FILED[3]
SEP 29 2006
Missouri Public
Service Commission

Exhibit No.:
Issues: Weather Normalization

Witness: Shawn E. Lange
Sponsoring Party: MO PSC Staff
Type of Exhibit: Direct Testimony
Case No.: ER-2006-0315
Date Testimony Prepared: June 23, 2006

MISSOURI PUBLIC SERVICE COMMISSION

UTILITY OPERATIONS DIVISION

DIRECT TESTIMONY

OF

SHAWN E. LANGE

EMPIRE DISTRICT ELECTRIC COMPANY

CASE NO. ER-2006-0315

Jefferson City, Missouri
June 2006

STAFF Exhibit No. 44
Case No(s). ER-2006-0315
Date 8-05-06 Rptr DF

BEFORE THE PUBLIC SERVICE COMMISSION

OF THE STATE OF MISSOURI

In the matter of The Empire District Company of Joplin, Missouri for authority to file tariffs increasing rates for electric service provided to customers in Missouri service area of the Company.	))))	Case No. ER-2006-0315

AFFIDAVIT OF SHAWN E. LANGE

STATE OF MISSOURI)
) ss.
COUNTY OF COLE)

Shawn E. Lange, of lawful age, on his oath states: that he has participated in the preparation of the foregoing Direct Testimony in question and answer form, consisting of 11 pages to be presented in the above case; that the answers in the foregoing Direct Testimony were given by him; that he has knowledge of the matters set forth in such answers; and that such matters are true and correct to the best of his knowledge and belief.

Shawn E Lange
Shawn E. Lange

Subscribed and sworn to before me this 21st day of June 2006.

Dawn L. Hake
DAWN L. HAKE Notary Public
My Commission Expires
March 16, 2009
Cole County
Commission #05407643

NOTARY PUBLIC NOTARY SEAL STATE OF MISSOURI

My commission expires_____

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DIRECT TESTIMONY

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DIRECT TESTIMONY

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EMPIRE DISTRICT ELECTRIC COMPANY

CASE NO. ER-2006-0315

Q. Please state your name and business address.

A. My name is Shawn E. Lange and my business address is Missouri Public Service Commission, P.O. Box 360, Jefferson City, MO 65102.

Q. What is your present position with the Missouri Public Service Commission (Commission)?

A. I am a Utility Engineering Specialist II in the Engineering Analysis Section, Energy Department, Utility Operations Division.

Q. Would you please review your educational background and work experience.

A. In December of 2002, I received a Bachelor of Science Degree in Mechanical Engineering from the University of Missouri, at Rolla. Since then, I have pursued dual Masters Degrees in Mechanical Engineering at the University of Missouri, at Columbia and Business Administration at William Woods University. I joined the Commission Staff (Staff) in January 2005. I am a registered Engineer-in-Training in the State of Missouri.

EXECUTIVE SUMMARY

Q. Please provide a brief summary of your testimony.

A. The purpose of the testimony is to provide a general description of weather normalization, describe the process I used, and present the results. The Staff's recommendation to the Commission on weather normalization is to adopt the Staff's weather adjustment, days adjustment, and the weather-normalized hourly net system loads.

Schedule 1 contains the adjustments to sales by rate class for Empire, Schedule 2 contains adjustments to attain the annual sum of the net-system load, Schedule 3 contains a monthly summary for the normalized net system load for Empire, and Schedule 4 contains a list of cases in which Staff's weather normalization method was used in the normalization of net system loads.

The results of the weather normalization of sales were used by Staff Witness Curt Wells to normalize revenues.

The weather-normalized loads were used as an input to the fuel run Staff Witness David W. Elliott used to normalized fuel and purchased power expense.

Normalization of Use

Electricity use is very sensitive to weather conditions. Because of the high saturation of air conditioning and the presence of significant electric space heating in Empire's service territories, the level of sales and the magnitude and shape of Empire's load curve are directly related to daily temperatures.

