

LG&E AND KU SERVICES COMPANY

KU Power System 2010 Analysis of System Losses

August 2012

Prepared by:



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August 16, 2012

Mr. Robert M. Conroy
Director of Rates
LG&E and KU Services Company
220 West Main Street
Louisville, KY 40202

RE: 2010 LOSS ANALYSIS – KU

Dear Mr. Conroy:

Transmitted herewith are the results of the 2010 Analysis of System Losses for LG&E and KU Services Company's Kentucky Utilities (KU) power system. Our analysis develops cumulative expansion factors (loss factors) for both demand (peak/kW) and energy (average/kWh) losses by discrete voltage levels applicable to metered sales data. Our analysis considers only technical losses in arriving at our final recommendations. Please note that the proposed loss factors include a common or system-wide transmission factor for both KU and LG&E studies.

On behalf of MAC, we appreciate the opportunity to assist you in performing the loss analysis contained herein. The level of detailed load research and sales data by voltage level, coupled with a summary of power flow data and power system model, forms the foundation for determining reasonable and representative power losses on the KU system. Our review of these data and calculated loss results support the proposed loss factors as presented herein for your use in various cost of service, rate studies, and demand analyses.

Should you require any additional information, please let us know at your earliest convenience.

Sincerely,

A handwritten signature in cursive script, reading "Paul M. Normand".

Paul M. Normand
Principal

Enclosure
PMN/tjp

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1.0 EXECUTIVE SUMMARY

This report presents KU 2010 Analysis of System Losses for the power systems as performed by Management Applications Consulting, Inc. (MAC). The study developed separate demand (kW) and energy (kWh) loss factors for each voltage level of service in the power system for KU. The cumulative loss factor results by voltage level, as presented herein, can be used to adjust metered kW and kWh sales data for losses in performing cost of service studies, determining voltage discounts, and other analyses which may require a loss adjustment.

The procedures used in the overall loss study were similar to prior studies and emphasized the use of "in house" resources where possible. To this end, extensive use was made of the Company's peak hour power flow data and transformer plant investments in the model. In addition, measured and estimated load data provided a means of calculating reasonable estimates of losses by using a "top-down" and "bottom-up" procedure. In the "top-down" approach, losses from the high voltage system, through and including distribution substations, were calculated along with power flow data, conductor and transformer loss estimates, and metered poles.

At this point in the analysis, system loads and losses at the input into the distribution substation system are known with reasonable accuracy. However, it is the remaining loads and losses on the distribution substations, primary system, secondary circuits, and services which are generally difficult to estimate. Estimated and actual Company load data provided the starting point for performing a "bottom-up" approach for calculating the remaining distribution losses. Basically, this "bottom-up" approach develops line loadings by first determining loads and losses at each level beginning at a customer's meter service entrance and then going through secondary lines, line transformers, primary lines, and finally distribution substation. These distribution system loads and associated losses are then compared to the initial calculated input into Distribution Substation loadings for reasonableness prior to finalizing the loss factors. An overview of the loss study is shown on Figure 1 on page 4.

Appendix A of this report presents the Transmission loss analysis which was calculated separately and the results incorporated into the final loss factors as shown on Table 1 on the next page.

Table 1 (columns (a) and (b)) also provides the final results from Appendix B for the 2010 calendar year. Exhibits 8 and 9 of Appendix B present a more detailed analysis of the final calculated summary results of losses by segments and delivery voltage of the power system. The following Table 1 cumulative loss expansion factors are applicable only to metered sales at the point of receipt for adjustment to the power system's input level.



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TABLE 1
Loss Factors at Sales (Meter) Level, Calendar Year 2010

<u>Voltage Level of Service</u>	<u>Total KU</u> (a)	<u>Delivery System (Excludes Transmission)</u> (b)	<u>Recalculated Total KU With Appendix A Transmission Losses</u> (c) (d) = 1/(c)	
<u>Demand (kW)</u>				
Transmission ¹	1.03295	1.00000	1.02805	0.97272
Primary Substation	1.03883	1.00569	1.03390	0.96721
Primary	1.06632	1.03230	1.06126	0.94228
Secondary	1.09017	1.05539	1.08499	0.92167
<u>Energy (kWh)</u>				
Transmission ¹	1.02827	1.00000	1.02271	0.97779
Primary Substation	1.03382	1.00540	1.02823	0.97255
Primary	1.05011	1.02124	1.04444	0.95745
Secondary	1.07651	1.04692	1.07069	0.93398
Losses – Net System Input ²	5.75% MWh 7.12% MW			
Losses – Net System Output ³	6.10% MWh 7.67% MW			

Notes: *Column (a) Results derived from Appendix A for Transmission and Appendix B for all remaining factors.*

Column (b) Column (a) loss factors excluding all Transmission-related losses.

Column (c) Column (b) delivery-only loss factors with incorporating the composite LG&E system-wide Transmission loss factors from Appendix A, Schedule 1, lines 5 and 10.

Column (d) All loss factors presented in columns (a), (b), and (c) are expansion factors applicable to metered sales as a multiplier. Column (d) is simply the inverse of column (c) and results in a loss factor that is used to divide metered sales to derive sales requirement at input.

The loss factors presented in the Delivery Only column of Table 1 are the Total KU loss factors divided by the transmission loss factor from column (a) in order to remove these losses from each service level loss factor. For example, the secondary distribution demand loss factor of 1.05539 includes the recovery of all remaining non-transmission losses from the distribution substation, primary lines, line transformers, secondary conductors and services.

¹ Reflects results for 500 kV, 345 kV, 161 kV, 138 kV and 69 kV from Appendix A.

² Net system input equals firm sales plus losses, Company use less non-requirement sales and related losses. See Appendix A, Exhibit 1, for their calculations.

³ Net system output uses losses divided by output or sales data as a reference.



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The net system input shown in Table 1 represents the MWh losses of 5.75% for the total KU load using calculated losses divided by the associated input energy to the system. The 7.12% represents the MW losses also using system input as a reference. The net system output reference shown in Table 1 represents MWh losses of 6.10% and MW losses of 7.17%. These results use the appropriate total losses for each but are divided by system output or sales. These calculations are all based on the data and results shown on Exhibits 1, 7 and 9 of the study.

Due to the very nature of losses being primarily a function of equipment loadings, the loss factor derivations for any voltage level must consider both the load at that level plus the loads from lower voltages and their associated losses. As a result, cumulative losses on losses equates to additional load at higher levels along with future changes (+ or -) in loads throughout the power system. It is therefore important to recognize that losses are multiplicative in nature (future) and not additive (test year only) for all future years to ensure total recovery based on prospective fixed loss factors for each service voltage.

The derivation of the cumulative loss factors (Appendix B) shown in Table 1 (columns (a) and (b)) have been detailed for all electrical facilities in Exhibit 9, page 1 for demand and page 2 for energy. Beginning on line 1 of page 1 (demand) under the secondary column, metered sales are adjusted for service losses on lines 3 and 4. This new total load (with losses) becomes the load amount for the next higher facilities of secondary conductors and their loss calculations. This process is repeated for all the installed facilities until the secondary sales are at the input level (line 45). The final loss factor for all delivery voltages using this same process is shown on line 46 and Table 1 for demand. This procedure is repeated in Exhibit 9, page 2, for the energy loss factors.

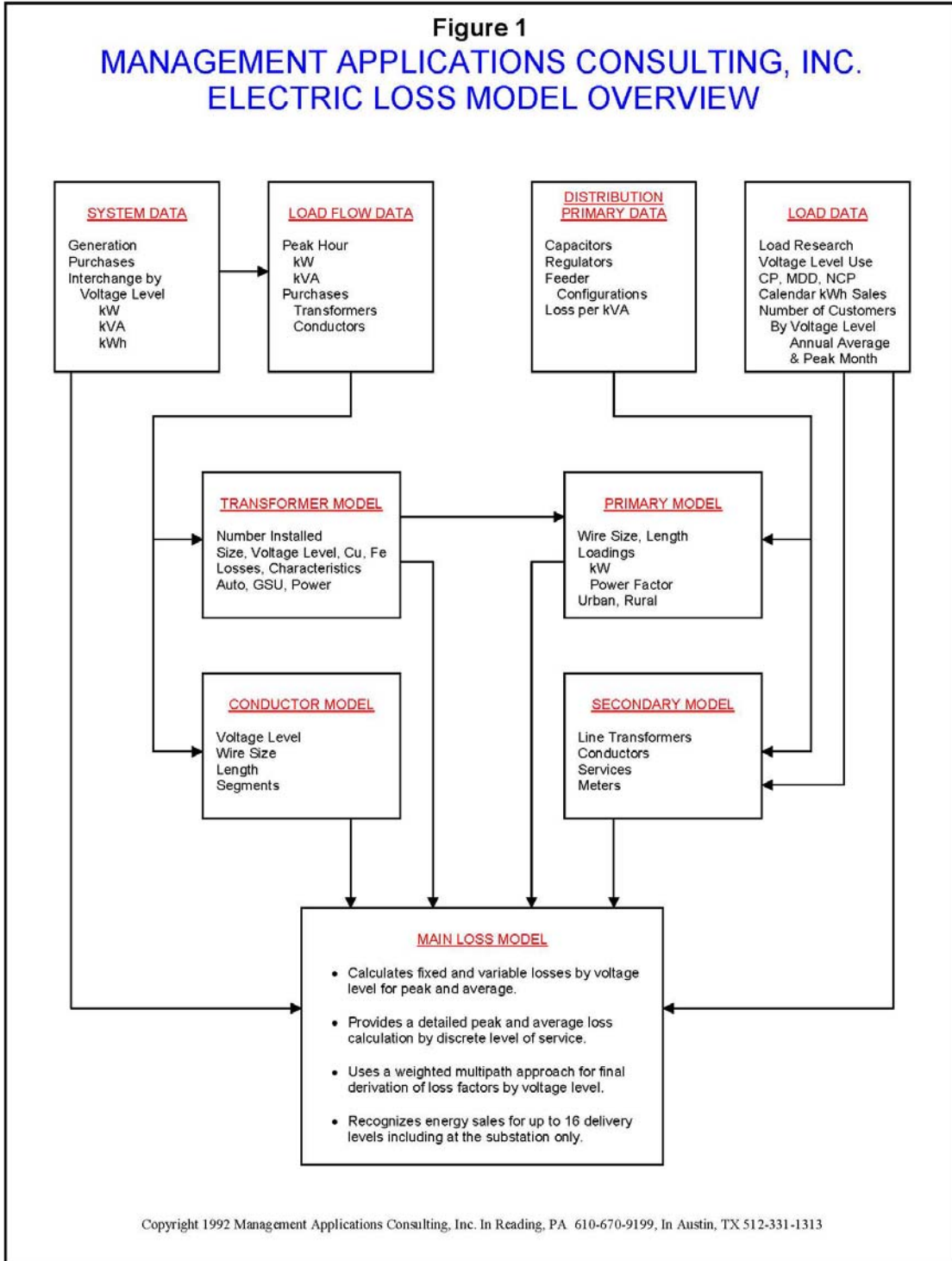
The loss factor calculation is simply the input required (line 45) divided by the metered sales (line 2).

An overview of the loss study is shown on Figure 1 on the next page. Figure 2 simply illustrates the major components that must be considered in a loss analysis.



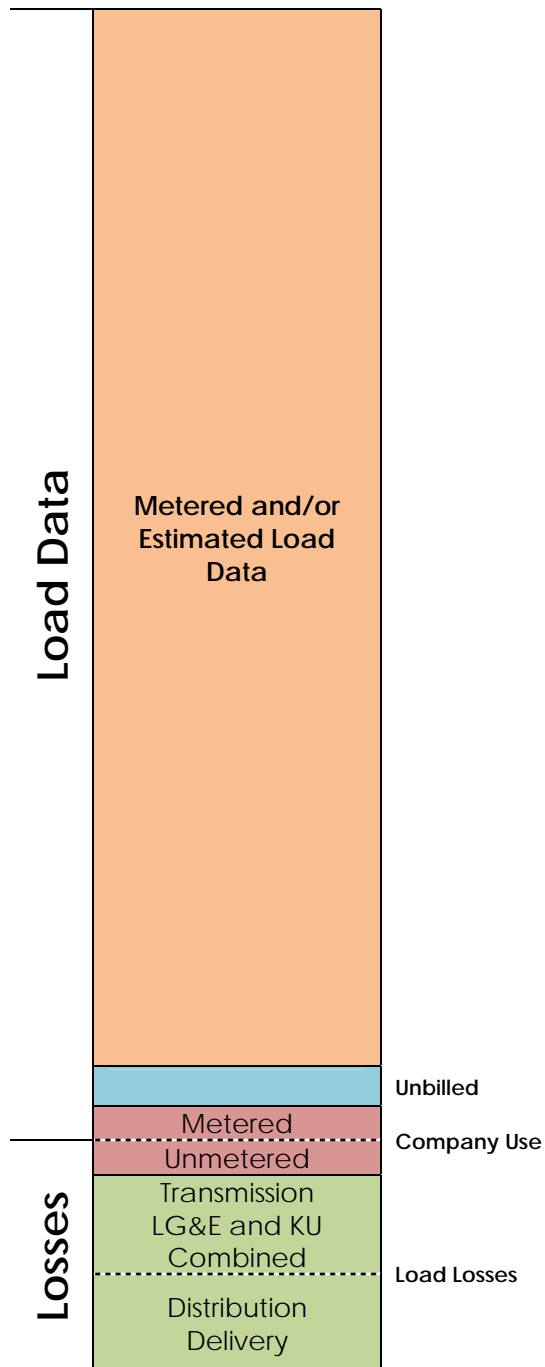
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Figure 2
LG&E and KU Services Company – KU
Jurisdiction Energy and Loss Components



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2010 Analysis of System Losses – KU Power System

2.0 INTRODUCTION

This report of the 2010 Analysis of System Losses for the KU power system provides a summary of results, conceptual background or methodology, description of the analyses, and input information related to the study.

2.1 Conduct of Study

Typically, between five to ten percent of the total kWh requirements of an electric utility is lost or unaccounted for in the delivery of power to customers. Investments must be made in facilities which support the total load which includes losses or unaccounted for load. Revenue requirements associated with load losses are an important concern to utilities and regulators in that customers must equitably share in all of these cost responsibilities. Loss expansion factors are the mechanism by which customers' metered demand and energy data are mathematically adjusted to the generation or input level (point of reference) when performing cost and revenue calculations.

