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Witness:	Dennis Patterson
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Type of Exhibit:	Direct Testimony
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MISSOURI PUBLIC SERVICE COMMISSION

UTILITY OPERATIONS DIVISION

DIRECT TESTIMONY

OF

DENNIS PATTERSON

UTILICORP UNITED, INC.
D/B/A/ MISSOURI PUBLIC SERVICE

CASE NO. ER-2001-672

Jefferson City, Missouri

December 2001

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Q. Please state your name and business address.

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

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

A. I am a Regulatory Economist in the Energy Department of the Utility Operations Division.

Q. Please review your educational background and work experience.

A. I was trained as an officer and aviator in the U.S. Army. I studied economics, math, sciences and languages at the University of Missouri, receiving an M.S. in Agricultural Economics (1989) and a B.A. in Latin American Studies (1983). I joined the Staff of the Commission in April, 1986. I established the Staff's centralized weather database, and have continued to maintain and improve it by obtaining data and applying methods from reliable sources. I have been employed by the Commission, the Missouri Army National Guard, the University of Missouri, U.S. Army Reserves, and the U.S. Army.

SUMMARY

Q. Please summarize the issues, position, method, process and products that you describe in your written direct testimony.

A. The relevant issue is weather normalization of test year electricity sales. The specific position I espouse in my testimony is that temperatures from the Kansas City International Airport (KCI) should be used to perform the weather normalization in this case. I will explain my method of tabulating a history of daily maximum temperatures and daily minimum temperatures for KCI that are consistent with daily maximum and minimum temperatures that were measured during the test year. Where it is not otherwise explained, the term "temperatures" will refer to daily maximum temperature and daily minimum temperature.

I provided the consistent history of KCI temperatures to staff witness Lena M. Mantle. The history included an observation of each day's temperatures for all days from January 1, 1961 through the last billing month of the test year, which ends in December of 2000. Daily temperatures dating from January 1, 1961 through December 31, 1990 contain adjustments that cause them to correspond with published normals from the National Oceanic and Atmospheric Administration (NOAA). The large data set containing these daily temperatures for KCI is provided in my working papers. In her direct testimony, Ms. Mantle will explain how she used this information to calculate actual and normal weather.

Q. Are the methods you applied in this case consistent with those used in previous cases?

A. Yes. The Commission accepted this methodology in the Report and Order for the Missouri Gas Energy rate case, Case No. GR-96-285. I developed the methodology in 1992, well in advance of the 1996 report and order, and have continued to apply it consistently since 1994 for weather normalization in electric, natural gas and water cases.

Q. What are the contents of your written direct testimony?

A. I have organized my written direct testimony in the following sections:

I. THE DEFINITION OF NORMAL WEATHER.

II. TEMPERATURE MEASUREMENT INCONSISTENCIES.

III. THE CALCULATION OF DAILY NORMAL TEMPERATURES.

THE DEFINITION OF NORMAL WEATHER

Q. What are weather normals?

A. "Normals have been defined as the arithmetic mean of a climatological element computed over a long time period." (**Climatography of the United States No. 81 Monthly Station Normals of Temperature, Precipitation, and Heating and Cooling Degree Days, 1961-90, MISSOURI, NOAA, National Climatic Data Center, Asheville, North Carolina**). NOAA applies this concept to temperature by calculating thirty-year temperature normals as monthly average maximum temperature and monthly average minimum temperature.

Q. What period is used by NOAA in its calculations of its thirty-year temperature normals?

A. NOAA uses the three most recent consecutive decades, which are currently the thirty years ending December 31, 1990. International agreements among members of the World Meteorological Organization, and its predecessor, the International Meteorological Committee, have established that three-decade periods are appropriately long and uniform periods for the calculation of normals. NOAA recalculates thirty-year normals at the end of each decade as a way of dealing with changes in measurement conditions and changes in the climate itself. The 1961-1990 normals were published in early 1992, and it is expected that the 1971-2000 normals will be published in early 2002.

Q. Has the Missouri Public Service Commission (Commission) made any findings with respect to the use of NOAA's thirty-year normal?

A. Yes. The use of the NOAA 30-year normal and 30-year normals period complies with a provision of the Commission's Report and Order in the Missouri Gas Energy rate case, Case No. GR-96-285. At page 18, the Commission's Report and Order states:

> The Commission finds that NOAA's 30-year normals is the more appropriate benchmark . . . In addition, the data upon which Staff's recommendation is based has gone through the processes established by NOAA to ensure the best data possible.

TEMPERATURE MEASUREMENT INCONSISTENCIES

Q. What type of weather station is maintained at KCI?

A. KCI has a first-order weather station. A first-order weather station is usually located at a regional or municipal airport, where the weather instruments are

continuously monitored by professional observers. The instruments record hourly temperature observations. Records are also kept of the maximum and minimum temperatures for the 24-hour day ending at midnight. In contrast, cooperative weather stations are usually manned by trained volunteers who visit the instruments at scheduled hours in the morning or afternoon, to record the maximum and minimum temperatures for the 24 hours ending at the time of the observation.

