Exhibit No.:	
Issue:	*Natural Gas Curtailment Events*
Witness:	*Warren T. Wood*
Sponsoring Party:	*MoPSC Staff*
Type of Exhibit:	*Direct Testimony*
Case No.:	*ER-97-81*

MISSOURI PUBLIC SERVICE COMMISSION

UTILITY SERVICES DIVISION

DIRECT TESTIMONY

OF

WARREN T. WOOD

THE EMPIRE DISTRICT ELECTRIC COMPANY

CASE NO. ER-97-81

Jefferson City, Missouri
February, 1997

DIRECT TESTIMONY

OF

WARREN T. WOOD

THE EMPIRE DISTRICT ELECTRIC COMPANY

CASE NO. ER-97-81

Q. Please state your name and business address.

A. Warren T. Wood, P.O. Box 360, Jefferson City, Missouri 65102.

Q. By whom are you employed and in what capacity?

A. I am a Staff Regulatory Engineer with the Missouri Public Service Commission (Commission).

Q. Please describe your educational and professional background.

A. In December 1987, I received a Bachelor of Science degree, with honors, in Civil Engineering from the University of Missouri at Columbia, Missouri. Upon graduation, I accepted employment with Black & Veatch Engineers - Architects and worked in the Energy and Environmental divisions of this consulting firm from January 1988 to October 1995. While at Black & Veatch I designed a wide range of concrete and steel structures, acted as an engineering liaison between the design office and joint venture partner offices, developed specifications, drafted engineering drawings, designed piping and piping supports, and wrote custom computer programs to assist in solving many types of engineering problems. My work while at Black & Veatch focused on new and retrofit work on coal, combustion turbine, and nuclear power plant projects. In October 1995 I accepted my current

position as a Regulatory Engineer in the Procurement Analysis Department of the Commission. I am a registered Professional Engineer in the States of Kansas and Missouri and hold a certificate of registration from the National Council of Examiners for Engineering and Surveying. I am also a member of Tau Beta Pi, an honorary engineering society, and Chi Epsilon, an honorary civil engineering society.

Q. What has been the nature of your duties at the Commission?

A. My responsibilities include reviewing and analyzing Commission regulated natural gas local distribution company (LDC) procurement plans, reliability considerations, and Actual Cost Adjustment (ACA) filings.

Q. Have you previously filed testimony before this Commission?

A. Yes, I have previously filed testimony before this Commission in Ozark Natural Gas Co., Inc., Case No. GA-96-264, Laclede Gas Company, Case No. GR-96-193, and Missouri Gas Energy, Case No. GR-96-285.

Q. What is the purpose of your direct testimony?

A. The purpose of my direct testimony is to provide support to the Missouri Public Service Commission Staff's (Staff's) use of 18 natural gas curtailment events in its production cost model.

Natural Gas Curtailment Events

Q. Why are natural gas curtailment events important to this case?

A. Natural gas curtailment events are an input to the Staff's production cost model and impact Empire District Electric Company's (Empire's) fuel costs.

Q. What are natural gas curtailment events?

A. For purposes of this case, I will define a natural gas curtailment event as any condition imposed by an interstate pipeline or supply contract that results in Empire being unable to receive and/or utilize natural gas at one or more of its generating facilities.

Q. How do natural gas curtailment events impact Empire?

A. Empire's test year fuel run derived for this case showed that Empire expects to use over 3.5 million Dekatherms (Dth) of natural gas per year. For comparison purposes, this represents the approximate natural gas usage of over 35,000 homes. With this level of natural gas usage, it can be seen that any loss by Empire of its ability to receive or utilize natural gas would impact its operations. When looking at curtailment event impacts it is important to note that Empire has 6 operational simple cycle combustion turbine (CT) units that use natural gas as a primary fuel. These units are Riverton 9, 10, and 11, Energy Center 1 and 2, and Stateline 1. Empire has 1 simple cycle CT unit that is currently under construction (Stateline 2). Stateline 2 is scheduled to be operational by June 1, 1997. When Stateline 2 is operational, Empire will have a generating capacity of 477 MW from units that use natural gas as a primary fuel. I have attached a map that shows where these CT units are located and what interstate pipeline segments serve them to my direct testimony as **Schedule 1.** I have attached a summary of the actual curtailment events that Empire experienced during the 1995-96 winter to my direct testimony as **Schedule 2,** which reflects 20 days of curtailments. When a natural gas curtailment event occurs and Empire determines that it is necessary (for voltage control, control of transmission line flows, or dynamic system stability) or cost effective to operate one of its CT units, Empire currently has to operate these units on standby fuel. Empire uses "Jet-A" distillate oil as a standby fuel

on all of its CT units except Riverton 10 & 11. Riverton 10 & 11 are not permitted to operate on standby fuel unless an emergency situation arises.

Q. How did you analyze the number of natural gas curtailment events to Empire's generating facilities?

A. The analysis of Empire's natural gas curtailment events involved, but was not limited to, reviewing the following 2 items:

1) historical weather data, and

2) data request (DR) responses.

Using the data provided through DR responses and comparing winter 1995-96 data to historical data I was able to determine a normalized number of curtailment events. Normalization allows the Staff to build data values that are unaffected by yearly fluctuations in weather.

Q. What historical weather data did you use?

A. I used a 30-year normal weather pattern that was provided by Staff witness Lena Mantle.

Q. Why was historical weather data necessary for your curtailment events analysis?

A. Abnormal or extreme weather patterns will affect the number of curtailment events in a given winter. When normalizing curtailment events, it is important that normalized weather data is used for the analysis.

Q. How did you compare normal versus observed weather in your curtailment events analysis and what were the results of this comparison?

