Exhibit No.:	230
Issue:	*Weather Variables*
Witness:	*Seoung Joun Won, PhD*
Sponsoring Party:	*MoPSC Staff*
Type of Exhibit:	*Rebuttal Testimony*
Case Nos.:	*GR-2017-0215 and GR-2017-0216*
Date Testimony Prepared:	*October 17, 2017*

MISSOURI PUBLIC SERVICE COMMISSION

COMMISSION STAFF DIVISION

TARIFF/RATE DESIGN

REBUTTAL TESTIMONY

OF

SEOUNG JOUN WON, PhD

Staff Exhibit No 230
Date 12-5-17 Reporter A.F
File No GR-2017-0215, GR-2017-0216

SPIRE MISSOURI, INC., d/b/a SPIRE

LACLEDE GAS COMPANY and MISSOURI GAS ENERGY
GENERAL RATE CASE

CASE NOS. GR-2017-0215 AND GR-2017-0216

Jefferson City, Missouri
October 2017

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Q. Please state your name and business address.

A. My name is Seoung Joun Won and my business address is Missouri Public Service Commission, P. O. Box 360, Jefferson City, Missouri 65102.

Q. Who is your employer and what is your present position?

A. I am employed by the Missouri Public Service Commission ("Commission") and my title is Regulatory Economist III in the Tariff/Rate Design Unit of the Operational Analysis Department, Commission Staff Division.

Q. Are you the same Seoung Joun Won who prepared the Weather Variables of Staff's Cost of Service Report ("Staff Report")?

A. Yes, I am.

EXECUTIVE SUMMARY

Q. What is the purpose of your rebuttal testimony?

A. The purpose of my rebuttal testimony is to address issues with the weather variables that Spire Missouri witness (for both LAC and MGE) Ms. Keri Feldman used to calculate weather normalization adjustments.

Q. Which aspects of the weather variables used by Ms. Feldman are you going to address?

A. I am addressing two issues: (1) the time period used to define normal weather and (2) the method of assigning the daily normal heating degree days ("HDDs").

THE TIME PERIOD USED TO DEFINE NORMAL WEATHER

Q. What is Staff's concern in Ms. Feldman's time period used to define normal weather?

A. Ms. Feldman used a 10-year normal for both divisions of Spire Missouri's weather normalization. The 10-year normal is a calculation of 10 years of average climatological variables used to calculate normal weather conditions. In this rate case, Ms. Feldman calculated the average HDDs over the last 10 years using the time period 2007-2016 for Spire Missouri's weather normalization of gas sales during the test year.

Q. Why did Ms. Feldman use the 10-year normal?

A. According to Ms. Feldman's testimony, she used a 10-year normal due to its Higher Correlation and Better Fit ("HC&BF") with the trend over the last several decades.

Q. Does Staff agree with Ms. Feldman?

A. No, Staff does not. In data request No. 0220, Staff requested that Spire Missouri provide all analysis showing the evidence of HC&BF and all Spire Missouri's response follows:

> The statement pertaining to HC&BF simply means that when updating the Company's normal with most recent year actuals, we are obtaining a better correlation of weather when normalizing actuals.

Because Spire Missouri provided no analysis of HC&BF and only restated their position, Staff cannot verify any evidence that the 10-year normal has a HC&BF than the 30-year normal based on Spire Missouri's workpapers or responses of Staff's data requests.

Q. Does Ms. Feldman explain why HC&BF is a proper criterion of determining normal weather?

A. No. In data request No. 0220, Staff specifically requested that Spire Missouri explain why HC&BF is a proper criterion for determining normal weather. Spire Missouri provided no explanation and only responded as follows:

> HC&BF was a phrase used internally when deciding to use a 10-year average normal, rather than a 30-year average normal.

Based on Spire Missouri's response, there is no reason to accept HC&BF as a proper criterion of determining normal weather.

Q. What is the difference between Ms. Feldman's 10-year normal HDD and Staff's 30-year normal HDD?

A. Ms. Feldman's 10-year normal HDDs are 1.5% and 0.4 % lower than Staff's 30-year normal HDD for LAC and MGE respectively. For calculating actual and normal HDD, both Spire Missouri and Staff used St. Louis International Airport ("STL") and Kansas City International Airport ("MCI") for LAC and MGE service territories respectively. A summary of Spire Missouri's and Staff's normal HDD is presented in Table 1.

Table 1 Normal HDD Comparison

	10-year	30-year
STL	4376	4444
MCI	5041	5063

Q. What is the effect of a lower normal HDD on gas rates?

A. A lower normal HDD potentially requires higher rates because of a lower normal usage of gas.

Q. Did Staff conduct any analysis to compare 10-year and 30-year normals?

A. Yes. Staff conducted a correlation analysis of daily HDD data series. As presented in Table 2 below, Staff's 30-year normal shows a higher correlation between actual and normal HDDs in both LAC and MGE service territories.

