

Exhibit No.:  
Issue: Class Cost-of-Service  
Witness: Daniel I. Beck  
Type of Exhibit: Direct  
Sponsoring Party: MoPSC Staff  
Case No.: ER-97-81

**MISSOURI PUBLIC SERVICE COMMISSION**  
**POLICY & PLANNING DIVISION**

**DIRECT TESTIMONY**

**OF**

**DANIEL I. BECK**

**THE EMPIRE DISTRICT ELECTRIC COMPANY**

**CASE NO. ER-97-81**

**Jefferson City, Missouri**

**February, 1997**

1 DIRECT TESTIMONY

2 OF

3 DANIEL I. BECK

4 THE EMPIRE DISTRICT ELECTRIC COMPANY

5 CASE NO. ER-97-81

6  
7 Q. Please state your name and business address.

8 A. My name is Daniel I. Beck and my business address is Missouri Public  
9 Service Commission, P. O. Box 360, Jefferson City, Missouri 65102.

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

12 A. I am a Utility Regulatory Engineer in the Economic Analysis  
13 Department of the Policy and Planning Division.

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

16 A. I have a Bachelor of Science Degree in Industrial Engineering from  
17 the University of Missouri at Columbia. Prior to joining the Commission in November,  
18 1987, I was employed by the Navy Plant Representative Office in St. Louis, Missouri as  
19 an Industrial Engineer. I am a registered professional engineer in the state of Missouri.

20 Q. What is the purpose of your direct testimony?

21 A. The purpose of this testimony is to sponsor the calculation of hourly  
22 demands at each voltage level for each COS class. In addition, I was responsible for the

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Daniel I. Beck

1 development of allocation factors that were subsequently applied to the cost of The  
2 Empire District Electric Company's (Company's) distribution system.

3  
4 **HOURLY CLASS LOADS AT EACH VOLTAGE LEVEL**

5 Q. Do you have any schedules that support the development of hourly  
6 class loads at each voltage level?

7 A. Yes. Schedule 1 shows the annual sales and losses at each voltage  
8 level for each Missouri revenue class that was included in the Staff's cost-of-service  
9 study. Schedule 2 shows the monthly coincident and non-coincident peak loads for each  
10 revenue class at generation. There are five different voltage levels that are used in this  
11 case: 1) at generation, 2) at transmission, 3) at substation, 4) at primary, and 5) at  
12 secondary. In addition to the monthly peaks at each voltage level for each class, I have  
13 also generated hourly loads for each class at each voltage level. Due to the sheer volume  
14 of these values (there are over 40,000 hourly loads for each class), I have not reproduced  
15 these values in schedule form but instead have workpapers in electronic format that  
16 support these calculations.

17 Q. What inputs were used to calculate hourly class loads at each voltage  
18 level?

19 A. The following inputs were used to calculate hourly class loads at each  
20 voltage level:

- 21 1. Normalized hourly class loads at the meter sponsored by Staff witnesses  
22 Kenneth Christie and Lena M. Mantle.  
23  
24 2. Normalized class sales sponsored by Staff witness Janice Pyatte.

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1                   3. Loss study sponsored by Staff witness Syed K. Ahmad and based on the  
2                   Company's analysis.

3  
4                   4. Customer maximum demands at secondary voltages sponsored by Staff  
5                   witnesses Janice Pyatte and Dennis Patterson.

6  
7                   Q. Which Staff witnesses were provided the resulting hourly loads at  
8                   each voltage level?

9                   A. Staff witnesses Anne E. Ross was provided annual class peak  
10                  demands at the various voltage levels and James C. Watkins was provided hourly class  
11                  loads at the generator.

12  
13                   **DISTRIBUTION SYSTEM ALLOCATION FACTORS**

14                  Q. Are you sponsoring schedules that support the development of  
15                  allocation factors that were subsequently applied to the cost of the Company's  
16                  distribution system?

17                  A. Yes. Schedule 3 shows how the costs of the distribution system (i.e.,  
18                  poles, lines, conductors, conduit, and transformers) are classified between primary and  
19                  secondary, between customer and demand related, and for transformers between single  
20                  phase and three phase. These allocators are used to split the costs into groupings that  
21                  can then be assigned or allocated to each of the classes.

22                  Q. What inputs were used to calculate the percentages on Schedule 3?

23                  A. The inputs to these calculations are:

24                  1. Current replacement costs estimates for distribution equipment in FERC  
25                  accounts 364, 365, 366, 367, and 368 provided by the Company.  
26

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2. Current property records for the same accounts provided by the Company.