A. I was primarily interested in the following 2 items:

1) Observed Weather At The Springfield Weather Station:

I have attached a chart that illustrates the weather from November 1, 1995 to March 31, 1996 and the curtailment events in that time frame to my direct testimony as **Schedule 3**. As **Schedule 3** shows, a correlation between curtailment events and weather resulting in a 46 heating degree day (HDD) or colder daily peak exist. At this point, it is appropriate to note that curtailment events are caused by several factors beyond just locally cold weather. Other factors that may affect curtailment event levels include unexpected changes in the short term weather forecast, length of the cold weather period, amount of advance notice of a cold weather period, widespread wellhead freeze-offs, and upward price spikes.

2) Normal Weather At The Springfield Weather Station:

I have attached a table that provides the Staff's 30-year normal monthly and peak HDDs for the Springfield weather station to my direct testimony as **Schedule 4**. The Staff's HDD values shown on **Schedule 4** are based on the 30-year time frame from 1966 to 1995. The National Oceanographic and Atmospheric Administration (NOAA) HDD values on **Schedule 4** are based on the 30-year time frame from 1961 to 1990.

I have attached two charts that illustrate the departures of observed weather from normals to my direct testimony as **Schedule 5** and **Schedule 6**. **Schedule 5** shows that monthly HDD totals during the 1995-96 winter were higher than normal all but one month between

November, 1995 and March, 1996. **Schedule 6** shows that daily HDD peaks during the 1995-96 winter were higher than normal during all of the months from November, 1995 through March, 1996.

Q. What is a Heating Degree Day (HDD)?

A. The term "heating degree day" is used to describe the temperature conditions that affect space heating loads. It is assumed that above some average temperature level, usually 65 degrees Fahrenheit, there is no significant space heating load. Heating degree days are the number of degrees Fahrenheit (expressed as an absolute value), on a given day, that the average temperature is less than 65 degrees Fahrenheit. Say, for example, during a 24 hour period that the high temperature was 50 degrees Fahrenheit and the low temperature was 20 degrees Fahrenheit, this temperature pattern would result in an average temperature of 35 degrees Fahrenheit. An average daily temperature of 35 degrees Fahrenheit would represent 30 heating degree days (65 - 35). Total heating degree days in a month is simply the sum of the daily values in that month. The peak heating degree day in a month is simply the heating degree day value that corresponds to the coldest average day in that month.

Q. What impact does observed weather during the 1995-96 winter period have on your curtailment events analysis?

A. Observed weather departures from normals may help to explain curtailment event level departures from normal levels. Basically, if a winter season is colder than normal, an abnormally high number of curtailment events may occur. If a winter season is warmer than normal, an abnormally low number of curtailment events may occur.

Considering the higher than normal monthly and peak HDD values of the 1995-96 winter I believe that the curtailment event levels used by Empire in this case are too high.

Q. How many curtailment events did Empire use in this case?

A. As stated by Company witness Brad Beecher in his direct testimony (page 10, lines 8 through 10) "...Empire selected a total of 20 winter days in the normalized run as being likely for gas curtailment (seven days in both January and February, and three days in both March and December)."

Q. How many curtailment events do you believe are appropriate for this case?

A. I believe that 18 curtailment event days should be used for this case.

Q. How did you determine that 18 curtailment event days was appropriate for this case?

A. As I indicated earlier, the attached **Schedule 3** shows that a correlation between curtailment events and a daily HDD value of approximately 46 exist. I have attached an illustration of the weather portrayed on **Schedule 3** in a ranked format to my direct testimony as **Schedule 7**. As **Schedule 7** shows, 13 of the 20 curtailment event days that occurred on Empire's system during the 1995-96 winter happened on days when the HDD value was 46 or higher. The remaining 7 curtailment event days all occurred in advance of, or following a weather spike that resulted in daily HDD values of 46 or higher.

I have attached an illustration of the weather portrayed on **Schedule 3** and overlaid ranked normal weather for comparison to my direct testimony as **Schedule 8**. As **Schedule 8** shows, a normal winter would have reflected fewer extreme weather spikes and fewer days with HDD values of 46 or higher. I have attached an illustration of the weather portrayed

on **Schedule 8** in a ranked format to my direct testimony as **Schedule 9**. As **Schedule 9** shows, a normal winter weather pattern would have only resulted in 9 days with HDD values of 46 or higher. Using the ranked normal weather data portrayed on **Schedule 8** and allowing one day for line pack development and one day for pipeline pressure recovery around each cold weather pattern, I determined that 18 days represents a reasonable number of curtailment events in a normal winter. It is important to note, however, if the constraints on the interstate pipeline that serve Empire were to change, the number of curtailment event days I have calculated could change. I have attached a summary of the curtailment event days that I believe are appropriate for this case to my direct testimony as **Schedule 10**.

Q. Please summarize your direct testimony.

A. My direct testimony provides an analysis to show that 18 natural gas curtailment event days are appropriate for use in the Staff's production cost model in this case. I have provided this information to Staff witness Tom Lin of the Energy Department for use in the production cost model used to calculate the Staff's fuel expense in this proceeding. In my analysis of Empire's natural gas curtailment events I was primarily interested in 1995-96 winter weather data, normal weather data, and DR responses. Comparing 1995-96 winter weather and normal weather data showed that the 1995-96 winter was an abnormally cold winter. Using the data provided through DR responses and comparing winter 1995-96 data to historical data I was able to determine a normalized number of curtailment events. I have attached a summary of the curtailment event days that I believe are appropriate for this case to my direct testimony as **Schedule 10**.

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 Empire District Electric Company of Joplin, Missouri, for authority to file tariffs increasing rates for electric service provided to customers in the Missouri service area of the Company.	)))))	Case No. ER-97-81

AFFIDAVIT OF WARREN T. WOOD

STATE OF MISSOURI)
) ss.
COUNTY OF COLE)

Warren T. Wood, 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 8 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.

