in a complaint case involving Union Electric Company d/b/a AmerenUE (Case No. EC-2002-1) and filed true-up testimony concerning jurisdictional allocations in an electric rate case involving Empire (Case No. ER-2001-299).

Q. To which of the operations of Aquila, Inc. are you directing your testimony?

A. My testimony is directed towards the electric operations of Aquila, Inc. in Missouri.

Q. What is the purpose of your testimony?

A. The purpose of this testimony is to recommend that the Commission adopt the system energy loss factors that I calculated for Aquila Networks – MPS (MPS) and Aquila Networks – L&P (L&P), as illustrated on Schedules 2 and 3 respectively, attached to this Direct Testimony. I also recommend the adoption of jurisdictional allocation

factors for demand and energy that I calculated for MPS as illustrated on Schedules 4 and 5 respectively, attached to this Direct Testimony. My testimony also describes how I determined these factors.

## EXECUTIVE SUMMARY

Q. Would you please summarize the results of your testimony?

A. I have calculated the following system energy loss factors:

MPS – 6.52% of Net System Input

L & P – 6.09% of Net System Input

I have calculated the following jurisdictional demand and energy allocation factors for MPS:

| | Retail | Wholesale |
|---|---|---|
| Demand | .9951 | .0049 |
| Energy | .9942 | .0058 |

## SYSTEM ENERGY LOSSES

Q. What is the result of your system energy loss factor calculation?

A. As shown on Schedule 2 attached to this Direct Testimony, I have calculated the system energy loss factor for MPS to be 0.0652, or 6.52% of MPS's Net System Input (NSI). Schedule 3 shows my calculated system energy loss factor for L&P to be 0.0609, or 6.09% of L&P's NSI.

Q. What are system energy losses?

A. System energy losses are the energy losses that occur in the electrical system (e.g., transmission and distribution lines, transformers, etc.) between the generating sources and the customers' meters. Also considered as system energy losses

are other amounts of energy such as diversion (stolen energy) or energy utilized in unmetered locations. However, these other items are comparably minute.

Q. How are system energy losses determined?

A. The basis for this calculation is that NSI equals the sum of "Retail Sales", "Wholesale Sales" (as applicable), "Company Use," and "System Energy Losses." This can be expressed mathematically as:

NSI = Retail Sales + Wholesale Sales + Company Use + System Energy Losses. NSI, Company Use, Retail Sales and Wholesale Sales are known; therefore, system energy losses may be calculated as follows:

System Energy Losses = NSI – Retail Sales - Wholesale Sales – Company Use. The system energy loss factor is the ratio of system energy losses to NSI:

System Energy Loss Factor = (System Energy Losses ÷ NSI)

Q. How is NSI determined?

A. In addition to the relationship expressed in the equation above, NSI is also equal to the sum of net generation, the net interchange and applicable resultant inadvertent flows. Net generation is the total energy output of each generating station minus the energy consumed internally to enable its production. Net interchange is the resultant of summing the following calculations:

1. The net of off-system purchases and sales and
2. The net of purchases and sales between operating divisions of Aquila.

Inadvertent flows is the term often utilized in the electric utility industry to describe the portion of the actual physical flows on one's electrical grid structures that are not accounted for in existing contractual and/or scheduled agreements. The output of

each generating station is monitored continuously, as is the net of inter-company and off-system purchases and sales and any resultant inadvertent flows. I obtained this information from data supplied by Aquila in response to Staff Data Request Nos. 81, 91, 92, 130, and 134.

Q. Why are inadvertent flows only included in the calculation of MPS?

A. In the response to Staff Data Request 130, Aquila reported the inadvertent flows reflected in Schedule 1 as pertaining to MPS and provided no information for L&P. Upon further questioning, I learned that MPS and L&P were considered as one control area, not separate divisions, in the monitoring and reporting of inadvertent flows. I was informed it would be next to impossible to allocate the data received between MPS and L&P. Therefore, without a means of allocating the reported information between the two operating divisions, I applied the total of the inadvertent flows to MPS.

