CON EDISON
ELECTRIC SYSTEM LOSSES
FOR THE
TWELVE MONTH PERIOD
ENDING DECEMBER 31, 2007

Prepared by:

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2007 Con Edison Electric Losses Study

Executive Summary

The calculated overall energy loss in the Con Edison electric system is 4,156,218 MWh or 6.64% of the 62,591,729 MWh net generation and purchase.

Based on modeling of component load and on equipment inventories, the losses are allocated as shown below in Table 1 – Allocation of Losses:

Table 1 - Allocation of Losses

Portion of the T&D Delivery System	Voltage Segment	Fixed Losses (MWh)	Variable Losses (MWh)
Transmission	500 kV	2,748	783
	345 kV	199,533	322,437
	138 kV	209,818	312,618
	69 kV	18,742	31,570
Distribution	Primary	127,158	702,499
	Secondary		979,510
	Metering	112,040	
	Equipment	485,932	246,577
Unaccounted for			404,255
TOTAL		1,155,970	3,000,248
TOTAL		4,156,218	

Introduction

The justification for the existence of any electric transmission and distribution system is to provide energy to the customer. And as with any energy system, delivery of electricity results in losses. Although small compared to the energy delivered and smaller still relative to generation and end use losses, electric transmission and distribution losses still represent significant cost and carbon footprint. Therefore it is important to study and to mitigate losses. The purpose of this study report is to identify and examine electric losses for Con Edison transmission and distribution systems.

1.0 Electric Power System Description

Con Edison supplies electricity to New York City and most of Westchester County. This is a dense urban area with some suburban localities. The Con Edison electric service area covers 604 square miles and serves a resident population of 9.2 million people representing 3.25 million electric customers (meters).

In discussing an electric transmission and distribution system it is convenient to visualize it as layers based on the nominal voltage the components operate at with the connection between layers as transformers.

Starting at the highest level, the Con Edison **transmission system** operates at 345kV, 138kV and 69kV. Transmission circuits north of New York City are largely overhead. Those in the City are underground, except for a few short circuits associated with Astoria and Arthur Kill generating stations. The Con Edison transmission system is comprised of 328 circuit miles of overhead transmission circuits and 670 circuit miles of underground transmission circuits.

Transmission feeders are connected at **substations**, and there are several types of substations, which generally provide one or more of the following functions:

- Switching – Power is transferred from one part of the transmission system to another
- Bulk power supply – Power is taken from the transmission system and sent to a substation from which it is distributed
- Distribution (at Con Edison - called an area substation) – Power is taken from the transmission system, transformed to distribution voltage (at Con Edison - 33kV, 27kV, or 13kV) and sent out on primary feeders.

The Con Edison system is comprised of 38 switching and bulk power substations and 60 area substations, which contain 405 transformers and phase angle regulators, as well as many circuit breakers and switches which do not enter into the study of losses.

In examination of losses, the interesting parts of the **distribution** system are distribution primary feeders, transformers, and secondary and services. In Manhattan, distribution is underground at 13,800 volts with most customers supplied via distributed networks at 120/208 volts. In The Bronx and Westchester, distribution is also at 13,800 volts, with some feeders supplying UG distributed networks, some feeders supplying unit substation transformers that feed a grid of OH 4,160 volt overhead feeders, and some feeders supplying overhead open wire autoloops at 13,800 volts. In Brooklyn and Queens, distribution is at 27,000 volts with some feeders supplying UG distributed networks, some feeders supplying unit substation transformers that feed a grid of OH 4,160 volt overhead feeders, and some feeders supplying overhead open wire autoloops at 27,000 volts. In Staten Island, distribution is at 33,000 volts and 13,800 volts with some feeders supplying overhead open wire auto loops at 13,800 volts and some unit substation transformers that feed a grid of 4,160 volt overhead feeders. In all regions, the distribution primary feeders supply local distribution transformers that transform the voltage to a customer utilization level of 120/208 volts, 120/240 volts or 265/460 volts. A few customers, called high tension customers, receive supply at distribution feeder voltage.

There are 2,177 primary feeders, including 27 – 33 kV, 325 – 27 kV, 1,053 – 13 kV and 772 – 4 kV that supply 80 distributed UG secondary networks as well as non-network load. There are 277,605,886 conductor feet of underground primary feeders and 55,174,272 conductor feet of overhead primary feeders. There are 35,000 underground distribution transformers (including 26,000 network units), 47,000 overhead distribution transformers, 165,806,770 conductor feet of underground secondary and services, and 112,413,384 conductor feet of overhead secondary and services.

1.1 Electric Power System Losses

Power losses in electrical systems can be categorized as technical losses and non-technical losses.

Technical Losses are electrical losses that are absorbed by the energized power system components (lines, transformers, etc.). Technical losses include the heat energy generated as current passes through each component and the magnetic energy needed to energize transformers. Losses are inherent to the distribution of electricity and cannot be eliminated, but it is possible to reduce losses by using more efficient, low-loss equipment and by deploying prudent design and operating practices. Some technical losses vary with the level of use of component capacity, i.e. the quantity of electricity being transmitted or distributed. In particular, most losses (those called I^2R losses) are proportional to the square of the current. As a result, transmission feeders are efficient over long distances because the extra high voltage requires proportionally less current to transport power. Distribution primary feeders are subject to a higher level of losses to transport the same block of power, but are much more localized. I^2R losses are also dependant on the length and the cross section of the lines.

Non-Technical Losses represent power that is delivered but not registered by revenue meters. These losses include energy theft, metering losses, and unaccounted for losses. Theft of electric service is energy delivered to customers that is not measured by the energy meter at the customer. This can happen as a result of meter tampering or by bypassing the meter. Also, all energy meters have acceptable accuracy limits within which they operate. Losses due to these tolerances in revenue metering accuracy are represented by the difference between the amount of energy delivered through the meters and the amount registered by the meters and represent unaccounted for energy

2.0 Results of the Study

2.1 Outlines for Calculating System Losses

Electric system technical losses can be further categorized as no load losses and variable losses. No load losses are the energy required by the system to energize equipment and keep the system ready, even when no load is being serviced. These losses do not vary with the system load. Variable losses or load losses, which result from current flowing through the equipment, change in proportion to the load - I^2R.

This loss study report includes the losses of each component in the transmission and distribution systems, from the customer meter up to and including the substation transformer and transmission system. Typical categories for transmission and distribution system losses include:

- Substation equipment (including Generation Step-Up (GSU) transformer)
- Transmission cable
- Distribution transformers (including network, non-network and unit substation transformers)
- Distribution Cable (including primary, secondary and service cable)
- Meters

2.2 Result of the 2007 Load Loss Study

2.2.1 General

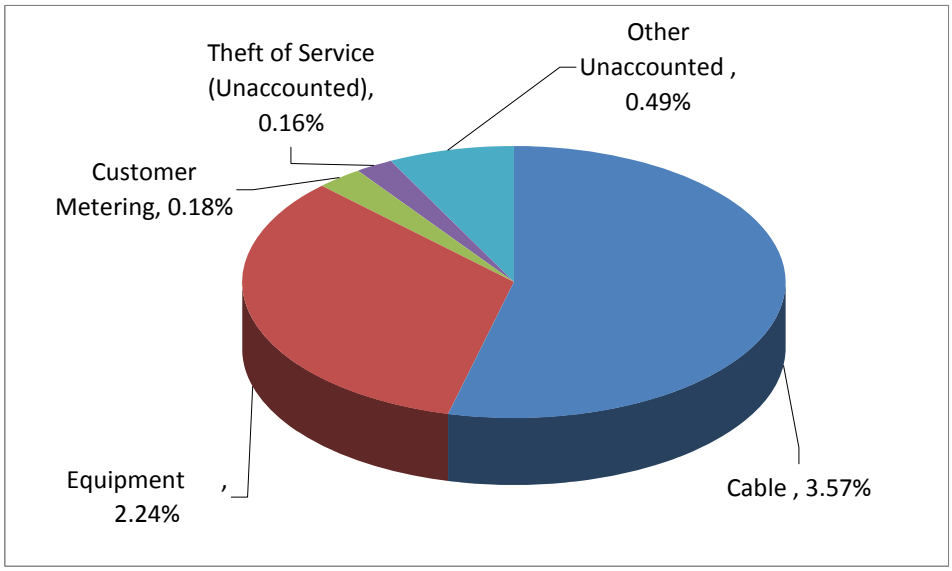
a) The total system losses for the calendar year period ending December 31, 2007 are: 4,156,218 MWh. This represents 6.64% of the 62,591,729 MWh total net generation and purchases. (Table II)

b) Estimated system losses that can be accounted for 2007 are 3,751,963 MWh or 5.99% of the net generation and purchases (see below Table 2).

Table 2 – Breakdown of Losses

		% Net Gen. &
	MWh	Purchases
Cable (Transmission and Distribution)	2,235,779	3.57
Equipment (Substation and Distribution)	1,404,144	2.24
Customer Electric Metering	112,040	0.18
Accounted Losses	**3,751,963**	**5.99**
Theft of Service	101,000	0.16
Other Unaccounted Losses	303,255	0.49
Total Unaccounted Losses	**404,255**	**0.65**
Total Losses	**4,156,218**	**6.64**

Chart for Table 2 - 2007 Losses Breakdown:

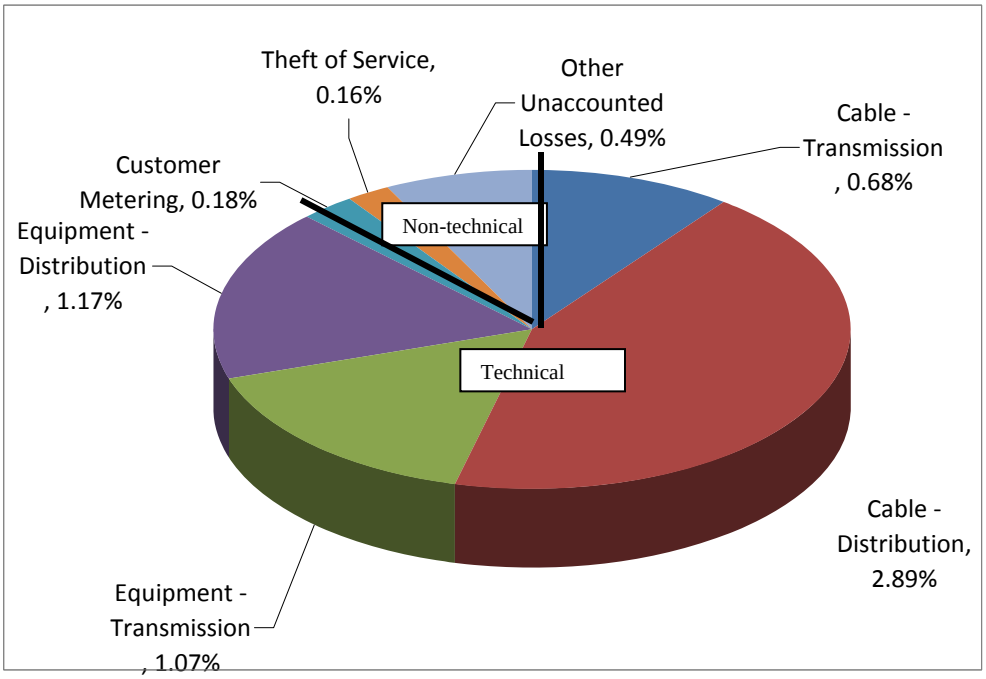


c) The estimated technical and non-technical losses are 3,693,923 MWh and 516,295 MWh or 5.81% and 0.83% of the net generation and purchases respectively. The breakdown is listed in Table 3.

Table 3 – Technical and Non-Technical Losses

Item	Losses (MWh)	Amount in percent of the Net Generation and Purchases
Technical losses	**3,639,923**	**5.81 %**
Transmission Cable	426,612	0.68 %
Substation Equipment	671,636	1.07 %
Transmission	**1,098,248**	**2.57 %**
Distribution Cable	1,809,167	2.89 %
Distribution Equipment	732,508	1.17 %
Distribution	**2,541,675**	**4.06 %**
Non-Technical losses	**516,295**	**0.83 %**
Theft of Service	101,000	0.16 %
Customer Metering	112,040	0.18 %
Other Unaccounted	303,255	0.49 %

Chart for Table 3 - Technical and Non-technical losses breakdown:



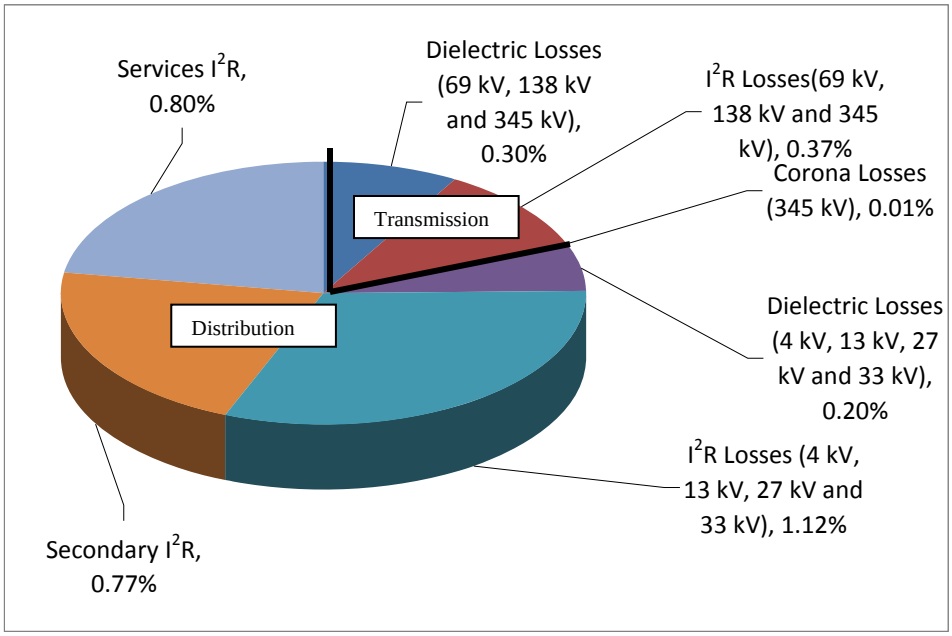
2.2.2 Cable Losses

The estimated cable losses for transmission and distribution are 426,612 MWh and 1,809,167 MWh, or 0.68% and 2.89% of the net generation and purchases respectively. The breakdown is listed in Table 4.