Warren T. Wood

WARREN T. WOOD

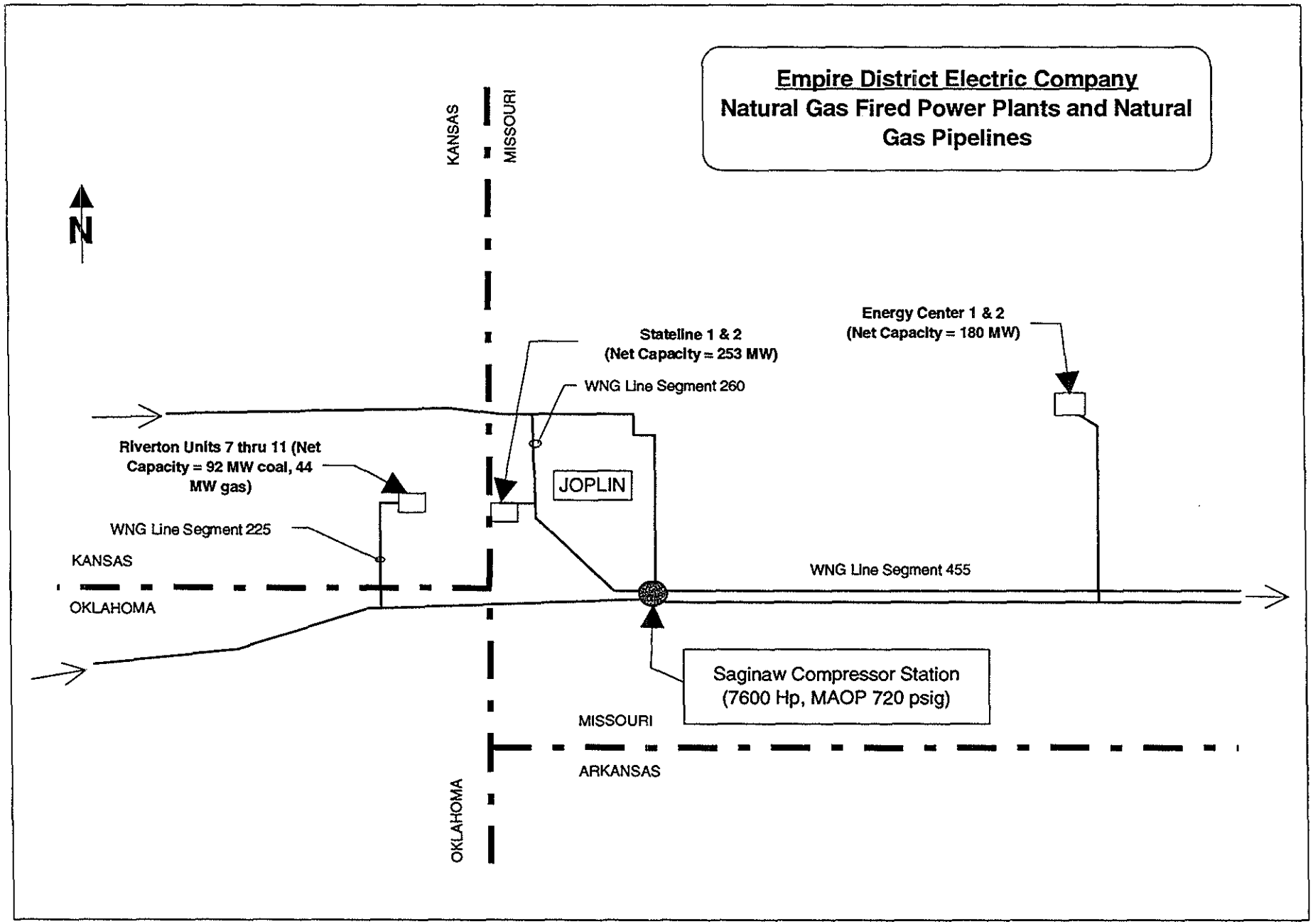
Subscribed and sworn to before me this 11th day of February, 1997.

Roberta A. McKiddy

Notary Public

My Commission Expires:

ROBERTA A. McKIDDY
Notary Public, State of Missouri
County of Cole
My Commission Expires 09/11/99


Empire District Electric Company
Natural Gas Fired Power Plants and Natural Gas Pipelines
KANSAS
MISSOURI
N
Stateline 1 & 2
(Net Capacity = 253 MW)
Energy Center 1 & 2
(Net Capacity = 180 MW)
WNG Line Segment 260
Riverton Units 7 thru 11 (Net Capacity = 92 MW coal, 44 MW gas)
JOPLIN
WNG Line Segment 225
KANSAS
OKLAHOMA
WNG Line Segment 455
Saginaw Compressor Station
(7600 Hp, MAOP 720 psig)
MISSOURI
ARKANSAS
OKLAHOMA