Q. What are Retail Sales, Wholesale Sales and Company Use?

A. Retail Sales and Wholesale Sales represent the jurisdictional energy metered within a particular system. In this case, MPS has both wholesale and retail customers on its system, while L&P has only retail customers. Company Use is the electricity used by Aquila at their facilities, with the exception of its power plants, such as the corporate office building. Retail Sales and Wholesale Sales data was provided in response to Staff Data Request No. 136. Company Use data was provided in response to Staff Data Request No. 135.

Q. Which Staff witness used your calculated system energy loss factors?

A. I provided my calculated system energy loss factors to Staff witness Shawn E. Lange.

## JURISDICTIONAL ALLOCATIONS

Q. Please define the phrase "jurisdictional allocation".

A. For purposes of my testimony, jurisdictional allocation refers to the process by which demand-related and energy-related costs are allocated to the applicable jurisdictions. Demand-related and energy-related costs are divided between two jurisdictions: retail and wholesale operations. The application of a particular allocation factor is dependent upon the types of costs being allocated. These calculations were performed for MPS only. L&P has no electric wholesale customers; thus, these calculations were not necessary for that division.

## DEMAND ALLOCATION FACTOR

Q. What is the definition of demand?

A. Demand refers to the rate of electric energy that is delivered to a system to meet the energy requirements of its customers, generally expressed in kilowatts or megawatts, either at an instant in time or averaged over a designated interval of time. In my analyses, I used hourly demands.

Q. What types of costs are allocated on the basis of demand?

A. Capital costs associated with generation and transmission plant and certain operational and maintenance expenses are allocated on this basis. This is appropriate because generation and transmission are planned, designed and constructed to meet the anticipated demand.

Q. What methodology did you use to determine the demand allocators?

A. I used what is known as the Four Coincident Peak (4 CP) methodology.

Q. What is meant by "coincident peak"?

A. The term coincident peak refers to the load in megawatts (MWs) in each of the jurisdictions that coincides with the hour of MPS's overall system peak recorded for each month in the test period.

Q. Why use peak demand as the basis for allocations?

A. Peak demand is the largest electric requirement occurring within a specified period of time (e.g., day, month, season, year) on a utility's system. In addition, for planning purposes, an amount must be included for meeting required contingency reserves. Since generation units and transmission lines are planned, designed, and constructed to meet a utility's anticipated system peak demands plus required reserves, the contribution of each individual jurisdiction to these peak demands is the appropriate basis on which to allocate the costs of these facilities.

Q. Please describe the procedure for calculating the jurisdictional demand allocation factors using the 4 CP methodology.

A. The allocation factor for each jurisdiction was determined using the following process:

a. Identify MPS's peak hourly load in each month for the four - month period June 2004 through September 2004 and sum the hourly peak loads.

b. Sum the particular jurisdiction's corresponding loads for the hours identified in a. above.

c. Divide b. above by a. above.

The result is the allocation factor for the particular jurisdiction. The sum of the demand allocation factors across all jurisdictions equals one. The system peak and associated jurisdictional peaks where determined from information provided in the response to Staff Data Requests 92, 93 and 133.

Q. What are the results of your calculations?

A. As shown on Schedule 4 attached to this Direct Testimony, the calculated demand jurisdictional allocation factors for the test year are as follows:

| | |
|---|---|
| Retail | 0.9949 |
| Wholesale | 0.0051 |

Q. Which Staff witness used your jurisdictional demand allocation factors?

A. I provided these jurisdictional demand allocation factors to Staff witness Phillip K. Williams.

## ENERGY ALLOCATION FACTOR

Q. What types of costs were allocated on the basis of energy?

A. Variable expenses, such as fuel and certain operational and maintenance (O&M) costs, are allocated to the jurisdictions based on energy consumption.

Q. How did you calculate the energy allocation factor?

A. The energy allocation factor for an individual jurisdiction is the ratio of the annual kilowatt-hour (kWh) usage in the particular jurisdiction to the total MPS system kWh usage. The sum of the energy allocation factors across jurisdictions equals one. Applicable jurisdictional kWh usage totals were provided in the response to Staff Data Request Nos. 92 and 136.

