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Issues: Revenue Normalization (Weather)
Witness: Edward L. Spitznagel, Jr.
Exhibit Type: Rebuttal
Sponsoring Party: Missouri-American Water Company
Case No.: WR-2007-0216, SR-2007-0217
Date: July 13, 2007

MISSOURI PUBLIC SERVICE COMMISSION

CASE NO. WR-2007-0216
SR-2007-0217

REBUTTAL TESTIMONY

OF

EDWARD L. SPITZNAGEL, JR.

ON BEHALF OF

MISSOURI-AMERICAN WATER COMPANY

MAWC Exhibit No. 21
Case No(s). WR-2007-0216
Date 8-14-07 Rptr pF

BEFORE THE PUBLIC SERVICE COMMISSION

OF THE STATE OF MISSOURI

IN THE MATTER OF MISSOURI-AMERICAN WATER COMPANY FOR AUTHORITY TO FILE TARIFFS REFLECTING INCREASED RATES FOR WATER AND SEWER SERVICE	)))))	**CASE NO. WR-2007-0216** **CASE NO. SR-2007-0217**

AFFIDAVIT OF EDWARD L. SPITZNAGEL

Edward L. Spitznagel, being first duly sworn, deposes and says that he is the witness who sponsors the accompanying testimony entitled "Rebuttal Testimony of Edward L. Spitznagel"; that said testimony and schedule were prepared by him and/or under his direction and supervision; that if inquires were made as to the facts in said testimony and schedule, he would respond as therein set forth; and that the aforesaid testimony and schedule are true and correct to the best of his knowledge.

Edward L. Spitznagel

State of Missouri
County of St. Louis
SUBSCRIBED and sworn to
Before me this 9th day of July 2007.

Notary Public

My commission expires:

Staci A. Olsen
Notary Public - Notary Seal
State of Missouri
St. Charles County
Commission # 05519210
My Commission Expires: March 20, 2009

REBUTTAL TESTIMONY
EDWARD L. SPITZNAGEL, JR.
MISSOURI-AMERICAN WATER COMPANY
CASE NO. WR-2007-0216

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REBUTTAL TESTIMONY

EDWARD L. SPITZNAGEL, JR.

WITNESS INTRODUCTION

Q. PLEASE STATE YOUR NAME, BUSINESS ADDRESS, AND EMPLOYER.

A. My name is Edward L. Spitznagel, Jr., and my business address is Campus Box 1146, One Brookings Drive, St Louis, Missouri 63130. I am employed by Washington University.

Q. ARE YOU THE SAME EDWARD L. SPITZNAGEL, JR., WHO PREVIOUSLY SUBMITTED PREPARED DIRECT TESTIMONY IN THIS PROCEEDING?

A. Yes, I am.

Q. HAVE YOU PREPARED ANY SCHEDULES THAT SUPPORT YOUR TESTIMONY?

A. Yes, I have prepared one schedule. It is marked for identification as Rebuttal Schedule ELS-3.

PURPOSE

Q. WHAT IS THE PURPOSE OF THIS TESTIMONY?

A. The purpose of this testimony is to rebut certain aspects of the weather-normalization methods of Dennis L. Patterson, Witness for the Missouri Public Service Commission (PSC) Staff. Because of the large number of computations

involved, my rebuttal will focus on the specific case of St. Louis County Water Company (SLCWC) quarterly-billed residential customers. Due to the large number of customers in this class, the difference between my gallons-per-customer day (GCD) estimate and Dennis Patterson's GCD estimate is the major factor in the difference between the SLCWC and the PSC Staff revenue estimates.

Q. WHAT NUMBERS OF CUSTOMERS DID YOU USE?

A. I used the annual number of bills provided to me by SLCWC, divided by 4, to obtain the average number of billed customers in each year. I divided the total gallons billed each year by the average number of billed customers and by the number of days in the year to obtain my estimates of GCD.

Q. WHAT NUMBERS OF CUSTOMERS DID DENNIS PATTERSON USE?

A. Dennis Patterson estimated the number of customers each year by a multi-step process. He began by obtaining the number of SLCWC residential meters in use from 1993 through 2006. He then ran a regression of the number of meters on three variables for the nine years 1993 through 2001 and used this to project the numbers of meters in use for the years 2002 through 2008 separately for regions that had been serviced prior to 2002 ("Old Meters") and for Webster Groves and Florissant, which were added in 2002 ("Recent Meters"). This computation can be found in Supplemental Schedule 1-2 to his Supplemental Direct Testimony of June 18, 2007. He then ran a regression of the number of customers billed each year on the projected numbers of meters and one variable he called "Dummies," again for

the years 1993 through 2001. He used this to project the numbers of customers for the years 2002 through 2008 separately for regions that had been serviced prior to 2002 and for Florissant and Webster Groves, which were added in 2002. This computation can be found in Revised Schedule 4-7 to his Supplemental Direct Testimony of June 18, 2007.

Q. WHY WAS SUCH A COMPLICATED METHOD USED, AND ARE THERE WEAKNESSES IN IT?

A. The method was used to provide separate estimates of customers for the regions described above, which then can be used to estimate water utilization separately for these two regions. Mr. Patterson's reason for making the separate estimates is described on page 9 of Direct Testimony of Dennis L. Patterson dated June 5, 2007. On that page, he estimates the usage of the Florissant and Webster Groves customers added in 2002 to be 0.752 that of the existing customers. This number, 0.752, which is based on one year's experience, is then used in his subsequent computations for the years 2003 through 2008. The assumption that the usage ratio can be accurately measured from a single year, 2002, and that it remains constant for the next six years, 2003 through 2008, is a weakness of Mr. Patterson's computations.