An acceptable accounting of losses can be determined for any given time period using available engineering, system, and customer data along with empirical relationships. This loss analysis for the delivery of demand and energy utilizes such an approach. A microcomputer loss model⁴ is utilized as the vehicle to organize the available data, develop the relationships, calculate the losses, and provide an efficient and timely avenue for future updates and sensitivity analyses. Our procedures and calculations are similar with prior loss studies, and they rely on numerous databases that include customer statistics and power system investments.

Company personnel performed most of the data gathering and data processing efforts and checked for reasonableness. MAC provided assistance as necessary to construct databases, transfer files, perform calculations, and check the reasonableness of results. A review of the preliminary results provided for additions to the database and modifications to certain initial assumptions based on available data. Efforts in determining the data required to perform the loss analysis centered on information which was available from existing studies or reports within the Company. From an overall perspective, our efforts concentrated on five major areas:

1. System information concerning peak demand and annual energy requirements by voltage level,
2. High voltage power system power flow data and associated loss calculations,
3. Distribution system primary and secondary loss calculations,
4. Derivation of fixed and variable losses by voltage level, and
5. Development of final cumulative expansion factors at each voltage for peak demand (kW) and annual energy (kWh) requirements at the point of delivery (meter).

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2.2 Electric Power Losses

Losses in power systems consist of primarily technical losses with a much smaller level of non-technical losses.

Technical Losses

Electrical losses result from the transmission of energy over various electrical equipment. The largest component of these losses is power dissipation as a result of varying loading conditions and are oftentimes called load losses which are proportional to the square of the current (I^2R). These losses can be as high as 75% of all technical losses. The remaining losses are called no-load and represent essentially fixed (constant) energy losses throughout the year. These no-load losses represent energy required by a power system to energize various electrical equipment regardless of their loading levels. The major portion of no-load losses consists of core or magnetizing energy related to installed transformers throughout the power system.

Non-Technical Losses

These are unaccounted for energy losses that are related to energy theft, metering, non-payment by customers, and accounting errors. Losses related to these areas are generally very small and can be extremely difficult and subjective to quantify. Our efforts generally do not develop any meaningful level as appropriate because we assume that improving technology and utility practices have minimized these amounts.

2.3 Description of Model

The loss model is a customized applications model, constructed using the Excel software program. Documentation consists primarily of the model equations at each cell location. A significant advantage of such a model is that the actual formulas and their corresponding computed values at each cell of the model are immediately available to the analyst.

A brief description of the three (3) major categories of effort for the preparation of each loss model is as follows:

- Main sheet which contains calculations for all primary and secondary losses, summaries of all conductor and transformer calculations from other sheets discussed below, output reports and supporting results.



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- Transformer sheet which contains data input and loss calculations for each distribution substation. Separate iron and copper losses are calculated for each transformer by identified type.

Appendix A presents a separate hourly loss study result which derived the loss factors for the combined LG&E system-wide Transmission only (69 kV through 500 kV) of the LG&E and KU power system. These Transmission results are then incorporated on Table 1 of the Executive Summary to derive the final KU 2010 loss factors by voltage level of energy delivery.

Appendix B presents a detailed loss study result which derives the loss factors for the Company's system-wide power system. Appendix B, Exhibits 8 and 9, presents the final detailed summary results of the demand and energy losses for each major portion of the total KU power system.



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3.0 METHODOLOGY

3.1 Background

The objective of a Loss Study is to provide a reasonable set of energy (average) and demand (peak) loss expansion factors which account for system losses associated with the transmission and delivery of power to each voltage level over a designated period of time. The focus of this study is to identify the difference between total energy inputs and the associated sales with the difference being equitably allocated to all delivery levels. Several key elements are important in establishing the methodology for calculating and reporting the Company's losses. These elements are:

- Selection of voltage level of services,
- Recognition of losses associated with conductors, transformations, and other electrical equipment/components within voltage levels,
- Identification of customers and loads at various voltage levels of service,
- Review of generation or net power supply input at each level for the test period studied, and
- Analysis of kW and kWh sales by voltage levels within the test period.

The three major areas of data gathering and calculations in the loss analysis were as follows:

1. System Information (monthly and annual)
 - MWH generation and MWH sales.
 - Coincident peak estimates and net power supply input from all sources and voltage levels.
 - Customer load data estimates from available load research information, adjusted MWH sales, and number of customers in the customer groupings and voltage levels identified in the model.
 - System default values, such as power factor, loading factors, and load factors by voltage level.



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2. High Voltage System (Appendix A)

- Conductor information was summarized from a database by the Company which reflects the transmission system by voltage level. Extensive use was made of the Company's power flow data with the losses calculated and incorporated into the final loss calculations.
- Transformer information was developed in a database to model transformation at each voltage level. Substation power, step-up, and auto transformers were individually identified along with any operating data related to loads and losses.
- Power flow data and calculations for each hour (8760) formed the basis for the peak and annual load losses in the high voltage (500 kV through 69 kV) loss calculations.

3. Distribution System (Appendix B)

- Distribution Substations – Data was developed for modeling each substation as to its size and loading. The Company provided loss characteristics for each transformer. Loss calculations were performed from this data to determine no load losses separately for each transformer. The annual load losses were calculated using an average load level for each transformer which replaced the prior Hoebel formula method.
- Primary lines – Line loading and loss characteristics for several representative primary circuits were obtained from the Company. These loss results developed kW loss per MW of load and a composite average percentage was calculated to derive the primary loss estimate.
- Line transformers – Losses in line transformers were based on each customer service group's size, as well as the number of customers per transformer. Accounting and load data provided the foundation with which to model the transformer loadings and to calculate load and no load losses.
- Secondary network – Typical secondary networks were estimated for conductor sizes, lengths, loadings, and customer penetration for residential and small general service customers.
- Services – Typical services were estimated for each secondary service class of customers identified in the study with respect to type, length, and loading.



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The loss analysis was thus performed by constructing the model in segments and subsequently calculating the composite until the constraints of peak demand and energy were met:

- Information as to the physical characteristics and loading of each transformer and conductor segment was modeled.
- Conductors, transformers, and distribution were grouped by voltage level, and unadjusted losses were calculated.
- The loss factors calculated at each voltage level were determined by "compounding" the per-unit losses. Equivalent sales at the supply point were obtained by dividing sales at a specific level by the compounded loss factor to determine losses by voltage level.
- The resulting demand and energy loss expansion factors were then used to adjust all sales to the generation or input level in order to estimate the difference.
- Reconciliation of kW and kWh sales by voltage level using the reported system kW and kWh was accomplished by adjusting the initial loss factor estimates until the mismatch or difference was eliminated (Appendix B, Exhibits 6 and 7).

3.2 Calculations and Analysis

This section provides a discussion of the input data, assumptions, and calculations performed in the loss analysis. Specific appendices have been included in order to provide documentation of the input data utilized in the model.

3.2.1 Bulk and Transmission Lines (500 kV – 69 kV)

The transmission line losses were calculated based on a modeling of unique voltage levels identified by the Company's power flow data and configuration for the entire integrated Power System (Appendix A). Specific information as to length of line, type of conductor, voltage level, and hourly loading were utilized as data input in the power flow analyses.

Actual MW and MVA line loadings were based on KU's hourly loading conditions. Calculations of line losses were performed and summarized by fixed and variable components for both Transmission and GSU facilities for reporting purposes as shown in Appendix A of this report.



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3.2.2 Bulk and Transmission Transformers

The transmission transformer loss analysis required several steps in order to properly consider the characteristics associated with various transformer types; such as, step-up, auto transformers, distribution substations, and line transformers. In addition, further efforts were required to identify both iron and copper losses within each of these transformer types in order to obtain reasonable peak (kW) and average annual energy (kWh) losses. While iron losses were considered essentially constant for each hour, recognition had to be made for the varying degree of copper losses due to hourly equipment loadings.

The remaining miscellaneous losses considered in the loss study consisted of several areas which do not lend themselves to any reasonable level of modeling for estimating their respective losses and were therefore lumped together into a single loss factor of 0.10%. The typical range of values for these losses is from 0.10% to 0.25%, and we have assumed the lower value to be conservative at this time. The losses associated with this loss factor include bus bars, unmetered station use, and grounding transformers.

3.2.3 Distribution System

The load data at the substation and customer level, coupled with primary and secondary network information, was sufficient to model the distribution system in adequate detail to calculate losses.

Distribution Substations

The Distribution Substation loss derivation required several steps to recognize the loss characteristics relating to iron or fixed losses versus the copper or load varying (I^2R) losses. The fixed component was based on Company loss characteristics from manufacturer's test results. The annual variable loss calculations considered a different approach by using an average hourly loading level and used this to the peak hour losses as a ratio $(\text{average/peak})^2$ times 8760 hours with an average adjustment factor and peak hour losses.

Primary Lines

Primary line loadings take into consideration the available distribution load along with the actual customer loads including losses. Primary line loss estimates were prepared by the Company for use in this loss study. These estimates considered loads per substation, voltage levels, loadings, total circuit miles, wire size, and single- to three-phase investment estimates. All of these factors were considered in calculating the actual demand (kW) and energy (kWh) for the primary system.



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Line Transformers

Losses in line transformers were determined based on typical transformer sizes for each secondary customer service group and an estimated or calculated number of customers per transformer. Accounting records and estimates of load data provided the necessary database with which to model the loadings. These calculations also made it possible to determine separate copper and iron losses for distribution line transformers, based on a table of representative losses for various transformer sizes.

Secondary Line Circuits

A calculation of secondary line circuit losses was performed for loads served through these secondary line investments. Estimates of typical conductor sizes, lengths, loadings and customer class penetrations were made to obtain total circuit miles and losses for the secondary network. Customer loads which do not have secondary line requirements were also identified so that a reasonable estimate of losses and circuit miles of these investments could be made.

Service Drops and Meters

Service drops were estimated for each secondary customer reflecting conductor size, length and loadings to obtain demand losses. A separate calculation was also performed using customer maximum demands to obtain kWh losses. Meter loss estimates were also made for each customer and incorporated into the calculations of kW and kWh losses included in the Summary Results.



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4.0 DISCUSSION OF RESULTS

A brief description of each Exhibit is provided in Appendices A and B:

Exhibit 1 – Summary of Company Data

This exhibit reflects system information used to determine percent losses and a detailed summary of kW and kWh losses by voltage level. The loss factors developed in Exhibit 7 are also summarized by voltage level.

Exhibit 2 – Summary of Conductor Information

A summary of MW and MWH load and no load losses for Distribution conductors by voltage levels is presented. The sum of all calculated losses by high voltage is based on input data information provided in Appendix A. Percent losses are based on equipment loadings.

Exhibit 3 – Summary of Transformer Information

This exhibit summarizes Distribution transformer losses by various types and voltage levels throughout the system. Load losses reflect the copper portion of transformer losses while iron losses reflect the no load or constant losses. MWH losses are estimated using an average load loss factor for copper and the annual load losses times the test year hours.

Exhibit 4 – Summary of Losses Diagram (2 Pages)

This loss diagram represents the inputs and output of power at system peak conditions. Page 1 details information from all points of the power system and what is provided to the distribution system for primary loads. This portion of the summary can be viewed as a "top down" summary into the distribution system.

Page 2 represents a summary of the development of primary line loads and distribution substations based on a "bottom up" approach. Basically, loadings are developed from the customer meter through the Company's physical investments based on load research and other metered information by voltage level to arrive at MW and MVA requirements during peak load conditions by voltage levels.

Exhibit 5 – Summary of Sales and Calculated Losses

Summary of Calculated Losses represents a tabular summary of MW and MWH load and no load losses by discrete areas of delivery within each voltage level. Losses have been identified and are derived based on summaries obtained from Exhibits 2 and 3 and losses associated with meters, capacitors and regulators.



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Exhibit 6 – Development of Loss Factors, Unadjusted

This exhibit calculates demand and energy losses and loss factors by specific voltage levels based on sales level requirements. The actual results reflect loads by level and summary totals of losses at that level, or up to that level, based on the results as shown in Exhibit 5. Finally, the estimated values at generation are developed and compared to actual generation to obtain any difference or mismatch.

Exhibit 7 – Development of Loss Factors, Adjusted

The adjusted loss factors are the results of adjusting Exhibit 6 for any difference. All differences between estimated and actual are prorated to each level based on the ratio of each level's total load plus losses to the system total. These new loss factors reflect an adjustment in losses due only to the kW and kWh mismatch.

Exhibit 8 – Adjusted Losses and Loss Factors by Facility

These calculations present an expanded summary detail of Exhibit 7 for each segment of the power system with respect to the flow of power and associated losses from the receipt of energy at the meter to the generation for the KU power system.

Exhibit 9 – Summary of Losses by Delivery Voltage

These calculations present a reformatted summary of losses presented in Exhibits 7 and 8 by power system delivery segment as calculated by voltage level of service based on reported metered sales.



Appendix A

Results of LG&E (KU and LG&E) Transmission System 2010 Loss Analysis



**Louisville Gas and Electric Company (LGE)
Kentucky Utilities Company (KU)
2011 Transmission Loss Analysis**

Pages 1-2	Index
Schedule 1, Page 3	<p>Presents the summary loss results of the calculated hourly losses for the Company's LGE and KU control areas at the annual peak hour and for the annual average losses for all hours of the year.</p> <p>Calculated loss factors are applicable to the metered (output) sales level.</p> <p>All data is from Schedule 2.</p> <p>Section I - Summarizes the transmission loss results with GSU losses included.</p> <p>Section II - Summarizes GSU only losses.</p> <p>Section III - Summarizes the transmission only losses excluding GSU losses.</p>
Schedule 1A, Page 4	<p>Presents the summary loss results of the calculated hourly losses for the Company's LGE control areas at the annual peak hour and for the annual average losses for all hours of the year.</p>
Schedule 1B, Page 5	<p>Presents the summary loss results of the calculated hourly losses for the Company's KU control areas at the annual peak hour and for the annual average losses for all hours of the year.</p>
Schedule 2, Page 6	<p>Summary of the summer and winter peak hour MW and annual MWH losses for LGE and KU and the total system.</p> <p>Results are detailed by segment and season: Summer (June, July, August, and September), Winter (all months excluding Summer months).</p> <p>Loss data is from Schedule 3.</p>
Schedule 3, Page 7	<p>Summary of MW and MWH loss results for each control area by season and voltage level.</p>
Schedule 4, Page 8	<p>Summary of seasonal peak hour MW and average MWH loss results for LGE by season and voltage level.</p>

**Louisville Gas and Electric Company (LGE)
Kentucky Utilities Company (KU)
2011 Transmission Loss Analysis**

**Schedule 5,
Page 9** Summary of seasonal peak hour MW and average MWH loss results for KU by season and voltage level.

Appendices:

Page 10 A - Peak Demand
Page 11 B - Monthly Energy
Page 12 C - Energy Summary
Page 13 D - Demand Summary

Appendices include summaries of hourly calculation of losses for each identified type at transmission voltage levels by season identified by fixed and variable with GSU losses identified separately.