The weather during the test year differed from normal conditions. The months of January and February 2005 were warmer than normal. The effect of this condition was to decrease the amount of electricity consumed relative to normal levels. The months of

June through September 2005 were warmer than normal. The effect of this condition was to increase the amount of electricity consumed relative to normal levels.

Hourly Net System Loads

The hourly loads were normalized using the method described in the document "Weather Normalization of Electric Loads, Part A: Hourly Net System Loads" (November 28, 1990), written by Dr. Michael Proctor, Missouri Public Service Commission's Chief Economist.

Normal Weather Variables

The normal weather variables were developed using the method described in the document "Weather Normalization of Electric Loads, Demonstration: Calculation of Weather Normals" (October 25, 1991), written by Martin Turner, the former Manager of Missouri Public Service Commission's Research and Planning Department. The normal weather variables were developed using the consecutive 30 years from January 1, 1971 to December 31, 2000.

NORMALIZATION OF USAGE

Q. Why is it necessary to weather normalize electricity usage?

A. Electricity usage is very sensitive to weather conditions. Because of the high saturation of air conditioning and the presence of significant electric space heating in Empire's service territories, the magnitude and shape of Empire's load is directly related to daily temperatures. The weather during the test year differed from normal conditions. The months of January and February 2005 were warmer than normal. The warmer than normal temperatures resulted in decreased energy consumption and lower than normal heating usage. The months of June through September 2005 were warmer

than normal. The warmer than normal temperatures resulted in increased energy consumption and higher than normal cooling usage.

Q. What method did you use to calculate the weather adjustments to class usage?

A. I used the Hourly Electric Load Model (HELM) to calculate the weather adjustments to class usage. In this model, the response to daily weather is first estimated for each of the rate classes from hourly class level load data. Weather normalized usage is then calculated for each month for each of the weather sensitive classes, given normal weather variables based on the estimated response. The weather variables are carefully matched to correspond to the usage in the time period over which usage was recorded. The weather adjustment to class usage is calculated as the difference between the weather normalized usage and the actual usage.

Q. Do any Missouri electric utilities use HELM?

A. Yes. Empire used HELM to weather normalized its billing month sales in this rate case. Kansas City Power and Light Company (KCPL), Aquila, Inc. (Aquila), Union Electric Company d/b/a AmerenUE (AmerenUE), and Empire have all used HELM to analyze loads in their Missouri resource planning process. Aquila also used HELM to weather normalize sales in their most recent rate cases.

Q. Has Staff previously used HELM?

A. Yes, Staff has used HELM in rate cases involving Empire and Aquila. HELM has been used by staff since the mid-1990s.

Q. What are the inputs to this model?

A. There are four data inputs into the model – actual billing month class usage, hourly class load data, and actual and normal daily weather variables. The monthly class usage and the hourly class loads were supplied by Empire. I used the actual high and low temperatures for the test year (12 months ending December 31, 2005) and the history (30 years ending December 31, 2000) of high and low temperatures for the Springfield Regional Airport (SGF) National Oceanic Atmospheric Administration (NOAA) weather station.

Q. How was the days adjustment determined?

A. HELM includes a calculation of the adjustment necessary to convert the billing month sales, which corresponds to how customer meters are read, to calendar month sales. The model calculates the weather normalized usage on a daily basis and then aggregates these daily usages to estimate the weather adjustment to both billing and calendar month sales. I calculated the "days adjustment" as the difference between the weather normalized calendar month sales and the weather normalized billing month sales.

Q. Did you independently perform a weather impact analysis on hourly class load data to determine the appropriate weather response functions?

A. Yes. The hourly loads from the classes that were found to be weather sensitive were then used to develop weather response functions in the HELM model.

Q. How did you determine which rate classes were weather sensitive?

A. Empire supplied hourly class load data for the time period dating October 1, 2003 through December 31, 2005. The hourly loads were plotted against mean daily temperature to ascertain the weather sensitivity of each class.

Q. Which classes were deemed to be weather sensitive?

A. The rate classes that were deemed to be weather sensitive were the residential (RG), commercial (CB), space heating (SH), total electric building (TEB), and general power (GP) classes.