Table 4 – Cable Losses

Cable Losses	Losses (MWh)	Amount in percent of the Net Generation and Purchases
Cable losses accounted for	**3,751,963**	**3.57 %**
Transmission Cable Losses	**426,612**	**0.68 %**
Dielectric Losses (69 kV, 138 kV and 345 kV)	190,297	0.30 %
I^2R Losses(69 kV, 138 kV and 345 kV)	231,814	0.37 %
Corona Losses (345 kV)	4,501	0.01 %
Distribution Cable Losses	**1,809,167**	**2.89 %**
Dielectric Losses (4 kV, 13 kV, 27 kV and 33 kV)	127,158	0.20 %
I^2R Losses (4 kV, 13 kV, 27 kV and 33 kV)	702,499	1.12 %
I^2R Secondary	479,240	0.77 %
I^2R Services	500,270	0.80 %

Chart for Table 4 - Breakdown of Cable Losses (transmission and distribution)



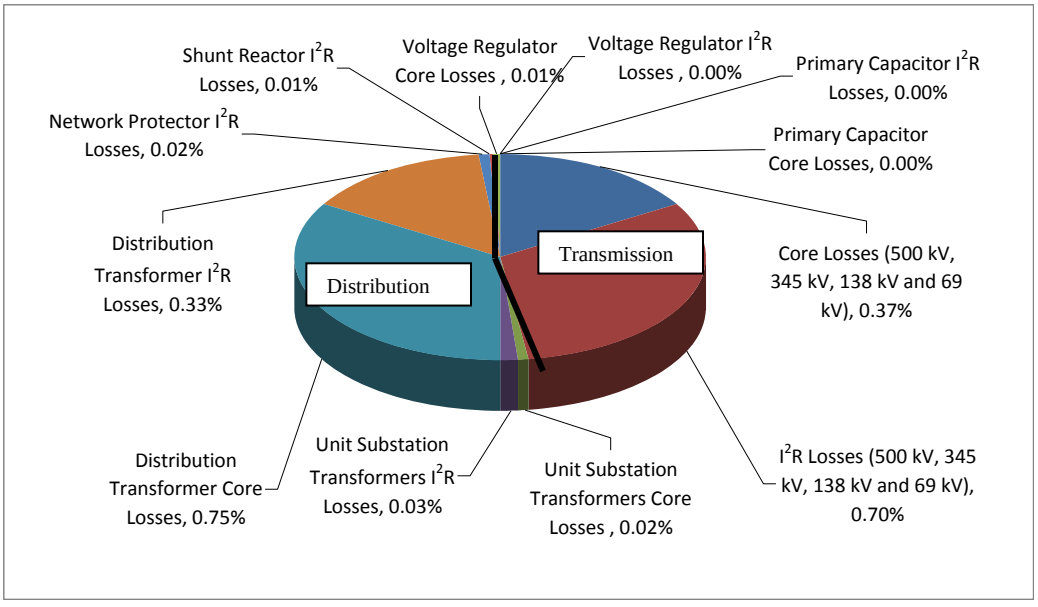
2.2.3 Equipment Losses

The estimated equipment losses for station and distribution are 671,636 MWh and 732,508 MWh, or 1.07% and 1.17% of the net generation and purchases. The breakdowns of the equipment losses in the study are as shown in Table 5:

Table 5 – Equipment Losses

Equipment Losses	Losses (MWh)	Amount in percent of the Net Generation and Purchases
Total equipment losses accounted for	**1,404,144**	**2.24 %**
Station Equipment Losses	**671,636**	**1.07 %**
Core Losses (500 kV, 345 kV, 138 kV and 69 kV)	236,043	0.37 %
I^2R Losses (500 kV, 345 kV, 138 kV and 69 kV)	435,593	0.70 %
Distribution Equipment Losses	**732,508**	**1.17 %**
Unit Substation Transformers Core Losses	13,813	0.02 %
Distribution Transformer Core Losses	470,068	0.75 %
Voltage Regulator Core Losses	1,878	0.01 %
Primary Capacitor Core Losses	172	0.00 %
Total Distribution Equipment Core (No-Load) Losses	485,931	0.78%
Unit Substation Transformers I^2R Losses	20,573	0.03 %
Distribution Transformer I^2R Losses	208,752	0.33 %
Network Protector I^2R Losses	9,716	0.02 %
Shunt Reactor I^2R Losses	6,176	0.01 %
Voltage Regulator I^2R Losses	1,338	0.00 %
Primary Capacitor I^2R Losses	22	0.00 %
Total Distribution Equipment I^2R (Load) Losses	246,577	1.95%

Chart for Table 5 - Breakdown of Equipment Losses (Station and distribution)



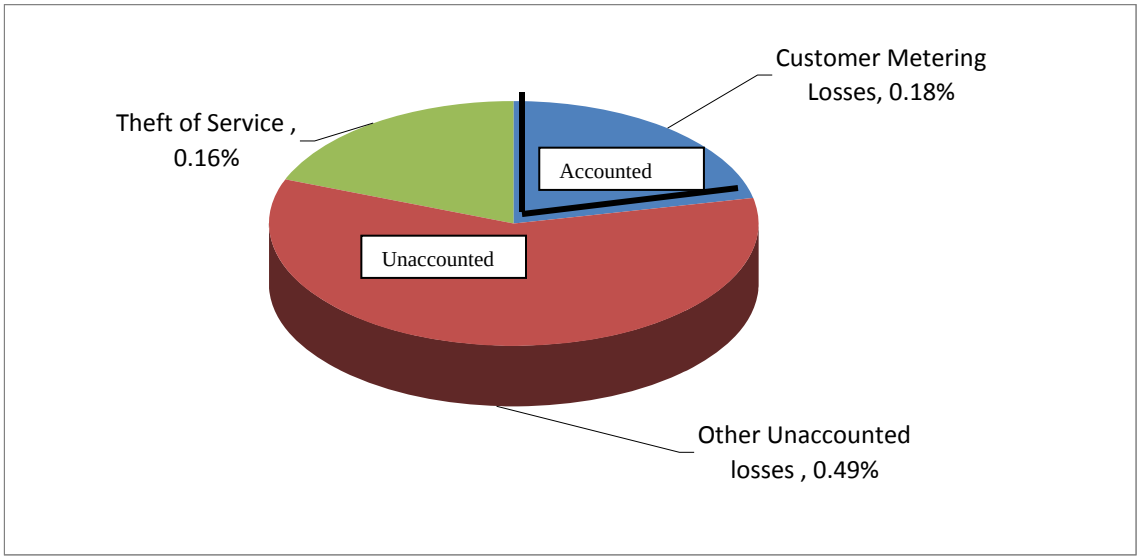
2.2.4 Total Non-technical Losses and Unaccounted Losses

The estimated non-technical losses, including customer metering, theft of service and unaccounted losses, are 516,295 MWh or 0.83% of the net generation and purchases. The breakdown of the non-technical losses is as shown in Table 6:

Table 6 – Total Non-Technical Losses

Non-technical Losses	Losses (MWh)	Amount in percent of the Net Generation and Purchase
Total non-technical losses estimated	**516,295**	0.83 %
Customer Metering Losses	112,040	0.18 %
Theft of Service	101,000	0.16 %
Other Unaccounted losses	303,255	0.49 %

Chart for Table 6 - Breakdown of Non-technical losses



Summary Of Electric Losses						
For 12 Months Period Ending December 31, 2007						
	Overhead		Underground		Total (O.H. & U.G.)	
		% Net Gen.		% Net Gen.		% Net Gen.
	MWh	& Purchases	MWh	& Purchases	MWh	& Purchases
Transmission Cable						
Dielectric Losses						
345 kV	-	-	76,791	0.123	76,791	0.123
138 kV	-	-	108,595	0.173	108,595	0.173
69 kV	-	-	4,911	0.008	4,911	0.008
					190,297	**0.304**
I^2R Loss						
345 kV	122,763	0.196	47,155	0.075	169,918	0.271
138 kV	1,429	0.002	54,333	0.087	55,762	0.089
69 kV	-	-	6,134	0.010	6,134	0.010
					231,814	**0.370**
Corona Losses						
345 kV	4,501	0.007	-	-	**4,501**	**0.007**
Distribution Cable						
Dielectric Losses						
33 kV	1972	0.003	2791	0.004	4,763	0.008
27 kV	2785	0.004	77648	0.124	80,434	0.129
13 kV	8055	0.013	33041	0.053	41,096	0.066
4 kV	604	0.001	261	0.000	865	0.001
					127,158	**0.203**
I^2R Loss						
33 kV	10578	0.017	10909	0.017	21,487	0.034
27 kV	5435	0.009	169689	0.271	175,124	0.280
13 kV	69251	0.111	207423	0.331	276,674	0.442
4 kV	188,937	0.302	40,277	0.064	229,214	0.366
					702,499	**1.122**
Secondary Losses						
Secondary	91,790	0.147	387,451	0.619	479,240	0.766
Services	166,170	0.265	334,099	0.534	500,270	0.799
					979,510	**1.565**
Transmission Cable	128,693	0.206	297,919	0.476	**426,612**	**0.682**
Distribution Cable	545,578	0.872	1,263,589	2.019	**1,809,167**	**2.890**
Total Cable Losses	**674,271**	**1.077**	**1,561,508**	**2.495**	**2,235,779**	**3.572**

Summary Of Electric Losses						
For 12 Months Period Ending December 31, 2007						
	Overhead		Underground		Total (O.H. & U.G.)	
		% Net Gen.		% Net Gen.		% Net Gen.
Distribution Equipment	**MWh**	**& Purchases**	**MWh**	**& Purchases**	**MWh**	**& Purchases**
Unit Substation Transformers						
Core Loss	-	-	-	-	13,813	0.022
I^2R Loss	-	-	-	-	20,573	0.033
Total	-	-	-	-	**34,386**	**0.055**
Distribution Transformers						
Core Loss	118,097	0.203	351,972	0.605	470,069	0.751
I^2R Loss	94,816	0.163	113,936	0.196	208,752	0.334
Total	212,913	0.366	465,908	0.801	**678,821**	**1.085**
Network Protectors						
Losses	-	-	**9,716**	0.017	**9,716**	**0.016**
Shunt Reactors						
Losses	-	-	**6,176**	0.011	**6,176**	**0.010**
Voltage Regulators						
Core Loss	1,878	0.003	-	-	1,878	0.003
I^2R Loss	1,338	0.002	-	-	1,338	0.002
Total	3,217	0.006	-	-	**3,217**	**0.005**
Rectifiers						
Core Loss	-	-		0.000	0	0.000
I^2R Loss	-	-		0.000	0	0.000
Total	-	-	0	0.000	**0**	**0.000**
Primary Capacitors						
Core Loss	172	-	-	-	172	-
I^2R Loss	22	-	-	-	22	-
Total	193	-	-	-	**193**	-
Total Distribution Equipment Losses	216,323	0.372	481,799	0.828	**732,508**	**1.170**

Summary Of Electric Losses						
For 12 Months Period Ending December 31, 2007						
	Overhead		Underground		Total (O.H. & U.G.)	
		% Net Gen.		% Net Gen.		% Net Gen.
Station Equipment	**MWh**	**& Purchases**	**MWh**	**& Purchases**	**MWh**	**& Purchases**
500 kV						
Core Loss	-	-	-	-	2,748	0.004
I^2R Loss	-	-	-	-	783	0.001
Total	-	-	-	-	**3,531**	**0.006**
345 kV						
Core Loss	-	-	-	-	118,241	0.189
I^2R Loss	-	-	-	-	152,519	0.244
Total	-	-	-	-	**270,760**	**0.433**
138 kV						
Core Loss	-	-	-	-	101,223	0.162
I^2R Loss	-	-	-	-	256,856	0.410
Total	-	-	-	-	**358,078**	**0.572**
69 kV						
Core Loss	-	-	-	-	13,831	0.022
I^2R Loss					25,436	0.041
Total	-	-	-	-	**39,266**	**0.063**
Total Station Equipment Losses	-	-	-	-	**671,636**	**1.073**

Summary Of Electric Losses						
For 12 Months Period Ending December 31, 2007						
	Overhead		Underground		Total (O.H. & U.G.)	
		% Net Gen.		% Net Gen.		% Net Gen.
	MWh	& Purchases	MWh	& Purchases	MWh	& Purchases
Customer Electric Metering	-	-	-	-	112,040	0.179
Total Distribution Equipment Losses	-	-	-	-	732,508	1.170
Total Station Equipment Losses					671,636	1.073
Total Cable Losses	-	-	-	-	2,235,779	3.572
Total Losses accounted for	-	-	-	-	3,751,963	5.994
by Engineering						
Losses not accounted for by					303,255	0.484
Engineering						
Estimated Theft of Service					101,000	0.161
Total unaccounted losses					404,255	0.646
Total System Losses (accounted	-	-	-	-	4,156,218	6.640
and unaccounted for)						
Net Generation and Net	-	-	-	-	62,591,729	-
Purchase other utilities						

Consolidated Edison Company of New York, Inc.

Production Statistics - Electric

Electric Distribution Losses And Other Variances - KWh

	Month of December		Twelve months ended December	
	2007	2006	2007	2006
Total Available:				
Electric Energy Generated				
Steam Power Generation				
60 Cycle - Net	249,237,000	235,855,000	2,885,894,000	2,781,565,000
25 Cycle - Net	-	-	-	-
Total - Steam Power Generation	249,237,000	235,855,000	2,885,894,000	2,781,565,000
Nuclear Power Generation	-	-	-	-
Internal Combustion Engine Power Generation	2,000	52,000	2,477,000	4,037,000
Total Generated	249,239,000	235,907,000	2,888,371,000	2,785,602,000
Purchased Power	1,894,598,000	1,908,303,000	24,550,981,000	25,085,351,000
NYPA Purchases - Power for Jobs	13,485,000	15,584,000	168,410,000	196,865,000
Total Purchased Power	1,908,083,000	1,923,887,000	24,719,391,000	25,282,216,000
Off-System Sales	(76,554,000)	(128,671,000)	(824,769,000)	(776,144,000)
Total Available for full service customers	2,080,768,000	2,031,123,000	26,782,993,000	27,291,674,000
All Other Energy Requirements	2,950,552,000	2,809,703,000	35,808,736,000	33,335,756,414
Total Available in Franchise Area	5,031,320,000	4,840,826,000	62,591,729,000	60,627,430,414
Used:				
Electric Energy Sold	2,028,831,098	1,979,446,029	25,314,647,798	26,100,714,249
Municipal Distribution Agencies	-	-	-	-
NYPA Delivery Service	807,208,359	766,437,764	10,304,667,219	9,823,086,749
KIAC Customers	38,240,400	34,628,400	387,033,600	404,116,800
Retail Choice Delivery	1,771,292,125	1,676,258,069	21,531,883,620	19,256,267,740
Economic Development	62,207,289	62,766,596	723,201,488	723,904,839
Total Available in Franchise Area	4,707,779,271	4,519,536,858	58,261,433,725	56,308,090,377
Electric Energy Used by Company	18,061,226	11,782,697	174,077,071	162,448,587
Electric Energy Supplied without Direct Charge - Westchester	-	-	-	-
Total Accounted For	4,725,840,497	4,531,319,555	58,435,510,796	56,470,538,964
Dist. Losses and Other Variances	305,479,503	309,506,445	4,156,218,204	4,156,891,450
Percent	6.1%	6.4%	6.6%	6.9%

Table II

PART II: CABLE LOSSES

1. **DATA AND CALCULATION FOR TRANSMISSION CABLE LOSSES**

2. **DATA AND CALCULATION FOR DISTRIBUTION CABLE LOSSES**

1. CON EDISON TRANSMISSION CABLE LOSSES

FOR THE PERIOD OF JANUARY 01- DECEMBER 31, 2007

TRANSMISSION FEEDER ENGINEERING

1. Introduction:

The Con Edison transmission system consists of overhead and underground transmission feeders as detailed below. The predominant overhead construction is lattice tower with typically two feeders per tower line. Bundled conductors are standard for most overhead feeders. The underground system consists of the largest high pressure paper insulated pipe type cable system in the world. There remain shorter lengths of self contained paper insulated cable and newer lines are now being constructed with solid dielectric insulation.