3. Estimates for the percentage of specific equipment that serves secondary and primary voltages for accounts 364, 365, 367, and 368 provided by the Company in Case No. ER-95-279, its previous rate case.

Q. How where these inputs used to calculate the percentages found on

Schedule 3?

A. For accounts 364, 365, 367, and 368, the information was used to compute the percentage of cost that were assigned as primary and secondary. For account 366, the same inputs were not available so the percentage for account 367 was used.

The customer/demand split for the secondary component was estimated for account 368, Transformers, using the zero intercept method presented in Schedule 4. Transformers are attached to primary lines and lower the voltage from primary to secondary. The decision regarding the installation of transformers with direct service lines to customers versus having secondary lines between the transformer and the service lines is affected by both engineering and economic factors. In essence, secondary lines allow the utility to use a larger transformer that serves more customers when this is more economical. For this reason, the customer/demand split for transformers was also applied to secondary lines and equipment.

Q. What inputs were used for the distribution allocators?

A. The following inputs were used to develop the allocators:

1. Class demands and customer maximum demands described earlier in my testimony.

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- 1                   2. Customer numbers at various voltage levels derived from customer
- 2                   numbers provided by Staff witnesses David G. Winter and Janice Pyatte.
- 3                   3. Customer weights from Case No. ER-95-279 including customers per
- 4                   transformer, service length per customer, and the replacement cost of
- 5                   meters per customer.
- 6

7                   Q. Which Staff witness was provided the distribution allocators that you

8                   developed?

9                   A. Staff witness Anne E. Ross was provided these results.

10                  Q. Does this conclude your direct testimony?

11                  A. Yes, it does.

12

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 ) CASE NO. ER-97-81  
Increasing Rates for Electric Service Provided to )  
Customers in the Missouri Service Area of the Company. )

AFFIDAVIT OF DANIEL I. BECK

STATE OF MISSOURI )  
 ) ss  
COUNTY OF COLE )

Daniel I. Beck, 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 5 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.

Daniel I. Beck

Daniel I. Beck

Subscribed and sworn to before me this 20th day of February, 1997.

Rosemarie Reed

Notary Public

My commission expires June 1, 1997

# EMPIRE DISTRICT ELECTRIC

## Rate Case NO. ER-97-81

### Normalized Test Year Usage & Losses

Step Losses	Residential	Small General Service	Large General Service	Large Power Service	Special Contracts	Total MO System
Secondary	1,268,822,757	392,190,124	764,042,148	51,003,381		2,476,058,410
No-Load	3.65%	3.14%	2.38%	1.74%		3.13%
kW	46,270,450	12,303,726	18,156,665	889,678		77,620,519
Variable	1.41%	1.37%	1.32%	1.27%		1.37%
kW	17,834,513	5,377,076	10,057,787	649,439		33,918,814
Primary	1,332,927,720	409,870,926	792,256,599	52,542,498		2,587,597,743
Additional Sales			108,549,251	453,743,695		562,292,946
Total Primary	1,332,927,720	409,870,926	900,805,850	506,286,193		3,149,890,689
No-Load	0.00%	0.00%	0.00%	0.00%		0.00%
kW	0	0	0	0		0
Variable	1.17%	1.15%	1.11%	1.07%		1.13%
kW	15,532,575	4,713,743	9,990,568	5,424,792		35,661,678
Substation	1,348,460,294	414,584,669	910,796,418	511,710,984		3,185,552,367
Additional Sales					63,249,725	63,249,725
Total Substation	1,348,460,294	414,584,669	910,796,418	511,710,984	63,249,725	3,248,802,093
No-Load	0.35%	0.32%	0.23%	0.19%	0.15%	0.28%
kW	4,718,568	1,339,287	2,112,524	948,512	92,380	9,211,272
Variable	0.26%	0.25%	0.24%	0.24%	0.23%	0.25%
kW	3,447,306	1,045,961	2,216,732	1,203,636	144,363	8,057,997
Transmission	1,356,626,168	416,969,917	915,125,675	513,863,133	63,486,468	3,266,071,362
Additional Sales					54,156,387	54,156,387
Total Transmission	1,356,626,168	416,969,917	915,125,675	513,863,133	117,642,855	3,320,227,749
No-Load	0.37%	0.31%	0.23%	0.20%	0.16%	0.29%
kW	4,993,276	1,287,766	2,105,212	1,031,563	187,273	9,605,090
Variable	2.90%	2.86%	2.76%	2.67%	2.60%	2.81%
kW	39,278,710	11,917,021	25,248,900	13,710,908	3,060,132	93,215,672
Generation	1,400,898,154	430,174,704	942,479,787	528,605,604	120,890,261	3,423,048,512
Total Sales	1,268,822,757	392,190,124	872,591,399	504,747,076	117,406,112	3,155,757,468
Total Losses	132,075,397	37,984,580	69,888,389	23,858,528	3,484,149	267,291,044
Loss Percentage	10.41%	9.69%	8.01%	4.73%	2.97%	8.47%