Q. Were weather and days adjustments made to non-Missouri usage?

A. Yes, non-Missouri usage was weather normalized and days adjustments were calculated using the same method used for Missouri usage. I combined all of the usage for each rate class that was weather sensitive from all of the non-Missouri jurisdictions by billing month, and cycle to calculate non-Missouri weather normalized usage.

Q. Did you make any adjustments or corrections to the cycle usage data?

A. Yes. The usage data provided by EDE was separated by known billing corrections (bad original bill and associated "cancel") and correct bills. While reviewing this billing data, I noticed that the usage occurring in December 2005 for the known billing corrections was large and positive, indicating billing corrections had occurred and the normal amount of cancels were not in that month. I was able to adjust the positive known billing correction usage by combining obvious incorrectly billed usage with the corresponding canceled usage and rebilled usage from the billing cycle data in January and February 2006.

HOURLY NET SYSTEM LOADS

Q. What is hourly net system load?

A. Hourly net system load is the hourly electric supply necessary to meet the energy demands of a company's customers and the company's own internal needs. It is net of (i.e., does not include) station use, which is the electricity requirement of the

company's generating plants. The hourly loads used in my analysis of the test year, January 2005 through December 2005, were provided to Staff in response to Data Request number 13 and the respective supplements to that request. I also used hourly load data submitted monthly by Empire in compliance with Commission rule 4 CSR 240-3.190 to cross check and correct errors that were found in the data request response.

Q. What method did Staff use to weather normalize net system hourly loads?

A. The Staff's weather normalization procedure was developed by the Economic Analysis Department of the Commission in 1988. The process is described in detail in the document "Weather Normalization of Electric Loads, Part A: Hourly Net System Loads" (November 28, 1990), written by Dr. Michael Proctor, Missouri Public Service Commission's Chief Economist.

Q. Briefly summarize the process you used.

A. In order to reflect normal weather, daily peak and average loads are adjusted independently, but using the same methodology. Independent adjustments are necessary because average loads respond differently to weather than peak loads.

Daily average load is calculated as the daily energy divided by twenty-four hours and the daily peak is the maximum hourly load for the day. Separate regression models estimate both a base component, which is allowed to fluctuate across time, and a weather sensitive component, which measures the response to daily fluctuations in weather for daily average loads and peak loads. The regression parameters, along with the difference between normal and actual cooling and heating measures, are used to calculate weather adjustments to both the average and peak loads for each day. The adjustments for each day are added respectively to the actual average and peak loads for each day. The

starting point for allocating the weather normalized daily peak and average loads to the hours is the actual hourly loads. A unitized load curve is calculated for each day as a function of the actual peak and average loads for that day. The corresponding weather normalized daily peak and average loads, along with the unitized load curves, are used to calculate weather normalized hourly loads.

This process includes many checks and balances, which are included in the spreadsheets that are used. In addition, the analyst is required to examine the data at several points in the process.

Q. Has this method been used in other rate cases?

A. Yes, this method has been used in several cases brought before this Commission. Please refer to Schedule 4 for a list of these cases.

Q. What data was used in this process?

A. Actual hourly net system loads for the time period from July 1, 2004 through December 31, 2005 were provided by Empire. The actual daily weather variables from the NOAA Springfield weather station were used. I calculated the normal weather variables using a method developed by the Staff in 1991. The process is described in the document "Weather Normalization of Electric Loads, Demonstration: Calculation of Weather Normals" (October 25, 1991), written by Martin Turner, the former Manager of Missouri Public Service Commission's Research and Planning Department, and summarized in the next section of my testimony.

Q. Were modifications made to the test year weather normalized hourly net system loads to account for Staff's adjustments to test year usage?

A. Yes. I adjusted the weather-normalized hourly net system loads to be consistent with the Staff's weather-normalized, annualized test year usage.