SCHEDULE 1

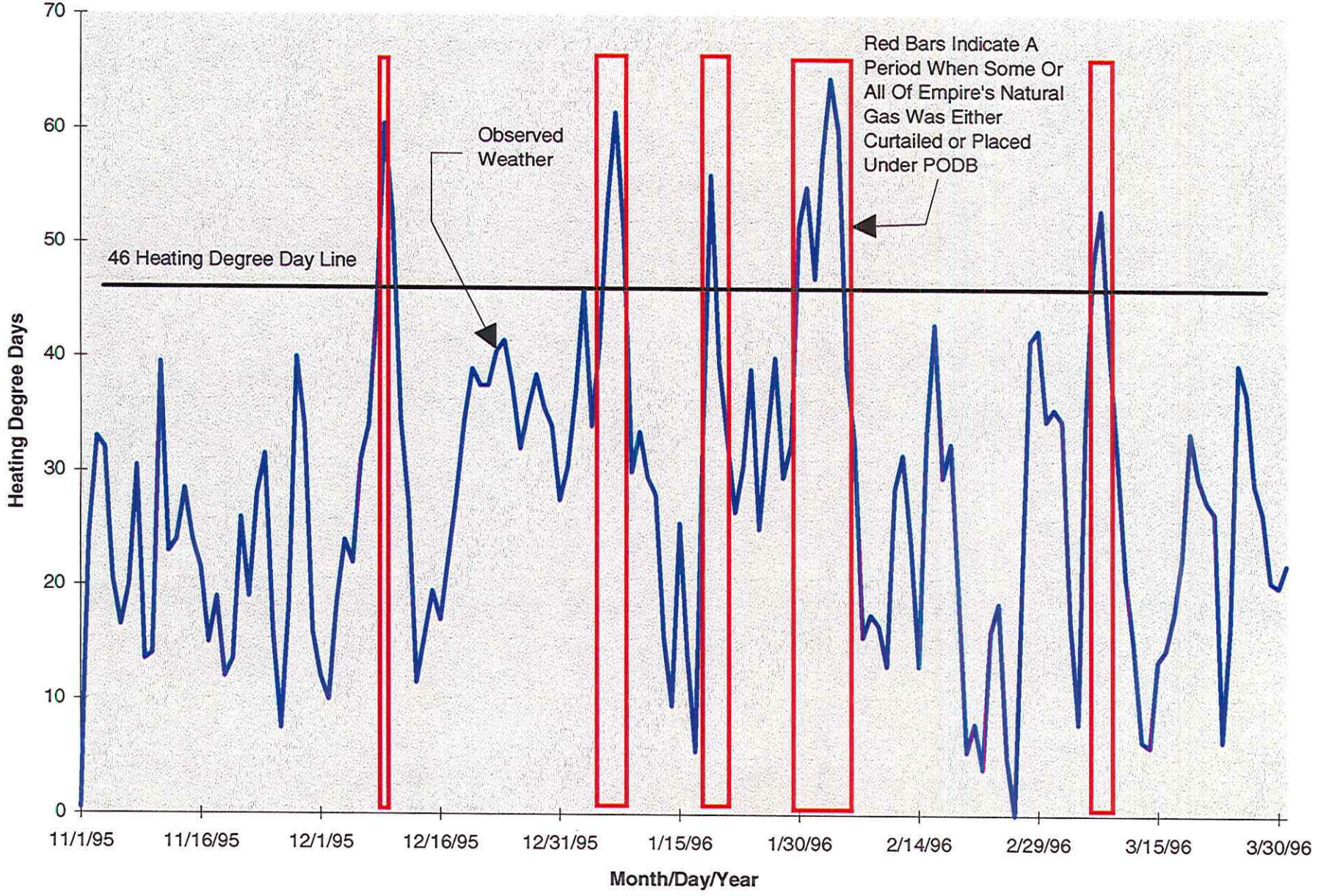
Empire District Electric Company
Actual 1995-96 Winter Curtailment or PODB Events

Date	Line Segment No. 455 Energy Center 1 & 2	Line Segment No. 260 Stateline 1 & 2	Line Segment No. 225 Riverton Units 9 - 11	HDD Value (Springfield)
12/9/95	Verbally Curtailed			60.5
1/5/96	Transport. Curtailed			41.5
1/6/96	Transport. Curtailed			53.5
1/7/96	Transport. Curtailed			61.5
1/8/96	Transport. Curtailed			51
1/18/96	Transport. Curtailed	Period Of Daily Bal.	Period Of Daily Bal.	34.5
1/19/96	Transport. Curtailed	Period Of Daily Bal.	Period Of Daily Bal.	56
1/20/96	Transport. Curtailed	Period Of Daily Bal.	Period Of Daily Bal.	39.5
1/30/96	Transport. Curtailed	Transport. Curtailed	Transport. Curtailed	51.5
1/31/96	Transport. Curtailed	Transport. Curtailed	Transport. Curtailed	55
2/1/96	Transport. Curtailed	Transport. Curtailed	Transport. Curtailed	47
2/2/96	Transport. Curtailed	Transport. Curtailed	Transport. Curtailed	57.5
2/3/96	Transport. Curtailed	Transport. Curtailed	Transport. Curtailed	64.5
2/4/96	Transport. Curtailed	Transport. Curtailed	Transport. Curtailed	60
2/5/96	Supply Curtailed	Supply Curtailed	Supply Curtailed	39
2/6/96	Supply Curtailed	Supply Curtailed	Supply Curtailed	32.5
3/6/96	Period Of Daily Bal.	Period Of Daily Bal.	Period Of Daily Bal.	34
3/7/96	Transport. Curtailed	Period Of Daily Bal.	Period Of Daily Bal.	48
3/8/96	Transport. Curtailed	Period Of Daily Bal.	Period Of Daily Bal.	53
3/9/96	Transport. Curtailed	Period Of Daily Bal.	Period Of Daily Bal.	41

SCHEDULE 2

Empire District Electric Company
Case No. ER-97-81

Observed Weather & Natural Gas Curtailments From 11/1/95 To 3/31/96
(Springfield Weather Station)