Table 2 Correlation between Actual and Normal Daily HDD

	10-year	30-year
STL	0.76	0.98
MCI	0.85	0.97

Q. Based on Staff's analysis of Spire Missouri's position, does Staff consider it appropriate to use Spire Missouri's 10-year normal in this case?

A. Staff has found no evidence that the 10-year normal is more appropriate than the 30-year normal for gas case weather normalization.

Q. Has this issue been before the Commission in previous cases?

A. Actually, the Commission's decision in Case No. GR-96-0285, found that it was appropriate to use a 30-year normal rather than a 10-year normal. This decision may be found in the Report and Order, page 18, lines 5-6. The Commission states that "The Commission finds that NOAA's 30-year normals is the more appropriate benchmark."

THE METHOD OF ASSIGNING DAILY NORMAL HDDS

Q. What is Staff's concern in Spire Missouri's method of assigning daily normal HDDs?

A. Spire Missouri's method of assigning daily normal HDDs is not based on a systematic procedure but a subjective decision by Spire Missouri personnel. Because of Spire Missouri's non-systematic subjective methods, as presented in Figure 1 and Figure 2, below, Spire Missouri's daily normal HDDs data series does not match with the test year weather patterns. Therefore, Spire Missouri's weather normalization introduces a bigger estimation error in Spire Missouri's regression model for weather normalization adjustments.

Q. What is Spire Missouri's method of assigning daily normal HDDs?

A. According to its response to Staff's data request No. 0121.1, Spire Missouri's allocation method is based on seasonal patterns. In data request No. 0121.2, Staff requested an explanation of the pattern used for allocating each day's normal HDD from monthly normal. The response is as follows:

> It is based on the judgement of the analyst and their cumulative experience working with such data over a number of years.

Q. What is Staff's position on Spire Missouri's method of allocating daily normal HDDs?

A. Because Spire Missouri's allocation method relies on a subjective personal decision, Staff cannot find any proper reason to agree with Spire Missouri's method for weather normalization. In addition, there is a possibility that Spire Missouri's weather normalization adjustments are seriously biased.

Q. How does Spire Missouri's method of allocating daily normal HDDs introduce bias into its weather normalization adjustments?

A. Weather normalization adjustments are calculated based on regression models using the relationship between gas usage and HDDs. If daily normal HDDs are not properly allocated then the weather normalization adjustments are incorrect because of a bigger estimation error. The reason is that all regression models are not perfect and the estimated gas usage based on given HDDs includes some level of estimation error, so that a bigger difference between normal and actual HDDs will introduce a bigger estimation error.[1]

[1] With no error, if a regression model perfectly explained the relationship between HDD and gas usage then the R-square of the regression model should be 1. R-squares of regression models used for Spire Missouri's weather normalization are less than 1.