Voltage (kV)	Type	Length (Circuit Miles)
138	Overhead	22.9
230	Overhead	0.5
345	Overhead	398.9
500	Overhead	5.3

Voltage (kV)	Type	Length (Circuit Miles)
69	Underground	55.8
138	Underground	461.1
345	Underground	153.6

2. Methodology for Determining Losses:

The Loss Study for the Con Edison electric transmission system encompasses calculation of the following losses:

- Dielectric Losses for insulated underground feeders
- I^2R Losses
- Corona Losses for overhead 345kV feeders

Losses are calculated as follows:

A. Dielectric Losses:

- Per unit cable loss = $\dfrac{0.00276\ Eo^2\ \varepsilon\ \tan\delta}{\text{Log}\ (D/d)}$ Watt/Ft/Cond
- *Where*
  1. *Eo = line to neutral voltage*
  2. *ε = dielectric constant of the insulating material*

3. tan δ = dissipation factor
4. *D = outer diameter over insulation*
5. *d = outer diameter of conductor*

- **Per unit (PU) Loss for type of cable x length x 8760 hrs**

B. I^2R Losses:

Calculation of I^2R losses (a. k. a. copper loss, ohmic loss and Joule heating loss) consists of three parts:

- Average feeder current for feeders was obtained from PI for the period January 01, 2007 to December 31, 2007 for most feeders. Current for those feeders without PI data were estimated based upon best system characteristics such as parallel paths.

- Feeder Electrical Resistance

Electrical resistance values of each feeder are found from the following impedance diagrams:

EO-17000-Z
EO-2075-Z
EO-5612-Z
EO-5864-Z
EO-5807-Z
EO-6390-Z
EO-6391-Z
EO-7247-Z

- I^2R **loss = (I^2) x R total x 8760 hrs**

C. Corona Losses

Corona Losses are calculated only for the 345kV overhead transmission lines. Losses for 138 kV overhead transmission lines are negligible and not calculated for this study. The calculations are based upon the EPRI AC Transmission Line Reference Book – 200 kV and Above, Third Edition (Red Book) Chapter 11 and EPRI (HERBS 2.0 Hyperlinked EPRI Redbook), Computer programs. .

3. Results:

1. Dielectric Losses- (Underground)

Dielectric Losses	**MWh**
345kV	76,791
138kV	108,595
69kV	4,911
Total:	**190,297**

2. I^2R losses:

Voltage Segment	**Overhead MWh**	**Underground MWh**	**Total MWh**
345kV	122,763	47,155	169,328
138kV	1,429	54,333	55,762
69kV	--	6,134	6,134
		Total:	**231,224**

3. Corona Losses- (345kV Overhead only):

Corona Losses:	**4,501 MWH**

Corona Loss calculations for 230kV and 500kV Feeders were not considered, due to very short feeder length. Corona losses at 138kV are also negligible.

4. **TOTAL TRANSMISSION SYSTEM LOSS: 426,022 MWH**

2. Con Edison Distribution Cable Losses
For the period of January 1 – December 31, 2007

Distribution Engineering

1.0 Introduction

The 2007 distribution cable losses (dielectric and I^2R losses) for the twelve months period ending December 31, 2007 were calculated and summary of result is listed in Table A. The loss calculations were based on the following criteria:

1.1 Dielectric Losses

Dielectric losses occur only in the cable used for primary feeders (voltage class 4 kV through voltage class 33 kV) with both paper insulation and polyethylene (XLP, EPR) insulation. Dielectric losses are energy lost through cable insulation. Also, all dielectrics (except vacuum) have two types of losses: One is a conduction loss, representing the flow of actual charge through the dielectric and the other is a dielectric loss due to movement or rotation of the atoms or molecules in an alternating electric field. The annual unit losses shown in Table C – (1) were calculated by multiplying the dielectric constants by the appropriate cable lengths and by the number of hours in a year (typically 8,760 hours in a year).

1.2 I^2R Losses (or Copper losses)

In any given conductor, such energy is proportionate to the square of the load current. For distribution lines (4 kV to 33 kV), losses were determined using the average distribution feeder currents based on independent peak loads of each network or load area. The I^2R losses for the designated cable sizes were calculated by multiplying the average line current by the loss factor, total mileage of the conductors (obtained from Property Records), and the number of hours in a year. On the other hand I^2R losses for the secondary mains and services were calculated based on the loading level of their feeding transformers and the mileage of the different size conductors.

1.3 2007 Distribution Cable Losses

Table 1 - 2007 Distribution Cable Losses Summary

	2007 Data	
	MWh	% of Net generation and Purchases
Dielectric Losses	127,158	0.203
I^2R Losses		
Primary	702,449	1.122
Secondary and Services	979,510	1.565
Total	**1,809,167**	**2.890**

I. The estimated dielectric losses for 2007 distribution cable were 127,158 MWh, or 0.20 of the net generation and purchase.

II. The estimated I^2R losses for 2007 primary (4 kV to 33 kV) distribution cables were 702,449 MWh, or 1.12% of the net generation and purchases.

III. Copper losses for 2007 secondary and services cable were also 979,510 MWh, or 1.57% of the net generation and purchases. These losses were attributed from the list below:

2.0 Methodology

2.1 Losses Calculation

Tables B-(1) through B-(16) show I^2R losses for distribution cable installed as of December 31, 2007. In order to perform the loss calculations, three basic values for each cable size, and class had to be established, and they are:

1. Average system loss factor – The average loss factor was used for all types of cable (primary, secondary, and services). This average was derived using data (hourly load and system peak) available through our Plant Information System or "PI". The 2007 average loss factor was 0.325.

2. Cable resistances – Electric resistance values for each cable type was collected from the Impedance Specifications under Electric Operations (EO) specifications: EO-2057, 2059, 2060, and 2061. These values were utilized for copper loss calculations.

3. Cable losses at peak loading – Different methods were applied to calculate average peak cable losses for various voltage classes:

(a) <u>Primary Feeder – 4kV to 33kV</u>

The average current for the 4kV to 33 kV voltage classes, which is the base for the I^2R losses, was calculated by obtaining the average maximum value from the PI and the ECC system. In addition, these values are checked with the result from the PVL system. Section 2.2 shows more details on all the guidelines and procedures that were followed to calculate the losses on the distribution feeders.

(b) <u>Overhead & Underground Secondary Mains and Services</u>

Underground secondary and service cable loading for the network system have a capacity factor of 57.6%, and overhear secondary and service cable for the radial system have a capacity factor of 68.2%. These factors were furnished and obtained from distribution equipment. A typical capacity factor can be obtained by dividing the peak apparent load, which is measured in volt-amp[VA] to the total connected apparent power, which is measured in volt-amp[VA];

Capacity Factor = Peak Load [MVA] / Total Connected apparent power [MVA];

This percentage was used when calculating the average currents on services cable. In addition, underground secondary current was obtained from the Yorkville network (3M) in the PVL program as the benchmark value. In order to simplify the losses calculations with an acceptable error range, aluminum conductor cables were replaced with their copper equivalents for the resistivity constant which is measured in ohm/1000-ft. The method of grouping looks as follows:

<u>Secondary Underground</u>

- 105, 150, 167 KCMIL Cu and 167, 211 KCMIL lumped with 2/0 Cu.
- 200, 230, 250 KCMIL Cu and 350 KCMIL Al lumped with 4/0 Cu.
- 350, 550, 600 KCMIL Cu and 750 KCMIL Al lumped with 500 KCMIL Cu.

- 80 KCMIL and smaller sizes as well as 800 KCMIL and larger were disregarded.

Secondary Overhead

- #8, #10 Cu & #2 Al lumped with #6 Cu.
- #1, #4 Cu & 105 KCMIL Al lumped with #2 Cu.
- 4/0 Cu & 300, 350 KCMIL Al lumped with 2/0 Cu.
- 500 and larger sizes were disregarded.

Services Underground

- #5, #8* Cu and #4 Al lumped with #6 Cu
- #1, #3, #4, 40, 41, 60, 80 Cu and 1/0 Al lumped with #2 Cu.
- 105, 150 KCMIL Cu and 167, 210 KCMIL Al lumped with 2/0 Cu.
- 200, 250 KCMIL Cu and 350 Al lumped with 4/0 Cu.
- 300, 400 KCMIL Cu lumped with 350 KCMIL Cu
- 1000 KCMIL Cu lumped with 750 KCMIL Cu.

#8* size was treated separately in Brooklyn due to the considerable quantity involved.

Services Overhead

Since the overhead services are not broken down by sizes, #2 Cu was assumed to be an average size.

2.2 Procedures uses for Calculation

Procedure used for calculating losses on distribution feeders, secondary, and services.

l) **13kV to 33kV Primary Feeders** – Losses were calculated as follows:

Step 1. Current for each primary feeder was obtained from PI system and the average of maximum current was calculated.

Step 2. Size, type, and resistance per 1000 feet of cable used on these feeders:

a. Impedance and charging kVARS for 13, 27, and 33 kV single conductors EO-2060.

b. Impedance and charging current data for multi-conductor paper insulated lead covered cable E0-2061.

Step 3. The below steps ‘a’ to ‘I’ outline the basic steps for calculating the average primary feeder currents.

a. Normal feeder ratings for 13 kV, 27 kV, and 33kV was referenced from EO-6033

b. Maximum current for the largest size cable used in the feeder is obtained from the average of maximum currents from the PI data.

c. Minimum current for the largest size cable used = (Maximum Current / Normal Ratings) x the normal rating of the subsequent smaller size cable.

d. Average current for the largest size cable = Minimum current + 2 / 3 (Maximum current – Minimum current)

e. Maximum current for the second largest size cable used is equal to the minimum current of the largest cable size.

f. Minimum current for the second largest size cable used in the feeder is obtained with the same procedure as outlined in "step 3c" for the largest size.

g. Average current for the second largest size cable is obtained with the same procedure as outlined in "Step 3d".

h. The above procedure was used to calculate maximum, minimum, and average current values for various cable sizes. The only exception was for the minimum current of the smallest size cable which was = 500 kVA / ($\sqrt{3}$ x kV)

Step 4. Peak losses– which are the I^2R per foot of cable

Step 5. Determine the length of cables by size for each service area. This data was extracted from Property Records.

Step 6. Total Losses on cables for each borough was calculated as follows:

Total losses (MWh) = total cable length x peak losses x average loss factor x time

Where:

Cable Length	= ft
Losses	= I^2R
Time	= 8,760 hours
Average Loss Factor	= 0.325

The calculated average current values were cross checked with the Poly Voltage Load Flow (PVL) generated load losses.

II) 4kV Primary Feeders - Losses were calculated as follows:

Step 1. Current values of Brooklyn, Queens, Staten Island and Westchester were obtained from the ECC Unit Substation Application of the PI system, and the Bronx current values for 4 kV feeders are the same in 2002 load loss study.

Step 2. Average current is obtained by averaging available maximum currents of the three phases for all service areas.

Step.3. Size, type, and resistance per 1000 feet of cable used on these feeders were referenced from EO-2059.

Step 4. The following were calculated by finding:

a. Underground portion – was assumed same average current for the following cable sizes (500, 350, 4/0, and 2/0 Cu) the currents are obtained form the ECC Unit Substation Application of the PI system.

b. Overhead Portion:

1. Maximum current for 477 Al, 2/0 Cu, and 4/0 Cu conductors were assumed the same as the current in underground cables which is= "Step 3". The maximum current for the smaller cable sizes (#2, and #6 Cu) was assumed to be at 50% value the next larger cable size.

2. Minimum current for 477 Al and 4/0 Cu conductors were assumed the same as the maximum current in “Step 5b1”.

3. Average current for all sizes = Minimum current + 2/3 (Maximum current – Minimum current.

The rest of follows same procedures as outlined in steps 3 through 6 in Part I.

III) Underground Network Secondary Cables - Losses were calculated as follows:

There are four basic sizes of underground secondary cables, 750 KCMIL, 500 KCMIL, 4/0, and 2/0 Copper. The size, type, and resistance per 1000 feet for the secondary cable were referenced from EO-2057. Also Table D-4 summarizes the calculated underground secondary cable ampacities.

A. 750 KCMIL is used in all customer service areas for inter-vault ties in multi-bank 1000 kVA network installations and street feeds. Six sets of 750 KCMIL cable is the standard configuration used for 1000 kVA network transformers. The 100% of nameplate rating for 1000 kVA network transformers is 445 amperes per cable. The average normal loading of network transformers on the system for 2007 was calculated to be 53% of the nameplate rating. Consequently, the loading for the 750 KCMIL cable during peak period (no contingency) is 238 amperes.

B. 500 KCMIL cables as street mains in Manhattan, Bronx, Staten Island, and Westchester are used exclusively for inter-vault ties between 500 kVA network transformers and for street tie from transformer vaults. Four sets of 500 KCMIL cable is the standard used for inter-vault ties and street feeds. The 100% of nameplate rating of the network transformer is 334 amperes per cable. Using the average normal loading of 57.6% nameplate rating, loading of 500 KCMIL cable during the peak period is 178 amperes.

C. In Brooklyn and Queens, 500 KCMIL cable is used both for transformer ties and street mains. The normal loading of street mains will vary from 178 amperes maximum at the transformer feed to zero at the minimum points in the network. The average current of 119 amperes per cable was calculated.

D. The maximum current for 4/0 copper cables was assumed to be the same as the average current for the next larger size 500 KCMIL. The minimum current was assumed to be zero. The average current was found using the method described in Part I - Step 3e.

E. The maximum current for 2/0 copper cable was assumed to be the same as the average current for the next larger size (4/0 Cu). The average current was found using the method described in Part I - Step 3e.

Note: Steps 3 through 6 in Part I of section 2.2 were again used to calculate losses for each size.

IV) Overhead Non-network Secondary - Losses were calculated as follows:

There are three basic sizes of overhead secondary. They are 2/0, #2, and #6 Cu, in addition to the equivalent sizes for aluminum. In order to determine the I^2R losses, several secondary systems supplied from 75 kVA overhead transformers loaded at 100% were used. This is the average overhead transformer with average overhead loading. Based on these criteria, it was found that the effective average currents for calculating copper losses are as follows (Table D-4): 2/0 - 70 amperes, #2 – 45 amperes, #6 – 30 amperes. Once the average currents were computed, Steps 6 thru 8 as stated in Part I was repeated.

V) Services - Losses were calculated as follows:

To determine the I^2R losses for overhead and underground services, the capacity factor of 57.6% for underground and 68.3% for overhead were utilized for all distribution transformers. This factor (Table E) was then multiplied by the rated current of different sizes in order to calculate the average current (Table D-5). The size, type, and resistance per 1000 feet for the services cable was referenced from EO-2057.

VI) Contingency Operation of Networks

During contingency operation of networks, loading on feeders, transformers and secondary mains is increased causing a corresponding increase in the following I^2R losses. Steps were performed in order to quantify the incremental losses during contingency:

Step 1: With the use of PVL, obtain a sample network (2X) with no contingency, second (N-2) contingency and (N-3) third contingency. Obtain the increment in percentage compared with normal (no contingency) operation, where an increment of 16.23% for primary feeders and 17.32% for secondary cables under second contingency (N-2) operation.