Workpapers:

Page 14 1 - LGE
Page 15 2 - KU
Workpapers 1 and 2 present detailed summary results of eight separate power flows for each control area (LGE and KU) for a total of sixteen unique simulations and loss results.

Page 16 3 - Corona Loss Calculations
Page presents the Corona loss estimate and calculations by voltage level and control area (LGE and KU) for the peak in MW and the annual MWH for 2010.

Page 17 Page presents the pole miles by company and voltage level.

LGEE (LGE & KU) 2011 TRANSMISSION LOSS ANALYSIS (1)

I TRANSMISSION LOSSES WITH GSU		LOSSES	% OF TOTAL TRANSMISSION	INPUT	OUTPUT	LOSS FACTOR (Input/Output)	
A. DEMAND		Peak (MW) Summer (June - September)					
1	LGE	57.9	27.8%	4,060	4,002	1.01448	
2	KU	150.3	72.2%	4,865	4,715	1.03187	
3	Total Demand Losses Combined (3)	208.2	100.0%	7,905	7,697	1.02705	
4	Unmetered Station Use Adjustment					0.00100	
5	Demand Loss Factor					1.02805	
B. ENERGY		Annual MWH					
6	LGE	199,404	21.5%	21,626,727	21,427,323	1.00931	
7	KU	727,568	78.5%	27,462,725	26,735,158	1.02721	
8	Total Energy Losses Combined (3)	926,971	100.0%	43,634,621	42,707,650	1.02171	
9	Unmetered Station Use Adjustment					0.00100	
10	Energy Loss Factor					1.02271	
II TRANSMISSION GSU LOSSES		LOSSES (MW)			LOSSES (MWH)		
A. GSU LOSSES (2)		FIXED	VARIABLE	TOTAL	FIXED	VARIABLE	TOTAL
11	LGE	2.90	8.50	11.40	15,715	38,826	54,541
12	KU	2.40	5.40	7.80	14,820	25,784	40,604
13	Total GSU Losses	5.30	13.90	19.20	30,535	64,610	95,145
III TRANSMISSION ONLY LOSSES		LOSSES	% OF TOTAL TRANSMISSION	INPUT	OUTPUT	LOSS FACTOR (Input/Output)	
A. DEMAND LOSSES (Loss II-A)		Peak (MW) Summer (June - September)					
14	LGE	46.5	24.6%	4,049	4,002	1.01163	
15	KU	142.5	75.4%	4,857	4,715	1.03021	
16	Total Demand Combined (2)	189.0	100.0%	7,886	7,697	1.02456	
17	Unmetered Station Use Adjustment					0.00100	
18	Demand Loss Factor					1.02556	
B. ENERGY LOSSES (Loss II-A)		Annual MWH					
19	LGE	144,863	17.4%	21,572,186	21,427,323	1.00676	
20	KU	686,964	82.6%	27,422,121	26,735,158	1.02570	
21	Total Energy Combined (2)	831,826	100.0%	43,539,476	42,707,650	1.01948	
22	Unmetered Station Use Adjustment					0.00100	
23	Energy Loss Factor					1.02048	

Notes:

- (1) Study Period from February 2011 through January 2012.
- (2) GSU losses from Schedule 3.
- (3) See Schedule 1A, Schedule 1B, and Schedule 2.

LGE 2011 TRANSMISSION LOSS ANALYSIS

I TRANSMISSION LOSSES WITH GSU

	LOSSES	INPUT	OUTPUT	LOSS FACTOR (Input/Output)	
A. DEMAND					
<u>Peak (MW) Summer (June - September)</u>					
1	LGE	57.9	4,060	4,002	1.01448
2	Unmetered Station Use Adjustment				0.00100
3	Demand Loss Factor				1.01548
B. ENERGY					
<u>Annual MWH</u>					
4	LGE	199,404	21,626,727	21,427,323	1.00931
5	Unmetered Station Use Adjustment				0.00100
6	Energy Loss Factor				1.01031

II TRANSMISSION GSU LOSSES

	LOSSES (MW)			LOSSES (MWH)			
	FIXED	VARIABLE	TOTAL	FIXED	VARIABLE	TOTAL	
A. GSU LOSSES (1)							
7	LGE	2.90	8.50	11.40	15,715	38,826	54,541

III TRANSMISSION ONLY LOSSES

	LOSSES	INPUT	OUTPUT	LOSS FACTOR (Input/Output)	
A. DEMAND LOSSES					
<u>Peak (MW) Summer (June - September)</u>					
8	LGE (Line 1 - Line 7)	46.5	4,049	4,002	1.01163
9	Unmetered Station Use Adjustment				0.00100
10	Demand Loss Factor				1.01263
B. ENERGY LOSSES					
<u>Annual MWH</u>					
11	LGE (Line 4 - Line 7)	144,863	21,572,186	21,427,323	1.00676
12	Unmetered Station Use Adjustment				0.00100
13	Energy Loss Factor				1.00776

Notes:

1. GSU losses from Schedule 3.
2. See Schedule 2

KU 2011 TRANSMISSION LOSS ANALYSIS

I TRANSMISSION LOSSES WITH GSU

		LOSSES	INPUT	OUTPUT	LOSS FACTOR (Input/Output)
	A. DEMAND	Peak (MW) Summer (June - September)			
1	KU	150.3	4,865	4,715	1.03187
2	Unmetered Station Use Adjustment				0.00100
3	Demand Loss Factor				1.03287
	B. ENERGY	Annual MWH			
4	KU	727,568	27,462,725	26,735,158	1.02721
5	Unmetered Station Use Adjustment				0.00100
6	Energy Loss Factor				1.02821

II TRANSMISSION GSU LOSSES

		LOSSES (MW)			LOSSES (MWH)		
		FIXED	VARIABLE	TOTAL	FIXED	VARIABLE	TOTAL
	A. GSU LOSSES (1)						
7	KU	2.40	5.40	7.80	14,820	25,784	40,604

III TRANSMISSION ONLY LOSSES

		LOSSES	INPUT	OUTPUT	LOSS FACTOR (Input/Output)
	A. DEMAND LOSSES	Peak (MW) Summer (June - September)			
8	KU (Line 1 - Line 7)	142.5	4,857	4,715	1.03021
9	Unmetered Station Use Adjustment				0.00100
10	Demand Loss Factor				1.03121
	B. ENERGY LOSSES	Annual MWH			
11	KU (Line 4 - Line 7)	686,964	27,422,121	26,735,158	1.02570
12	Unmetered Station Use Adjustment				0.00100
13	Energy Loss Factor				1.02670

Notes:

1. GSU losses from Schedule 3.
2. See Schedule 2

LGEE (LGE & KU) POWER FLOW RESULTS - SUMMARY OF LOSSES

TRANSMISSION LOSSES WITH GSU	PEAK (SUMMER)		PEAK (OTHER)		ANNUAL	
	Total (MW)	% of Total System Losses	Total (MW)	% of Total System Losses	Total Annual (MWH)	% of Total System Losses
<u>LGE</u>						
1 Transmission Use (Peak MW, Annual MWH)	4,002		3,300		21,427,323	
2 Input (Line 1 + Line 5)	4,060		3,328		21,626,727	
Transmission						
3 Fixed	5.9	2.9%	5.2	2.3%	43,657	4.7%
4 Variable	52.0	25.0%	22.5	10.0%	155,747	16.8%
5 Total Transmission - LGE	57.9	27.8%	27.7	12.3%	199,404	21.5%
6 Losses % of Input (Line 5/Line 2)	1.43%		0.83%		0.92%	
7 Losses % of Output (Line 5/Line 1)	1.45%		0.84%		0.93%	
<u>KU</u>						
8 Transmission Use (Peak MW, Annual MWH)	4,715		4,961		26,735,158	
9 Input (Line 8 + Line 12)	4,865		5,159		27,462,725	
Transmission						
10 Fixed	8.2	3.9%	8.1	3.6%	67,476	7.3%
11 Variable	142.0	68.2%	190.0	84.1%	660,091	71.2%
12 Total Transmission - KU	150.3	72.2%	198.1	87.7%	727,568	78.5%
13 Losses % of Input (Line 12/Line 9)	3.09%		3.84%		2.65%	
14 Losses % of Output (Line 2/Line 8)	3.19%		3.99%		2.72%	
<u>TOTAL LGE & KU</u>						
15 LGEE Load (Peak MW, Annual MWH) Input	8,925		8,487		49,089,452	
16 LGE Energy Delivery to KU	-1,020		-1,228		-5,454,831	
17 Total Load (Peak MW, Annual MWH)	7,905		7,259		43,634,621	
Transmission						
18 Fixed	14.2	6.8%	13.4	5.9%	111,133	12.0%
19 Variable	194.0	93.2%	212.5	94.1%	815,838	88.0%
20 Total System	208.2	100.0%	225.9	100.0%	926,971	100.0%
21 Losses % of Input (Line 20/Line 15)	2.33%		2.66%		1.89%	
22 Losses % of Output (Line 20/(Line 15/Line 20))	2.39%		2.73%		1.92%	
COMBINED LGEE DELIVERED ENERGY & LOSSES						
	SUMMER		WINTER		ANNUAL	
23 LGEE Load (All data in MWH) Output	17,146,907		31,015,574		48,162,481	
24 LGE Energy Delivery to KU	-1,689,262		-3,765,569		-5,454,831	
25 Total Load (Annual MWH) Output	15,457,645		27,250,005		42,707,650	
Transmission Losses						
26 Fixed	37,940	11.1%	73,193	12.5%	111,133	12.0%
27 Variable	303,970	88.9%	511,869	87.5%	815,838	88.0%
28 Total Transmission Losses	341,909	100.0%	585,062	100.0%	926,971	100.0%
29 Losses % of Output (Line 28/Line 23)	1.99%		1.89%		1.92%	

LGEE (LGE & KU) POWER FLOW RESULTS - TOTAL TRANSMISSION

CONDUCTOR AND TRANSFORMER LOSSES (MW)

TIME	MW TRANSMISSION USE	Transmission Fixed	Transmission Variable	GSU Fixed	GSU Variable	Subtotal Conductor & Transformer	Load Adjustment for Combined Only
OTHER - LGE							
1 PEAK - MW	3,300	3.15	16.50	2.10	6.00	27.75	1228.00
2 LOSS % TO LOAD		0.095%	0.500%	0.064%	0.182%	0.841%	
3 LOSS % TO TOTAL LOSSES		11.349%	59.461%	7.568%	21.622%	100.000%	
4							
5 OTHER MWH	13,679,183	18,668	63,034	10,054	24,023	115,779	3,765,569
6 LOSS % TO LOAD		0.136%	0.461%	0.073%	0.176%	0.846%	
7 LOSS % TO TOTAL LOSSES		16.124%	54.443%	8.684%	20.749%	100.000%	
SUMMER - LGE							
8 PEAK - MW	4,002	3.05	43.50	2.90	8.50	57.95	1020.00
9 LOSS % TO LOAD		0.076%	1.087%	0.072%	0.212%	1.448%	
10 LOSS % TO TOTAL LOSSES		5.262%	75.066%	5.004%	14.668%	100.000%	
11							
12 SUMMER MWH	7,748,140	9,274	53,887	5,661	14,803	83,625	1,689,262
13 LOSS % TO LOAD		0.120%	0.695%	0.073%	0.191%	1.079%	
14 LOSS % TO TOTAL LOSSES		11.090%	64.439%	6.770%	17.702%	100.000%	
TOTAL ANNUAL - LGE							
15 SUMMER PEAK - MW	4,002	3.05	43.50	2.90	8.50	57.95	1020.00
16 ANNUAL MWH	21,427,323	27,942	116,921	15,715	38,826	199,404	5,454,831
17 LOSS % TO TOTAL ANNUAL OUTPUT		0.130%	0.546%	0.073%	0.181%	0.931%	
LOSS FACTORS - LGE							
18 Demand						1.01448	
19 Energy						1.00931	
OTHER - KU							
20 PEAK - MW	4,961	5.81	183.94	2.30	6.10	198.15	
21 LOSS % TO LOAD		0.117%	3.708%	0.046%	0.123%	3.994%	
22 LOSS % TO TOTAL		2.930%	92.831%	1.161%	3.079%	100.000%	
23							
24 OTHER MWH	17,336,391	35,105	408,661	9,366	16,151	469,283	
25 LOSS % TO LOAD		0.202%	2.357%	0.054%	0.093%	2.707%	
26 LOSS % TO TOTAL LOSSES		7.481%	87.082%	1.996%	3.442%	100.000%	
SUMMER - KU							
27 PEAK - MW	4,715	5.81	136.65	2.40	5.40	150.25	
28 LOSS % TO LOAD		0.123%	2.898%	0.051%	0.115%	3.187%	
29 LOSS % TO TOTAL		3.864%	90.945%	1.597%	3.594%	100.000%	
30							
31 SUMMER MWH	9,398,766	17,551	225,647	5,454	9,633	258,285	
32 LOSS % TO LOAD		0.187%	2.401%	0.058%	0.102%	2.748%	
TOTAL ANNUAL - KU							
33 PEAK - MW	4,715	5.81	136.65	2.40	5.40	150.25	
34 ANNUAL MWH	26,735,158	52,656	634,307	14,820	25,784	727,568	
35 LOSS % TO TOTAL ANNUAL OUTPUT		0.197%	2.373%	0.055%	0.096%	2.721%	
LOSS FACTORS - KU							
36 Demand						1.03187	
37 Energy						1.02721	
TOTAL ANNUAL - LGEE OUTPUT & LOSSES							
38 PEAK SUMMER - MW	8,717	8.86	180.15	5.30	13.90	208.20	1020.00
39 SUMMER MWH	17,146,907	26,825	279,534	11,115	24,436	341,909	1,689,262
40 PEAK OTHER MW	8,262	8.96	200.44	4.40	12.10	225.90	1228.00
41 OTHER MWH	31,015,574	53,773	471,695	19,420	40,174	585,062	3,765,569
42 ANNUAL MWH	48,162,481	80,598	751,228	30,535	64,610	926,971	5,454,831