Q. What are the calculated energy allocation factors in this case?

A. The factors are shown in Schedule 5 and repeated here.

| | |
|---|---|
| Retail | .9942 |
| Wholesale | .0058 |

Q. Which Staff witness used your jurisdictional energy allocation factors?

A. I provided these jurisdictional energy allocation factors to Staff witness Phillip K. Williams.

Q. Does this conclude your prepared Direct Testimony?

A. Yes, it does.

TESTIMONY AND REPORTS FILED
BEFORE THE MISSOURI PUBLIC SERVICE COMMISSION

BY ALAN J. BAX

| COMPANY | CASE NUMBER |
|---|---|
| Aquila Networks – MPS | ER-2004-0034 |
| Union Electric Company d/b/a AmerenUE | EO-2004-0108 |
| Empire District Electric Company | ER-2002-0424 |
| Kansas City Power and Light | EA-2003-0135 |
| Union Electric Company d/b/a AmerenUE | EO-2003-0271 |
| Aquila Networks – MPS | EO-2004-0603 |
| Union Electric Company d/b/a AmerenUE | EC-2002-0117 |
| Three Rivers and Gascosage Electric Coops | EO-2005-0122 |
| Union Electric Company d/b/a AmerenUE | EC-2002-1 |
| Empire District Electric Company | ER-2001-299 |
| Aquila Networks – MPS | EA-2003-0370 |
| Union Electric Company d/b/a AmerenUE | EW-2004-0583 |
| Union Electric Company d/b/a AmerenUE | EO-2005-0369 |
| Union Electric Company d/b/a AmerenUE | EC-2005-0352 |
| Missouri Public Service | ER-2001-672 |
| Aquila Networks – MPS | EO-2003-0543 |
| Macon Electric Coop | EO-2005-0076 |
| Union Electric Company d/b/a AmerenUE | EC-2004-0556 |
| Union Electric Company d/b/a AmerenUE | EC-2004-0598 |
| Empire District Electric Company | ER-2004-0570 |
| Union Electric Company d/b/a AmerenUE | EC-2005-0110 |
| Union Electric Company d/b/a AmerenUE | EC-2005-0177 |
| Union Electric Company d/b/a AmerenUE | EC-2005-0313 |
| Empire District Electric Company | EO-2005-0275 |
| Aquila Networks – MPS | EO-2005-0270 |

| | Net Generation | Net Interchange | Inadvertant Flows | Net System Input (NSI) | Retail Sales | Wholesale Sales | Company Use | Total Sales |
|---|---|---|---|---|---|---|---|---|
| January | 345,740 | 181,944 | 1,763 | 529,447 | 470,239 | 6,687 | 911 | 477,836 |
| February | 313,162 | 161,476 | (598) | 474,040 | 467,214 | 7,320 | 2,543 | 477,077 |
| March | 308,138 | 128,381 | (96) | 436,423 | 405,512 | 5,689 | 3,300 | 414,500 |
| April | 219,886 | 173,623 | 3,869 | 397,378 | 366,063 | 3,430 | (3,339) | 366,154 |
| May | 245,508 | 226,620 | (1,704) | 470,424 | 385,354 | 2,031 | 510 | 387,895 |
| June | 342,588 | 157,783 | (2,111) | 498,260 | 445,913 | 2,532 | 459 | 448,905 |
| July | 343,532 | 140,562 | 395 | 484,489 | 514,920 | 2,727 | 534 | 518,181 |
| August | 342,266 | 208,919 | 782 | 551,967 | 511,888 | 2,641 | 506 | 515,035 |
| September | 406,378 | 87,343 | 315 | 494,036 | 492,574 | 2,744 | 532 | 495,850 |
| October | 275,520 | 136,776 | (1,113) | 411,183 | 406,857 | 2,360 | 460 | 409,677 |
| November | 233,112 | 196,261 | (598) | 428,775 | 369,288 | 2,180 | 467 | 371,935 |
| December | 277,430 | 228,307 | 1,730 | 507,467 | 426,607 | 2,529 | 922 | 430,058 |
| | 3,653,260 | 2,027,995 | 2,634 | 5,683,889 | 5,262,430 | 42,871 | 7,804 | 5,313,105 |