Step 2: With the use of PI, obtain the frequency of second contingency (N-2) in 2007 of N-2 networks per borough (Manhattan, Brooklyn, Queens and the Bronx) where:

Manhattan has an average frequency of 16 second contingency in 2007; Brooklyn has an average frequency of 17 second contingency in 2007; Queens has an average frequency of 35 second contingency in 2007; the Bronx has an average frequency of 26 second contingency in 2007.

Step 3: Calculate the percentage of average duration of second contingency (N-2) operation in 2007 per borough (Manhattan, Brooklyn, Queens and the Bronx) where the four service areas have an average duration of 26.45 hours experienced second contingency in 2007.

Step 4: Multiply the frequency and average duration of second contingency (N-2) operation in 2007 per borough (Manhattan, Brooklyn, Queens and the Bronx), and divide it with 8,760 hours, which is a typical number of hours in a year, and where:

Manhattan has experienced in second contingency for an average period of 4.7% in 2007; Brooklyn has experienced in second contingency for an average period of 5.1% in 2007; Queens has experienced in second contingency for an average period of 10.7% in 2007; the Bronx has experienced in second contingency for an average period of 7.7% in 2007.

Step 5: Multiply the results obtained from step 4 per borough (Manhattan, Brooklyn, Queens and the Bronx) to the increment in percentage obtained PVL model result from step 1 for both primary and secondary cables.

Manhattan has an increment of 0.768% for load in primary and an increment of 0.820% for load in secondary during second contingency in 2007; Brooklyn has an increment of 0.833% for load in primary and an increment of 0.889% for load in secondary during second contingency in 2007; Queens has an increment of 1.736% for load in primary and an increment of 1.853% for load in secondary during second contingency in 2007; the Bronx has an increment of 1.249% for load in primary and an increment of 1.334% for load in secondary during second contingency in 2007.

Step 6: Loss due to contingency operation, in particular second contingency (N-2), are calculated by multiplying the respected primary and secondary losses in Manhattan, Brooklyn, Queens and the Bronx to the percentage of increment obtained from step 5.

Manhattan has additional I^2R losses of approximately 911 MWh in primary and additional losses of 874 MWh for load in secondary during contingency operation in 2007. Brooklyn has additional copper losses of approximately 588 MWh for load in primary and an increment of approximately 978 MWh for load in secondary during second contingency in 2007. Queens has additional copper losses of approximately 1,682 MWh for load in primary and an increment of approximately 1,982 MWh for load in secondary during second contingency in 2007. The Bronx has additional copper losses of approximately 535 MWh for load in primary and an increment of approximately 394 MWh for load in secondary during second contingency in 2007.

Consolidated Edison Of New York, INC
Estimated Annual Energy Losses For Distribution Cable
Installed As Of December 31, 2007

	Overhead		Underground		Total O.H. & U.G.	
	(MWh)	% Of Net Gen. & Purchases	(MWh)	% Of Net Gen. & Purchases	(MWh)	% Of Net Gen. & Purchases
A) Dielectric Losses						
33kV	1,972	0.003	2,791	0.004	4,763	0.008
27kV	2,785	0.004	77,648	0.124	80,434	0.129
13kV	8,055	0.013	33,041	0.053	41,096	0.066
4kV	604	0.001	261	0.000	865	0.001
Total	13,417	0.021	113,741	0.182	**127,158**	**0.203**
B) Copper Losses						
33kV	10,578	0.017	10,909	0.017	21,487	0.034
27kV	5,435	0.009	169,689	0.271	175,124	0.280
13kV	69,251	0.111	207,423	0.331	276,674	0.442
4kV	188,937	0.302	40,277	0.064	229,214	0.366
Total	274,201	0.438	428,297	0.684	**702,499**	**1.122**
C) Secondary Losses	91,790	0.147	387,451	0.619	**479,240**	**0.766**
D) Services Losses	166,170	0.265	334,099	0.534	**500,270**	**0.799**
Total Losses	545,578	0.872	1,263,589	2.019	**1,809,167**	**2.890**

TABLE A

Consolidated Edison Of New York, INC
Distribution Engineering Department
Cable Copper Losses Calculation, Year - 2007

District	Size	Quantity	Current	Resistance	I^2R	Losses
	KCMIL/AWG	(ft)	(Amps)	(OHMS/1000ft)		(MWh)
33KV Overhead						
Staten Island	133	298,385	133	0.092	1.627	1,382
Staten Island	211	614,033	236	0.059	3.286	5,621
Staten Island	350	157,241	236	0.036	2.005	878
Staten Island	477	2,818	236	0.041	2.284	18
Staten Island	500	302,747	343	0.027	3.177	2,679
27KV Overhead						
Brooklyn	133	859,407	90	0.092	0.745	1,823
Brooklyn	211	148,370	90	0.059	0.478	202
Brooklyn	350	42,880	90	0.036	0.292	36
Brooklyn	477	303,462	90	0.041	0.332	287
Brooklyn	500	14,667	220	0.027	1.307	55
Queens	133	425,846	110	0.092	1.113	1,350
Queens	211	142,468	110	0.059	0.714	290
Queens	350	30,520	110	0.036	0.436	38
Queens	477	59,979	110	0.041	0.496	85
Queens	500	188,850	269	0.027	1.954	1,050
Bronx	350	15,555	193	0.036	1.341	59

Consolidated Edison Of New York, INC
Distribution Engineering Department
Cable Copper Losses Calculation, Year - 2007

District	Size	Quantity	Current	Resistance	I^2R	Losses
13KV Overhead	**KCMIL/AWG**	**(ft)**	**(Amps)**	**(OHMS/1000ft)**		**(MWh)**
Bronx	133	497,642	99	0.092	0.902	1,278
Bronx	211	232,482	99	0.059	0.578	383
Bronx	300	100,755	193	0.042	1.564	449
Bronx	350	14,670	193	0.036	1.341	56
Bronx	477	251,826	193	0.041	1.527	1,095
Bronx	500	213,585	306	0.027	2.528	1,537
Bronx	600	124	306	0.018	1.685	1
Bronx	750	12,900	306	0.018	1.685	62
Staten Island	133	130,516	138	0.092	1.752	651
Staten Island	211	362,851	138	0.059	1.124	1,161
Staten Island	300	510,662	249	0.042	2.604	3,786
Staten Island	350	895	249	0.036	2.232	6
Staten Island	477	1,114,613	249	0.041	2.542	8,067
Staten Island	500	45,366	360	0.027	3.499	452
Staten Island	750	1,308	360	0.018	2.333	9
Manhattan	133	654	89	0.092	0.729	1
Brooklyn	133	5,894	112	0.092	1.154	19

Consolidated Edison Of New York, INC
Distribution Engineering Department
Cable Copper Losses Calculation, Year - 2007

District	Size	Quantity	Current	Resistance	I^2R	Losses
13KV Overhead	**KCMIL/AWG**	**(ft)**	**(Amps)**	**(OHMS/1000ft)**		**(MWh)**
Queens	133	5,532	141	0.092	1.829	29
Queens	211	22,727	212	0.059	2.652	172
Queens	477	14,184	212	0.040	1.798	73
Westchester	133	3,903,920	112	0.092	1.154	12,827
Westchester	211	1,307,162	112	0.059	0.740	2,754
Westchester	300	514,687	220	0.042	2.033	2,979
Westchester	350	405,810	220	0.036	1.742	2,013
Westchester	477	3,191,148	220	0.041	1.984	18,029
Westchester	500	1,620,303	298	0.027	2.398	11,061
Westchester	600	645	298	0.018	1.598	3
Westchester	750	66,489	298	0.018	1.598	303

Consolidated Edison Of New York, INC
Distribution Engineering Department
Cable Copper Losses Calculation, Year - 2007

District	Size	Quantity	Current	Resistance	I^2R	Losses
4KV Overhead	KCMIL/AWG	(ft)	(Amps)	(OHMS/1000ft)		(MWh)
Bronx	#2	924,962	78	0.180	1.095	2,884
Bronx	#6	10,826	39	0.460	0.700	22
Bronx	133	1,321,880	157	0.092	2.268	8,534
Bronx	211	173,350	235	0.059	3.258	1,608
Bronx	477	106,429	235	0.040	2.209	669
Staten Island	#2	857,930	87	0.180	1.362	3,328
Staten Island	#6	37,698	44	0.460	0.891	96
Staten Island	133	3,572,437	175	0.092	2.818	28,656
Staten Island	211	209,752	262	0.059	4.050	2,419
Staten Island	477	785,638	262	0.040	2.746	6,141
Brooklyn	#2	611,412	50	0.180	0.450	783
Brooklyn	#6	1,333	25	0.460	0.288	1
Brooklyn	133	1,821,649	99	0.092	0.902	4,676
Brooklyn	211	294,064	149	0.059	1.310	1,097
Brooklyn	477	248,169	149	0.040	0.888	627
Queens	#2	2,232,362	59	0.180	0.627	3,982
Queens	#6	80,384	30	0.460	0.414	95
Queens	133	5,146,522	119	0.092	1.303	19,089
Queens	211	372,115	178	0.059	1.869	1,980
Queens	477	1,285,699	178	0.040	1.267	4,639
Westchester	#2	8,278,559	88	0.180	1.394	32,853
Westchester	#6	1,163,486	44	0.460	0.891	2,950
Westchester	133	5,823,224	176	0.092	2.850	47,246
Westchester	211	372,115	264	0.059	4.112	4,356
Westchester	477	1,285,699	264	0.040	2.788	10,205

Consolidated Edison Of New York, INC
Distribution Engineering Department
Cable Copper Losses Calculation, Year - 2007

District	Size	Quantity	Current	Resistance	I^2R	Losses
Secondary	KCMIL/AWG	(ft)	(Amps)	(OHMS/1000ft)		(MWh)
Manhattan	#2	1,273	45	0.175	0.354	1
Manhattan	#6	92	30	0.442	0.398	0
Manhattan	133	4,644	70	0.089	0.436	6
Bronx	#2	2,187,881	45	0.175	0.354	2,207
Bronx	#6	21,504	30	0.442	0.398	24
Bronx	133	4,107,937	70	0.089	0.436	5,100
Staten Island	#2	2,304,583	45	0.175	0.354	2,325
Staten Island	#6	10,725	30	0.442	0.398	12
Staten Island	133	8,897,300	70	0.089	0.436	11,047
Brooklyn	#2	1,473,353	45	0.175	0.354	1,486
Brooklyn	#6	25,420	30	0.442	0.398	29
Brooklyn	133	8,037,586	70	0.089	0.436	9,979
Queens	#2	2,498,758	45	0.175	0.354	2,521
Queens	#6	39,277	30	0.442	0.398	44
Queens	133	17,221,662	70	0.089	0.436	21,382
Westchester	#2	19,797,233	45	0.175	0.354	19,974
Westchester	#6	232,995	30	0.442	0.398	264
Westchester	133	12,393,109	70	0.089	0.436	15,387

Consolidated Edison Of New York, INC
Distribution Engineering Department
Cable Copper Losses Calculation, Year - 2007

District	Size	Quantity	Current	Resistance	I^2R	Losses
		(ft)	(Amps)	(OHMS/1000ft)		(MWh)
Manhattan	2	4,332	81	0.180	1.181	15
Bronx	2	3,147,461	81	0.180	1.181	10,583
Staten Island	2	5,302,377	81	0.180	1.181	17,828
Brooklyn	2	4,379,682	81	0.180	1.181	14,726
Queens	2	7,100,963	81	0.180	1.181	23,875
Westchester	2	13,223,237	81	0.180	1.181	44,460

Consolidated Edison Of New York, INC
Distribution Engineering Department
Cable Copper Losses Calculation, Year - 2007

District	Size	Quantity	Current	Resistance	I^2R	Losses
33KV System	KCMIL	(ft)	(Amps)	(OHMS/1000ft)		(MWh)
Staten Island	211	362,057	236	0.059	3.286	3,387
Staten Island	500	787,152	343	0.027	3.177	7,119
Staten Island	750	66,911	343	0.018	2.118	403
27KV System						
Brooklyn	133	11,453,253	90	0.092	0.745	24,299
Brooklyn	211	10,230	90	0.059	0.478	14
Brooklyn	250	26,902	90	0.050	0.405	31
Brooklyn	350	436,293	90	0.036	0.292	362
Brooklyn	450	305	220	0.029	1.404	1
Brooklyn	500	11,945,086	220	0.027	1.307	44,441
Brooklyn	600	264,266	220	0.023	1.113	838
Brooklyn	750	225,483	220	0.018	0.871	559
Losses due to contingency operation						588
Queens	133	8,851,488	110	0.092	1.113	28,053
Queens	211	10,997	110	0.059	0.714	22
Queens	250	318	110	0.050	0.605	1
Queens	350	27,540	110	0.036	0.436	34
Queens	450	5,110	110	0.029	0.351	5
Queens	500	12,076,128	269	0.027	1.954	67,171
Queens	600	22,272	269	0.023	1.664	106
Queens	750	399,684	269	0.018	1.302	1,482
Losses due to contingency operation						1,682

Consolidated Edison Of New York, INC
Distribution Engineering Department
Cable Copper Losses Calculation, Year - 2007

District	Size	Quantity	Current	Resistance	I^2R	Losses
13KV System	KCMIL	(ft)	(Amps)	(OHMS/1000ft)		(MWh)
Manhattan	133	7,494,662	109	0.092	1.093	23,323
Manhattan	211	56,971	109	0.059	0.701	114
Manhattan	250	113,981	109	0.050	0.594	193
Manhattan	300	2,121,087	214	0.042	1.923	11,615
Manhattan	350	1,108,902	214	0.036	1.649	5,205
Manhattan	450	2,473	214	0.029	1.328	9
Manhattan	500	3,805,028	214	0.027	1.236	13,395
Manhattan	600	17,808	214	0.023	1.053	53
Manhattan	750	10,026,757	339	0.018	2.069	59,050
Manhattan	800	806,931	339	0.017	1.954	4,488
Manhattan	1000	255,346	339	0.014	1.609	1,170
Losses due to contingency operation						911
Bronx	133	4,228,209	99	0.092	0.902	10,854
Bronx	211	10,526	99	0.059	0.578	17
Bronx	250	5,155	99	0.050	0.490	7
Bronx	300	1,209,760	193	0.042	1.564	5,388
Bronx	350	492,396	193	0.036	1.341	1,880
Bronx	500	875,905	193	0.027	1.006	2,508
Bronx	600	79,046	193	0.023	0.857	193
Bronx	750	4,168,545	306	0.018	1.685	20,003
Bronx	800	377,097	306	0.017	1.592	1,709
Bronx	1000	80,847	306	0.014	1.311	302
Losses due to contingency operation						535

Consolidated Edison Of New York, INC
Distribution Engineering Department
Cable Copper Losses Calculation, Year - 2007

District	Size	Quantity	Current	Resistance	I^2R	Losses
13KV System	KCMIL	(ft)	(Amps)	(OHMS/1000ft)		(MWh)
Staten Island	133	24,590	138	0.092	1.752	123
Staten Island	211	1,511	249	0.059	3.658	16
Staten Island	300	339	249	0.050	3.100	3
Staten Island	350	1,488	249	0.036	2.232	9
Staten Island	500	6,550	360	0.027	3.499	64
Staten Island	750	606,226	360	0.018	2.333	3,940
Staten Island	1000	9,608	360	0.014	1.814	49
Westchester	133	1,349,922	112	0.092	1.154	4,435
Westchester	211	27,157	112	0.059	0.740	57
Westchester	250	2,733	112	0.050	0.627	5
Westchester	300	729,340	220	0.042	2.033	4,221
Westchester	350	114,640	220	0.036	1.742	569
Westchester	500	173,670	298	0.027	2.398	1,186
Westchester	600	29,347	298	0.023	2.042	171
Westchester	750	5,491,992	298	0.018	1.598	24,993
Westchester	800	324,370	298	0.017	1.510	1,394
Westchester	1000	923,146	298	0.014	1.243	3,268