Q. How were the hourly loads adjusted to account for the annual adjustments to usage?

A. I added weather normalized wholesale usage and company usage to the Staff's weather normalized, annualized test year usage for both Missouri and non-Missouri. Then, I increased the annual usage adjustment by the loss factor supplied to me by Staff witness Erin Maloney in order to obtain the additional amount of generation (net system input) necessary to serve this additional generation. A factor was applied to each hour of the weather-normalized loads to produce an annual sum of the hourly net-system loads that equals the adjusted test year usage, plus losses, and consistent with normalized revenues. A table showing each of these adjustments to attain the annual sum of the net-system load is shown in Schedule 2. A monthly summary of the adjusted loads is shown on Schedule 3.

Q. Which Staff witness used your hourly-normalized net system loads?

A. Staff witness David W. Elliott used the test year hourly normalized system loads in developing test year fuel and purchased power expense.

NORMAL WEATHER VARIABLES

Q. What did you use to represent normal weather in these calculations?

A. The normal weather used in both the normalization of class usage and hourly net system loads was calculated using Staff's ranking method and daily weather values for the time period January 1, 1971 through December 31, 2000. Staff's ranking

method estimates daily normal values, which range from the temperature value that is "normally" the hottest to the temperature value that is "normally" the coldest.

Using ranked normals to estimate the weather adjustment to usage is important because electricity use does not respond to temperature by a constant factor. Customer response to a change in temperature of one degree from 70 to 71 is very different from a change in temperature of one degree from 90 to 91. This is generally due because most people who use air conditioning would be utilizing them at 90 and the one degree change would not cause a noticeable change in the runtime of the air conditioner. A change in one degree from 70 to 71 may cause people to start to use their air conditioners. The ranking method of calculating normals allows for a more accurate estimate of changes in usage due to deviations from normal weather.

Using ranked normals is also important in estimating fuel and purchased power expense because these expenses are greatly impacted by the range of daily weather. Since every year has a range of high and low temperatures, the daily normals should also reflect the range of the weather distribution (normal highs and lows). The ranking method that was used estimates normal high and low temperatures.

Q. How are the daily normals derived?

A. The daily normal variables are calculated by ranking the temperatures in each year of the history. These temperatures are then averaged by rank, not by the day of the year. This results in the normal hottest variable being the average of the hottest days in each year of the history. The second normal hottest variable is based on the average of the second hottest days of each year and so forth. The normal variables calculated from this ranking are then assigned to the days in the test year based on the rankings of the

actual temperatures in the year. This assignment results in as small a weather normalization adjustment to the hourly loads on each day as is possible for a given annual adjustment.

Q. Does this conclude your direct testimony?

A. Yes, it does.

Empire District Electric Company
Actual and Weather Normalized Sales (kWh)
Jan-Dec 2005
RG-Residential (Missouri Jurisdiction)

Billing Month	Actual	Weather Norm	Weather Adj	% Weather Adj
Jan-05	175,531,958	189,431,833	13,899,875	7.92%
Feb-05	151,342,915	167,775,035	16,432,120	10.86%
Mar-05	128,542,759	137,406,618	8,863,859	6.90%
Apr-05	118,418,069	115,261,806	(3,156,263)	-2.67%
May-05	95,723,656	93,790,171	(1,933,485)	-2.02%
Jun-05	120,713,640	112,284,669	(8,428,971)	-6.98%
Jul-05	157,143,654	148,254,498	(8,889,156)	-5.66%
Aug-05	170,149,978	162,846,416	(7,303,562)	-4.29%
Sep-05	170,211,467	150,766,067	(19,445,400)	-11.42%
Oct-05	119,670,913	105,444,111	(14,226,802)	-11.89%
Nov-05	100,805,473	98,813,826	(1,991,647)	-1.98%
Dec-05	152,473,247	154,164,911	1,691,664	1.11%
Total	1,660,727,729	1,636,239,961	(24,487,768)	-1.47%
Days Adj	(4,584,799)			

Empire District Electric Company
Actual and Weather Normalized Sales (kWh)
Jan-Dec 2005
CB-Commercial (Missouri Jurisdiction)