# PRODUCTION AND TRANSMISSION DEMAND ALLOCATORS

MISSOURI TRANSMISSION DELIVERY: CLASS DEMANDS AT TIME OF SYSTEM PEAK "AT GENERATION"												
CP Demands	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
CLASSES												
Residential Service	200,397	268,505	327,375	398,099	372,390	265,984	185,025	215,829	366,686	409,757	379,621	372,752
Small General Service	60,921	64,545	58,607	96,592	68,152	84,023	78,419	90,538	105,023	105,676	113,734	89,575
Large General Service	123,194	139,581	121,267	154,734	130,272	150,483	152,308	154,156	168,051	172,758	193,549	156,916
Large Power Service	63,692	68,790	43,562	65,818	59,588	66,552	76,123	69,754	75,980	84,652	75,927	82,157
Special Contracts	14,746	14,612	14,381	15,621	14,501	14,193	6,546	10,950	11,124	15,667	7,423	15,725
<b>SUM OF CLASSES</b>	<b>462,950</b>	<b>556,032</b>	<b>565,191</b>	<b>730,864</b>	<b>644,904</b>	<b>581,236</b>	<b>498,421</b>	<b>541,227</b>	<b>726,864</b>	<b>788,510</b>	<b>770,253</b>	<b>717,125</b>

MISSOURI TRANSMISSION DELIVERY: CLASS DEMANDS AT TIME OF CLASS PEAK "AT GENERATION"												
NCP Demands	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
CLASSES												
Residential Service	200,397	268,505	327,375	398,099	372,390	281,317	213,761	240,902	366,686	440,501	423,178	408,036
Small General Service	85,537	89,891	89,459	96,918	93,183	92,080	82,325	90,538	113,235	124,788	119,021	110,116
Large General Service	152,134	149,691	152,786	163,451	158,150	155,117	158,162	164,895	177,268	190,639	196,332	181,877
Large Power Service	71,775	70,349	66,640	71,431	75,087	68,890	77,626	76,445	80,127	86,608	82,505	87,039
Special Contracts	15,062	15,387	14,640	15,621	14,578	15,037	14,920	15,233	15,735	16,080	15,911	16,300
<b>SUM OF CLASSES</b>	<b>524,905</b>	<b>593,823</b>	<b>650,900</b>	<b>745,521</b>	<b>713,389</b>	<b>612,440</b>	<b>546,794</b>	<b>588,013</b>	<b>753,051</b>	<b>858,616</b>	<b>836,948</b>	<b>803,369</b>

Note: 1) "At Generation" means at the voltage level coming from the production power source, going into the transmission lines. These are the demands at the voltage level appropriate for use in allocating either production or transmission costs.

**Classification for Accounts 364 through 368**

	#364 Poles	#365 Overhead Conductors	#366 Underground Conduit	#367 Underground Conductors
Primary	0.71668	0.80666	0.72302	0.72302
Secondary - Demand	0.09358	0.06386	0.09149	0.09149
Secondary - Customer	0.18974	0.12948	0.18549	0.18549
	1.00000	1.00000	1.00000	1.00000

	#368 Transformers
Primary	0.00000
Secondary - Demand	0.33030
Secondary - Customer - Single Phase	0.50080
Secondary - Customer - Three Phase	0.16890
	1.00000