Figure 1 Actual and Normals of Daily HDD in STL

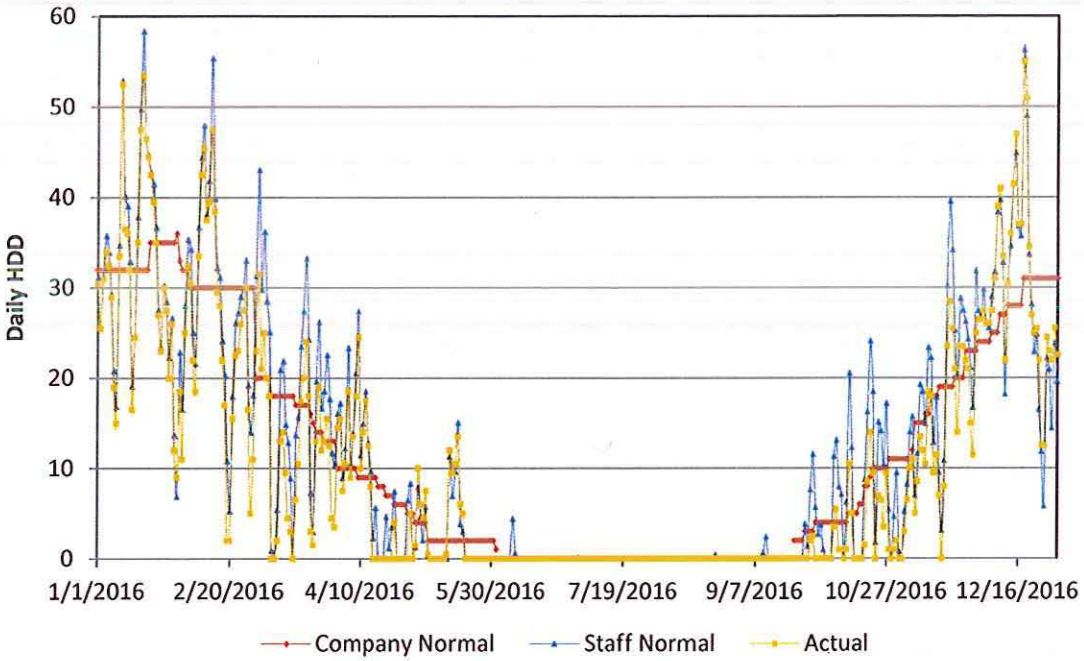
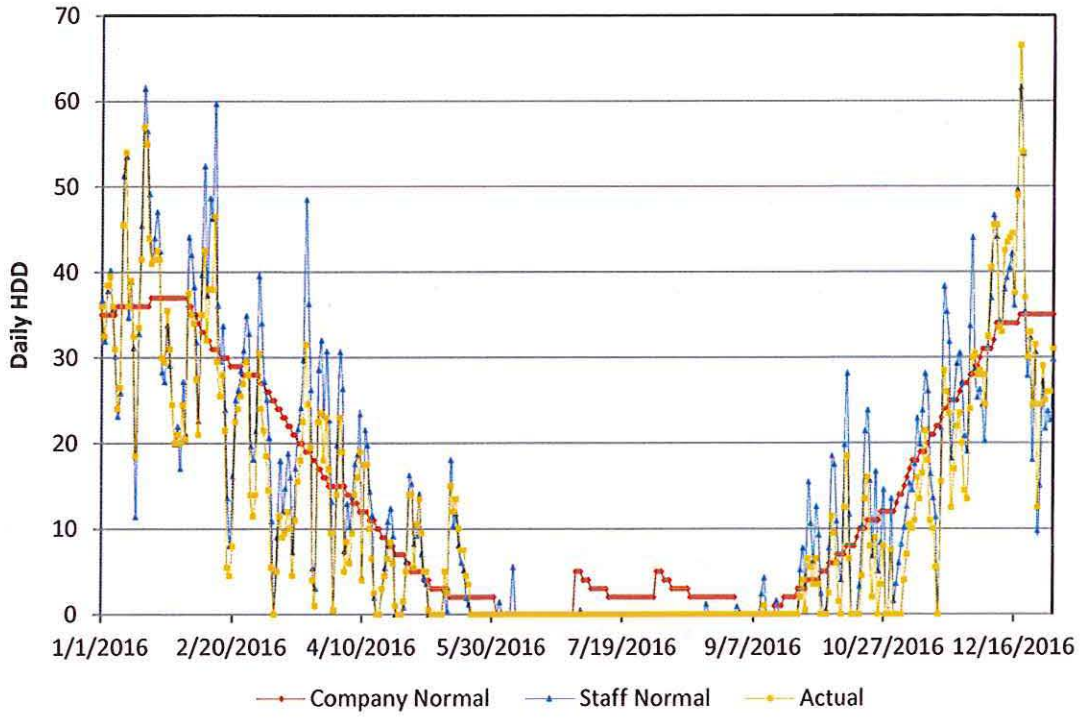


Figure 2 Actual and Normals of Daily HDD in MCI



Q. Why is the Staff's method of allocating daily HDDs better?

A. As presented in Figure 1 and Figure 2, Staff's allocation method can minimize differences between normal and actual HDDs for given monthly HDDs. As explained in the Cost of Service Report, Staff used a ranking method. For more detailed information regarding Staff's ranking method and its statistical advantages, see an article published a peer-reviewed journal, "Energy Economics."[2]

Q. Does this conclude your rebuttal testimony?

A. Yes, it does.

[2] Won, S. J., Wang, X. H., & Warren, H. E. (2016). Climate normals and weather normalization for utility regulation. Energy Economics, 54, 405-416.

BEFORE THE PUBLIC SERVICE COMMISSION

OF THE STATE OF MISSOURI

In the Matter of Laclede Gas Company's Request to Increase Its Revenues for Gas Service	)))	Case No. GR-2017-0215
In the Matter of Laclede Gas Company d/b/a Missouri Gas Energy's Request to Increase Its Revenues for Gas Service	)))	Case No. GR-2017-0216

AFFIDAVIT OF SEOUNG JOUN WON, PhD

STATE OF MISSOURI)
) ss.
COUNTY OF COLE)

COMES NOW SEOUNG JOUN WON, PhD and on his oath declares that he is of sound mind and lawful age; that he contributed to the foregoing Rebuttal Testimony; and that the same is true and correct according to his best knowledge and belief.

Further the Affiant sayeth not.

SEOUNG JOUN WON, PhD

JURAT

Subscribed and sworn before me, a duly constituted and authorized Notary Public, in and for the County of Cole, State of Missouri, at my office in Jefferson City, on this 13th day of October, 2017.

D. SUZIE MANKIN
Notary Public - Notary Seal
State of Missouri
Commissioned for Cole County
My Commission Expires: December 12, 2020
Commission Number: 12412070

Notary Public