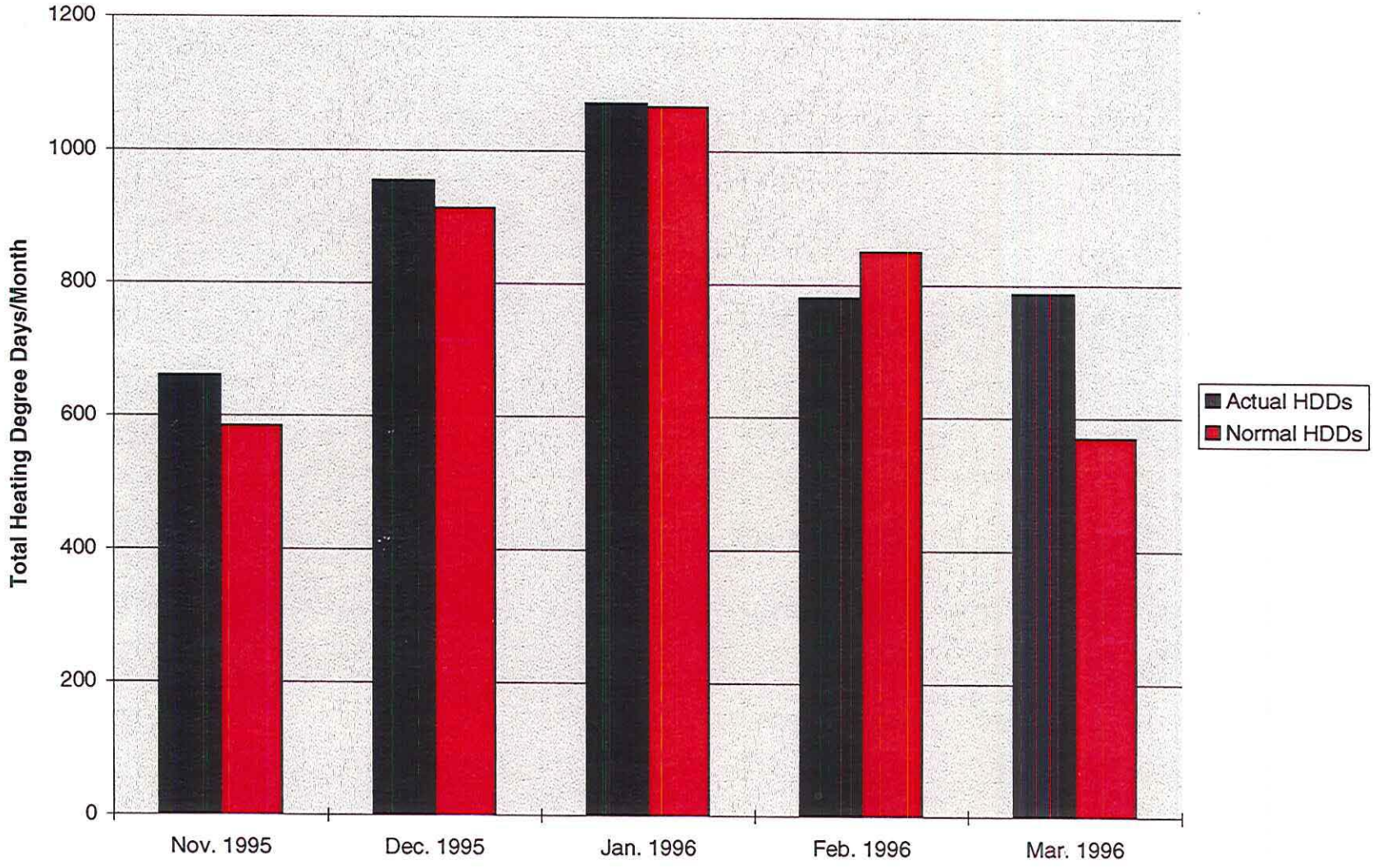
SCHEDULE 3

	Normal HDD/Month		Normal Peak/Month
Month	Staff	NOAA	Staff
Oct	254.27	249	23.33
Nov	584.17	570	37.84
Dec	912.97	921	52.13
Jan	1066.29	1051	60.03
Feb	849.79	820	53.82
Mar	569.42	589	38.25
Apr	282.71	280	26.3
May	90.97	110	14.41
June	3.45	5	2.27
July	0	0	0
Aug	0.13	0	0.13
Sep	51.16	43	12.17