Billing Month	Actual	Weather Norm	Weather Adj	% Weather Adj
Jan-05	28,401,739	29,460,428	1,058,689	3.73%
Feb-05	25,583,015	27,300,050	1,717,035	6.71%
Mar-05	23,208,986	24,524,430	1,315,444	5.67%
Apr-05	24,068,386	24,171,501	103,115	0.43%
May-05	22,238,154	22,242,930	4,776	0.02%
Jun-05	27,563,865	26,518,152	(1,045,713)	-3.79%
Jul-05	31,833,808	30,596,978	(1,236,830)	-3.89%
Aug-05	33,098,717	32,139,225	(959,492)	-2.90%
Sep-05	33,622,796	31,053,131	(2,569,665)	-7.64%
Oct-05	27,435,187	25,218,657	(2,216,530)	-8.08%
Nov-05	22,230,705	21,740,058	(490,647)	-2.21%
Dec-05	25,697,359	25,829,969	132,610	0.52%
Total	324,982,717	320,795,509	(4,187,208)	-1.29%
Days Adj	(465,329)			

Empire District Electric Company
Actual and Weather Normalized Sales (kWh)
Jan-Dec 2005
SH-Small Heating (Missouri Jurisdiction)

Billing Month	Actual	Weather Norm	Weather Adj	% Weather Adj
Jan-05	9,464,759	10,032,581	567,822	6.00%
Feb-05	8,148,323	8,935,275	786,952	9.66%
Mar-05	6,756,689	7,271,035	514,346	7.61%
Apr-05	6,935,793	6,986,791	50,998	0.74%
May-05	5,775,633	5,768,679	(6,954)	-0.12%
Jun-05	6,960,580	6,811,735	(148,845)	-2.14%
Jul-05	8,196,976	7,991,192	(205,784)	-2.51%
Aug-05	8,690,415	8,515,050	(175,365)	-2.02%
Sep-05	8,655,794	8,260,118	(395,676)	-4.57%
Oct-05	7,388,096	6,983,597	(404,499)	-5.48%
Nov-05	6,106,140	6,003,308	(102,832)	-1.68%
Dec-05	8,303,134	8,310,376	7,242	0.09%
Total	91,382,332	91,869,737	487,405	0.53%
Days Adj	12,626			

Empire District Electric Company
Actual and Weather Normalized Sales (kWh)
Jan-Dec 2005
TEB-Total Electric Bldg (Missouri Jurisdiction)

Billing Month	Actual	Weather Norm	Weather Adj	% Weather Adj
Jan-05	31,139,768	32,417,005	1,277,237	4.10%
Feb-05	25,835,519	27,794,556	1,959,037	7.58%
Mar-05	23,365,123	24,858,955	1,493,832	6.39%
Apr-05	24,795,598	25,011,519	215,921	0.87%
May-05	24,378,222	24,453,391	75,169	0.31%
Jun-05	27,409,446	26,802,470	(606,976)	-2.21%
Jul-05	33,362,401	32,489,361	(873,040)	-2.62%
Aug-05	33,432,156	32,759,255	(672,901)	-2.01%
Sep-05	34,523,256	32,940,171	(1,583,085)	-4.59%
Oct-05	30,774,478	29,117,175	(1,657,303)	-5.39%
Nov-05	25,453,043	25,100,201	(352,842)	-1.39%
Dec-05	32,203,341	32,297,082	93,741	0.29%
Total	346,672,351	346,041,141	(631,210)	-0.18%
Days Adj	(1,102,370)			

Empire District Electric Company
Actual and Weather Normalized Sales (kWh)
Jan-Dec 2005
GP-General Power (Missouri Jurisdiction)