LGE POWER FLOW RESULTS

CONDUCTOR AND TRANSFORMER LOSSES (MW)

TIME	MW-LGE TRANSMISSION USE	Transmission Fixed (4)	Transmission Variable	GSU Fixed	GSU Variable	Subtotal Conductor & Transformer	
OTHER - LGE							
1	PEAK - MW	3,300	3.15	16.50	2.10	6.00	27.75
2	LOSS % TO LOAD		0.095%	0.500%	0.064%	0.182%	0.841%
3	LOSS % TO TOTAL LOSSES		11.349%	59.461%	7.568%	21.622%	100.000%
4							
5	OTHER MWH	13,679,183	18,668	63,034	10,054	24,023	115,779
6	LOSS % TO LOAD		0.136%	0.461%	0.073%	0.176%	0.846%
7	LOSS % TO TOTAL LOSSES		16.124%	54.443%	8.684%	20.749%	100.000%
SUMMER - LGE							
8	PEAK - MW	4,002	3.05	43.50	2.90	8.50	57.95
9	LOSS % TO LOAD		0.076%	1.087%	0.072%	0.212%	1.448%
10	LOSS % TO TOTAL LOSSES		5.262%	75.066%	5.004%	14.668%	100.000%
11							
12	SUMMER MWH	7,748,140	9,274	53,887	5,661	14,803	83,625
13	LOSS % TO LOAD		0.120%	0.695%	0.073%	0.191%	1.079%
14	LOSS % TO TOTAL LOSSES		11.090%	64.439%	6.770%	17.702%	100.000%
TOTAL ANNUAL - LGE							
15	SUMMER PEAK - MW	4,002	3.05	43.50	2.90	8.50	57.95
16	LOSS % TO SUMMER PEAK MW		0.076%	1.087%	0.072%	0.212%	1.448%
17	ANNUAL MWH	21,427,323	27,942	116,921	15,715	38,826	199,404
18	LOSS % TO ANNUAL MWH		0.130%	0.546%	0.073%	0.181%	0.931%
LOSS FACTORS - LGE							
19	Demand						1.01448
20	Energy						1.00931

NOTES:

- (1) Summer Period includes June, July, August, and September.
- (2) Other Period includes all non Summer Period months.
- (3) Transmission Use = Load + Exports + Passthroughs
- (4) Transmission Fixed includes Corona Losses

KU POWER FLOW RESULTS

CONDUCTOR AND TRANSFORMER LOSSES (MW)

TIME	MW-KU TRANSMISSION USE	Transmission Fixed (4)	Transmission Variable (5)	GSU Fixed	GSU Variable	Subtotal Conductor & Transformer	
OTHER - KU							
1	PEAK - MW	4,961	5.81	183.94	2.30	6.10	198.15
2	LOSS % TO LOAD		0.117%	3.708%	0.046%	0.123%	3.994%
3	LOSS % TO TOTAL LOSSES		2.930%	92.831%	1.161%	3.079%	100.000%
4							
5	OTHER MWH	17,336,391	35,105	408,661	9,366	16,151	469,283
6	LOSS % TO LOAD		0.202%	2.357%	0.054%	0.093%	2.707%
7	LOSS % TO TOTAL LOSSES		7.481%	87.082%	1.996%	3.442%	100.000%
SUMMER - KU							
8	PEAK - MW	4,715	5.81	136.65	2.40	5.40	150.25
9	LOSS % TO LOAD		0.123%	2.898%	0.051%	0.115%	3.187%
10	LOSS % TO TOTAL LOSSES		3.864%	90.945%	1.597%	3.594%	100.000%
11							
12	SUMMER MWH	9,398,766	17,551	225,647	5,454	9,633	258,285
13	LOSS % TO LOAD		0.187%	2.401%	0.058%	0.102%	2.748%
14	LOSS % TO TOTAL LOSSES		6.795%	87.364%	2.112%	3.730%	100.000%
TOTAL ANNUAL - KU							
15	SUMMER PEAK - MW	4,715	5.81	136.65	2.40	5.40	150.25
16	LOSS % TO SUMMER PEAK MW		0.123%	2.898%	0.051%	0.115%	3.187%
17	ANNUAL MWH	26,735,158	52,656	634,307	14,820	25,784	727,568
18	LOSS % TO ANNUAL MWH		0.197%	2.373%	0.055%	0.096%	2.721%
LOSS FACTORS - KU							
19	Demand						1.03187
20	Energy						1.02721

NOTES:

- (1) Summer Period includes June, July, August, and September.
- (2) Other Period includes all non Summer Period months.
- (3) Transmission Use = Load + Exports + Passthroughs
- (4) Transmission Fixed includes Corona Losses
- (5) Transmission Variable includes Losses at 0.5% from Appendix A (MW) and Appendix B (MWH)

Kentucky Utilities	OTHER	SUMMER	OTHER	SUMMER
	2/11/11 8:00 February-11	7/11/11 16:00 July-11		
Loads:				
1 KU Load (including losses)	4,292	4,102		
2 EKPC on KU	446	355		
3 TVA on KU	59	58		
4 OMU Load (3%)	-	12		
5 BREC on KU	6	6		
6 KMPA Load (3%)	108	129		
7 Total Load	<u>4,911</u>	<u>4,662</u>	4,911.00	4,662.00
Export (Delivered):				
8 KU Off-System Sales	-	-		
9 AMEM - Pass Through	-	-		
10 CARGILL - Pass Through	-	-		
11 OMU Exports	249	204		
12 KMPA Exports	-	-		
13 Constellation - Pass Through	-	-		
14 TEA - Pass Through	-	-		
15 TVA (OATT) - Pass Through	-	-		
16 Total Exports	<u>249</u>	<u>204</u>	249.00	204.00
17 BTM (0.5%) - OMU Network Load	112	182		
18 BTM (0.5%) - KMPA Gen	-	49		
19 Total BTM	<u>112</u>	<u>231</u>		
20 Losses at 0.5%	0.560	1.155	5,160.00	4,866.00
21 Losses from Schedule 5, Lines 1 and 8			-198.71	-151.41
22 Peak MW Load			<u>4,961.29</u>	<u>4,714.59</u>

Louisville Gas and Electric

Loads:				
23 LGE Load (including losses)	1,725	2,654		
23 EKPC on LGE	61	77		
24 Hoosier on LGE	5	6		
25 Total Load	<u>1,791</u>	<u>2,737</u>	1,791.00	2,737.00
Export (Delivered):				
26 IMEA	146	146		
27 IMPA	155	157		
28 LGE Off-System Sales	8	-		
29 OVEC to SIGE	-	-		
30 Total Exports	<u>309</u>	<u>303</u>	309.00	303.00
31 LGE to KU	1,228	1,020	1,228.00	1,020.00
32 Losses from Schedule 4, Lines 1 and 8			3,328.00	4,060.00
33 Peak MW Load			-27.75	-57.95
			<u>3,300.25</u>	<u>4,002.05</u>

Notes:

- (1) Information above was gathered through the Peak Load spreadsheet which is used for FERC Form 1 data collection. Additionally, information was gathered from the individual billings each month, which also flows into FERC Form 1.
- (2) OSS information was gathered through multiple spreadsheets from Revenue Accounting and Transmission groups.

Kentucky Utilities

Prepared by: FR/DH

	February-11	March-11	April-11	May-11	June-11	July-11	August-11	September-11	October-11	November-11	December-11	January-12	Total	Other	Summer
Loads:															
1 KU Load (including losses)	1,882,033	1,838,010	1,567,127	1,688,187	1,906,541	2,167,087	2,097,914	1,653,158	1,650,548	1,687,623	1,918,215	2,083,767	22,140,210		
2 EKPC on KU	192,766	183,756	155,967	163,451	164,293	182,579	182,121	147,273	142,289	161,421	192,322	213,632	2,081,870		
3 TVA on KU	30,019	26,656	20,497	22,985	27,885	34,587	29,211	21,634	19,664	26,719	36,278	34,830	330,965		
4 OMU Load (3%)	-	-	-	555	-	1,043	1,328	165	6,757	-	-	-	9,848		
5 BREC on KU	3,047	2,972	2,440	2,382	2,575	2,943	3,367	3,272	3,715	2,495	3,797	4,364	37,370		
6 KMPA Load (3%)	53,933	54,624	50,868	58,455	71,032	79,177	77,514	57,137	49,740	51,011	56,115	56,274	715,880		
7 Total Load	2,161,798	2,106,018	1,796,898	1,936,015	2,172,326	2,467,416	2,391,455	1,882,639	1,872,713	1,929,269	2,206,727	2,392,867	25,316,143	16,402,307	8,913,836
Export (Delivered):															
8 KU Off-System Sales	10,003	1,971	14	13,001	23,568	12,175	4,828	384	29,307	2,890	542	265	98,948		
9 AMEM - Pass Through	-	-	2,400	-	-	-	-	-	12,000	2,400	11,338	51,500	79,638		
10 CARGILL - Pass Through	31,261	100	-	23,399	2,400	-	-	20,527	13,749	70	-	-	91,506		
11 OMU Exports	165,206	183,023	175,905	50,051	156,463	143,444	137,842	155,042	106,507	137,874	176,030	158,940	1,746,327		
12 KMPA Exports	-	-	-	-	-	-	-	-	59	-	-	-	59		
13 Constellation - Pass Through	-	-	-	11,734	4,740	24,485	34,163	25,048	34,099	-	-	-	134,269		
14 TEA - Pass Through	-	-	-	-	-	-	-	-	59	66	-	-	125		
15 TVA (OATT) - Pass Through	-	-	308	-	-	-	-	-	-	-	-	-	308		
16 Total Exports	206,470	185,094	178,627	98,185	187,171	180,104	176,833	201,001	195,780	143,300	187,910	210,705	2,151,180	1,406,071	745,109
17 BTM (0.5%) - OMU Network Load	64,375	67,851	62,989	71,662	86,097	103,156	96,293	73,876	61,587	65,420	69,832	70,719	893,857		
18 BTM (0.5%) - KMPA Gen	-	-	-	1,054	4,315	9,837	4,422	858	1,839	-	1,479	1,872	25,677		
19 Total BTM	64,375	67,851	62,989	72,716	90,412	112,993	100,715	74,734	63,426	65,420	71,311	72,591	919,534		
20 Losses at 0.5%	322	339	315	364	452	565	504	374	317	327	357	363	4,598		
21 Total MWH Input														17,808,378	9,658,945
22 Losses from Schedule 5, Lines 5 and 12														-471,986	-260,179
23 Total MWH Output														17,336,391	9,398,766

Louisville Gas and Electric

	February-11	March-11	April-11	May-11	June-11	July-11	August-11	September-11	October-11	November-11	December-11	January-12	Total	Other	Summer
Loads:															
23 LGE Load (including losses)	903,869	935,217	852,840	998,568	1,189,433	1,431,090	1,316,506	968,118	877,979	870,461	958,046	988,020	12,290,147		
24 EKPC on LGE	25,617	24,530	20,953	24,482	30,141	37,883	33,856	23,583	21,869	22,649	27,706	29,346	322,615		
25 Hoosier on LGE	3,006	3,093	2,628	3,247	3,465	3,908	3,767	3,220	3,081	2,998	3,210	3,263	38,886		
26 Total Load	932,492	962,840	876,421	1,026,297	1,223,039	1,472,881	1,354,129	994,921	902,929	896,108	988,962	1,020,629	12,651,648	7,606,677	5,044,971
Export (Delivered):															
27 IMEA	87,925	74,691	45,921	89,073	102,288	100,626	86,582	74,691	75,238	61,640	90,715	99,872	989,262		
28 IMPA	93,431	79,319	48,912	94,516	107,515	106,729	90,741	77,329	79,575	65,340	97,587	105,971	1,046,965		
29 LGE Off-System Sales	155,240	139,458	45,904	124,917	96,244	96,890	49,158	108,739	205,726	207,341	158,716	95,688	1,484,021		
30 OVEC to SIGE	-	-	-	-	-	-	-	-	-	-	-	-	-		
31 Total Exports	336,596	293,468	140,737	308,506	306,047	304,245	226,481	260,759	360,539	334,321	347,018	301,531	3,520,248	2,422,716	1,097,532
32 LGE to KU	484,518	444,877	370,225	397,072	364,002	440,065	446,201	438,994	458,456	438,203	561,790	610,428	5,454,831	3,765,569	1,689,262
33 Total MWH Input														13,794,962	7,831,765
34 Losses from Schedule 4, Lines 5 and 12														-115,779	-83,625
35 Total MWH Output														13,679,183	7,748,140

Information above was gathered through the Peak Load spreadsheet which is used for FERC Form 1 data collection. Additionally, information was gathered from the individual billings each month, which also flows into FERC Form 1 OSS information was gathered through multiple spreadsheets from Revenue Accounting and Transmission groups.