Total	4665.33	4638

Empire District Electric Company
Case No. ER-97-81

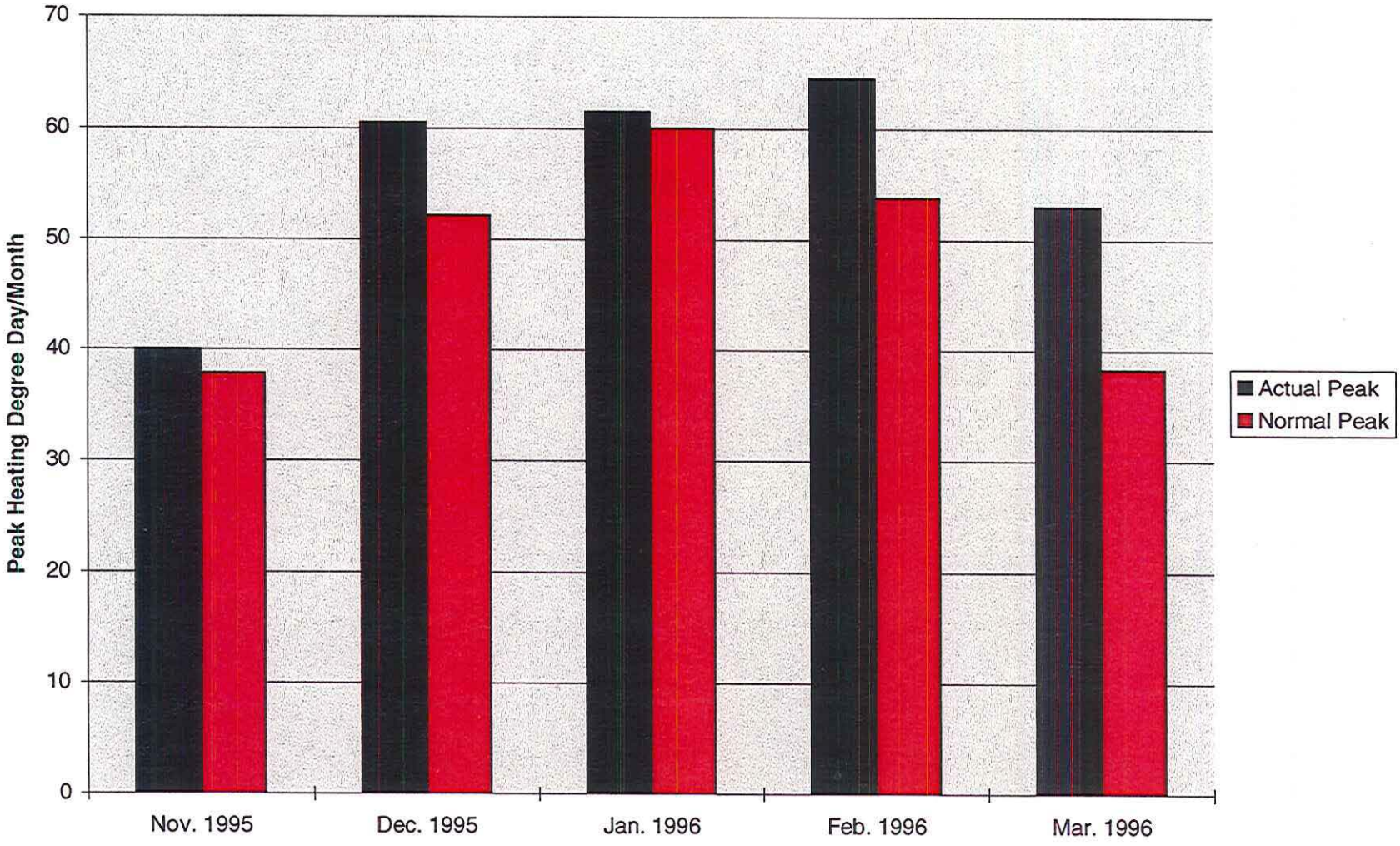
Observed Weather From 11/1/95 To 3/31/96 vs. Normal Weather
(Springfield Weather Station)



SCHEDULE 5

Empire District Electric Company
Case No. ER-97-81

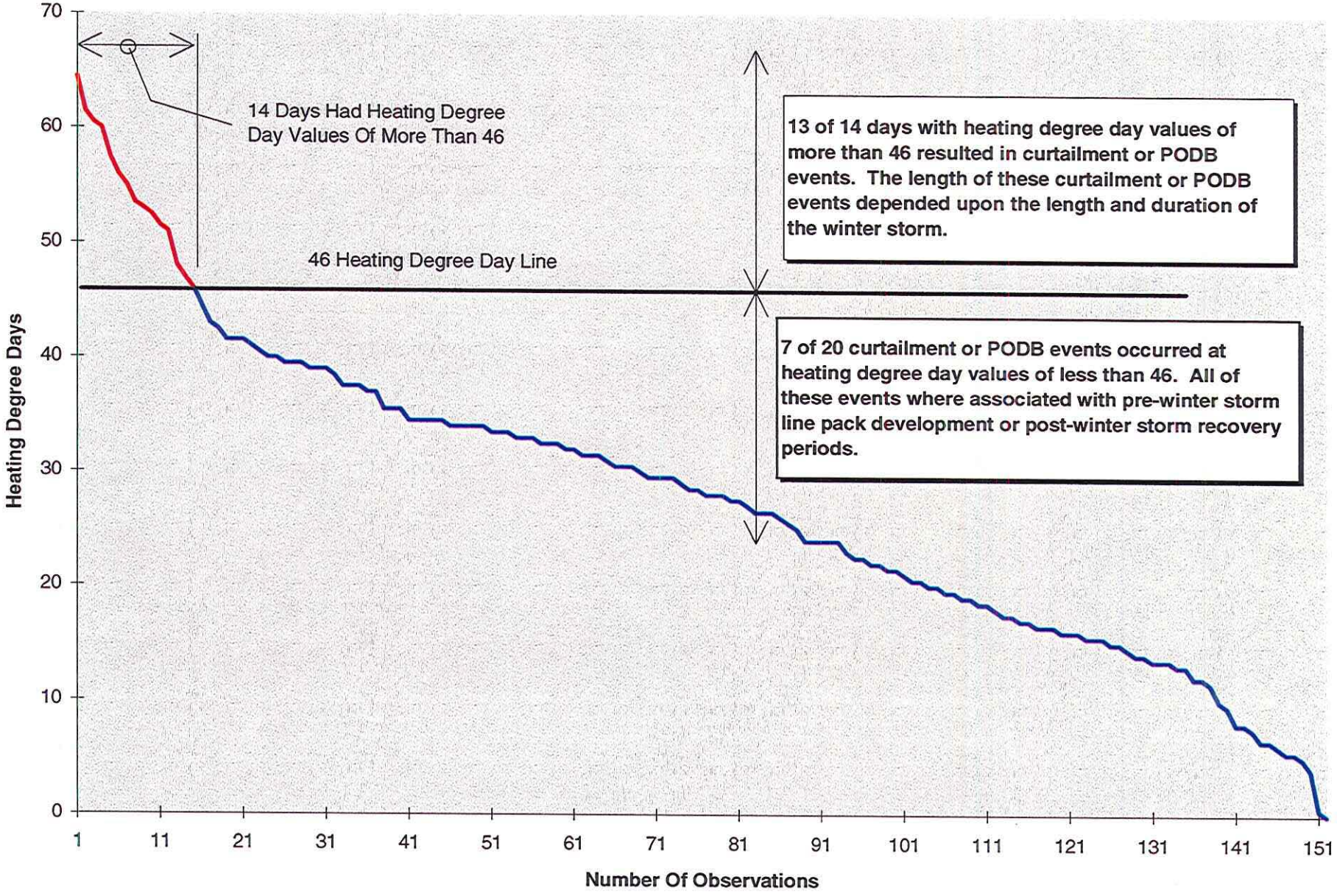
Observed Weather From 11/1/95 To 3/31/96 vs. Normal Weather
(Springfield Weather Station)