## Account #388: Transformers

Size	Phase	Quantity	Percent	Booked Cost	Unit Cost	Replacement Cost	Unit Cost	0.5 w	0.5 dummy	0.5 wX	0.5 wY	0.5 Y <sup>2</sup>	Total Predicted Costs	Zero Intercept Costs	Demand Costs
3.0	1	740	0.0108	70,885.84	95.79	197,388.23	266.74	0.1041	0.0000	0.3123	27.7892	511.58	378,588.59	382,718.19	15,850.39
5.0	1	2,824	0.0414	426,439.93	151.01	945,065.37	334.85	0.2034	0.0000	1.0169	68.0601	525.86	1,485,025.28	1,384,211.06	100,814.21
7.0	1	12	0.0002	1,674.34	156.20	5,201.83	433.49	0.0133	0.0000	0.0928	5.7468	540.14	8,481.66	5,881.92	596.74
10.0	1	10,701	0.1567	3,624,520.94	338.71	5,025,248.35	469.81	0.3959	0.0000	3.9589	185.9122	561.58	6,009,230.94	5,245,199.19	764,031.75
12.0	1	8	0.0001	648.80	81.10	2,304.78	288.10	0.0108	0.0000	0.1299	3.1185	575.84	4,806.70	3,921.28	685.42
15.0	1	13,933	0.2041	5,499,754.95	394.73	7,481,681.94	535.54	0.4517	0.0000	8.7780	241.9230	597.28	8,321,581.33	6,829,395.42	1,492,185.92
25.0	1	18,979	0.2487	8,160,495.08	480.62	10,807,780.58	636.54	0.4987	0.0000	12.4669	317.4280	668.68	11,353,095.48	8,322,421.93	3,030,673.54
50.0	1	5,340	0.0782	3,825,377.47	716.38	4,881,602.08	914.18	0.2797	0.0000	13.8831	255.6551	847.15	4,523,783.88	2,617,452.92	1,906,330.96
75.0	1	31	0.0005	28,168.83	908.67	35,611.47	1,148.78	0.0213	0.0000	1.5981	24.4778	1,025.65	31,795.02	15,184.95	16,600.07
100.0	1	24	0.0004	28,433.39	1,101.39	37,168.19	1,548.59	0.0187	0.0000	1.8749	29.0339	1,204.14	28,899.39	11,763.63	17,135.56
187.0	1	11	0.0002	16,168.74	1,489.89	23,498.35	2,136.30	0.0127	0.0000	2.1197	27.1158	1,682.51	18,507.60	5,391.78	13,115.84
500.0	1	4	0.0001	18,954.38	4,738.60	19,392.98	4,848.25	0.0077	0.0000	3.8270	37.1088	4,060.07	16,240.27	1,960.64	14,279.63
1.0	2	8	0.0001	3,701.95	462.74	3,701.95	462.74	0.0108	0.0000	0.0108	5.0090	497.30	3,978.40	3,921.28	57.12
3.0	2	174	0.0025	13,868.26	79.70	38,330.86	220.29	0.0505	0.0000	0.1514	11.1208	511.58	89,014.78	85,287.79	3,726.98
5.0	2	1,070	0.0157	172,516.21	161.23	352,319.46	329.27	0.1252	0.0000	0.6259	41.2200	525.86	562,668.92	524,470.90	38,198.02
7.0	2	8	0.0001	932.18	118.52	3,142.09	392.76	0.0108	0.0000	0.0758	4.2514	540.14	4,321.11	3,921.28	389.83
10.0	2	1,077	0.0158	328,526.21	303.18	475,524.17	441.53	0.1258	0.0000	1.2559	55.4533	581.58	604,797.84	527,902.02	78,895.82
12.0	2	6	0.0001	284.46	47.41	1,097.74	182.96	0.0094	0.0000	0.1125	7.1751	575.84	3,455.03	2,940.98	514.07
15.0	2	1,587	0.0232	547,615.26	345.06	805,484.90	507.54	0.1525	0.0000	2.2869	77.3788	597.28	947,846.81	777,883.48	169,963.33
25.0	2	2,802	0.0410	1,213,585.71	433.11	1,704,688.96	608.38	0.2026	0.0000	5.0645	123.2463	688.68	1,873,571.68	1,373,427.54	500,144.13
30.0	2	1	0.0000	221.31	221.31	764.53	764.53	0.0038	0.0000	0.1148	2.9259	704.35	704.35	490.16	214.19
37.0	2	13	0.0002	5,591.03	430.08	12,712.11	977.85	0.0138	0.0000	0.5105	13.4830	754.33	9,806.33	6,372.08	3,434.25
50.0	2	2,572	0.0377	1,603,065.45	623.29	2,238,383.74	870.29	0.1941	0.0000	9.7044	188.9125	847.15	2,178,871.19	1,280,680.81	918,180.38
75.0	2	1,805	0.0235	1,471,734.98	916.97	1,931,032.10	1,203.14	0.1533	0.0000	11.4960	184.4653	1,025.65	1,648,161.75	788,708.36	859,455.39
100.0	2	1,196	0.0175	1,294,587.83	1,082.43	1,714,631.57	1,433.64	0.1324	0.0000	13.2351	189.7440	1,204.14	1,440,153.06	588,231.03	853,922.03
