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Witness: Warren
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Case No.: GR-93-172

MISSOURI PUBLIC SERVICE COMMISSION

POLICY & PLANNING DIVISION

DIRECT TESTIMONY

OF

HENRY E. WARREN

MISSOURI PUBLIC SERVICE,

A DIVISION OF UTILICORP UNITED, INC.

CASE NO. GR-93-172

Jefferson City, Missouri

May, 1993

DIRECT TESTIMONY

OF

HENRY E. WARREN

MISSOURI PUBLIC SERVICE,

A DIVISION OF UTILICORP UNITED, INC.

CASE NO. GR-93-172

Q. Please state your name and business address?

A. My name is Henry E. Warren and my business address is Missouri Public Service Commission, P. O. Box 360, Jefferson City, Missouri.

Q. Please state your educational and professional background?

A. I received a Bachelor of Arts and a Master of Arts in Economics from the University of Missouri-Columbia, and a PhD in Economics from Texas A&M University. Previously, I was an Economist with the U.S. National Oceanic and Atmospheric Administration.

Q. Have you previously filed testimony before the Missouri Public Service Commission (Commission)?

A. Yes, in Case No. GR-93-42, the gas rate case of St. Joseph Light and Power.

Q. What is the purpose of your direct testimony?

A. I will address: 1) The selection of weather stations for the weather normalization procedure, 2) The weather normalization of gas sales and transportation for the Commercial and Industrial Interruptible customers (Rate codes 817, 818, and 812) and for the Industrial Firm

customers (Rate codes 802 and 806) for the test year, ending September 30, 1992, and 3) The calculation of coincident and non-coincident peak daily demand.

Q. What weather stations were selected for the analysis of the weather sensitivity of the usage by Missouri Public Service (MPS) customers?

A. Schedule 1 contains the MPS districts, cities in the districts, and stations selected. Weather stations were selected that had good records of daily maximum and minimum temperature during the test year. In addition the stations were required to be in the U.S. National Oceanic and Atmospheric Administration current list of stations having normal annual heating degree days. Current normal heating degree days are based on temperature observations for July 1, 1961 through June 30, 1990.

Q. What are the objectives of weather normalization methods?

A. The objectives of weather normalization are: (1) to estimate weather sensitive usage from the statistical relationship between usage and heating degree days during the test year; and (2) using this estimated relationship, determine the appropriate adjustments to sales for differences between normal heating degree days and test year heating degree days.

Q. What determines the sensitivity of gas usage by Large Service Customers?

A. Gas usage may be weather sensitive or non-weather sensitive. Weather sensitive usage varies with heating requirements within the billing cycle. This usage varies with the heating degree days in the billing cycle. The major weather sensitive use of gas is space heating. Non-weather sensitive usage does not vary with heating requirements during the billing cycle. The standard index of weather that measures space heating requirements is the heating degree day.

Q. How were heating degree days calculated?

A. The heating degree days in a day are the difference between mean daily temperature (the average of the high and low daily temperatures) and the base, 65°F. If the mean daily temperature is below 65 degrees Fahrenheit, the heating degree days are 65 minus the mean. Otherwise, the heating degree days are equal to zero. For example, if a day had a mean daily temperature of twenty degrees (20°F), then that day would have 45 heating degree days (65 - 20 = 45). Heating degree days are assumed to be additive, that is the heating requirement for a meter read cycle is the sum of the heating degree days over the cycle days. Daily test year and daily normal heating degree days were calculated by the Commission Staff.

Q. Why is it important to set rates based on usage levels that are representative of normal weather?

A. Test year revenues from current rates are calculated by multiplying rate components by the corresponding levels of usage. If the weather sensitive usage levels are depressed due to below normal heating degree days, then test year revenues will also be below normal. Since fixed costs do not vary with weather, a depressed level of revenues compared to costs would result in the Company getting a larger rate increase (Costs - Revenues) than would be just and reasonable. Volumetric rates are calculated by dividing allowed test year costs by test year gas usage for each class. If usage levels reflect the influence of abnormal weather, proposed rates will be distorted by these deviations from normal weather conditions.

Q. What is the Staff's recommendation for weather adjusted gas usage for the Interruptible Commercial and Interruptible and Firm Industrial customers in your analysis?

A. The Staff recommends a 4.1 percent increase from actual test year usage for sales gas and 0.5 percent increase in usage for transported gas. The combined adjustment is 0.8 percent (27,847 Mcf) for the large customers in this analysis (Schedule 2).

Q. What adjustments were made to the test year usage and customers prior to your analysis?

A. Staff witness, Dr. Michael Proctor adjusted the customer usage for transfers to other rate classes and customer deletions during the test year. In addition adjustments were made for anticipated changes in usage including major changes in customer operations and changes in the method of balancing transportation volumes.