Consolidated Edison Of New York, INC
Distribution Engineering Department
Cable Copper Losses Calculation, Year - 2007

District	Size	Quantity	Current	Resistance	I^2R	Losses
4KV System	KCMIL	(ft)	(Amps)	(OHMS/1000ft)		(MWh)
Manhattan	500	1,600	235	0.027	1.491	7
Bronx	133	38,042	235	0.092	5.081	550
Bronx	211	206,795	235	0.056	3.093	1,821
Bronx	350	379,041	235	0.036	1.988	2,145
Bronx	500	182,722	235	0.027	1.491	776
Bronx	750	15,152	235	0.018	0.994	43
Staten Island	133	15,371	262	0.092	6.315	276
Staten Island	211	86,153	262	0.056	3.844	943
Staten Island	350	76,074	262	0.036	2.471	535
Staten Island	500	327,257	262	0.027	1.853	1,727
Staten Island	750	78,780	262	0.018	1.236	277
Brooklyn	133	74,649	149	0.092	2.042	434
Brooklyn	211	548,937	149	0.056	1.243	1,943
Brooklyn	350	1,493,244	149	0.036	0.799	3,398
Brooklyn	500	532,089	149	0.027	0.599	908

Consolidated Edison Of New York, INC
Distribution Engineering Department
Cable Copper Losses Calculation, Year - 2007

District	Size	Quantity	Current	Resistance	I^2R	Losses
4KV System	**KCMIL**	**(ft)**	**(Amps)**	**(OHMS/1000ft)**		**(MWh)**
Queens	133	224,300	178	0.092	2.915	1,861
Queens	211	528,589	178	0.056	1.774	2,670
Queens	350	796,965	178	0.036	1.141	2,588
Queens	500	2,139,915	178	0.027	0.855	5,212
Queens	600	5,802	178	0.023	0.729	12
Westchester	133	143,076	264	0.092	6.412	2,612
Westchester	211	340,844	264	0.056	3.903	3,787
Westchester	350	317,480	264	0.036	2.509	2,268
Westchester	500	586,764	264	0.027	1.882	3,144
Westchester	600	1,949	264	0.023	1.603	9
Westchester	750	87,702	264	0.019	1.324	331

Consolidated Edison Of New York, INC
Distribution Engineering Department
Cable Copper Losses Calculation, Year - 2007

District	Size	Quantity	Current	Resistance	I^2R	Losses
Secondary	KCMIL	(ft)	(Amps)	(OHMS/1000ft)		(MWh)
Manhattan	133	89,710	47	0.090	0.199	51
Manhattan	211	43,327,936	88	0.056	0.434	53,494
Manhattan	500	24,428,385	168	0.026	0.734	51,036
Manhattan	750	577,340	252	0.019	1.207	1,983
Losses due to contingency operation						874
Bronx	133	167,638	47	0.090	0.199	95
Bronx	211	24,654,313	88	0.056	0.434	30,439
Bronx	500	8,240,308	168	0.026	0.734	17,216
Bronx	750	73,268	252	0.019	1.207	252
Losses due to contingency operation						394
Staten Island	133	253,934	47	0.090	0.199	144
Staten Island	211	411,133	88	0.056	0.434	508
Staten Island	500	220,892	168	0.026	0.734	461
Staten Island	750	5,256	252	0.019	1.207	18
Brooklyn	133	1,030,709	47	0.090	0.199	583
Brooklyn	211	45,003,898	88	0.056	0.434	55,564
Brooklyn	500	25,714,800	168	0.026	0.734	53,723
Brooklyn	750	51,538	252	0.019	1.207	177
Losses due to contingency operation						978

Consolidated Edison Of New York, INC
Distribution Engineering Department
Cable Copper Losses Calculation, Year - 2007

District	Size	Quantity	Current	Resistance	I^2R	Losses
Secondary	KCMIL	(ft)	(Amps)	(OHMS/1000ft)		(MWh)
Queens	133	660,460	47	0.090	0.199	374
Queens	211	58,497,423	88	0.056	0.434	72,223
Queens	500	16,322,684	168	0.026	0.734	34,101
Queens	750	81,874	252	0.019	1.207	281
Losses due to contingency operation						1,982
Westchester	133	272,830	47	0.090	0.199	154
Westchester	211	5,056,871	88	0.056	0.434	6,243
Westchester	500	1,639,059	168	0.026	0.734	3,424
Westchester	750	57,460	252	0.019	1.207	197

Consolidated Edison Of New York, INC
Distribution Engineering Department
Cable Copper Losses Calculation, Year - 2007

District	Size	Quantity	Current	Resistance	I^2R	Losses
	KCMIL/AWG	(ft)	(Amps)	(OHMS/1000ft)		(MWh)
Manhattan	6	1,717,983	47	0.460	1.016	4,970
Manhattan	2	2,586,229	81	0.180	1.181	8,696
Manhattan	133	845,421	126	0.090	1.429	3,439
Manhattan	211	1,136,460	165	0.056	1.525	4,933
Manhattan	350	15,708	223	0.036	1.790	80
Manhattan	500	4,670,031	287	0.025	2.059	27,379
Manhattan	750	136,805	318	0.019	1.921	748
Bronx	6	1,515,951	47	0.460	1.016	4,386
Bronx	2	3,269,795	81	0.180	1.181	10,994
Bronx	133	585,669	126	0.090	1.429	2,382
Bronx	211	762,805	165	0.056	1.525	3,311
Bronx	350	7,327	223	0.036	1.790	37
Bronx	500	1,771,754	287	0.025	2.059	10,387
Bronx	750	6,852	318	0.019	1.921	37
Staten Island	6	6,661	47	0.460	1.016	19
Staten Island	2	825,712	81	0.180	1.181	2,776
Staten Island	133	83,444	126	0.090	1.429	339
Staten Island	211	104,908	165	0.056	1.525	455
Staten Island	350	988	223	0.036	1.790	5
Staten Island	500	236,703	287	0.025	2.059	1,388
Staten Island	750	360	318	0.019	1.921	2

Consolidated Edison Of New York, INC
Distribution Engineering Department
Cable Copper Losses Calculation, Year - 2007

District	Size	Quantity	Current	Resistance	I^2R	Losses
	KCMIL/AWG	(ft)	(Amps)	(OHMS/1000ft)		(MWh)
Brooklyn	8	1,481,279	36	0.760	0.985	4,154
Brooklyn	6	8,221,855	47	0.460	1.016	23,785
Brooklyn	2	21,756,512	81	0.180	1.181	73,151
Brooklyn	133	1,212,556	126	0.090	1.429	4,933
Brooklyn	211	1,260,571	165	0.056	1.525	5,472
Brooklyn	350	8,692	223	0.036	1.790	44
Brooklyn	500	3,022,130	287	0.025	2.059	17,718
Brooklyn	750	36,689	318	0.019	1.921	201
Queens	6	3,731,934	47	0.460	1.016	10,796
Queens	2	13,634,710	81	0.180	1.181	45,843
Queens	133	907,158	126	0.090	1.429	3,690
Queens	211	1,027,458	165	0.056	1.525	4,460
Queens	350	4,024	223	0.036	1.790	21
Queens	500	2,499,755	287	0.025	2.059	14,655
Queens	750	34,083	318	0.019	1.921	186
Westchester	6	309,110	47	0.460	1.016	894
Westchester	2	1,456,272	81	0.180	1.181	4,896
Westchester	133	669,915	126	0.090	1.429	2,725
Westchester	211	709,183	165	0.056	1.525	3,078
Westchester	350	2,116	223	0.036	1.790	11
Westchester	500	933,112	287	0.025	2.059	5,470
Westchester	750	11,429	318	0.019	1.921	63

Consolidated Edison Of New York, INC
Distribution Engineering Department
Estimated Cable Copper Losses Year - 2007

Summary Of I^2R Losses (MWh)							
Underground							
	Manhattan	**Bronx**	**Brooklyn**	**Queens**	**Staten Island**	**Westchester**	**Total Loss (MWh)**
33kV					10,909		10,909
27kV			71,133	98,556			169,689
13kV	119,526	43,396			4,203	40,298	207,423
4kV	7	5,335	6,683	12,343	3,758	12,150	40,277
	119532	**48731**	**77816**	**110899**	**18870**	**52448**	**428,297**
Overhead							
	Manhattan	**Bronx**	**Brooklyn**	**Queens**	**Staten Island**	**Westchester**	**Total Loss (MWh)**
33kV					10,578		10,578
27kV		59	2,402	2,974			5,435
13kV	1	4,860	19	273	14,131	49,967	69,251
4kV		13,717	7,185	29,785	40,639	97,610	188,937
							274,201
Secondary							
	Manhattan	**Bronx**	**Brooklyn**	**Queens**	**Staten Island**	**Westchester**	**Total Loss (MWh)**
Underground	107,438	48,395	111,505	108,962	1,131	10,020	387,451
Overhead	7	7,332	11,495	23,948	13,384	35,624	91,790
							479,240
Services							
	Manhattan	**Bronx**	**Brooklyn**	**Queens**	**Staten Island**	**Westchester**	**Total Loss (MWh)**
Underground	53,640	33,656	138,287	84,966	5,305	18,246	334,099
Overhead	22	15,773	21,949	35,586	26,573	66,268	166,170
							500,270

Consolidated Edison of New York, INC
Distribution Engineering Department
Dielectric Loss Constant

	Dielectric Loss (watts/ft/conductor)															
Cable Size	4 kV (60 Hz)				13 kV (60 Hz)				27 kV (60 Hz)				33kV (60 Hz)			
KCMIL or AWG	Paper	XLP	EPR	POLY	Paper	XLP	EPR	POLY	Paper	XLP	EPR	POLY	Paper	XLP	EPR	POLY
1 x 8	0.0018			0				0				0				0
1 x 6	0.0013			0			0.0037	0.00222				0				0
1 x 2	0.0012		0.0006	0.0004			0.0049	0.00294				0				0
1 x 1/0	0.0021			0			0.0057	0.00342				0				0
1 x 2/0	0.0023	0.0002	0.0008	0.0006	0.052	0.0014	0.0062	0.00428	0.146	0.0041	0.017	0.01055				0
3 x 2/0	0.0023			0	0.049			0	0.138			0				0
1 x 4/0	0.0028		0.0010	0.000667	0.052	0.0017	0.0073	0.00506				0	0.193	0.0063	0.026	0.022717
3 x 4/0	0.0028			0				0	0.166			0				0
1 x 150				0				0	0.383			0				0
1 x 200	0.0028			0				0				0				0
1 x 250	0.0031			0	0.072			0	0.483			0				0
3 x 250	0.0031			0				0	0.178			0				0
1 x 300	0.0033	0.0003	0.0012	0.0009	0.072	0.0020	0.0084	0.00584	0.188			0				0
1 x 350	0.0033			0		0.0020	0.0087	0.00602		0.0059		0.00295	0.253			0
3 x 350	0.0033			0	0.072			0	0.199			0				0
3 x 350 (LPOF)	.			0				0	0.067			0				0
1 x 400				0	0.072			0				0				0
1 x 450				0	0.072			0	0.213			0				0
1 x 500	0.0038	0.0003	0.0014	0.001033		0.0023	0.010	0.00692		0.0064	0.027	0.0167		0.0080	0.033	0.028833
3 x 500	0.0038			0	0.083			0	0.227			0	0.286			0
1 x 600	0.0045			0	0.089			0				0				0
3 x 600	0.0045			0				0	0.248			0				0
3 x 600 (LPOF)				0				0	0.078			0				0
1 x 750		0.0004	0.0017	0.001267	0.098	0.0028	0.012	0.00832	0.269	0.0075	0.032	0.01975	0.337	0.0099	0.041	0.035817
1 x 800	0.0052			0				0	0.270			0				0
3 x 800	0.0052			0	0.101			0				0				0
1 x 1000		0.0005	0.0020	0.0015	0.121	0.0033	0.014	0.00972				0				0
1 x 1500					0.140				0.383							
1 x 2500					0.179				0.483							

2007 Average Primary Feeder Ampacities

Borough	Size (KCMIL)	Normal Rating (Amps)	Avg Load Current (Amps)	Max Current (Amps)	Min Current (Amps)	Avg Current (Amps)
Staten Island	500 & Above	415	387	387	256	**343**
(33KV)	4/0	275		256	196	**236**
	2/0	210		196	9	**133**
Brooklyn	500 & Above	370	265	265	130	**220**
(27KV)	2/0 To 500	182		130	11	**90**
Queens	500 & Above	370	324	324	159	**269**
(27KV)	2/0 To 500	182		159	11	**110**
Manhattan	800/750	465	387	387	244	**339**
(13KV)	350	293		244	153	**214**
	2/0	184		153	21	**109**
Bronx	800/750	465	349	349	220	**306**
(13KV)	350	293		220	138	**193**
	2/0	184		138	21	**99**
Staten Island	500 & Above	376	403	403	275	**360**
(13KV)	4/0	257		275	197	**249**
	2/0	184		197	21	**138**
Westchester	500 & Above	376	322	322	251	**298**
(13KV)	350	293		251	158	**220**
	2/0	184		158	21	**112**

TABLE D-1

2007 Average Feeder Ampacities
4kV Underground System

Borough	Size (KCMIL)	Normal Rating (Amps)	Avg Current (Amps)
Manhattan	500	495	**235**
Brooklyn	500	495	**149**
	350	415	**149**
	211	315	**149**
	133	240	**149**
Bronx	500	495	**235**
	350	415	**235**
	211	315	**235**
	133	240	**235**
Queens	500	495	**178**
	350	415	**178**
	211	315	**178**
	133	240	**178**
Staten Island	750	570	**262**
	500	495	**262**
	350	415	**262**
	211	315	**262**
	133	240	**262**
Westchester	500	495	**264**
	350	415	**264**
	211	315	**264**
	133	240	**264**

Table D-2

2007 Average Feeder Ampacities For 4kV Overhead System

Borough	Cable Size (KCMIL)	Normal Rating (Amps)	Avg Load Current (Amps)	Max Current (Amps)	Min Current (Amps)	Avg Current (Amps)
Brooklyn	477 (AL)	620		149	149	**149**
	211	485	149	149	149	**149**
	133	365		149	0	**99**
	2	240		75	0	**50**
	6	135		37	0	**25**
Bronx	477 (AL)	620		235	235	**235**
	211	485	235	235	235	**235**
	133	365		235	0	**157**
	2	240		118	0	**78**
	6	135		59	0	**39**
Queens	477 (AL)	620		178	178	**178**
	211	485	178	178	178	**178**
	133	365		178	0	**119**
	2	240		89	0	**59**
	6	135		45	0	**30**
Staten Island	477 (AL)	620		262	262	**262**
	211	485	262	262	262	**262**
	133	365		262	0	**175**
	2	240		131	0	**87**
	6	135		66	0	**44**
Westchester	477 (AL)	590		264	264	**264**
	211	445	264	264	264	**264**
	133	350		264	0	**176**
	2	215		132	0	**88**
	6	125		66	0	**44**