Billing Month	Actual	Weather Norm	Weather Adj	% Weather Adj
Jan-05	62,265,945	62,571,683	305,738	0.49%
Feb-05	58,246,024	59,111,824	865,800	1.49%
Mar-05	56,061,213	56,985,287	924,074	1.65%
Apr-05	62,361,337	63,011,421	650,084	1.04%
May-05	64,097,480	64,283,856	186,376	0.29%
Jun-05	71,555,936	70,556,208	(999,728)	-1.40%
Jul-05	77,565,055	76,384,612	(1,180,443)	-1.52%
Aug-05	80,538,743	79,354,114	(1,184,629)	-1.47%
Sep-05	86,126,580	83,297,317	(2,829,263)	-3.29%
Oct-05	75,299,418	73,128,628	(2,170,790)	-2.88%
Nov-05	65,730,797	65,087,700	(643,097)	-0.98%
Dec-05	67,405,778	67,228,167	(177,611)	-0.26%
Total	827,254,306	821,000,817	(6,253,489)	-0.76%
Days Adj	(1,156,707)			

THE EMPIRE DISTRICT ELECTRIC COMPANY
COMPONENTS OF ANNUAL NET SYSTEM INPUT
ER-2006-0315

	As Recorded Sales (kWh)	Billing Adjustments	Large Customer Annualizations	Normalization for Weather	Days Adjustment	Additional kWh from Cust Growth	Total EDE Normalized kWh
Mo Retail	4,064,987,726	-	17,078,480	(35,072,270)	(7,576,451)	76,232,504	4,115,649,989
Non-Mo Retail	545,559,377	-	45,435	(5,291,760)	(1,588,333)	6,230,469	544,955,188
W1 Wholesale	328,913,099		-	(4,075,784)	-	-	324,837,314
Company Use	10,263,287		-	-	-	-	10,263,287
Total Usage	4,949,723,489	-	17,123,915	(44,439,814)	(9,164,784)	82,462,972	4,995,705,778
Losses	6.98%		6.98%	6.98%	6.98%	6.98%	6.98%
NSI	5,321,138,991	-	18,408,853	(47,774,473)	(9,852,488)	88,650,798	5,370,571,681

Empire District
Net System Load
Normalized for 2005*
ER-2006-0315

Month	Monthly Usage (MWh)				Monthly Peaks (MW)				Load Factor	
	Actual	Normal	Adj	% Adj	Actual	Normal	Adj	% Adj	Actual	Normal
Jan-05	465,208	510,034	44,826	9.64%	900	1,012	112	12.49%	0.69	0.68
Feb-05	388,035	426,588	38,553	9.94%	820	1,001	181	22.11%	0.70	0.63
Mar-05	407,048	416,131	9,083	2.23%	818	900	82	10.01%	0.67	0.62
Apr-05	348,126	358,829	10,703	3.07%	622	642	20	3.17%	0.78	0.78
May-05	390,323	392,298	1,975	0.51%	820	852	32	3.87%	0.64	0.62
Jun-05	473,583	459,451	(14,132)	-2.98%	1,033	1,029	(4)	-0.43%	0.64	0.62
Jul-05	524,428	532,682	8,254	1.57%	1,087	1,084	(3)	-0.25%	0.65	0.66
Aug-05	546,386	535,157	(11,229)	-2.06%	1,050	1,066	16	1.57%	0.70	0.67
Sep-05	463,032	438,228	(24,804)	-5.36%	991	1,003	12	1.21%	0.65	0.61
Oct-05	391,842	387,153	(4,689)	-1.20%	854	774	(80)	-9.40%	0.62	0.67
Nov-05	400,103	412,706	12,603	3.15%	839	850	11	1.37%	0.66	0.67
Dec-05	494,941	501,316	6,375	1.29%	1,032	1,100	68	6.56%	0.64	0.61
Annual	5,293,055	5,370,572	77,517	1.46%	1,087	1,100	13	1.17%	0.56	0.56

* Normalized for weather, growth, and large customers

Cases in Which Staff's Weather Normalization Method Was Used
in the Normalization of Net System Loads

EO-87-175	ER-94-163	EM-2000-292
EO-90-101	ER-94-174	ER-2001-299
EO-90-138	ER-95-279	ER-2001-672
ER-93-37	ER-97-81	EC-2002-1
ER-93-41	EM-97-575	ER-2002-424
EO-93-351	ER-2004-0034	ER-2004-0570
ER-2005-0436	ER-2006-0315	