Q. How did you match gas usage data and weather data in your methodology?

A. A table provided by Mr. Pat Verderber of MPS contained customer records on meter reading dates and usage. The data used in these calculations cover the test year's billing months of October, 1991 through September, 1992. The daily heating degree days from Staff's weather data files for the appropriate weather station (Schedule 1) were matched by the Commission Staff to each of the bill reading cycles for the 817, 818, 802, 812, and 806 customers and their meter reading cycles in the test year. Thus, gas usage data was matched directly with the weather over the days in which the gas was used.

Q. How did you calculate average cycle usage and heating degree days from the data sets?

A. For each read cycle, gas usage was divided by the corresponding number of days to calculate average daily usage. The same procedure was applied to the heating degree days to determine the average heating degree days per day during the cycle.

Q. What method of analysis have you used to measure the relationship between gas usage and weather conditions?

A. I used regression analysis, which is a statistical procedure which relates variations in the independent variable, heating degree days per day of the read cycle (HDD/day) to variations in the dependent variable, usage per day in the cycle (MCF/day). A separate regression analysis was computed on each of the 66 large customers.

Q. What criteria were proposed for determining if a customer was weather sensitive?

A. Two of the results of the regression were evaluated. First, the estimated coefficient that relates HDD/day to usage MCF/day for the customer had to be significantly different than zero (statistically), and second, the regression had to explain 60 percent of the variation in cycle usage, i.e. the $\underline{R}^2$ of the regression ($0<R^2<1$), was greater than 0.60. Apart from the regression results, the third criteria was that the cycle with peak daily demand (MCF/day) had to occur in November through March.

Q. What was the result of the evaluation of the large customers?

A. Commercial Interruptible Southern System (817) -- All three customers are weather sensitive.

Industrial Interruptible Southern System (818) -- Eight customers are weather sensitive and eight are not weather sensitive. Industrial Interruptible Northern System (812) -- two are weather sensitive and four are not weather sensitive. Industrial Firm Southern System (802) -- Twenty-one are weather sensitive and five are not weather sensitive. Industrial Firm Northern System (806) -- Twelve customers are weather sensitive and three are not weather sensitive. For these 66 large customers -- 46 are weather sensitive and 20 are not weather sensitive.

Q. How was normalized test year usage calculated from the regression results?

A. Two adjustments were made. For non-weather sensitive customers the Days Adjustment was the only adjustment. This adjustment was made if the twelve cycles contained more (or less) than 365 days. This is the Days Adjustment (Schedule 2). The day difference (Normal Days - Test Year Days) was multiplied by the average use per day by the customer in the test year.

For weather sensitive customers both a Days Adjustment and a Weather Adjustment were made. For weather sensitive customers the day difference is multiplied by the intercept term estimated by the regression. For the Weather Adjustment the twelve heating degree day differences (Normal Cycle HDD/day - Test Year Cycle HDD/day) are computed for the meter reading cycles for the

customer during the test year. To calculate the Weather Adjustment the degree day difference for each cycle is multiplied by the coefficient of HDD/day from the regression. These Weather Adjustments and Days Adjustments are summed over the cycles to determine the total adjustment for each customer. The two adjustments are then summed over the customers in each rate class to obtain the Total Days Adjustment, Total Weather Adjustment, and Total Adjusted Volumes for the rate classes (Schedule 2). The Total Adjusted Volumes are the normalized test year usage.

Q. What types of peak daily demand did you calculate?

A. Coincident Peak Demand and Non-Coincident Peak Demand. Coincident Peak Demand is calculated over the heating season (November - March). Non-Coincident Peak Demand is calculated over the entire year.

Q. How did you calculate Coincident and Non-Coincident Peak Demand?

A. Weather sensitive customers, by definition, only have Coincident Peak Demand. The coincident daily peak demand is estimated from the regression equation coefficients using the Mean Peak Day. Mean Peak Day was derived from a thirty year set of degree day values over the normals period (July 1, 1961 - June 30, 1990). In the normals period in each heating year, the day with the maximum heating degree days is selected. The mean heating

degree days for these thirty days is the Mean Peak Day. For weather sensitive customers the Coincident Peak is the Mean Peak Day multiplied by the estimated coefficient of (MCF/day) plus the estimated intercept term for each customer. These Coincident Peaks are then summed over all weather sensitive customers.

For Non-Weather Sensitive customers the Coincident Peak is determined directly from the test year MCF/day in the months November-March. A separate Non-Coincident Peak occurs for a Non-Weather Sensitive customer if a higher peak MCF/day occurs in a cycle in the test year outside the November-March period. The aggregate Coincident Peak (Schedule 3) is the sum of the Coincident Peaks across all customers. The aggregate Non-Coincident Peak is the sum of Coincident Peaks for customers with their peak day in November-March plus the Non-Coincident Peaks of the Non-Weather Sensitive Customers.