LGEE Loss Summary

LGE Loss Summary			Transmission Losses		Generation Losses	
Season	Month		Fixed	Variable	Fixed	Variable
1	O	01	1,944	8,405	1,405	3,124
2	O	02	1,753	7,950	1,165	3,114
3	O	03	1,970	8,159	1,205	3,317
4	O	04	1,923	6,323	1,217	2,547
5	O	05	1,978	9,932	1,207	3,076
6	S	06	1,877	13,384	1,289	3,615
7	S	07	1,933	16,655	1,542	4,380
8	S	08	1,940	15,067	1,454	3,936
9	S	09	1,915	8,781	1,376	2,872
10	O	10	1,999	7,087	1,180	2,917
11	O	11	1,937	6,926	1,273	2,856
12	O	12	1,960	8,252	1,402	3,072
13		Total	23,129	116,921	15,715	38,826
14		Summer Corona	1,609			
15	S	Total LGE Summer	9,274	53,887	5,661	14,803
16		Other Corona	3,204			
17	O	Total LGE Other	18,668	63,034	10,054	24,023

KU Loss Summary			Transmission Losses		Generation Losses	
Season	Month		Fixed	Variable	Fixed	Variable
18	O	01	3,246	66,020	1,272	2,314
19	O	02	2,937	65,153	1,209	2,146
20	O	03	3,279	51,357	1,244	2,220
21	O	04	3,200	40,542	1,058	1,929
22	O	05	3,312	41,568	1,190	2,000
23	S	06	3,155	59,549	1,405	2,449
24	S	07	3,247	64,025	1,459	2,832
25	S	08	3,260	61,754	1,436	2,666
26	S	09	3,187	42,213	1,154	1,686
27	O	10	3,306	42,719	1,079	1,752
28	O	11	3,189	49,382	1,089	1,865
29	O	12	3,271	54,623	1,225	1,925
30		Total	38,589	638,905	14,820	25,784
31		Summer Corona	4,702			
32	S	Total KU Summer	17,551	227,541	5,454	9,633
33		Other Corona	9,365			
34	O	Total KU Other	35,105	411,364	9,366	16,151

LGEE Loss Summary			Transmission Losses		Generation Losses	
Season	Month		Fixed	Variable	Fixed	Variable
35	O	01	5,190	74,425	2,677	5,438
36	O	02	4,690	73,103	2,374	5,260
37	O	03	5,249	59,516	2,449	5,537
38	O	04	5,123	46,865	2,275	4,476
39	O	05	5,290	51,500	2,397	5,076
40	S	06	5,032	72,933	2,694	6,064
41	S	07	5,180	80,680	3,001	7,212
42	S	08	5,200	76,821	2,890	6,602
43	S	09	5,102	50,994	2,530	4,558
44	O	10	5,305	49,806	2,259	4,669
45	O	11	5,126	56,308	2,362	4,721
46	O	12	5,231	62,875	2,627	4,997
47		Total	61,718	755,826	30,535	64,610
48		Summer Corona	6,311			
49	S	Total LGEE Summer	26,825	281,428	11,115	24,436
50		Other Corona	12,569			
51	O	Total LGEE Other	53,773	474,398	19,420	40,174

Notes:

(1) Includes Corona Losses from Workpaper 3

Summer Peak Hour 2011-07-11-1600

		Transmission Losses		Generation Losses	
		Fixed (1)	Variable	Fixed	Variable
1	KU	5.8	137.8	2.4	5.4
2	LG&E	3.0	43.5	2.9	8.5
3	Combined	8.9	181.3	5.3	13.9

Winter Peak Hour 2011-02-11-0800

		Transmission Losses		Generation Losses	
		Fixed (1)	Variable	Fixed	Variable
4	KU	5.8	184.5	2.3	6.1
5	LG&E	3.1	16.5	2.1	6.0
6	Combined	9.0	201.0	4.4	12.1

		Corona Losses (MW)	
		Fixed (1)	
7	KU	1.606	
8	LG&E	0.549	
9	Combined	2.155	

Notes:

(1) Includes Corona Losses from Workpaper 3

Hour	LG&E Load	KU on LG&E	EKPC on LG&E	HE on LG&E	LG&E T Loss-f	LG&E T Loss-v	LG&E G Loss-f	LG&E G Loss-v	Net Export	BLG Export	Month
2011-02-01-0100	1217.7	6.3	35.6	4.3	2.6	11.5	1.7	4.6	1394.6	0	02
2011-02-01-0200	1179.1	6	34.4	4.4	2.6	11	1.7	4.4	1373.9	0	02
2011-02-01-0300	1147.9	5.8	33.6	4	2.6	10.8	1.7	4.3	1354.7	0	02
2011-02-01-0400	1138.1	5.6	33	4	2.6	11.6	1.7	4.3	1374.9	0	02
2011-02-01-0500	1149.1	5.7	33.8	3.9	2.6	12	1.7	4.5	1398.1	0	02
2011-02-01-0600	1201.1	6	37.3	4	2.6	12.5	1.7	4.6	1379.2	0	02
2011-02-01-0700	1347.6	6.8	41.9	4.1	2.6	15.3	1.7	5.6	1454.3	0	02
2011-02-01-0800	1429.8	7.2	43.4	4.3	2.6	15.6	1.7	5.6	1354.1	0	02
2011-02-01-0900	1431	7.1	41.9	4.7	2.6	15.6	1.7	5.5	1329.5	0	02
2011-02-01-1000	1424.8	7	41	4.6	2.6	15.4	1.7	5	1236.6	0	02
2011-02-01-1100	1440.5	7	40.8	4.6	2.6	14	1.7	4.6	1122.7	0	02
2011-02-01-1200	1442.4	6.9	40.3	4.5	2.6	14.3	1.7	4.7	1132	0	02
2011-02-01-1300	1438.7	6.8	40.3	4.5	2.6	14.5	1.7	4.8	1159.1	0	02
2011-02-01-1400	1394.7	6.7	39.4	4.4	2.6	13.6	1.7	4.6	1138.9	0	02
2011-02-01-1500	1371.6	6.6	39	4.6	2.6	13.2	1.7	4.3	1098	0	02
2011-02-01-1600	1388.5	6.7	39.7	4.6	2.6	13.2	1.7	4.2	1038.9	0	02
2011-02-01-1700	1408.8	6.8	41.6	4.3	2.6	13.5	1.7	4.3	1064.8	0	02
2011-02-01-1800	1448.7	7	44.2	4.3	2.6	14.7	1.7	4.6	1129.1	0	02
2011-02-01-1900	1483.7	7.2	45.7	4.4	2.6	15.1	1.7	4.8	1162.1	0	02
2011-02-01-2000	1450.8	7.1	45.2	4.7	2.6	15	1.7	4.6	1149.2	0	02
2011-02-01-2100	1414.2	7	44	4.7	2.6	14.5	1.7	4.6	1163.9	0	02
2011-02-01-2200	1337.9	6.6	41.1	4.6	2.6	12.8	1.7	4.5	1190.9	0	02
2011-02-01-2300	1255.5	6.1	37.2	4.2	2.6	11.5	1.7	4.1	1168.2	0	02
2011-02-02-0000	1140.4	5.7	32.8	4	2.6	9	1.7	3.4	1062.1	0	02
2011-02-02-0100	1076.3	5.4	30.7	4.3	2.6	8.1	1.7	3.2	1029.2	0	02
2011-02-02-0200	1046.7	5.3	30.5	4.2	2.6	7.9	2.1	3.3	1168.7	0	02
2011-02-02-0300	1071.2	5.4	32.4	4.1	2.6	8.1	2.1	3.5	1273.5	0	02
2011-02-02-0400	1101.7	5.7	35.5	4.2	2.6	8.3	2	3.6	1282.3	0	02
2011-02-02-0500	1162.1	6.1	38.3	4.3	2.6	9.4	2.1	4.2	1451.1	0	02
2011-02-02-0600	1230.2	7	42.9	4.5	2.6	10.5	2.1	4.6	1495.4	0	02
2011-02-02-0700	1387.9	8.1	49.3	4.7	2.6	13.1	2.1	5.6	1531.5	0	02
2011-02-02-0800	1502.7	9	51.8	4.6	2.6	15.4	2.1	6.5	1611.9	0	02
2011-02-02-0900	1511.5	9	50.4	4.6	2.6	15.2	2.1	6.3	1585.1	0	02
2011-02-02-1000	1514.9	9.3	49.8	4.8	2.6	15.1	2.1	6.2	1560.6	0	02
2011-02-02-1100	1544.2	9.1	49.4	4.9	2.6	15.6	2.1	6.4	1580	0	02
2011-02-02-1200	1552	9.1	49	4.7	2.6	15.7	2.1	6.4	1549	0	02
2011-02-02-1300	1558.5	9	48.6	4.5	2.6	15.9	2.1	6.8	1617.1	0	02
2011-02-02-1400	1559.7	8.9	48.3	4.5	2.6	16	2.1	6.7	1606.8	0	02
2011-02-02-1500	1554.9	8.8	47.3	4.5	2.6	15.8	2.1	6.6	1601.7	0	02
2011-02-02-1600	1538.9	8.7	47.9	4.6	2.6	15.6	2.1	6.5	1595	0	02
2011-02-02-1700	1537.9	8.6	50.4	5	2.6	15.6	2.1	6.9	1654.1	0	02
2011-02-02-1800	1556.3	9	52.5	5	2.6	15.6	2.1	6.7	1595.9	0	02
2011-02-02-1900	1616.8	9.4	56.5	5	2.6	16.6	2.1	6.5	1492.9	0	02
2011-02-02-2000	1618.7	9.4	57.6	5	2.6	16.6	2.1	6.5	1486	0	02

Hour	KU Load	KU on LG&E	KU on EKPC	EKPC on KU	BREC on KU	TVA on KU	OMU on KU	KMPA on KU	KU T Loss-f	KU T Loss-v	KU G Loss-f	KU G Loss-v	Net Export	OMU Export	PADP Gen	Month
2011-02-01-0100	2345.7	6.3	59.6	280.6	5	37.6	82	68.6	4.4	85.8	1.9	2.1	-1050.5	146.1	0	02
2011-02-01-0200	2259.9	6	57.9	265.6	4.9	35.2	83.5	65	4.4	82.9	1.9	1.9	-924.7	200.2	0	02
2011-02-01-0300	2191.3	5.8	56.9	257.6	4.7	33.7	82.5	63.8	4.4	82.7	1.9	1.8	-891.2	209	0	02
2011-02-01-0400	2131.8	5.6	56.5	257.6	4.7	32.5	83.8	63.4	4.4	88.1	1.9	1.9	-713	261.3	0	02
2011-02-01-0500	2137.1	5.7	56.5	259.3	4.5	32.5	85.3	64.1	4.4	88	1.9	2.1	-658.3	285.5	0	02
2011-02-01-0600	2244.3	6	58.2	274.8	5.3	33.8	86.3	66.1	4.4	92.3	1.9	2.3	-679.2	282.5	0	02
2011-02-01-0700	2500.3	6.8	62.4	286.8	5.5	37.6	91.7	72.1	4.3	103.6	1.9	3.5	-549.8	277.5	0	02
2011-02-01-0800	2682.1	7.2	67.2	271.4	5.6	43	102.2	82.5	4.3	100	1.9	3.5	-768.4	277	0	02
2011-02-01-0900	2691.9	7.1	68.7	287	5.7	40.3	110.7	88.1	4.3	100.7	1.9	3.5	-802.1	259.3	0	02
2011-02-01-1000	2698.6	7	69	273.9	6.1	38.8	111.1	91.6	4.3	100.1	1.9	3.5	-811.1	222.6	0	02
2011-02-01-1100	2693.2	7	68.6	279.1	5.4	38.7	111.1	92.6	4.4	92.6	1.9	3.1	-1025.6	139.2	0	02
2011-02-01-1200	2651	6.9	67.8	248.7	5.9	38.1	111	93.1	4.4	90.2	1.9	3	-973.1	146.9	0	02
2011-02-01-1300	2613.9	6.8	67	275.6	6	37.6	110	93.3	4.4	90.3	1.8	3.2	-891.5	181	0	02
2011-02-01-1400	2572.4	6.7	66.8	272.8	5.7	37.1	108.8	92.7	4.4	85.9	1.8	2.9	-969.7	143.2	0	02
2011-02-01-1500	2589.4	6.6	67.4	265.5	5.9	36.7	111.3	91.2	4.4	86.2	1.8	3.1	-898.7	166	0	02
2011-02-01-1600	2575.3	6.7	66.9	274.1	6.1	36.9	111.4	89.8	4.4	88.3	1.8	3.3	-812.7	181	0	02
2011-02-01-1700	2602.6	6.8	67.8	275.4	6.3	38.4	108.4	87.5	4.4	91.7	1.8	3.4	-803	190.5	0	02
2011-02-01-1800	2624.9	7	68.9	238.4	5.8	41.1	109.3	86.5	4.4	94.1	1.8	3.5	-723.5	205.5	0	02
2011-02-01-1900	2663.8	7.2	69.2	302.1	5.5	43.6	111.1	87.6	4.4	92.3	1.8	3.7	-789.1	204.2	0	02
2011-02-01-2000	2622.6	7.1	68.4	289	5.7	44.3	112.1	87.7	4.4	93.4	1.8	3.6	-713.7	256.7	0	02
2011-02-01-2100	2563.1	7	66.5	273.6	6	43.4	110.2	89.2	4.4	90.2	1.8	3.4	-687.2	282	0	02
2011-02-01-2200	2507.5	6.6	64.8	209.9	6.6	42.3	103.5	89.6	4.4	82.9	1.8	3	-751.7	205	0	02
2011-02-01-2300	2368.7	6.1	61.7	207	6	40.3	99.1	87.9	4.4	79.3	1.8	2.5	-830.1	182.7	0	02
2011-02-02-0000	2254.8	5.7	59.2	259.1	6.1	39.4	100.7	85.1	4.4	67.9	1.8	1.7	-1208.7	5.4	0	02
2011-02-02-0100	2176.4	5.4	57.5	224.2	5	38.8	96.9	81.1	4.4	58.5	1.8	1.6	-1101	62.2	0	02
2011-02-02-0200	2133.6	5.3	56.1	215.2	5.4	41	96.4	79.9	4.4	65.9	1.8	1.8	-950.7	105.5	0	02
2011-02-02-0300	2110	5.4	57.9	216.3	5.3	44.4	98.6	79.9	4.4	68.5	1.8	1.7	-899.7	151.2	0	02
2011-02-02-0400	2176.8	5.7	60.6	227	5.2	47	96.1	79.4	4.4	69.7	1.8	1.8	-955	156	0	02
2011-02-02-0500	2336.8	6.1	63.4	169.1	5	48.8	95.2	80.5	4.4	77.7	1.8	1.9	-1049.8	155.8	0	02
2011-02-02-0600	2567.8	7	68.1	194.7	5.6	52.8	96.9	83.3	4.4	88.2	1.8	2.4	-1133.3	155	0	02
2011-02-02-0700	2924.8	8.1	74.6	226.9	5.4	58.2	102.9	89.2	4.3	112.3	1.9	3.4	-1207.1	154.8	0	02
2011-02-02-0800	3226	9	81.8	238.4	5.4	64.2	113.3	99.3	4.3	124.3	1.9	4.5	-1232.2	149.9	0	02
2011-02-02-0900	3300.9	9	84.2	232.4	6	62.8	119.2	103.1	4.3	126.6	1.9	4.6	-1250.3	142.5	0	02
2011-02-02-1000	3382	9.3	84.9	235.4	6.4	63	121.8	105.2	4.3	133.4	1.9	4.8	-1295.4	137.9	0	02
2011-02-02-1100	3356	9.1	85.9	238.8	6.8	63.9	123.4	106.3	4.3	134.6	1.9	4.8	-1275.6	137.7	0	02
2011-02-02-1200	3363.5	9.1	86.2	239.7	6.6	62.9	123.4	106.9	4.3	136.2	2	4.8	-1235.3	138.5	0	02
2011-02-02-1300	3378.4	9	85.4	236.6	6.5	62.3	123.5	106.1	4.3	141.1	2	4.7	-1315.8	137.3	0	02
2011-02-02-1400	3340.1	8.9	85.3	232.6	7.3	60.8	125.9	104.4	4.3	142.4	2	4.7	-1293.7	137.4	0	02
2011-02-02-1500	3329	8.8	84.5	230.2	6.9	60.1	127.1	103.6	4.3	141.5	2	4.6	-1289.9	137.4	0	02
2011-02-02-1600	3260.3	8.7	83.9	232.4	7.1	60.1	125.4	102.5	4.3	139.7	2	4.5	-1250.9	138.6	0	02
2011-02-02-1700	3267.5	8.6	84.2	273.5	7.4	61.6	110.9	100.9	4.3	142.4	1.9	4.4	-1376.6	138.8	0	02
2011-02-02-1800	3385	9	85	325.2	7.4	64.4	112.4	102.1	4.3	138.9	1.9	4.6	-1384.8	180.4	0	02
2011-02-02-1900	3495.9	9.4	86.9	325.3	6.7	68.5	119	106.7	4.3	143.5	1.9	4.9	-1408.1	233.8	0	02
2011-02-02-2000	3498	9.4	87.8	340	6.3	69.5	122.9	108.5	4.3	146.4	1.9	4.9	-1405.7	260.1	0	02