SCHEDULE 6

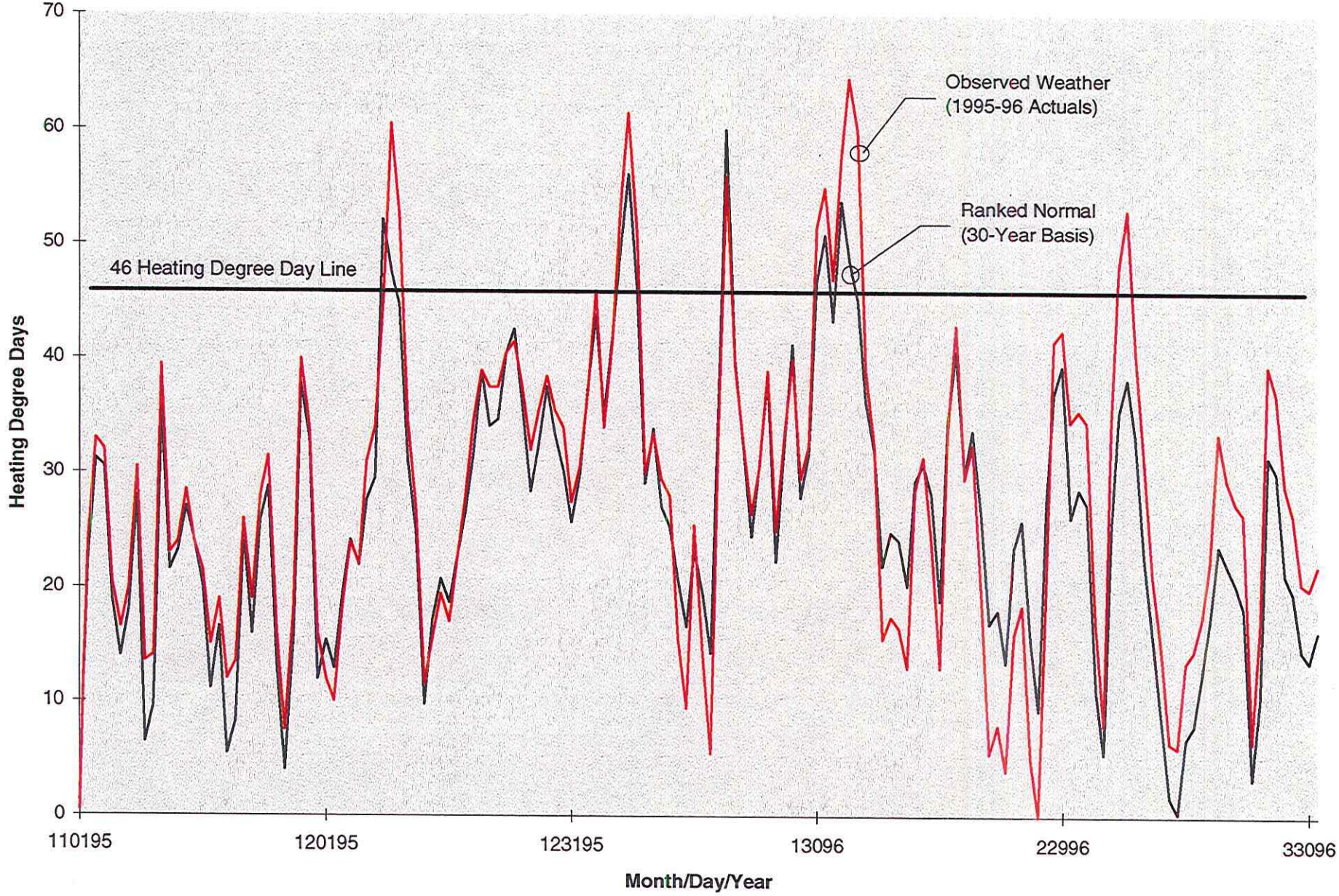
SCHEDULE 7

Ranking Of Observed Weather From 11/1/95 To 3/31/96
(Springfield Weather Station)