When temperature normals are calculated for first-order stations and selected cooperative stations, special measures are taken to insure that all the years of temperatures in the calculations are consistent. To achieve this consistency, NOAA makes adjustments to the historical temperatures for the effects of changes in observation practice, changes in instrument type, and changes in instrument location.

Q. When are temperatures published for these stations?

A. For first-order and cooperative stations, the original daily temperatures are first subjected to quality checks. When the quality checks are complete, the daily temperatures are deemed official and printed in monthly publications. When the daily temperatures are published, monthly average temperatures are published with them. After making adjustments for changes in measurement conditions, NOAA eventually calculates normal monthly temperatures from the monthly averages of daily temperature observations.

Q. Did the temperature data series for KCI include any exposure changes?

A. Yes, there have been four since 1961. First, the weather station was moved in 1972, from the urban river bottom location at the Kansas City Municipal Airport to the current prairie location at KCI. The former urban location was at 742 feet

elevation, while the current location is at 1014 feet elevation. This event is documented in the **"2000 LOCAL CLIMATOLOGICAL DATA ANNUAL SUMMARY WITH COMPARATIVE DATA, KANSAS CITY, MISSOURI"** (Asheville, North Carolina: National Climatic Data Center, 151 Patton Avenue, Rm 120, Asheville NC 28801-5001). (Annual Summary). Second, the Annual Summary also includes an entry for a site change of two miles in April 1979. Third, there was a thermometer type change in October 1984. These three exposure changes took place during the 1961-1990 normals period. Finally, outside the normals period, the Automated Surface Observing System (ASOS) was commissioned in July of 1995.

Q. Did NOAA calculate adjustments for the inconsistencies that occurred during the normals period?

A. Yes. NOAA calculated monthly adjustments for the 1972 station change and the site move of 1979, but calculated no adjustments for the instrument type change of 1984. In effect, the NOAA adjustment for the 1984 exposure change was zero for all months.

Q. How did NOAA calculate these adjustments?

A. NOAA calculated these adjustments with reference to monthly average temperatures at surrounding stations where no exposure changes took place for a sufficient length of time before and after the dates of the exposure change at KCI. Adjusted monthly average maximum temperatures and adjusted monthly average minimum temperatures for KCI are published by NOAA in the computer tape deck, **"TD-9641: 1961-90 SEQUENTIAL TEMPERATURE AND PRECIPITATION"** (Asheville, North Carolina: National Climatic Data Center, NOAA/NESDIS/NCDC,

Federal Building, 37 Battery Park Avenue, Asheville, NC, 28801-2733). I will refer to these 360 observations containing adjusted monthly average maximum temperature and adjusted monthly average minimum temperature as the "NOAA sequentials" for KCI. The adjustment process is described in an undated narrative that was supplied with the tape deck.

Q. Do published NOAA temperature normals for KCI contain adjustments from the NOAA sequentials?

A. Yes. NOAA's normal temperatures for the 12 calendar months for KCI are each calculated as the average of all the adjusted temperatures observations for that month, over thirty years, from the NOAA sequentials.

Q. Has NOAA calculated adjustments for exposure changes that occurred after 1990?

A. No. While the earlier exposure changes were adjusted when the 1961-1990 normals were calculated, the exposure change that occurred in1995 will not be addressed until the 1971-2000 normals are published.

Q. Will this recent exposure change have significant effects on the calculation of averages for the 1971-2000 normals period?

A. It is not yet possible to make this judgment with confidence. However, crosschecks of annual cooling degree-day (CDD) averages for the two periods indicate that these effects will be minimal.

Q. What are CDD?

A. Cooling degree-days (CDD) are a weather measure that has been used in the past to model electricity usage. They are defined with respect to mean daily temperature (MDT).

First, MDT is calculated as the average of the day's maximum and minimum temperature. Then, CDD for a day are defined as the remainder obtained by subtracting 65° F from the day's MDT. CDD are set to zero if MDT is below 65° F.

Q. What were the results of the crosschecks of annual CDD?

A. The crosschecks showed no statistically significant difference between the 1961-1990 normals period and the 1971-2000 averaging period. Annual average CDD were 1301 for the 1961-1990 normals period, and 1321 for the 1971-2000 averaging period. The difference of 20 CDD is much smaller than the standard deviation of annual CDD over the years 1961-1990 (about 200 CDD), and is therefore not statistically significant.

Q. Were you able to verify the size of any effects from the commissioning of ASOS at KCI in 1995?

A. Not at this time. It would be very time-consuming to calculate adjustments for temperatures recorded before such exposure changes that could be used to make the records consistent with temperatures measured afterward. There did not appear to be a great need to devote resources to such an analysis.