LGE & KU - CORONA LOSS ESTIMATE

	VOLTAGE (kV)	MILES	CORONA PEAK LOSS FACTOR (MW Mile)	CORONA LOSSES (MW)	CORONA WINTER HOURS & LOSSES (MWH)	CORONA SUMMER HOURS & LOSSES (MWH)	CORONA TOTAL LOSSES (MWH)
A. Fair Weather Corona Losses							
	LGE				5,832	2,928	
1	345	172	0.0032	0.549	3,204	1,609	4,813
2	161	116	0.0000	0.000	0	0	0
3	138	334	0.0000	0.000	0	0	0
4	69	289	0.0000	0.000	0	0	0
5	Subtotal	911		0.549	3,204	1,609	4,813
	KU				5,832	2,928	
6	500	57	0.0060	0.341	1,990	999	2,989
7	345	395	0.0032	1.265	7,375	3,703	11,078
8	161	518	0.0000	0.000	0	0	0
9	138	888	0.0000	0.000	0	0	0
10	69	2,218	0.0000	0.000	0	0	0
11	Subtotal	4,076		1.606	9,365	4,702	14,067
12	TOTAL	4,987		2.155	12,569	6,311	18,880
B. Unmetered Station Use							
13	Estimated Unmetered Substation Use at			0.0010			

NOTE:

(1) Lines 5 and 11 loss results included in Schedules 3, 4, and 5.

LGE & KU

Voltage by Company	Number of Miles		
	LGE	KU	Total
1 LGE			
2 Overhead			
3 345	171.7		
4 161	116.4		
5 138	329.6		
6 69	286.3		
7 Total Overhead	904.0		904.0
8			
9 Underground			
10 138	4.0		
11 69	2.9		
12 Total Underground	6.9		6.9
13			
14 Total LGE	910.9		910.9
15			
16 KU			
17 500		56.9	
18 345		395.2	
19 161		518.2	
20 138		887.6	
21 69		2,218.4	
22			
23 Total KU		4,076.3	4,076.3
24			
25			
26 Total Pole Miles	910.9	4,076.3	4,987.2

Appendix B

Results of KU
2010 Loss Analysis



KENTUCKY UTILITIES 2010 LOSS ANALYSIS

KENTUCKY UTILITIES

EXHIBIT 1

SUMMARY OF COMPANY DATA

ANNUAL PEAK	4,354 MW
ANNUAL SYSTEM INPUT	23,358,179 MWH
ANNUAL SALES	22,015,243 MWH
SYSTEM LOSSES @ INPUT	1,342,936 or 5.75%
SYSTEM LOAD FACTOR	61.2%

SUMMARY OF LOSSES - OUTPUT RESULTS

SERVICE	KV	--- MW --- Input	% TOTAL	--- MWH --- Input	% TOTAL
TRANS	500,345,138 69	138.9 3.19%	44.78%	642,185 2.75%	47.82%
PRIM SUBS	33,12,1	20.6 0.47%	6.64%	102,336 0.44%	7.62%
PRIMARY	33,12,1	91.5 2.10%	29.49%	267,414 1.14%	19.91%
SECONDARY	120/240,to,477	59.2 1.36%	19.09%	331,001 1.42%	24.65%
TOTAL		310.2 7.12%	100.00%	1,342,936 5.75%	100.00%

SUMMARY OF LOSS FACTORS

SERVICE	KV	CUMMULATIVE SALES EXPANSION FACTORS			
		DEMAND (Peak)		ENERGY (Annual)	
		d	1/d	e	1/e
TOT TRANS	500,345,138 69	1.03295	0.96810	1.02827	0.97251
PRIM SUBS	33,12,1	1.03883	0.96262	1.03382	0.96728
PRIMARY	33,12,1	1.06632	0.93781	1.05011	0.95228
SECONDARY	120/240,to,477	1.09017	0.91729	1.07651	0.92892

SUMMARY OF CONDUCTOR INFORMATION

EXHIBIT 2

DESCRIPTION	CIRCUIT MILES	LOADING % RATING	----- MW LOSSES -----		
			LOAD	NO LOAD	TOTAL
--- BULK ----- 500 KV OR GREATER -----					
TIE LINES	0.0	0.00%	0.000	0.000	0.000
<u>BULK TRANS</u>	<u>0.0</u>	<u>0.00%</u>	<u>0.000</u>	<u>0.000</u>	<u>0.000</u>
SUBTOT	0.0		0.000	0.000	0.000
--- TRANS ----- 138 KV TO 500.00 KV -----					
TIE LINES	0	0.00%	0.000	0.000	0.000
TRANS1	345 KV	0.0	0.000	0.000	0.000
<u>TRANS2</u>	<u>138 KV</u>	<u>0.0</u>	<u>0.000</u>	<u>0.000</u>	<u>0.000</u>
SUBTOT	0.0		0.000	0.000	0.000
--- SUBTRANS ----- 35 KV TO 138 KV -----					
TIE LINES	0	0.00%	0.000	0.000	0.000
SUBTRANS1	KV	0.0	0.000	0.000	0.000
SUBTRANS2	KV	0.0	0.000	0.000	0.000
<u>SUBTRANS3</u>	<u>KV</u>	<u>0.0</u>	<u>0.000</u>	<u>0.003</u>	<u>0.003</u>
SUBTOT	0.0		0.000	0.003	0.003
PRIMARY LINES	16,372		80.472	4.246	84.718
SECONDARY LINES	3,708		4.160	0.000	4.160
SERVICES	7,637		9.210	1.131	10.341
TOTAL	27,717		93.843	5.380	99.223

----- MWH LOSSES -----		
LOAD	NO LOAD	TOTAL
0	0	0
<u>0</u>	<u>0</u>	<u>0</u>
0	0	0
0	0	0
<u>0</u>	<u>0</u>	<u>0</u>
0	0	0
0	0	0
<u>0</u>	<u>26</u>	<u>26</u>
0	26	26
230,573	37,193	267,766
11,528	0	11,528
29,961	9,910	39,872
272,062	47,130	319,192

SUMMARY OF TRANSFORMER INFORMATION

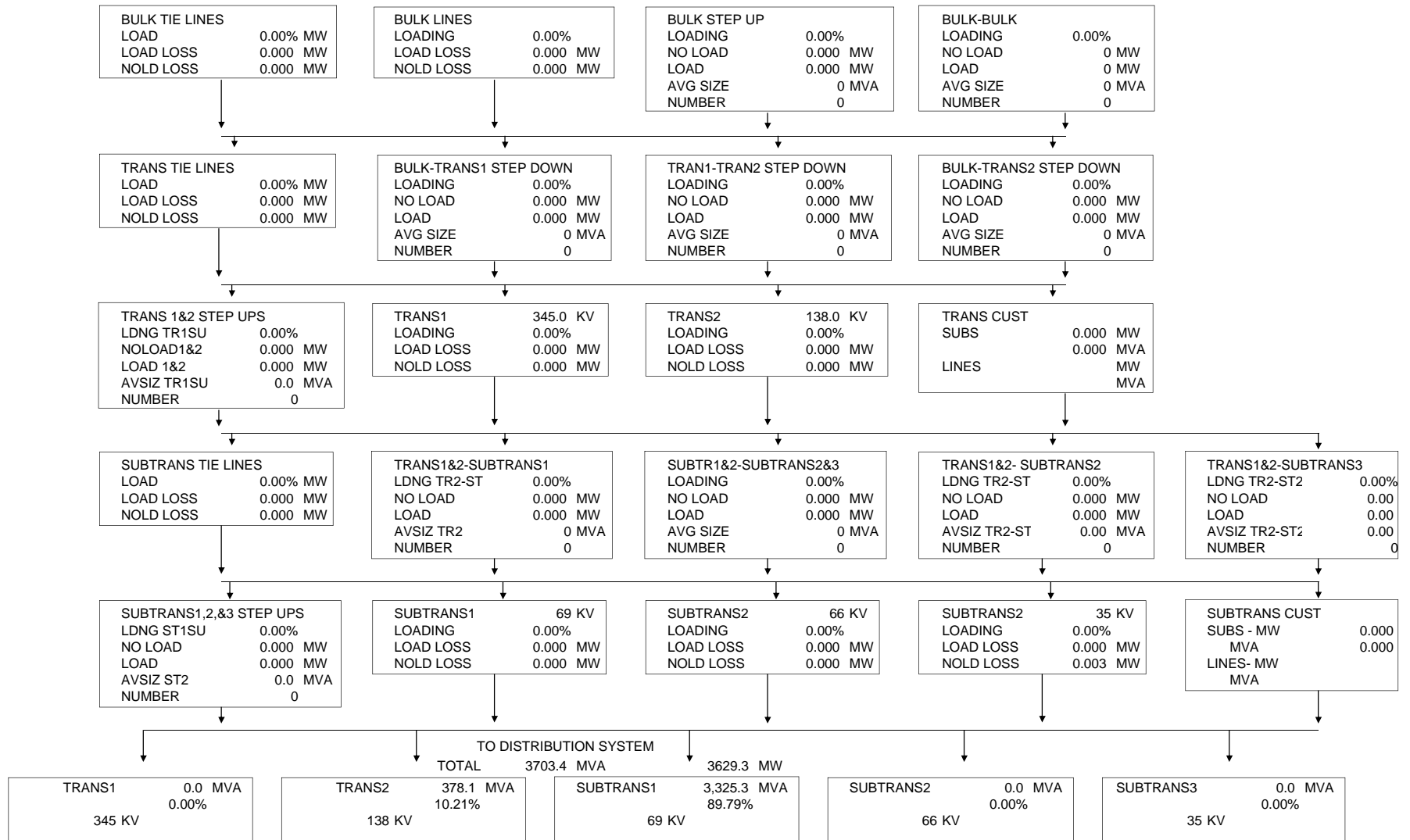
EXHIBIT 3

DESCRIPTION	KV CAPACITY		NUMBER TRANSFMR	AVERAGE SIZE	LOADING %	MVA LOAD	----- MW LOSSES -----			----- MWH LOSSES -----			
	VOLTAGE	MVA					LOAD	NO LOAD	TOTAL	LOAD	NO LOAD	TOTAL	
BULK STEP-UP	500	0.0	0	0.0	0.00%	0	0.000	0.000	0.000	0	0	0	
BULK - BULK		0.0	0	0.0	0.00%	0	0	0.000	0.000	0	0	0	
BULK - TRANS1	345	0.0	0	0.0	0.00%	0	0.000	0.000	0.000	0	0	0	
BULK - TRANS2	138	0.0	0	0.0	0.00%	0	0.000	0.000	0.000	0	0	0	
TRANS1 STEP-UP	345	0.0	0	0.0	0.00%	0	0.000	0.000	0.000	0	0	0	
TRANS1 - TRANS2	138	0.0	0	0.0	0.00%	0	0.000	0.000	0.000	0	0	0	
TRANS1-SUBTRANS1	69	0.0	0	0.0	0.00%	0	0.000	0.000	0.000	0	0	0	
TRANS1-SUBTRANS2	66	0.0	0	0.0	0.00%	0	0.000	0.000	0.000	0	0	0	
TRANS1-SUBTRANS3	35	0.0	0	0.0	0.00%	0	0.000	0.000	0.000	0	0	0	
TRANS2 STEP-UP	138	0.0	0	0.0	0.00%	0	0.000	0.000	0.000	0	0	0	
TRANS2-SUBTRANS1	69	0.0	0	0.0	0.00%	0	0.000	0.000	0.000	0	0	0	
TRANS2-SUBTRANS2	66	0.0	0	0.0	0.00%	0	0.000	0.000	0.000	0	0	0	
TRANS2-SUBTRANS3	35	0.0	0	0.0	0.00%	0	0.000	0.000	0.000	0	0	0	
SUBTRAN1 STEP-UP	69	0.0	0	0.0	0.00%	0	0.000	0.000	0.000	0	0	0	
SUBTRAN2 STEP-UP	66	0.0	0	0.0	0.00%	0	0.000	0.000	0.000	0	0	0	
SUBTRAN3 STEP-UP	35	0.0	0	0.0	0.00%	0	0.000	0.000	0.000	0	0	0	
SUBTRAN1-SUBTRAN2	66	0.0	0	0.0	0.00%	0	0.000	0.000	0.000	0	0	0	
SUBTRAN1-SUBTRAN3	35	0.0	0	0.0	0.00%	0	0.000	0.000	0.000	0	0	0	
SUBTRAN2-SUBTRAN3	35	0.0	0	0.0	0.00%	0	0.000	0.000	0.000	0	0	0	
DISTRIBUTION SUBSTATIONS													
TRANS1 -	345	33	0.0	0	0.0	0.00%	0	0.000	0.000	0.000	0	0	0
TRANS1 -	345	12	0.0	0	0.0	0.00%	0	0.000	0.000	0.000	0	0	0
TRANS1 -	345	1	0.0	0	0.0	0.00%	0	0.000	0.000	0.000	0	0	0
TRANS2 -	138	33	0.0	0	0.0	0.00%	0	0.000	0.000	0.000	0	0	0
TRANS2 -	138	12	704.7	28	25.2	53.66%	378	0.878	0.836	1.715	3,041	6,042	9,083
TRANS2 -	138	1	0.0	0	0.0	0.00%	0	0.000	0.000	0.000	0	0	0
SUBTRAN1-	69	33	279.0	18	15.5	39.75%	111	0.226	0.301	0.527	784	2,257	3,041
SUBTRAN1-	69	12	4,973.6	374	13.3	55.44%	2,758	7.347	6.518	13.865	25,435	47,736	73,171
SUBTRAN1-	69	1	957.4	164	5.8	47.72%	457	1.412	1.610	3.022	4,888	12,550	17,439
SUBTRAN2-	66	33	0.0	0	0.0	0.00%	0	0.000	0.000	0.000	0	0	0
SUBTRAN2-	66	12	0.0	0	0.0	0.00%	0	0.000	0.000	0.000	0	0	0
SUBTRAN2-	66	1	0.0	0	0.0	0.00%	0	0.000	0.000	0.000	0	0	0
SUBTRAN3-	35	33	0.0	0	0.0	0.00%	0	0.000	0.000	0.000	0	0	0
SUBTRAN3-	35	12	0.0	0	0.0	0.00%	0	0.000	0.000	0.000	0	0	0
SUBTRAN3-	35	1	0.0	0	0.0	0.00%	0	0.000	0.000	0.000	0	0	0
PRIMARY - PRIMARY			147.6	50	3.0	44.74%	66	0.198	0.200	0.398	686	1,750	2,437
LINE TRANSFRMR			9,359.1	229,808	40.7	31.58%	2,956	11.556	28.926	40.482	27,494	253,394	280,888
TOTAL			16,421	230,442				21.617	38.391	60.008	62,328	323,729	386,058