Table D-3

2007 Underground And Overhead Secondary Cable Ampacities

Underground Secondary					
Size	Load Factor	Bank Current	All Boroughs	Manhattan, Bronx, Staten Island, Westchester	Brooklyn, Queens
(KCMIL)		(Amps)	Avg(Amps)	Avg(Amps)	Avg(Amps)
750	53%	445	238		
500	53%	334		178	119
4/0			79		
2/0			53		

Overhead Secondary			
Size			All Boroughs
(KCMIL)			Avg(Amps)
2/0			70
# 2			45
# 6			30

TABLE D-4

2007 Underground And Overhead Services Cable Ampacities

Underground Services			
Size	**Normal Rating**	**Capacity Factor**	**All Boroughs**
(KCMIL)	(Amps)		**Avg(Amps)**
8	65	58%	**37**
6	85	58%	**49**
2	145	58%	**84**
133	225	58%	**130**
211	295	58%	**170**
350	400	58%	**230**
500	515	58%	**297**
750	570	58%	**328**

Overhead Services			
Size	**Normal Rating**	**Capacity Factor**	**All Boroughs**
(KCMIL)	**(Amps)**		**Avg(Amps)**
2	145	68%	**99**

TABLE D-5

Consolidated Edison Company of New York, INC.
2007 Network and Non-Network Capacity Factor

Distribution Total Peak Load MW	12807
Average Power Factor(PF)	0.8
Distribution Total Peak Load MVA	16493

Total Connected MVA	
Year 2007	
Network	21639
Non-Network	5916

Network Peak Transformer Loading %	57.6%
Network Peak Load	12455

Non Network Load	4038.3
Non Network Capacity Factor	68.3%

Table E

PART III: EQUIPMENT AND METERING LOSSES

1. **SUBSTATION EQUIPMENT LOSSES**

2. **DISTRIBUTION EQUIPMENT LOSSES**

   (UNIT SUBSTATIONS ARE PART OF DISTRIBUTION EQUIPMENT)

3. **ELECTRIC METERS AND METER DEVICES**

1. Con Edison Substation Equipment Losses

For the Period of January 1, 2007 --- December 31, 2007

Substation Equipment Engineering and
Control System Engineering

ELECTRIC ENERGY LOSSES (Substation Equipment)

For the Period of January 1 – December 31, 2007

1. Introduction

Losses associated with equipment generally fall into two classes. "No load losses" or core losses describes the energy lost as heat in the core of energized transformers. No load losses are fixed values for each individual piece of equipment. They do not depend on loading. "Load losses" or I^2R losses describe the energy lost due to sending current through the equipment winding. They are proportional to the square of the current.

The following equipment on our System was surveyed for this study:

a. Area Substation Transformers – 260
b. Switching (Transmission) Substation Transformers – 78
c. Phase Angle Regulators (PARs) – 21
d. Shunt Reactors non-switchable (14) and switchable (33)
e. Generator Step-up transformers (GSU) -- 6

2. Methodology

The methodology used for calculating losses is as follows:

A. Core losses as per ANSI/IEEE C57.12.00

a. Transformer, PARs and GSUs:
No-load Loss from manufacturer's test report x (105 % of Rated Voltage)^2 x number of units x 8760 hrs = Annual no-load losses (MW-Hrs). System Operating Voltage is normally 105 % of rated kV.

b. Shunt reactors – switched and un-switched:
Losses from manufacturer's test report x (105 % of Rated Voltage)^2 x 8760 hrs. Shunt Reactor losses are considered No-Load.

B. I^2R losses as per ANSI/IEEE C57.12.00

a. Copper losses (load losses), I2R were taken from the manufacturer's test report at rated (neutral) and at top (100%) name plate rating (TNPR).

b. The Load Loss for the stand-by spare bank (at 33 Substations) was not included in the total tally

c. Series reactors – switched and un-switched

Load losses were taken from the manufacturer's test at rated (neutral) and TNPR. Such losses are considered load losses since they vary as the loading of the feeder to which they are connected.

In order to calculate annual core and copper losses, data stored in PI data base is used to determine the system peak load, area and switching stations' average and peak loads, the system loss factor and load factor. The capacity factor is derived as the ratio of the system peak load to the system installed capacity. Use of these factors is discussed below.

C. System Load Factor (L_dF):

Defined as the ratio of the average load supplied during a designated period to the maximum demand in MWs occurring in that period. Actual hourly loading during 2007 was obtained from our PI Data System.

$$\text{Load factor } (L_dF) = \frac{\text{Average load (MW)}}{\text{Peak demand (MW)}} \text{ or } \frac{\text{Total MW-Hrs for the Year}}{8760 \times \text{Peak Annual MW Load}}$$

For reactors the load factor is considered as 1.0 per unit (p.u.).
Series Reactors located at 3 of our stations (7 Total) were counted only while they were energized during the "Summer Period" June 1 thru Sept 1.

D. System Loss factor (LF):

Adjusts Peak Load losses to estimate average annual losses. Actual hourly loading during 2007 was obtained from our PI Data System. The average of the sum of the squares of the average hourly load/ peak demand, i.e. the average of the sum of the load factor squared, over a period of 8760 Hours.

$$\text{Loss factor} = \frac{\sum (\text{Average hourly load, MW})^2 / (\text{System Peak load, MW})^2}{8760}$$

$$= \text{Average } ((L_dF_1)^2 + (L_dF_2)^2)$$

E. **Capacity Factor (C_F)**

The capacity factor relates the system peak to the area and switching station installed capacity. It is calculated by using the system peak from PI and dividing it by the product of the installed[+] capacity,(MVA) and the power factor of the load.

$$\text{Capacity factor } (C_F) = \frac{\text{System Peak Load, MW}}{\text{Installed capacity, MVA x load power factor}}$$

[+] the installed capacity for switching stations includes the PARs.

Note: By using the system peak load for the capacity factor it is appreciated that The station peak load may not occur at the same time as the system peak. However, though the area and switching peaks are not coincident with the system peak they are similar but shifted in time and as such is as close an approximation that the PI data provides.

3. Generator Step-up Transformers (GSU)

These transformers have been included in the load loss study for 2007. The load and loss factors are derived as shown below.

1. Load and loss factor for GSUs is a function of the hours operated online and a per unit loading. Factors used are those from a previous 1992 Loss Survey Report since the have seen little change in operational requirements (as per the Steam. Operations Department).

Load (P.U.)	Effective load ($P.U.^2$)	Hours of operation	Effective load hours
1.0	1.0	5000	1 x 5000 = 5000
0.75	0.56	2000	0.56 x 2000 = 1120
0.5	0.25	1000	0.25 x 1000 = 250
		Total = 8000	Total = 6370

Load factor = 0.80
Loss factor = 0.34

Annual Equipment Losses

The 2007 Annual Substation Equipment Losses have been broken down by voltage classes for transformers – area and switching stations, reactors - shunt and series and PARs. The annual losses computed depended on the duration and loading the equipment experienced in respect to the system peak load. The capacity factor captures the relationship between the load loss and the system peak load and is directly related to how the peak load impacted the equipment installed capacity.

The capacity factor is given as the ratio of the system peak load in megawatts (MW) to the product of the system connected capacity in MVA and the power factor of the connected load.

The load power factor used for the area and switching stations is 90 % and was obtained from Area station Planning‘s 2007-2016 Area Substation and Sub-transmission Feeder Ten Year Load Relief program (TYLR) and Electrical Engineering’s 2007 Tie Feeder Rating Tabulation.

The annual Equipment losses is the sum of all equipment core losses (no-load) and Copper losses (load losses),

Total annual core losses = total no-load losses (MW) x 8760 hrs Eq.1

Total annual copper losses = total copper losses (MW) x 8760 x LF x $(CF)^2$ Eq.2

OR

Total annual equipment losses = (total NLL + total LL x LF x CF^2) x 8760 Eq. 3

As an example the annual equipment load losses for the area stations were calculated as shown below

Annual Load Losses, LL = total TNPR losses (MW) x 8760 x LF x $(CF)^2$

Where, TNPR = top nameplate rated losses (Mfgr. test report)

Capacity Factor, CF = $\frac{\text{system peak load (MW)}}{\text{System connected capacity (MVA) x pf}}$

Example:

Annual 345 kV area station load losses = 106.414 x 0.3243 x $\frac{(12807)^2}{(17817 \times 0.9)^2}$ x 8760

= 1,349.3 MWh

Total annual 345 kV area station Losses

= total no-load losses x 8760 + total Load Losses x 8760
= (0.142 + 0.154) x 8760 MWh
= 2,593.3 MWh

A similar calculation was done for the switching stations. However, the installed capacity includes the PARs TNPR since they are considered as part of the switching station equipment.

The reactor losses were treated as load losses since once put in service will vary only as the load on the feeder. Since the load on the reactors is considered to be the average load of the feeder (to which it is attached) the capacity factor was set equal to ratio of the average feeder current to the nameplate current rating of the reactor, i.e. its installed capacity.

The shunt reactors though switchable are, however, kept in service year-round so the load losses were calculated over the 8760 hours. The 138 KV current limiting (CL) series reactors are non-switchable hence the load losses were also considered over 8760 hours. The 345 KV series reactors are switchable and are usually placed in service for six months of the year, consequently the load losses were calculated over 4380 hours.

4. Un-metered Light and Power (L&P) Consumption

Un-metered light and power (L&P) consumption is the energy used by the substation such as fans, pumps, heaters, cooling stations and lighting is not metered and not reported in the monthly consumption by company facility. However, Con Edison was able extrapolate data from our remote monitoring system (RMS) and found these losses to account for 0.29% of net generation and purchases or approximately 179,195 MWh.

The average Area Substation L&P load was extrapolated from 10 Area Substations with L&P load boards supplied by network transformers monitored by RMS. The average load for 2007 was based on the 12 month average. The average Transmission Substation L&P load was extrapolated from 3 Transmission Substations with L&P load boards supplied by network transformers monitored by RMS. The average Cooling Plant L&P load was extrapolated from 3 Cooling Plants with L&P load boards supplied by network transformers monitored by RMS. The average load for 2007 was based on the 12 month average.

The average load board power for a given category (Area Station, Transmission Station and Cooling Plant) was multiplied by the number of stations in a category and 8,760 hours/year. The total energy 179,195 MWh or 0.29% of the net generation and purchases is the sum of the energy consumed by each category.

2007 Summary of Substation Equipment Losses

	TNPR	No-Load Loss	Load Loss	Load	Loss	Capacity	Station			Annual Losses (MW-Hrs)		
	MVA	MW	MW	Factor[4]	Factor[4]	Factor[5]	PF			No-Load	Load	TOTAL
Area SS												
345 KV	131	0.142	0.745	0.5577	0.3243	0.7987	0.90	8760	=	1,244	1,349	2,593
138 KV	15,748	8.374	93.197	0.5577	0.3243	0.7987	0.90	8760	=	73,353	168,894	242,247
69 KV	1,938	1.292	12.472	0.5577	0.3243	0.7987	0.90	8760	=	11,316	22,601	33,917
Switching SS												
500 KV	1,000	0.314	0.910	0.5577	0.3243	0.5503	0.90	8760	=	2,748	783	3,531
345 KV	16,587	7.276	38.696	0.5577	0.3243	0.5503	0.90	8760	=	63,741	33,287	97,027
138 KV	2,127	0.837	6.153	0.5577	0.3243	0.5503	0.90	8760	=	7,334	5,293	12,627
69 KV	250	0.161	1.479	0.5577	0.3243	0.5503	0.90	8760	=	1,412	1,272	2,685
PAR's												
345 KV	3,475	1.547	8.287	0.646	0.429	0.5503	0.90	8760	=	13,548	9,431	22,979
138 KV	2,061	0.914	4.713	0.646	0.429	0.5503	0.90	8760	=	8,007	5,363	13,370
69 KV	360	0.126	1.373	0.646	0.429	0.5503	0.90	8760	=	1,102	1,562	2,664
Shunt Reactors [1]												
345 KV	1,945	4.533		1.00	1.00		0.90	8760	=	39,708		39,708
138 KV	460	0.923		1.00	1.00		0.90	8760	=	8,083		8,083
Series Reactors [2]												
345 KV	2,546		3.105	1.00	0.50	0.09	0.90	4380	=		53	53
138 KV	427		2.078	1.00	1.00	0.05	0.90	8760	=		49	49
GSU[3]	930	0.507	3.389	0.80	0.34			8760	=	4,446	6,461	10,906
	26.945	176.597	System Peak	12,807	MW					236,043	256,398	492,441
												MW-Hrs

1 Shunt Reactors (Switchable, but in service all year)

2 345 kV Series Reactors are Switchable (normally in service May 1 to Oct 15) , 138 kV CL Reactors are Non-Switchable

3 East River GSU's (includes Station Aux Units)

4 Load & Loss Factors (Area, Sw Stat. & PARs) calculated, using 2007 System Load Data, from PI

5 Capacity Factor (System Peak Load / System Connected Capacity)

2. Con Edison Distribution Equipment Losses
For the period of January 1 – December 31, 2007

Distribution Engineering

1. Introduction.

The Con Edison Distribution equipment can be divided into three categories – network, non-network and unit substation equipment. Network equipment includes network transformers, network protectors, and shunt reactors. Non-network equipment includes unit substation transformers, overhead transformers, URD (submersible) transformers, pad mounted transformers, grounding transformers, voltage regulators, and capacitors. All data used for the Distribution Equipment Losses in the Electrical systems losses study were taken from Distribution Equipment Management System (DEMS).

2. Methodology.

The following method was used to calculate energy loss in distribution transformers during 2007:

a) *Annual Average No-Load Loss Energy (kWh)= Number of Units x Average No Load Loss x Time*

No Load Loss (Watts) = derived from guaranteed losses supplied for equipment

Time = 8,760 hours

b) *Annual Average Load Loss Energy (kWh)= Number of Units x Average Load Loss x Time x Transformer Loading Factor*^{2}

Load Loss (Watts) = derived from guaranteed losses supplied for equipment

Time = 8,760 hours

(Transformer Loading Factor)^2 = Loss Factor x (Capacity Factor)^2

$$\text{Loss Factor} = \frac{(\text{Actual Hourly Load})^2 / 8{,}760}{(\text{System Peak Load})^2}$$

$$\text{Capacity Factor} = \frac{\text{Peak Load}}{\text{Connected Capacity}}$$

The values for the basic parameters used in the equations above are:

System Annual Loss Factor = 0.325
Network Capacity Factor = 0.576
Radial Capacity Factor = 0.682

3. Results.

The results are summarized in a table below.