150.0	2	3	0.0000	5,157.16	1,719.05	11,887.13	3,982.38	0.0086	0.0000	0.9943	26.2851	4,433.80	13,301.39	10,088.47	3,212.92
187.0	2	683	0.0100	1,117,879.20	1,636.72	1,405,535.74	2,057.89	0.1000	0.0000	16.7028	205.8232	1,882.51	1,149,153.68	334,779.09	814,374.59
250.0	2	44	0.0006	96,583.39	2,195.08	126,249.33	2,889.30	0.0254	0.0000	6.3464	72.8393	2,275.11	100,105.01	21,567.03	78,537.98
333.0	2	28	0.0004	67,199.98	2,400.00	105,244.84	3,758.74	0.0203	0.0000	6.7435	76.1175	2,887.72	80,296.12	13,724.47	66,571.65
500.0	2	19	0.0003	71,233.34	3,749.12	90,841.69	4,781.14	0.0167	0.0000	8.3408	79.7574	4,080.07	77,141.29	9,313.03	67,828.26
1.0	3	1	0.0000	399.81	399.81	427.97	427.97	0.0038	0.0000	0.0383	1.6378	561.58	561.58	490.16	71.40
15.0	3	14	0.0002	7,478.63	534.19	8,502.69	607.33	0.0143	0.0000	0.2148	8.6967	597.28	8,361.60	6,862.24	1,499.36
25.0	3	857	0.0126	832,285.62	971.16	1,039,058.33	1,212.43	0.1120	0.0000	2.8009	135.6349	688.68	573,037.45	420,068.68	152,970.57
37.0	3	32	0.0005	25,148.71	785.90	41,039.16	1,282.47	0.0216	0.0000	0.8010	27.7843	754.33	24,138.65	15,685.11	8,453.54
50.0	3	1,220	0.0179	1,332,340.38	1,092.08	1,643,517.31	1,347.15	0.1337	0.0000	6.8836	180.0765	847.15	1,033,523.66	597,994.86	435,528.80
75.0	3	806	0.0118	1,184,705.17	1,469.86	1,457,593.87	1,808.43	0.1087	0.0000	8.1488	198.4861	1,025.65	828,670.63	395,068.74	431,601.90
100.0	3	739	0.0108	1,176,087.18	1,591.47	1,387,418.00	1,877.43	0.1040	0.0000	10.4036	195.3205	1,204.14	889,680.46	382,228.04	527,632.43
150.0	3	100	0.0015	422,281.95	4,222.92	481,367.40	4,613.67	0.0383	0.0383	5.7408	178.5671	4,433.80	443,379.63	336,282.38	107,097.25
187.0	3	384	0.0056	844,677.03	2,199.68	922,960.69	2,403.54	0.0750	0.0000	12.5241	180.2521	1,882.51	848,083.48	188,221.33	457,862.14
225.0	3	21	0.0003	65,492.96	3,118.71	110,552.58	5,264.41	0.0175	0.0175	3.9460	92.3258	4,989.28	104,354.93	70,619.30	33,735.63
300.0	3	182	0.0027	916,057.17	5,033.28	1,014,878.82	5,576.28	0.0516	0.0516	15.4889	287.8997	5,504.77	1,001,867.91	612,033.94	389,833.97
500.0	3	147	0.0022	953,167.93	6,484.14	1,063,519.20	7,234.82	0.0484	0.0484	23.2002	335.6985	6,932.73	1,019,111.60	494,335.10	524,776.50
750.0	3	93	0.0014	782,792.87	8,417.13	900,102.58	9,878.52	0.0369	0.0369	27.6800	357.2015	8,717.69	810,744.61	312,742.62	498,002.19
1000.0	3	58	0.0008	574,928.47	9,912.53	635,468.69	10,958.32	0.0291	0.0291	29.1459	319.3314	10,502.64	609,153.13	195,043.78	414,109.35
1500.0	3	48	0.0007	559,435.07	11,654.90	603,469.57	12,572.28	0.0265	0.0265	39.7717	333.3478	14,072.55	875,482.32	161,415.54	514,066.78
2000.0	3	22	0.0003	320,598.73	14,572.67	350,231.22	15,919.60	0.0180	0.0180	35.9008	285.7832	17,642.46	388,134.04	73,982.12	314,151.92
2500.0	3	50	0.0007	915,779.24	18,315.58	974,872.82	19,493.46	0.0271	0.0271	67.6531	527.5172	21,212.36	1,060,618.23	168,141.19	892,477.04

68,277

40,625,711

53,078,248.95 35,548,444.20 17,531,804.75

## Regression Output:

Constant	0
Std Err of Y Est	30.15334434
R Squared	0.945287273
No. of Observations	47
Degrees of Freedom	44
Intercept	490.1597229
Dummy	2872.864098
X	7.139816342
X Coefficient(s)	490.1597229 2872.864098 7.139816342
Std Err of Coef.	32.53641507 407.8485115 0.411817306

Customer Component	0.6697
Demand Component	0.3303