Another weakness is in the regression model in Supplemental Schedule 1-2 used to smooth and project the meter counts. The variable representing time is the natural logarithm of (year minus 1986). This transformed variable involves two choices that have no theoretical justification. The first choice is the natural logarithm, which

slows the rate of growth as time advances. Infinitely many other functions, including all powers with exponent between 0 and 1 also have that property, and there is no justification provided why the logarithm should be preferred over any of them. The second choice is subtracting the year 1986. No justification is given for why the base year should be 1986, as opposed to any other year.

A variable called "i2003" is used as the third variable in this regression. This variable is not documented in Mr. Patterson's testimony, particularly as to why for the fitting of the model it has the values 0 (four times), –0.5 (four times), and 1 (one time) in an irregular pattern, and has the value 0 for the projections into the future years 2007 and 2008.

Yet another weakness is the whole idea of estimating a smoothed number of customers, when later on Mr. Patterson combines these smoothed estimates with the total (non-smoothed) amounts of water billed.

Q. HOW DID DENNIS PATTERSON MAKE WEATHER-NORMALIZED ESTIMATES OF GCD FOR HIS "OLD CUSTOMERS"?

A. He first fit a multiple regression model for the years 1990 through 2001 with GCD as the dependent variable, and three independent variables, a moisture variable called DNSHORT, a variable called "Trend 2006" equal to year minus 2006, and a variable called "old swaps." This computation is found in Revised Schedule 6-7 for his Supplemental Direct Testimony of June 18, 2007. The variable DNSHORT is based on precipitation measured at the weather station at Lambert St. Louis International Airport. The origin of the variable "old swaps" is not documented in Mr. Patterson's

testimony. For the 12 years over which the model is fit, it has the values 0 (four times), –0.5 (one time), –1 (three times), 0.5 (one time), 1 (two times), and 1.5 (one time), and has the value 0 for the projections into the years 2002 through 2008.

Q. ARE THERE WEAKNESSES IN THIS PORTION OF THE WEATHER NORMALIZATION?

A. Yes. First, the moisture variable DNSHORT is derived from precipitation and temperature measured at one point, the weather station at Lambert St. Louis International Airport, but Mr. Patterson is using it to normalize water usage over all of St. Louis County excepting Florissant and Webster Groves. Precipitation can be highly variable over the county particularly in spot thundershowers, which are not well represented by measurements made at a single point.

Second, the variable "old swaps" appears to have been created ad hoc to increase the fit of the model, ultimately resulting in an R-square of 0.9979, where an R-square equal to 1 is a perfect fit. In artificial intelligence, such an extraordinarily good fit is known as "over-fitting." The model may look good on the data to which it is fit, but it cannot be relied upon to give reliable extrapolations. For example, given the "Standard Error" of 0.578721 reported in Revised Schedule 6-7, statistical theory says we would expect 95% of all future predictions of GCD to lie within approximately 2 standard errors (= 2×0.578721 = 1.157) of their actual values. In the column headed by "Regression Line" in Revised Schedule 6-7, the GCD estimates for the years 2002 through 2006 are 279.40, 268.28, 277.43, 290.03, and 291.81. The actual all-customer GCD values for 2002 through 2006 are 271.3,

243.4, 251.7, 273.4, and 284.6, respectively, found in Schedule 3-4 of Direct Testimony of Dennis L. Patterson. These include Florissant and Webster Groves, but they can be adjusted to the "Old Customers" by the formula:

$GCD_{OLD} = GCD_{ALL} \times$ total customers / (old customers + 0.752 $\times$ new customers)

where the factor 0.752 comes from page 9 of Direct Testimony of Dennis L. Patterson.

In Rebuttal Schedule ELS-3, I have compared Dennis Patterson's estimates from 2002 through 2006 with the corresponding actual "Old Customer" values. I found that none of them lie within two standard errors of each other, when in fact we were expecting most or all of them to lie within a two standard error distance. Under the assumption of normality, I have calculated the probabilities of exceeding the actual numbers of standard errors and found all of them to be exceedingly small, the largest probability being less than one in five hundred.

In all five cases, Dennis Patterson's estimates exceed the actual "Old Customer" values, which in turn causes his model to underestimate the downward time trend in GCD and therefore over-estimate future water consumption under normal weather. Because of these flaws and similar ones made in his other models, I believe his weather-normalized estimates are inaccurate.

Q. DOES THIS CONCLUDE YOUR REBUTTAL TESTIMONY?

A. Yes, it does.

Rebuttal Schedule ELS-3

Year	Old customers	New Customers	GCD_{ALL}	Adjustment Factor	GCD_{OLD}	Patterson GCD_{OLD}	Distance Apart in SE's	Within 2 SE's?	Probability of Exceeding Given Distance*
2002	296,960	23,100	271.31	1.0182	276.25	279.40	5.443	No	5.2451E-08
2003	298,051	22,787	243.41	1.0179	247.77	268.28	35.433	No	5.3206E-275
2004	299,079	23,399	251.73	1.0183	256.34	277.43	36.444	No	8.4896E-291
2005	300,051	24,076	273.36	1.0188	278.49	290.03	19.929	No	2.29551E-88
2006	300,974	24,513	284.60	1.0190	290.01	291.81	3.097	No	0.001955079
Standard Error:		0.578721							
* Assuming normality									