Net Generation and Net Purchase other utilities	62,591,729					
Network Losses - 2007						
	Manhattan	**Bronx**	**Brooklyn**	**Queens**	**Staten Island**	**Westchester**
Total Network Losses	208,669	47,805	92,254	97,333	5,793	29,946
0.77%	0.33%	0.08%	0.15%	0.16%	0.01%	0.05%
Non - Network Losses - 2007						
		Bronx	**Brooklyn**	**Queens**	**Staten Island**	**Westchester**
Total Non Network Losses		16,213	19,343	37,757	27,772	109,764
0.34%		0.03%	0.03%	0.06%	0.04%	0.18%

2007 Distribution Equipment Summary
Data Table

Net Generation and Net	62,591,729,000							
Purchase other utilities								
Estimated Annual System Energy Losses For 2007								
Manhattan								
				Avg Losses (Watts)		**Annual Losses (Kilowatt - Hours)**		
System	**Equipment**	**kVA Class**	**Units**	**No Load**	**Avg Load**	**No Load**	**Load**	**Total**
Network	Transformers	2500	1079	3016	10461	28,507,353	10,661,715	39,169,068
		2000	308	2955	6055	7,972,826	1,761,559	9,734,386
		1000	5886	1907	6131	98,327,514	34,086,625	132,414,139
		500	1450	1078	2898	13,692,756	3,969,162	17,661,918
		333	353	672	1933	2,079,043	644,635	2,723,678
		167	260	405	1063	921,669	261,141	1,182,810
		(300, 200, 150,	225	312	839	615,037	178,366	793,403
		100, 75, 50)	**9561**	0	0	**152,116,198**	**51,563,204**	**203,679,401**
	Network	2800	795	-	970	-	728,402	728,402
	Protectors	2000	600	-	495	-	280,536	280,536
		1120	555	-	767	-	402,088	402,088
		1000	5739	-	611	-	3,312,149	3,312,149
		500	1843	-	153	-	266,348	266,348
		Total	**9532**				**4,989,523**	**4,989,523**
							Manhattan Total Network Losses:	**208,668,924**
						No Load	**Load**	**Total Losses**
					Total	**152,116,198**	**56,552,727**	**208,668,924**
						0.24%	**0.09%**	**0.33%**

2007 Distribution Equipment Summary
Data Table

Estimated Annual System Energy Losses For 2007								
Bronx								
				Avg Losses (Watts)		Annual Losses (Kilowatt - Hours)		
System	**Equipment**	**kVA Class**	**Units**	**No Load**	**Load**	**No Load**	**Load**	**Total**
Network	Transformers	2500	122	3020	10395	3,227,534	1,197,890	4,425,424
		2000	30	2955	6055	776,574	171,580	948,154
		1000	799	1847	5880	12,927,596	4,437,686	17,365,282
		500	1904	1086	2878	18,113,437	5,175,951	23,289,389
		167	46	672	1933	270,923	84,003	354,927
		(300,150,100	146	302	813	386,288	112,165	498,453
		75,50,25)	**3047**			**35,702,353**	**11,179,275**	**46,881,628**
	Network	2800	112	-	970	-	102,618	102,618
	Protectors	2000	25	-	495	-	11,689	11,689
		1120	249	-	767	-	180,396	180,396
		1000	565	-	611	-	326,078	326,078
		500	2091	-	153	-	302,188	302,188
		Total	**3042**				**922,970**	**922,970**
					Bronx Total Network Losses:			**47,804,598**
						No Load	**Load**	**Total Losses**
					Total	**35,702,353**	**12,102,245**	**47,804,598**
						0.06%	**0.02%**	**0.08%**

2007 Distribution Equipment Summary
Data Table

Estimated Annual System Energy Losses For 2007								
Bronx								
				Avg Losses (Watts)		Annual Losses (Kilowatt - Hours)		
System	**Equipment**	**kVA Class**	**Units**	**No Load**	**Load**	**No Load**	**Load**	**Total**
Radial	O.H.	225	253	533	5436	1,181,277	1,821,194	3,002,471
	Transformers	200	3	468	2386	12,299	9,479	21,778
		167	12	334	1818	35,110	28,889	63,999
		150	599	376	2193	1,972,962	1,739,489	3,712,451
		100	218	186	1099	355,200	317,256	672,457
		75	1291	177	1127	2,001,721	1,926,666	3,928,387
		50	485	109	630	463,097	404,612	867,709
		45	133	124	875	144,470	154,105	298,575
		38	95	90	502	74,898	63,151	138,049
		25	38	75	327	24,966	16,455	41,421
		15	11	62	382	5,974	5,564	11,539
		10	9	62	382	4,888	4,553	9,441
		Total	**3147**			**6,276,864**	**6,491,412**	**12,768,276**
	URD	50	8	104	636	**7,288**	**6,738**	**14,026**
	Transformers							
	Pad Mounted	2000	3	2604	15223	68,433	60,475	128,908
	Transformers	1000	60	1432	10274	752,659	816,295	1,568,954
		500	58	1084	4803	550,759	368,890	919,649
		300	28	751	2378	184,205	88,171	272,376
		167	1	243	1533	2,129	2,030	4,159
		150	15	407	2239	53,480	44,474	97,953
		75	2	332	606	5,817	1,605	7,422
		50	18	96	761	15,137	18,139	33,276
		25	1	76	275	666	364	1,030
		Total	**186**			**1,633,284**	**1,400,443**	**3,033,727**
	Grounding	31.5 Amps, 13kV	10	1188	-	**104,069**	-	**104,069**
	Transformers							
	Voltage	100	37	315	1445	102,098	70,799	172,897
	Regulators	75	22	255	1590	49,144	46,321	95,464
		50	6	205	835	10,775	6,634	17,409
		Total	**65**			**162,016**	**123,754**	**285,770**
	Primary	300 kVAR	62	12	10	6,517	821	7,338
	Capacitors					**6,517**	**821**	**7,338**
					Bronx Total Radial Losses:			**16,213,207**
						No Load	**Load**	**Total Losses**
					Total	**8,190,039**	**8,023,167**	**16,213,207**
						0.01%	**0.01%**	**0.03%**

2007 Distribution Equipment Summary
Data Table

Estimated Annual System Energy Losses For 2007								
Brooklyn								
				Avg Losses (Watts)		Annual Losses (Kilowatt - Hours)		
System	**Equipment**	**kVA Class**	**Units**	**No Load**	**Load**	**No Load**	**Load**	**Total**
Network	Transformers	2500	192	2864	10372	4,817,019	1,881,032	6,698,051
		2000	43	2955	6055	1,113,089	245,932	1,359,021
		1000	878	1989	6511	15,297,956	5,399,762	20,697,718
		500	4880	1072	2877	45,826,714	13,261,484	59,088,197
		(300, 150, 100, 50)	37	391	1090	126,882	38,096	164,977
		Total	**6030**			**67,181,659**	**20,826,306**	**88,007,965**
	Network	2800	155	-	970	-	142,016	142,016
	Protectors	2000	34	-	495	-	15,897	15,897
		1120	150	-	767	-	108,672	108,672
		1000	770	-	611	-	444,390	444,390
		500	4485	-	153	-	648,166	648,166
		Total	**5594**				**1,359,141**	**1,359,141**
	Shunt	1000	18	5500	-	867,240	-	867,240
	Reactors	600	48	4000	-	1,681,920	-	1,681,920
		300	11	3500	-	337,260	-	337,260
		Total	**77**			**2,886,420**		**2,886,420**
						Brooklyn Total Network Losses:		**92,253,526**
						No Load	**Load**	**Total Losses**
					Total	**70,068,079**	**22,185,447**	**92,253,526**
						0.11%	**0.04%**	**0.15%**

2007 Distribution Equipment Summary
Data Table

Estimated Annual System Energy Losses For 2007								
Brooklyn								
				Avg Losses (Watts)		Annual Losses (Kilowatt - Hours)		
System	**Equipment**	**kVA Class**	**Units**	**No Load**	**Load**	**No Load**	**Load**	**Total**
Radial	O.H.	225	367	481	2435	1,546,377	1,183,372	2,729,748
	Transformers	200	6	468	2386	24,598	18,957	43,555
		167	23	322	2210	64,877	67,309	132,186
		150	1368	452	1966	5,416,623	3,561,442	8,978,065
		100	367	190	1029	610,835	500,078	1,110,913
		75	1363	169	1202	2,017,840	2,169,484	4,187,324
		50	220	106	654	204,283	190,527	394,810
		45	61	136	813	72,673	65,671	138,344
		37.5	20	91	482	15,943	12,765	28,709
		25	11	84	283	8,094	4,122	12,216
		15	15	62	382	8,147	7,588	15,735
		10	4	41	255	1,437	1,351	2,787
		7.5	1	31	191	272	253	524
		5	2	20	0	350	0	350
		3	1	10	748	88	991	1,078
		Total	**3829**			**9,992,436**	**7,783,911**	**17,776,346**
	URD	150	3	540	1450	14,191	5,760	19,952
	Transformers	100	4	200	996	7,008	5,276	12,284
		75	1	310	925	2,716	1,225	3,940
		50	18	104	636	16,399	15,160	31,558
		25	2	70	328	1,226	869	2,095
		Total	**28**			**41,540**	**28,289**	**69,829**
	Pad Mounted	1000	22	1517	9069	292,356	264,203	556,560
	Transformers	500	12	1049	4499	110,271	71,491	181,762
		300	4	625	2557	21,900	13,544	35,444
		225	1	765	1167	6,701	1,545	8,247
		150	8	335	1695	23,477	17,956	41,433
		100	5	157	1246	6,877	8,250	15,126
		Total	**52**			**461,582**	**376,990**	**838,572**
	Grounding		3	1188	-	**31,221**	-	**31,221**
	Transformers							
	Voltage	100	110	315	1445	303,534	210,483	514,017
	Regulators	75	16	255	1590	35,741	33,688	69,429
		50	6	205	835	10,775	6,634	17,409
		Total	**132**			**350,050**	**250,805**	**600,855**
	Primary	300	213	12	10	22,391	2,821	25,211
	Capacitors	100	1	12	10	105	13	118
		15	7	12	10	736	93	829
		Total	**221**			**23,232**	**2,926**	**26,158**
						Brooklyn Total Radial Losses:		**19,342,981**
						No Load	**Load**	**Total Losses**
					Total	**10,900,059**	**8,442,921**	**19,342,981**
						0.02%	**0.01%**	**0.03%**

2007 Distribution Equipment Summary
Data Table

Estimated Annual System Energy Losses For 2007								
Queens								
				Avg Losses (Watts)		Annual Losses (Kilowatt - Hours)		
System	**Equipment**	**kVA Class**	**Units**	**No Load**	**Load**	**No Load**	**Load**	**Total**
Network	Transformers	2500	200	2971	10318	5,205,192	1,949,207	7,154,399
		2000	45	2955	6055	1,164,861	257,371	1,422,232
		1000	1102	2011	6722	19,413,229	6,997,011	26,410,239
		500	4547	1128	2947	44,930,180	12,657,197	57,587,377
		(300, 167, 150	179	437	1216	685,963	205,629	891,591
		, 100, 50)	**6073**			**71,399,425**	**22,066,413**	**93,465,838**
	Network	2800	144	-	970	-	131,937	131,937
	Protectors	2000	35	-	495	-	16,365	16,365
		1120	199	-	767	-	144,172	144,172
		1000	817	-	611	-	471,515	471,515
		500	4012	-	153	-	579,809	579,809
		Total	**5207**				**1,343,798**	**1,343,798**
	Shunt	1000	13	5500	-	626,340	-	626,340
	Reactors	600	41	4000	-	1,436,640	-	1,436,640
		300	15	3500	-	459,900	-	459,900
		Total	**69**			**2,522,880**		**2,522,880**
							Queens Total Network Losses:	**97,332,516**
						No Load	**Load**	**Total Losses**
					Total	**73,922,305**	**23,410,211**	**97,332,516**
						0.12%	**0.04%**	**0.16%**

2007 Distribution Equipment Summary
Data Table

Estimated Annual System Energy Losses For 2007								
Queens								
				Avg Losses (Watts)		Annual Losses (Kilowatt - Hours)		
System	**Equipment**	**kVA Class**	**Units**	**No Load**	**Load**	**No Load**	**Load**	**Total**
Radial	O.H.	225	583	484	2404	2,471,827	1,855,920	4,327,747
	Transformers	167	7	283	1988	17,354	18,428	35,781
		150	3152	499	1827	13,778,148	7,625,722	21,403,871
		100	681	183	1046	1,091,697	943,268	2,034,965
		75	1824	171	1233	2,732,279	2,978,133	5,710,412
		50	238	107	634	223,082	199,812	422,895
		45	66	129	845	74,583	73,851	148,434
		37.5	23	91	486	18,335	14,802	33,137
		25	72	84	283	52,980	26,982	79,963
		20	1	62	382	543	506	1,049
		15	27	44	248	10,407	8,867	19,274
		10	4	31	191	1,086	1,012	2,098
		Total	**6678**			**20,472,321**	**13,747,303**	**34,219,624**
	URD	150	2	499	1827	8,742	4,839	13,581
	Transformers	100	28	200	996	49,056	36,930	85,986
		50	27	104	636	24,598	22,739	47,337
		Total	**57**			**82,397**	**64,507**	**146,904**
	Pad Mounted	2000	1	3383	13162	29,635	17,429	47,064
	Transformers	1500	3	1995	15654	52,429	62,187	114,616
		1000	59	1560	9073	806,270	708,858	1,515,128
		500	55	949	4790	457,228	348,863	806,091
		300	10	430	2930	37,668	38,799	76,467
		150	2	311	1473	5,449	3,901	9,350
		100	18	157	1246	24,756	29,699	54,455
		50	7	98	782	6,009	7,249	13,258
		Total	**155**			**1,419,444**	**1,216,986**	**2,636,430**
Radial	Grounding		4	1188	-	**41,628**	-	**41,628**
	Transformers							
	Voltage	125	5	500	1535	21,900	10,163	32,063
	Regulators	100	131	315	1445	361,481	250,666	612,147
		75	23	255	1590	51,377	48,426	99,804
		50	2	205	835	3,592	2,211	5,803
		Total	**161**			**438,350**	**311,467**	**749,817**
	Primary	900	1	12	10	105	13	118
	Capacitors	300	204	12	10	21,444	2,701	24,146
		100	53	12	10	5,571	702	6,273
		Total	**258**			**27,121**	**3,416**	**30,537**
							Queens Total Radial Losses:	**37,824,940**
						No Load	**Load**	**Total Losses**
					Total	**22,481,261**	**15,343,679**	**37,824,940**
						0.04%	**0.02%**	**0.06%**

2007 Distribution Equipment Summary
Data Table

Estimated Annual System Energy Losses For 2007								
Staten Island								
				Avg Losses (Watts)		Annual Losses (Kilowatt - Hours)		
System	Equipment	kVA Class	Units	No Load	Load	No Load	Load	Total
Network	Transformers	2500	33	2778	10045	803,064	313,110	1,116,174
		2000	10	2955	6055	258,858	57,193	316,051
		1000	85	1884	6038	1,402,826	484,780	1,887,606
		500	118	1171	3019	1,210,439	336,494	1,546,933
		(300, 167, 100)	15	461	1284	60,585	18,199	78,784
		Total	**261**			**3,735,773**	**1,209,776**	**4,945,548**
	Network	2800	18	-	970	-	16,492	16,492
	Protectors	2000	2	-	495	-	935	935
		1120	19	-	767	-	13,765	13,765
		1000	66	-	611	-	38,091	38,091
		500	82	-	153	-	11,851	11,851
		Total	**187**				**81,134**	**81,134**
	Shunt	1500	6	6500	-	341,640	-	341,640
	Reactors	1000	3	5500	-	144,540	-	144,540
		600	8	4000	-	280,320	-	280,320
		Total	**17**			**766,500**		**766,500**
							Staten Island Total Network Losses:	5,793,182
						No Load	Load	Total Losses
					Total	4,502,273	1,290,909	5,793,182
						0.01%	0.00%	0.01%