**System Energy Loss Factor (Percentage) = [NSI - Total Sales]/NSI = .0652 (6.52%)**

**Schedule 2**

| | Net Generation | Net Interchange | Net System Input (NSI) | Retail | Company Use | Total Sales |
|---|---|---|---|---|---|---|
| January | 63,634 | 126,860 | 190,494 | 171,632 | 506 | 172,138 |
| February | 52,391 | 118,016 | 170,407 | 171,586 | 525 | 172,110 |
| March | 61,280 | 93,293 | 154,573 | 152,917 | 471 | 153,388 |
| April | 58,065 | 78,052 | 136,117 | 131,571 | 401 | 131,973 |
| May | 37,666 | 115,795 | 153,461 | 134,967 | 259 | 135,226 |
| June | 57,253 | 102,635 | 159,888 | 146,333 | 307 | 146,640 |
| July | 61,211 | 120,945 | 182,156 | 166,398 | 697 | 167,095 |
| August | 60,837 | 111,836 | 172,673 | 167,931 | -118 | 167,813 |
| September | 58,011 | 101,486 | 159,497 | 157,281 | 271 | 157,552 |
| October | 50,444 | 92,447 | 142,891 | 139,375 | 268 | 139,643 |
| November | 57,338 | 92,827 | 150,165 | 129,149 | 257 | 129,405 |
| December | 55,510 | 123,529 | 179,039 | 158,965 | 491 | 159,456 |
| | 673,640 | 1,277,721 | 1,951,361 | 1,828,106 | 4,333 | 1,832,439 |

**System Energy Loss Factor (Percentage) = [NSI - Total Sales]/NSI = .0609 (6.09%)**

# Demand Allocation Factor Calculation

| MONTH | HOUR | Load at System Peak RETAIL | WHOLESALE | SYSTEM PEAK |
|---|---|---|---|---|
| 1/5/2004 | 7:00 PM | 945.82 | 5.18 | 951.00 |
| 2/2/2004 | 7:00 PM | 888.09 | 4.91 | 893.00 |
| 3/4/2004 | 7:00 PM | 731.93 | 3.07 | 735.00 |
| 4/19/2004 | 9:00 PM | 678.74 | 3.26 | 682.00 |
| 5/20/2004 | 6:00 PM | 1059.36 | 4.64 | 1064.00 |
| 6/14/2004 | 5:00 PM | 1165.05 | 5.95 | 1171.00 |
| 7/13/2004 | 5:00 PM | 1336.81 | 7.19 | 1344.00 |
| 8/3/2004 | 5:00 PM | 1327.97 | 7.03 | 1335.00 |
| 9/14/2004 | 5:00 PM | 1128.91 | 4.09 | 1133.00 |
| 10/28/2004 | 8:00 PM | 723.37 | 3.63 | 727.00 |
| 11/30/2004 | 6:00 PM | 859.93 | 4.07 | 864.00 |
| 12/22/2004 | 7:00 PM | 951.47 | 5.53 | 957.00 |
| Sum (June to Sept) | | 4958.73 | 24.27 | 4983.00 |
| **Allocation Factor** | | **0.9951** | **0.0049** | **1.0000** |

**Schedule 4**

# Energy Allocation Factor Calculation

| | Retail Sales | Wholesale Sales | Total Sales |
|---|---|---|---|
| January | 470,239,005 | 6,686,690 | 476,925,695 |
| February | 467,214,112 | 7,320,400 | 474,534,512 |
| March | 405,511,835 | 5,688,550 | 411,200,385 |
| April | 366,063,437 | 3,430,460 | 369,493,897 |
| May | 385,354,018 | 2,031,270 | 387,385,288 |
| June | 445,913,318 | 2,532,160 | 448,445,478 |
| July | 514,920,176 | 2,727,250 | 517,647,426 |
| August | 511,887,634 | 2,641,110 | 514,528,744 |
| September | 492,573,821 | 2,743,850 | 495,317,671 |
| October | 406,857,285 | 2,359,740 | 409,217,025 |
| November | 369,287,905 | 2,180,380 | 371,468,285 |
| December | 426,607,399 | 2,529,290 | 429,136,689 |
| Sum | 5,262,429,945 | 42,871,150 | 5,305,301,095 |
| Adjustment City of Odessa | | (12,005,463) | (12,005,463) |
| Adjusted Sum | 5,262,429,945 | 30,865,687 | 5,293,295,632 |
| **Allocation Factor** | **0.9942** | **0.0058** | **1.0000** |

**Schedule 5**