Q. What are the coincident and non-coincident peak demands for the customers in your analysis?

A. The Coincident Peak is 18,744 MCF/Day and the Non-Coincident peak is 21,777 MCF/Day. These calculations are summarized in Schedule 3. The information on Coincident and Non-Coincident Peaks was provided to other Staff Witnesses to use in calculating allocation factors.

Q. Does this conclude your direct testimony?

A. Yes, it does.

BEFORE THE PUBLIC SERVICE COMMISSION

OF THE STATE OF MISSOURI

In the matter of Missouri Public Service tariff sheets designed to increase rates for gas service provided to customers in the Missouri service area of the company.	))))	CASE NO. GR-93-172

AFFIDAVIT OF HENRY E. WARREN

STATE OF MISSOURI)
) ss
COUNTY OF COLE)

Henry E. Warren, 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 9 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.

Henry E. Warren

Henry E. Warren

Subscribed and sworn to before me this 27th day of May, 1993.

Joyce C. Neuner

Notary Public

My commission expires June 18, 1993

Joyce C. Neuner, Notary Public
Osage County, State of Missouri
My Commission Expires June 18, 1993

Missouri Public Service
Case No. GR-93-172
Weather Stations Used in the Weather Normalization Procedure

System-District	Weather Station(s) for Normals	Cities in the District
South-110	Windsor	Leeton
South-120	Nevada	Deerfield, Nevada
South-150	Sedalia	Sedalia
South-160	Clinton	Clinton
South-170	Lexington[1]	Henrietta, Lexington
	Marshall[1]	Marshall, Richmond
South-180	Kansas City Airport (MCI)	Platte City, Tracy, Weston
North-170	Salisbury[2]	Brunswick, Keytesville, Glasgow, Salisbury
	Brookfield[2]	Brookfield, Bucklin, Chillicothe, Chula, Laclede, Marceline, Meadville, Utica, Wheeling
	Spickard[2]	Trenton

[1]Residential (800) and Firm Commercial (801) were normalized in aggregate. A simple average of these two stations was used for normalization of all the South-170 customers. Commercial Interruptible (817), Industrial Interruptible (818) and Industrial Firm (802) were individually normalized and the weather station corresponding to their location was used.

[2]Residential (804) and Firm Commercial (805) were normalized in aggregate. A simple average of these three stations was used for normalization of all of the North-170 customers. Industrial Interruptible (812) and Industrial Firm (806) were individually normalized and the weather station corresponding to their location was used.

Missouri Public Service
Case No. GR-93-172
Weather and Days Adjustments to Large Customers Sales and Transportation (MCF)

Rate Class	Rate Code	District	Number of Customers	Weather Sensitive Customers	Total Actual Sales & Transport	Total Weather Adjustment	Total Days Adjustment	Total Adjusted Mcf Volumes	Percent Adjusted Sales & Transp.
Commercial Interruptible	811	Northern	0	0	0	0	0	0	0
- Sales & Transportation	817	Southern	3	3	114,661	6,646	0	121,307	5.5%
		Total	3	3	114,661	6,646	0	121,307	5.5%
Industrial Interruptible	812	Northern	6	2	741,152	3,326	0	744,478	0.0%
- Sales & Transportation	818	Southern	16	8	2,525,803	10,286	(817)	2,535,272	0.4%
		Total	22	10	3,266,955	13,612	(817)	3,279,750	0.4%
Industrial Firm Sales	806	Northern	15	12	54,413	2,298	(148)	56,563	3.8%
	802	Southern	26	21	88,976	5,291	77	94,344	5.7%
		Total	41	33	143,389	7,589	(71)	150,907	5.0%
Total Sales and Transport									
Northern			21	14	795,565	5,624	(148)	801,041	0.7%
Southern			45	32	2,729,440	22,223	(741)	2,750,923	0.8%
Total			66	46	3,525,005	27,847	(888)	3,551,963	0.8%

Schedule 2

Missouri Public Service Company
Case No. GR-93-172
Large Customer's Coincident and Non-Coincident Daily Peak Demand

Service Class Volume Type(s)	Rate Code	District	Number of Customers	Non-Coincident Peak Mcf / Day	Coincident Peak Mcf / Day
Commercial Interruptible	811	Northern	0	0	0
- Sales & Transportation	817	Southern	3	1,043	1,043
		Total	3	1,043	1,043
Industrial Interruptible	812	Northern	6	4,032	3,507
- Sales & Transportation	818	Southern	16	15,425	12,929
		Total	22	19,456	16,435
Industrial Firm Sales	806	Northern	15	432	422
	802	Southern	26	845	843
		Total	41	1,278	1,265
Total MPS Mcfs / Day					
Northern			21	4,464	3,929
Southern			45	17,313	14,815
Total			66	21,777	18,744

Schedule 3