Q. Based on these facts, what is your recommendation regarding temperature adjustments?

A. In the present case, I would recommend that KCI temperature data be used, but with NOAA's adjustments over the normals period, 1961 through 1990.

CALCULATION OF DAILY NORMAL TEMPERATURES

Q. Do the NOAA monthly temperature normals contain sufficient detail for weather normalizing electricity use?

A. No, they do not. Daily temperature normals are also needed, because electricity usage varies differently at extreme daily temperatures than it does at mild ones.

Q. Does NOAA calculate daily normals for KCI that are consistent with the adjusted monthly normals?

A. Yes. Unfortunately, NOAA's daily normal temperatures are calculated from a smooth curve that has been fitted to the monthly normals, by a mathematical splining process that does not regain the lost information about the distribution of daily extremes. Although NOAA's daily temperature normals are appropriate for their stated purpose of averaging normal climatic values over intervals of time, they are not appropriate for the purpose of normalizing electricity usage.

Q. Is it possible to calculate daily temperature normals that include information about the distribution of extreme daily temperatures?

A. Yes. However, if daily temperature normals are to include the desired information about the distribution of days with extreme temperatures, then the daily normals must be calculated from properly adjusted daily temperature data that correspond with the NOAA normals.

Q. How is this correspondence insured?

A. Before daily temperature normals that are consistent with NOAA's monthly normals can be calculated, it is first necessary to calculate properly adjusted daily temperature data for the NOAA normals period. Fortunately, it is possible to

calculate the necessary adjustments by referring to the NOAA monthly sequentials for the 1961-1990 normals period. Thus, even though the thirty years of adjusted monthly temperature averages from the NOAA sequentials don't provide the required information about days with extreme temperatures, they do serve a necessary and crucial function as a benchmark for making the daily temperature data consistent over the NOAA normals period.

Q. What information did you use to calculate adjusted daily temperatures for the thirty-year NOAA normals period?

A. I used two NOAA temperature data sets to make these calculations. First, I consulted the NOAA sequentials (above). This data set has 30 entries for each of the 12 calendar months, or 360 entries. As stated above, the average of these 30 adjusted values for each of the 12 months constitute NOAA's 30-year normals. These 360 entries provide the benchmarks for adjusting actual daily temperatures in these months.

Second, I obtained official daily temperatures for the same 30-year time period from NOAA Internet sources such as the Midwest Climate Information Service and the National Climatic Data Center. The temperatures may also be compiled from other official NOAA data products and publications. The resulting data set includes the daily maximum and minimum temperatures for each day since January 1, 1961. In this data set, there are a total of 10,957 entries drawn from the 360 months in the 1961-1990 normals period. These are the actual daily temperatures that must be adjusted.

Q. How did you use the monthly sequentials make the adjustments to daily temperatures?

A. First, over the years 1961 through 1990, I calculated monthly averages of the actual daily temperatures that had to be adjusted. This provided 360 observations containing monthly averages of both actual daily maximum temperature and actual daily minimum temperature.

Second, I calculated temperature adjustments for each month of each of the thirty years. This was done by subtracting each of the 360 monthly averages of actual daily maximum and actual daily minimum temperature that were just calculated, from the corresponding adjusted maximum and minimum temperature in the monthly sequentials described above.

Finally, I applied the temperature adjustments just calculated for each of the 360 months in the thirty years by adding them to the corresponding observations of daily actual temperatures. These calculations yielded 10,957 observations containing the adjusted daily maximum and adjusted daily minimum temperature, over the 360 months in the years 1961 through 1990.

Q. How did you crosscheck your results to make sure that the adjusted daily temperatures corresponded to NOAA's normals?

A. For this crosscheck, I first took the monthly averages of the daily maximum and minimum temperatures that were just adjusted. I then verified that these monthly averages were equal to the benchmarks, which are the monthly sequential temperatures that were used by NOAA to calculate its 30-year temperature normals. I also verified that the twelve 30-year monthly averages of the adjusted daily temperatures were equal to NOAA's 12 monthly normal temperatures for KCI. The crosschecks were

successful in this case, thus insuring that the adjusted daily temperature products that I supplied to Ms. Mantle did correspond with the NOAA normals.

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 The Tariff Filing Of Missouri Public Service (MPS) A Division Of UtiliCorp United Inc., To Implement A General Rate Increase For Retail Electric Service Provided To Customers In The Missouri Service Area Of MPS.	))))))	Case No. ER-2001-672

AFFIDAVIT OF DENNIS PATTERSON

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

Dennis Patterson, 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 12 pages of Direct testimony 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 to the best of his knowledge and belief.

Dennis Patterson

Subscribed and sworn to before me this 4th day of December, 2001.

DAWN L. HAKE
Notary Public – State of Missouri
County of Cole
My Commission Expires Jan 9, 2005

Notary Public

My commission expires