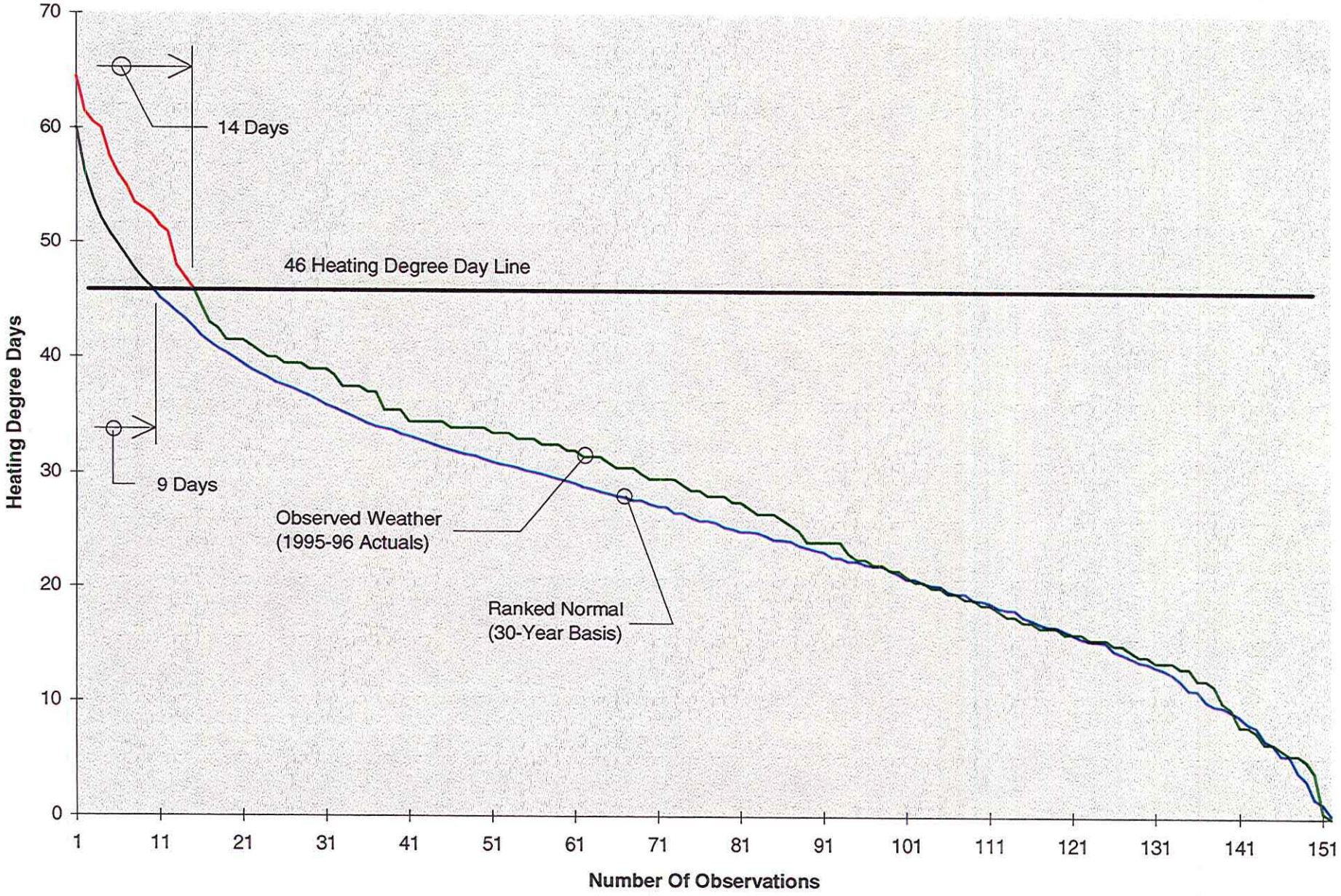
Empire District Electric Company
Case No. ER-97-81

Observed Weather From 11/1/95 To 3/31/96 vs. Ranked Normal Weather
(Springfield Weather Station)



SCHEDULE 8

Ranking of Observed Weather From 11/1/95 To 3/31/96 vs. Normal Weather
(Springfield Weather Station)



SCHEDULE 9

Empire District Electric Company
Staff's Normalized Natural Gas Curtailment Events

Date	Line Segment No. 455 Energy Center 1 & 2	Line Segment No. 260 Stateline 1 & 2[1,2,3]	Line Segment No. 225 Riverton Units 9 - 11	HDD Value (Springfield)
12/7/95	Transport. Curtailed	Transport. Curtailed	Transport. Curtailed	29.52
12/8/95	Transport. Curtailed	Transport. Curtailed	Transport. Curtailed	52.13
12/9/95	Transport. Curtailed	Transport. Curtailed	Transport. Curtailed	47.68
12/10/95	Transport. Curtailed	Transport. Curtailed	Transport. Curtailed	44.55
1/5/96	Transport. Curtailed	Transport. Curtailed	Transport. Curtailed	41.86
1/6/96	Transport. Curtailed	Transport. Curtailed	Transport. Curtailed	49.83
1/7/96	Transport. Curtailed	Transport. Curtailed	Transport. Curtailed	56.14
1/8/96	Transport. Curtailed	Transport. Curtailed	Transport. Curtailed	46.06
1/18/96	Transport. Curtailed	Transport. Curtailed	Transport. Curtailed	36.67
1/19/96	Transport. Curtailed	Transport. Curtailed	Transport. Curtailed	60.03
1/20/96	Transport. Curtailed	Transport. Curtailed	Transport. Curtailed	39.93
1/29/96	Transport. Curtailed	Transport. Curtailed	Transport. Curtailed	31.82
1/30/96	Transport. Curtailed	Transport. Curtailed	Transport. Curtailed	46.8
1/31/96	Transport. Curtailed	Transport. Curtailed	Transport. Curtailed	50.89
2/1/96	Transport. Curtailed	Transport. Curtailed	Transport. Curtailed	43.35
2/2/96	Transport. Curtailed	Transport. Curtailed	Transport. Curtailed	53.82
2/3/96	Transport. Curtailed	Transport. Curtailed	Transport. Curtailed	48.69
2/4/96	Transport. Curtailed	Transport. Curtailed	Transport. Curtailed	45.1

1) If Empire chooses to execute the Firm Transportation Service (FTS) portion of its agreement with WNG it would be assumed that Stateline Unit No. 1 would not be curtailed.
2) If Empire chooses not to execute the FTS portion of its agreement with WNG it would be assumed that Stateline Unit Nos. 1 & 2 would be curtailed simultaneously.
3) Stateline Unit No. 2 will not be operational until approximately 6/1/97.