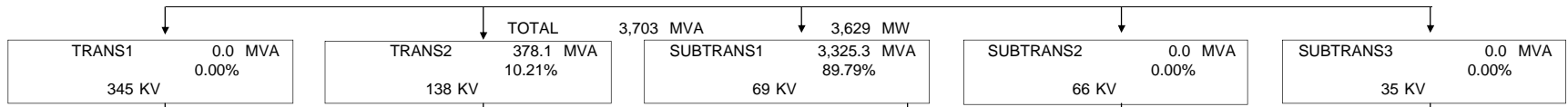
SUMMARY OF LOSSES DIAGRAM - DEMAND MODEL - SYSTEM PEAK

4354 MW

EXHIBIT 4 PAGE 1 of 2



FROM HIGH VOLTAGE SYSTEM



DISTRIBUTION SYSTEM LOAD

	PRIM1	PRIM2	PRIM3	PRIM1	PRIM2	PRIM3	PRIM1	PRIM2	PRIM3	PRIM1	PRIM2	PRIM3	PRIM1	PRIM2	PRIM3
VOLTAGE	33	12	1	33	12	1	33	12	1	33	12	1	33	12	1
LOAD MVA	0	0	0	0	378	0	111	2,758	457	0	0	0	0	0	0
% SYS TOT	0.00%	0.00%	0.00%	0.00%	10.21%	0.00%	2.99%	74.46%	12.34%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
NOLD LOSS	0.000	0.000	0.000	0.000	0.836	0.000	0.301	6.518	1.610	0.000	0.000	0.000	0.000	0.000	0.000
LOAD LOSS	0.000	0.000	0.000	0.000	0.878	0.000	0.226	7.347	1.412	0.000	0.000	0.000	0.000	0.000	0.000
AVG SIZE	0.0	0.0	0.0	0.0	25.2	0.0	15.5	13.3	5.8	0.0	0.0	0.0	0.0	0.0	0.0
NUMBER	0	0	0	0	28	0	18	374	164	0	0	0	0	0	0
DIVERSITY RATIO	0.000	0.000	0.000	0.000	1.000	0.000	1.000	1.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000

PRIMARY LINES	
LOADING	3538.386 MW
@ SYS PF	3610.598 MVA
LOAD LOSS	80.472 MW
NOLD LOSS	4.246 MW
TOT LOSS	84.718 MW

PRIM/PRIM TRANSF	
LOADING	66.024 MW
NOLD LOSS	0.200 MW
LOAD LOSS	0.198 MW
AVG SIZE	2.95
NUMBER	50

PRIM CUST LOADS	
NO LINES	0.000 MW
CUST SUB	0.000 MVA
NO LINES	71.500 MW
CO. SUB	72.959 MVA
PRIM WITH	750.000 MW
LINES	815.217 MVA

LINE TRANSFORMERS		
LOADING	2703.270 MW	2996.392 MVA
NOLD LOSS	28.926	MW
LOAD LOSS	11.556	MW
AVG SIZE	40.7	KVA
NUMBER	229808	

SECONDARY LINES	
LOAD	851.123 MW
LOAD LOSS	4.160 MW
NOLD LOSS	0.000 MW
TOT LOSS	4.160 MW

NO SECONDARY LINES	
LOAD	1811.665 MW

SERVICES	
LOAD	2658.627 MW
LOAD LOSS	9.210 MW
NOLD LOSS	1.131 MW
TOT LOSS	10.341 MW

CUSTOMER SECONDARY LOAD	
	2648.286 MW

SUMMARY of SALES and CALCULATED LOSSES

EXHIBIT 5

LOSS # AND LEVEL	MW LOAD	NO LOAD +	LOAD =	TOT LOSS	EXP FACTOR	CUM EXP FAC	MWH LOAD	NO LOAD +	LOAD =	TOT LOSS	EXP FACTOR	CUM EXP FAC
1 BULK XFMMR	0.0	0.00	0.00	0.00	0.000000	0.000000	0	0	0	0	0	0
2 BULK LINES	0.0	0.00	0.00	0.00	0.000000	0.000000	0	0	0	0	0.000000	0.000000
3 TRANS1 XFMR	0.0	0.00	0.00	0.00	0.000000	0.000000	0	0	0	0	0.000000	0.000000
4 TRANS1 LINES	0.0	0.00	0.00	0.00	0.000000	0.000000	0	0	0	0	0.000000	0.000000
5 TRANS2TR1 SD	0.0	0.00	0.00	0.00	0.000000	0.000000	0	0	0	0	0.000000	0.000000
6 TRANS GSU	0.0	0.00	0.00	0.00	0.000000	0.000000	0	0	0	0	0.000000	0.000000
7 TRANS2 LINES	0.0	0.00	0.00	0.00	0.000000	0.000000	0	0	0	0	0.000000	0.000000
TOTAL TRAN	4,354.0	7.58	131.32	138.90	1.032953	1.032953	23,358,179	59,557	582,628	642,185	1.0282702	1.0282702
8 STR1BLK SD												
9 STR1T1 SD	0.0	0.00	0.00	0.00	0.000000	0.000000	0	0	0	0	0.000000	0.000000
10 SRT1T2 SD	0.0	0.00	0.00	0.00	0.000000	0.000000	0	0	0	0	0.000000	0.000000
11 SUBTRANS1 LINES	0.0	0.00	0.00	0.00	0.000000	0.000000	0	0	0	0	0.000000	0.000000
12 STR2T1 SD	0.0	0.00	0.00	0.00	0.000000	0.000000	0	0	0	0	0.000000	0.000000
13 STR2T2 SD	0.0	0.00	0.00	0.00	0.000000	0.000000	0	0	0	0	0.000000	0.000000
14 STR2S1 SD	0.0	0.00	0.00	0.00	0.000000	0.000000	0	0	0	0	0.000000	0.000000
15 SUBTRANS2 LINES	0.0	0.00	0.00	0.00	0.000000	0.000000	0	0	0	0	0.000000	0.000000
16 STR3T1 SD	0.0	0.00	0.00	0.00	0.000000	0.000000	0	0	0	0	0.000000	0.000000
17 STR3T2 SD	0.0	0.00	0.00	0.00	0.000000	0.000000	0	0	0	0	0.000000	0.000000
18 STR3S1 SD	0.0	0.00	0.00	0.00	0.000000	0.000000	0	0	0	0	0.000000	0.000000
19 STR3S2 SD	0.0	0.00	0.00	0.00	0.000000	0.000000	0	0	0	0	0.000000	0.000000
20 SUBTRANS3 LINES	0.0	0.00	0.00	0.00	0.000000	0.000000	0	0	0	0	0.000000	0.000000
21 SUBTRANS TOTAL	0.0	0.00	0.00	0.00	0.000000		0	0	0	0	0.000000	
22 TOT TRANS LOSS FAC	4,354.0	7.58	131.32	138.90	1.032953	1.032953	23,358,179	59,557	582,628	642,185	1.028270	1.0282702
DISTRIBUTION SUBST												
TRANS1	0.0	0.00	0.00	0.00	0.000000	0.000000	0	0	0	0	0.000000	0.000000
TRANS2	370.5	0.84	0.88	1.71	1.004649	0.000000	1,945,541	6,042	3,041	9,083	1.0046905	0.000000
SUBTR1	3,258.8	8.43	8.99	17.41	1.005372	0.000000	17,111,051	62,543	31,107	93,650	1.0055032	0.000000
SUBTR2	0.0	0.00	0.00	0.00	0.000000	0.000000	0	0	0	0	0.000000	0.000000
SUBTR3	0.0	0.00	0.00	0.00	0.000000	0.000000	0	0	0	0	0.000000	0.000000
WEIGHTED AVERAGE	3,629.3	9.26	9.86	19.13	1.005298	1.038426	19,056,592	68,585	34,148	102,733	1.0054202	1.0338436
PRIMARY INTRCHNGE	0.0				0.000000		0				0.000000	
PRIMARY LINES	3,538.2	4.25	80.67	84.92	1.024590	1.063961	17,239,383	37,193	231,259	268,453	1.0158184	1.0501973
LINE TRANSF	2,703.3	28.93	11.56	40.48	1.015203	1.080136	13,498,846	253,394	27,494	280,888	1.0212504	1.0725145
SECONDARY	2,662.8	0.00	4.16	4.16	1.001565	1.081827	13,217,958	0	11,528	11,528	1.0008729	1.0734507
SERVICES	2,658.6	1.13	9.21	10.34	1.003905	1.086051	13,206,431	9,910	29,961	39,872	1.0030283	1.0767013
TOTAL SYSTEM		=====	=====	=====				=====	=====	=====		
		51.15	246.78	297.93				428,640	917,018	1,345,658		

DEVELOPMENT of LOSS FACTORS
UNADJUSTED
DEMAND

EXHIBIT 6

LOSS FACTOR LEVEL	CUSTOMER SALES MW	CALC LOSS TO LEVEL	SALES MW @ GEN	CUM PEAK EXPANSION FACTORS	
	a	b	c	d	1/d
BULK LINES	0.0	0.0	0.0	0.00000	0.00000
TRANS SUBS	0.0	0.0	0.0	0.00000	0.00000
TRANS LINES	0.0	0.0	0.0	0.00000	0.00000
SUBTRANS SUBS	0.0	0.0	0.0	0.00000	0.00000
TOTAL TRANS	574.0	18.9	592.9	1.03295	0.96810
PRIM SUBS	71.5	2.7	74.2	1.03843	0.96300
PRIM LINES	750.0	48.0	798.0	1.06396	0.93988
SECONDARY	<u>2,648.3</u>	<u>227.9</u>	<u>2,876.2</u>	1.08605	0.92077
TOTALS	4,043.8	297.5	4,341.3		

DEVELOPMENT of LOSS FACTORS
UNADJUSTED
ENERGY

LOSS FACTOR LEVEL	CUSTOMER SALES MWH	CALC LOSS TO LEVEL	SALES MWH @ GEN	CUM ANNUAL EXPANSION FACTORS	
	a	b	c	d	1/d
BULK LINES	0	0	0	0.00000	0.00000
TRANS SUBS	0	0	0	0.00000	0.00000
TRANS LINES	0	0	0	0.00000	0.00000
SUBTRANS SUBS	0	0	0	0.00000	0.00000
TOTAL TRANS	3,663,030	103,554	3,766,584	1.02827	0.97251
PRIM SUBS	1,713,570	57,993	1,771,563	1.03384	0.96726
PRIM LINES	3,472,084	174,289	3,646,373	1.05020	0.95220
SECONDARY	<u>13,166,559</u>	<u>1,009,893</u>	<u>14,176,452</u>	1.07670	0.92876
TOTALS	22,015,243	1,345,730	23,360,973		

ESTIMATED VALUES AT GENERATION

LOSS FACTOR AT VOLTAGE LEVEL	MW	MWH
BULK LINES	0.00	0
TRANS SUBS	0.00	0
TRANS LINES	0.00	0
SUBTRANS SUBS	0.00	0
SUBTRANS LINES	592.91	3,766,584
PRIM SUBS	74.25	1,771,563
PRIM LINES	797.97	3,646,373
SECONDARY	2,876.17	14,176,452
SUBTOTAL	4,341.31	23,360,973
ACTUAL ENERGY	4,354.00	23,358,179
MISSMATCH	(12.69)	2,794
% MISSMATCH	-0.29%	0.01%

DEVELOPMENT of LOSS FACTORS
ADJUSTED
DEMAND

EXHIBIT 7

LOSS FACTOR LEVEL	CUSTOMER SALES MW a	SALES ADJUST b	CALC LOSS TO LEVEL c	SALES MW @ GEN d	CUM PEAK EXPANSION FACTORS e	f=1/e
BULK LINES	0.0	0.0	0.0	0.0	0.00000	0.00000
TRANS SUBS	0.0	0.0	0.0	0.0	0.00000	0.00000
TRANS LINES	0.0	0.0	0.0	0.0	0.00000	0.00000
SUBTRANS SUBS	0.0	0.0	0.0	0.0	0.00000	0.00000
TOTAL TRANS	574.0	0.0	18.9	592.9	1.03295	0.96810
PRIM SUBS	71.5	0.0	2.8	74.3	1.03883	0.96262
PRIM LINES	750.0	0.0	49.7	799.7	1.06632	0.93781
SECONDARY	<u>2,648.3</u>	<u>0.0</u>	238.8	<u>2,887.1</u>	1.09017	0.91729
			310.2			
TOTALS	4,043.8	0.0	310.2	4,354.0		

DEVELOPMENT of LOSS FACTORS
ADJUSTED
ENERGY

LOSS FACTOR LEVEL	CUSTOMER SALES MWH a	SALES ADJUST b	CALC LOSS TO LEVEL c	SALES MWH @ GEN d	CUM ANNUAL EXPANSION FACTORS e	f=1/e
BULK LINES	0	0	0	0	0.00000	0.00000
TRANS SUBS	0	0	0	0	0.00000	0.00000
TRANS LINES	0	0	0	0	0.00000	0.00000
SUBTRANS SUBS	0	0	0	0	0.00000	0.00000
TOTAL TRANS	3,663,030	0	103,554	3,766,584	1.02827	0.97251
PRIM SUBS	1,713,570	0	57,958	1,771,528	1.03382	0.96728
PRIM LINES	3,472,084	0	174,001	3,646,085	1.05011	0.95228
SECONDARY	<u>13,166,559</u>	<u>0</u>	1,007,420	<u>14,173,979</u>	1.07651	0.92892
			1,342,934			
TOTALS	22,015,243	0	1,342,936	23,358,177		

ESTIMATED VALUES AT GENERATION

LOSS FACTOR AT VOLTAGE LEVEL	MW	MWH
BULK LINES	0.00	0
TRANS SUBS	0.00	0
TRANS LINES	0.00	0
SUBTRANS SUBS	0.00	0
SUBTRANS LINES	592.91	3,766,584
PRIM SUBS	74.28	1,771,528
PRIM LINES	799.74	3,646,085
SECONDARY	2,887.07	14,173,979
	4,354.00	23,358,177
ACTUAL ENERGY	4,354.00	23,358,179
MISSMATCH	0.00	(2)
% MISSMATCH	0.00%	0.00%

Adjusted Losses and Loss Factors by Facility

EXHIBIT 8

Unadjusted Losses by Segment

	MW	Unadjusted	MWH	Unadjusted
Service Drop Losses	10.34	10.31	39,872	39,876
Secondary Losses	4.16	4.15	11,528	11,529
Line Transformer Losses	40.48	40.38	280,888	280,916
Primary Line Losses	84.92	84.70	268,453	268,480
Distribution Substation Losses	19.13	19.08	102,733	102,744
<u>Transmission System Losses</u>	<u>138.90</u>	<u>138.90</u>	<u>642,185</u>	<u>642,185</u>
Total	297.93	297.52	1,345,658	1,345,730

Mismatch Allocation by Segment

	MW	MWH
Service Drop Losses	-0.83	158
Secondary Losses	-0.33	46
Line Transformer Losses	-3.23	1,116
Primary Line Losses	-6.78	1,066
Distribution Substation Losses	-1.53	408
<u>Transmission System Losses</u>	<u>0.00</u>	<u>0</u>
Total	-12.69	2,794

Adjusted Losses by Segment

	MW	% of Total	MWH	% of Total
Service Drop Losses	11.14	3.6%	39,718	3.0%
Secondary Losses	4.48	1.4%	11,483	0.9%
Line Transformer Losses	43.61	14.1%	279,800	20.8%
Primary Line Losses	91.48	29.5%	267,414	19.9%
Distribution Substation Losses	20.61	6.6%	102,336	7.6%
<u>Transmission System Losses</u>	<u>138.90</u>	<u>44.8%</u>	<u>642,185</u>	<u>47.8%</u>
Total	310.21	100.0%	1,342,936	100.0%

Loss Factors by Segment

	MW	MWH	
Retail Sales from Service Drops	2,648.286	13,166,559	
<u>Adjusted Service Drop Losses</u>	<u>11.140</u>	<u>39,718</u>	
Input to Service Drops	2,659.426	13,206,277	
Service Drop Loss Factor	1.00421	1.00302	
Output from Secondary	2,659.426	13,206,277	
<u>Adjusted Secondary Losses</u>	<u>4.482</u>	<u>11,483</u>	
Input to Secondary	2,663.908	13,217,760	
Secondary Conductor Loss Factor	1.00169	1.00087	
Output from Line Transformers	2,663.908	13,217,760	
<u>Adjusted Line Transformer Losses</u>	<u>43.609</u>	<u>279,800</u>	
Input to Line Transformers	2,707.517	13,497,560	
Line Transformer Loss Factor	1.01637	1.02117	
Retail Sales from Primary	750.000	3,472,084	
Req. Whls Sales from Primary	0.000	0	
<u>Input to Line Transformers</u>	<u>2,707.517</u>	<u>13,497,560</u>	
Output from Primary Lines	3,457.517	16,969,644	
<u>Adjusted Primary Line Losses</u>	<u>91.477</u>	<u>267,414</u>	
Input to Primary Lines	3,548.994	17,237,058	
Primary Line Loss Factor	1.02646	1.01576	
Output PI from Distribution Substations	3,548.994	17,237,058	
Req. Whls Sales from Substations	0.000	0	
Retail Sales from Substations	71.500	1,713,570	
Total Output from Distribution Substations	3,620.494	18,950,628	
<u>Adjusted Distribution Substation Losses</u>	<u>20.606</u>	<u>102,336</u>	
Input to Distribution Substations	3,641.100	19,052,964	
Distribution Substation Loss Factor	1.00569	1.00540	
Retail Sales at from SubTransmission	574.000	3,663,030	
Req. Whls Sales from SubTransmission	0.000	0	
Non-Req. Whls Sales from SubTransmission	0.000	0	
Losses	0.000	0	4457
<u>Input to Distribution Substations</u>	<u>3,641.100</u>	<u>19,052,964</u>	
Output from SubTransmission	4,215.100	22,715,994	4,354.000
<u>SubTransmission System Losses</u>	<u>138.900</u>	<u>642,185</u>	<u>138.900</u>
Input to Transmission	4,354.000	23,358,179	138.900
TotTransmission System Loss Factor	1.03295	1.02827	138.900

DEMAND MW

SUMMARY OF LOSSES AND LOSS FACTORS BY DELIVERY VOLTAGE

EXHIBIT 9
PAGE 1 of 2

SERVICE LEVEL	SALES MW	LOSSES	SECONDARY	PRIMARY	SUBSTATION	SUBTRANS	TRANSMISSION
1 SERVICES							
2 SALES	2,648.3		2,648.3				
3 LOSSES		11.1	11.1				
4 INPUT			2,659.4				
5 EXPANSION FACTOR 1.00421							
6 SECONDARY							
7 SALES							
8 LOSSES		4.5	4.5				
9 INPUT			2,663.9				
10 EXPANSION FACTOR 1.00169							
11 LINE TRANSFORMER							
12 SALES							
13 LOSSES		43.6	43.6				
14 INPUT			2,707.5				
15 EXPANSION FACTOR 1.01637							
16 PRIMARY							
17 SECONDARY			2,707.5				
18 SALES	750.0			750.0			
19 LOSSES		91.5	71.6	19.8			
20 INPUT			2,779.2	769.8			
21 EXPANSION FACTOR 1.02646							
22 SUBSTATION							
23 PRIMARY			2,779.2	769.8			
24 SALES	71.5				71.5		
25 LOSSES		20.6	15.8	4.4	0.4		
26 INPUT			2,795.0	774.2	71.9		
27 EXPANSION FACTOR 1.00569							
28 SUB-TRANSMISSION							
29 DISTRIBUTION SUBS							
30 SALES							
31 LOSSES							
32 INPUT							
33 EXPANSION FACTOR							
34 TRANSMISSION							
35 SUBTRANSMISSION							
36 DISTRIBUTION SUBS			2,795.0	774.2	71.9		
37 SALES	574.0						574.0
38 LOSSES		138.9	92.1	25.5	2.4		18.9
39 INPUT			2,887.1	799.7	74.3		592.9
40 EXPANSION FACTOR 1.03295							
41 TOTALS							
42 LOSSES		310.2	238.8	49.7	2.8		18.9
42 % OF TOTAL		100%	76.97%	16.03%	0.90%		6.10%
43 SALES	4,043.8		2,648.3	750.0	71.5		574.0
44 % OF TOTAL	100.00%		65.49%	18.55%	1.77%		14.19%
45 INPUT	4,354.0		2,887.1	799.7	74.3		592.9
46 CUMMULATIVE EXPANSION LOSS FACTORS			1.09017	1.06632	1.03883		1.03295
(from meter to system input)							

ENERGY MWH

SUMMARY OF LOSSES AND LOSS FACTORS BY DELIVERY VOLTAGE

EXHIBIT 9
PAGE 2 of 2

SERVICE LEVEL	SALES	LOSSES	SECONDARY	PRIMARY	SUBSTATION	SUBTRANS	TRANSMISSION
1 SERVICES							
2 SALES	13,166,559		13,166,559				
3 LOSSES		39,718	39,718				
4 INPUT			13,206,277				
5 EXPANSION FACTOR	1.00302						
6 SECONDARY							
7 SALES							
8 LOSSES		11,483	11,483				
9 INPUT			13,217,760				
10 EXPANSION FACTOR	1.00087						
11 LINE TRANSFORMER							
12 SALES							
13 LOSSES		279,800	279,800				
14 INPUT			13,497,560				
15 EXPANSION FACTOR	1.02117						
16 PRIMARY							
17 SECONDARY			13,497,560				
18 SALES	3,472,084.000			3,472,084			
19 LOSSES		267,414	212,699	54,714			
20 INPUT			13,710,259	3,526,798			
21 EXPANSION FACTOR	1.01576						
22 SUBSTATION							
23 PRIMARY			13,710,259	3,526,798			
24 SALES	1,713,570				1,713,570		
25 LOSSES		102,336	74,037	19,045	9,253		
26 INPUT			13,784,297	3,545,844	1,722,823		
27 EXPANSION FACTOR	1.00540						
28 SUB-TRANSMISSION							
29 DISTRIBUTION SUBS							
30 SALES							
31 LOSSES							
32 INPUT							
33 EXPANSION FACTOR							
34 TRANSMISSION							
35 SUBTRANSMISSION							
36 DISTRIBUTION SUBS			13,784,297	3,545,844	1,722,823		
37 SALES	3,663,030						3,663,030
38 LOSSES		642,185	389,684	100,242	48,705		103,554
39 INPUT			14,173,981	3,646,085	1,771,528		3,766,584
40 EXPANSION FACTOR	1.02827						
41 TOTALS		1,342,936	1,007,422	174,001	57,958		103,554
42 % OF TOTAL		100%	75.02%	12.96%	4.32%		7.71%
43 SALES	22,015,243		13,166,559	3,472,084	1,713,570		3,663,030
44 % OF TOTAL	100.00%		59.81%	15.77%	7.78%		16.64%
45 INPUT	23,358,179		14,173,981	3,646,085	1,771,528		3,766,584
46 CUMMULATIVE EXPANSION LOSS FACTORS (from meter to system input)			1.07651	1.05011	1.03382		1.02827

Appendix C

Discussion of Hoebel Coefficient



COMMENTS ON THE HOEBEL COEFFICIENT

The Hoebel coefficient represents an established industry standard relationship between peak losses and average losses and is used in a loss study to estimate energy losses from peak demand losses. H. F. Hoebel described this relationship in his article, "Cost of Electric Distribution Losses," Electric Light and Power, March 15, 1959. A copy of this article is attached.

Within any loss evaluation study, peak demand losses can readily be calculated given equipment resistance and approximate loading. Energy losses, however, are much more difficult to determine given their time-varying nature. This difficulty can be reduced by the use of an equation which relates peak load losses (demand) to average losses (energy). Once the relationship between peak and average losses is known, average losses can be estimated from the known peak load losses.

Within the electric utility industry, the relationship between peak and average losses is known as the loss factor. For definitional purposes, loss factor is the ratio of the average power loss to the peak load power loss, during a specified period of time. This relationship is expressed mathematically as follows:

$$\frac{(1) F_{LS} \cdot A_{LS}}{P_{LS}} \quad \text{where: } F_{LS} = \text{Loss Factor}$$
$$A_{LS} = \text{Average Losses}$$
$$P_{LS} = \text{Peak Losses}$$

The loss factor provides an estimate of the degree to which the load loss is maintained throughout the period in which the loss is being considered. In other words, loss factor is the ratio of the actual kWh losses incurred to the kWh losses which would have occurred if full load had continued throughout the period under study.

Examining the loss factor expression in light of a similar expression for load factor indicates a high degree of similarity. The mathematical expression for load factor is as follows:

$$\frac{(2) F_{LD} \cdot A_{LD}}{P_{LD}} \quad \text{where: } F_{LD} = \text{Load Factor}$$
$$A_{LD} = \text{Average Load}$$
$$P_{LD} = \text{Peak Load}$$

This load factor result provides an estimate of the degree to which the load loss is maintained throughout the period in which the load is being considered. Because of the similarities in definition, the loss factor is sometimes called the "load factor of losses." While the definitions are similar, a strict equating of the two factors cannot be made. There does exist, however, a relationship between these two factors which is dependent upon the shape of the load duration curve. Since resistive losses vary as the square of the load, it can be shown mathematically that the loss factor can vary between the extreme limits of load factor and load factor squared. The relationship between load factor and loss factor has become an industry standard and is as follows:



$$(3) F_{LS} \cdot H \cdot F_{LD}^2 + (1-H) \cdot F_{LD}$$

where: F_{LS} = Loss Factor
 F_{LD} = Load Factor
H = Hoebel Coeff

As noted in the attached article, the suggested value for H (the Hoebel coefficient) is 0.7. The exact value of H will vary as a function of the shape of the utility's load duration curve. In recent years, values of H have been computed directly for a number of utilities based on EEI load data. It appears on this basis, the suggested value of 0.7 should be considered a lower bound and that values approaching unity may be considered a reasonable upper bound. Based on experience, values of H have ranged from approximately 0.85 to 0.95. The standard default value of 0.9 is generally used.

Inserting the Hoebel coefficient estimate gives the following loss factor relationship using Equation (3):

$$(4) F_{LS} \cdot 0.90 \cdot F_{LD}^2 + 0.10 \cdot F_{LD}$$

Once the Hoebel constant has been estimated and the load factor and peak losses associated with a piece of equipment have been estimated, one can calculate the average, or energy losses as follows:

$$(5) A_{LS} \cdot P_{LS} \cdot [H \cdot F_{LD}^2 + (1-H) \cdot F_{LD}]$$

where: A_{LS} = Average Losses
 P_{LS} = Peak Losses
H = Hoebel Coefficient
 F_{LD} = Load Factor

Loss studies use this equation to calculate energy losses at each major voltage level in the analysis.