2007 Distribution Equipment Summary
Data Table

Estimated Annual System Energy Losses For 2007								
Staten Island								
				Avg Losses (Watts)		Annual Losses (Kilowatt - Hours)		
System	**Equipment**	**kVA Class**	**Units**	**No Load**	**Load**	**No Load**	**Load**	**Total**
Radial	O.H.	225, 200	175	552	2416	846,216	559,875	1,406,091
	Transformers	167	7	296	1838	18,151	17,037	35,188
		150	501	370	2204	1,623,841	1,462,196	3,086,037
		100	823	186	1106	1,340,963	1,205,344	2,546,308
		75	3082	160	1001	4,319,731	4,085,290	8,405,022
		50	2313	109	630	2,208,545	1,929,623	4,138,168
		45	470	123	869	506,416	540,846	1,047,262
		38	705	90	507	555,822	473,318	1,029,140
		25	161	74	339	104,367	72,274	176,641
		15	17	62	382	9,233	8,599	17,832
		10	8	62	382	4,345	4,047	8,392
		7.5	11	31	191	2,987	2,782	5,769
		5	10	21	127	1,840	1,682	3,521
		Total	**8283**			**11,542,456**	**10,362,914**	**21,905,371**
	URD	150	6	540	1450	28,382	11,521	39,903
	Transformers	100	1126	200	996	1,972,752	1,485,094	3,457,846
		75	8	310	925	21,725	9,799	31,524
		50	740	104	636	674,170	623,225	1,297,395
		25	44	70	328	26,981	19,111	46,092
		Total	**1924**			**2,724,010**	**2,148,750**	**4,872,760**
	Pad Mounted	2000	3	2604	15223	68,433	60,475	128,908
	Transformers	1000	64	1628	8258	912,722	699,860	1,612,582
		500	142	1053	4587	1,309,848	862,528	2,172,376
		300	99	703	2634	609,670	345,308	954,978
		150	82	419	1731	300,976	187,961	488,937
		75	8	332	606	23,267	6,420	29,686
		50	317	92	727	255,477	305,176	560,652
		25	17	75	304	11,169	6,844	18,013
		Total	**732**			**3,491,561**	**2,474,571**	**5,966,132**
	Voltage	167	33	500	1535	144,540	67,078	211,618
	Regulators	100	1	315	1445	2,759	1,913	4,673
		75	25	255	1590	55,845	52,637	108,482
		50	13	205	835	23,345	14,374	37,720
		Total	**72**			**226,490**	**136,003**	**362,493**
	Primary	900	204	12	10	21,444	2,701	24,146
	Capacitors	450	105	12	10	11,038	1,390	12,428
		300	281	12	10	29,539	3,721	33,260
		100	11	12	10	1,156	146	1,302
		Total	**601**			**63,177**	**7,958**	**71,136**
							Staten Island Total Radial Losses:	**27,772,411**
						No Load	**Load**	**Total Losses**
					Total	**14,811,609**	**12,960,801**	**27,772,411**
						0.02%	**0.02%**	**0.04%**

2007 Distribution Equipment Summary
Data Table

Estimated Annual System Energy Losses For 2007								
Westchester	Westchester							
				Avg Losses (Watts)		Annual Losses (Kilowatt - Hours)		
System	Equipment	kVA Class	Units	No Load	Load	No Load	Load	Total
Network	Transformers	2500	133	3163	10797	3,685,148	1,356,398	5,041,546
		2000	32	2955	6055	828,346	183,019	1,011,365
		1000	385	2114	7370	7,129,676	2,680,160	9,809,836
		500	915	1195	3107	9,578,403	2,685,312	12,263,715
		(300,167,150,	180	390	1093	614,829	185,915	800,744
		100,75,50,25)	**1645**			**21,836,402**	**7,090,804**	**28,927,206**
	Network	2800	102	-	970	-	93,455	93,455
	Protectors	2000	68	-	495	-	31,794	31,794
		1120	97	-	767	-	70,275	70,275
		1000	328	-	611	-	189,299	189,299
		500	863	-	153	-	124,720	124,720
		Total	**1458**				509,542	509,542
							1,019,085	**1,019,085**
							Westchester Total Network Losses:	**29,946,291**
						No Load	**Load**	**Total Losses**
					Total	**21,836,402**	**8,109,889**	**29,946,291**
						0.03%	**0.01%**	**0.05%**

2007 Distribution Equipment Summary
Data Table

Estimated Annual System Energy Losses For 2007								
Westchester	Westchester							
				Avg Losses (Watts)		Annual Losses (Kilowatt - Hours)		
System	Equipment	kVA Class	Units	No Load	Load	No Load	Load	Total
Radial	O.H.	225	785	556	2391	3,823,390	2,485,452	6,308,842
	Transformers	200	3	468	2386	12,299	9,479	21,778
		167	224	362	1860	710,331	551,718	1,262,049
		150	1595	389	2149	5,435,186	4,538,928	9,974,114
		100	512	191	1132	856,658	767,490	1,624,148
		75	3989	178	1063	6,219,968	5,615,049	11,835,016
		50	8088	109	629	7,722,746	6,736,712	14,459,458
		45	2041	124	878	2,217,016	2,372,978	4,589,994
		38	6928	90	506	5,462,035	4,642,101	10,104,136
		30	58	62	382	31,501	29,339	60,840
		25	1882	74	339	1,219,988	844,842	2,064,830
		20	12	62	382	6,517	6,070	12,588
		15	197	61	378	105,269	98,608	203,877
		10	105	62	382	57,028	53,114	110,142
		7.5	64	62	382	34,760	32,374	67,134
		5	97	31	191	26,341	24,534	50,875
		3	15	44	248	5,782	4,926	10,708
		Total	**26595**			**33,946,813**	**28,813,715**	**62,760,529**
	URD	167	20	279	1548	48,881	40,997	89,878
	Transformers	150	30	540	1450	141,912	57,603	199,515
		100	299	200	996	523,848	394,354	918,202
		75	22	310	925	59,743	26,948	86,691
		50	714	104	636	650,483	601,328	1,251,811
		25	175	70	328	107,310	76,010	183,320
		Total	**1260**			**1,532,177**	**1,197,240**	**2,729,417**
	Pad Mounted	2000	130	2407	15746	2,741,092	2,710,627	5,451,719
	Transformers	1500	2	1995	15654	34,952	41,458	76,411
		1000	373	1433	9790	4,682,299	4,835,571	9,517,870
		500	785	1112	4623	7,646,779	4,805,624	12,452,403
		300	458	704	2692	2,824,504	1,632,664	4,457,168
		225	2	765	1167	13,403	3,091	16,494
		167	24	260	1728	54,662	54,918	109,580
		150	302	406	1925	1,074,081	769,828	1,843,909
		100	1013	179	1098	1,588,425	1,472,882	3,061,307
		75	158	332	606	459,515	126,790	586,305
		50	2028	93	724	1,652,171	1,944,298	3,596,469
		25	799	75	288	524,943	304,716	829,659
		Total	**6074**			**23,296,826**	**18,702,467**	**41,999,292**
	Grounding	31.5 Amps, 13kV	96	1188	-	**999,060**	-	**999,060**
	Transformers							
	Voltage	167	31	500	1535	135,780	63,012	198,792
	Regulators	100	92	315	1445	253,865	176,040	429,905
		75	117	255	1590	261,355	246,342	507,697
		50	28	205	835	50,282	30,960	81,242
		Total	**268**			**701,282**	**516,355**	**1,217,637**
	Primary	900	144	12	10	15,137	1,907	17,044
	Capacitors	450	18	12	10	1,892	238	2,131
		300	281	12	10	29,539	3,721	33,260
		100	48	12	10	5,046	636	5,681
		Total	**491**			**51,614**	**6,502**	**58,116**
							Westchester Total Radial Losses:	**109,764,051**
						No Load	**Load**	**Total Losses**
					Total	**60,527,772**	**49,236,279**	**109,764,051**
						0.10%	**0.08%**	**0.18%**

2007 Manhattan Equipment Data

Estimated Annual System Energy Losses For 2007								
Manhattan								
				Avg Losses (Watts)		**Annual Losses (Kilowatt - Hours)**		
System	**Equipment**	**kVA Class**	**Units**	**No Load**	**Avg Load**	**No Load**	**Load**	**Total**
Network	Transformers	2500	1079	3016	10461	28,507,353	10,661,715	39,169,068
		2000	308	2955	6055	7,972,826	1,761,559	9,734,386
		1000	5886	1907	6131	98,327,514	34,086,625	132,414,139
		500	1450	1078	2898	13,692,756	3,969,162	17,661,918
		333	353	672	1933	2,079,043	644,635	2,723,678
		167	260	405	1063	921,669	261,141	1,182,810
		(300, 200, 150,	225	312	839	615,037	178,366	793,403
		100, 75, 50)	**9561**			**152,116,198**	**51,563,204**	**203,679,401**
	Network	2800	795	-	970	-	728,402	728,402
	Protectors	2000	600	-	495	-	280,536	280,536
		1120	555	-	767	-	402,088	402,088
		1000	5739	-	611	-	3,312,149	3,312,149
		500	1843	-	153	-	266,348	266,348
		Total	**9532**				**4,989,523**	**4,989,523**
					Manhattan Total Network Losses:			**208,668,924**
						No Load	**Load**	**Total Losses**
					Total	**152,116,198**	**56,552,727**	**208,668,924**

2007 The Bronx Equipment Data

Estimated Annual System Energy Losses For 2007								
Bronx								
				Avg Losses (Watts)		Annual Losses (Kilowatt - Hours)		
System	**Equipment**	**kVA Class**	**Units**	**No Load**	**Load**	**No Load**	**Load**	**Total**
Network	Transformers	2500	122	3020	10395	3,227,534	1,197,890	4,425,424
		2000	30	2955	6055	776,574	171,580	948,154
		1000	799	1847	5880	12,927,596	4,437,686	17,365,282
		500	1904	1086	2878	18,113,437	5,175,951	23,289,389
		167	46	672	1933	270,923	84,003	354,927
		(300,150,100	146	302	813	386,288	112,165	498,453
		75,50,25)	**3047**			**35,702,353**	**11,179,275**	**46,881,628**
	Network	2800	112	-	970	-	102,618	102,618
	Protectors	2000	25	-	495	-	11,689	11,689
		1120	249	-	767	-	180,396	180,396
		1000	565	-	611	-	326,078	326,078
		500	2091	-	153	-	302,188	302,188
		Total	**3042**				**922,970**	**922,970**
					Bronx Total Network Losses:			**47,804,598**
						No Load	**Load**	**Total Losses**
					Total	**35,702,353**	**12,102,245**	**47,804,598**

2007 The Bronx Equipment Data

Estimated Annual System Energy Losses For 2007								
Bronx								
				Avg Losses (Watts)		Annual Losses (Kilowatt - Hours)		
System	**Equipment**	**kVA Class**	**Units**	**No Load**	**Load**	**No Load**	**Load**	**Total**
Radial	O.H.	225	253	533	5436	1,181,277	1,821,194	3,002,471
	Transformers	200	3	468	2386	12,299	9,479	21,778
		167	12	334	1818	35,110	28,889	63,999
		150	599	376	2193	1,972,962	1,739,489	3,712,451
		100	218	186	1099	355,200	317,256	672,457
		75	1291	177	1127	2,001,721	1,926,666	3,928,387
		50	485	109	630	463,097	404,612	867,709
		45	133	124	875	144,470	154,105	298,575
		38	95	90	502	74,898	63,151	138,049
		25	38	75	327	24,966	16,455	41,421
		15	11	62	382	5,974	5,564	11,539
		10	9	62	382	4888.08	4552.6272	9440.7072
		Total	**3147**			**6,276,864**	**6,491,412**	**12,768,276**
	URD	50	8	104	636	**7,288**	**6,738**	**14,026**
	Transformers					**7,288**	**6,738**	**14,026**
	Pad Mounted	2000	3	2604	15223	68,433	60,475	128,908
	Transformers	1000	60	1432	10274	752,659	816,295	1,568,954
		500	58	1084	4803	550,759	368,890	919,649
		300	28	751	2378	184,205	88,171	272,376
		167	1	243	1533	2,129	2,030	4,159
		150	15	407	2239	53,480	44,474	97,953
		75	2	332	606	5,817	1,605	7,422
		50	18	96	761	15,137	18,139	33,276
		25	1	76	275	666	364	1,030
		Total	**186**			**1,633,284**	**1,400,443**	**3,033,727**
	Grounding	31.5 Amps, 13kV	10	1188	-	**104,069**	-	**104,069**
	Transformers							
	Voltage	100	37	315	1445	102,098	70,799	172,897
	Regulators	75	22	255	1590	49,144	46,321	95,464
		50	6	205	835	10,775	6,634	17,409
		Total	**65**			**162,016**	**123,754**	**285,770**
	Primary	300 kVAR	62	12	10	**6,517**	**821**	**7,338**
	Capacitors					**0**	**0**	**0**
						0	**0**	**0**
						6,517	**821**	**7,338**
					Bronx Total Radial Losses:			**16,213,207**
						No Load	**Load**	**Total Losses**
					Total	**8,190,039**	**8,023,167**	**16,213,207**

2007 Brooklyn Equipment Data

Estimated Annual System Energy Losses For 2007								
Brooklyn								
				Avg Losses (Watts)		Annual Losses (Kilowatt - Hours)		
System	**Equipment**	**kVA Class**	**Units**	**No Load**	**Load**	**No Load**	**Load**	**Total**
Network	Transformers	2500	192	2864	10372	4,817,019	1,881,032	6,698,051
		2000	43	2955	6055	1,113,089	245,932	1,359,021
		1000	878	1989	6511	15,297,956	5,399,762	20,697,718
		500	4880	1072	2877	45,826,714	13,261,484	59,088,197
		(300, 150, 100, 50)	37	391	1090	126,882	38,096	164,977
		Total	**6030**			**67,181,659**	**20,826,306**	**88,007,965**
	Network Protectors	2800	155	-	970	-	142,016	142,016
		2000	34	-	495	-	15,897	15,897
		1120	150	-	767	-	108,672	108,672
		1000	770	-	611	-	444,390	444,390
		500	4485	-	153	-	648,166	648,166
		Total	**5594**				**1,359,141**	**1,359,141**
	Shunt Reactors	1000	18	5500	-	867,240	-	867,240
		600	48	4000	-	1,681,920	-	1,681,920
		300	11	3500	-	337,260	-	337,260
		Total	**77**			**2,886,420**		**2,886,420**
					Brooklyn Total Network Losses:			**92,253,526**
						No Load	**Load**	**Total Losses**
					Total	**70,068,079**	**22,185,447**	**92,253,526**

2007 Brooklyn Equipment Data

Estimated Annual System Energy Losses For 2007								
Brooklyn								
				Avg Losses (Watts)		Annual Losses (Kilowatt - Hours)		
System	**Equipment**	**kVA Class**	**Units**	**No Load**	**Load**	**No Load**	**Load**	**Total**
Radial	O.H.	225	367	481	2435	1,546,377	1,183,372	2,729,748
	Transformers	200	6	468	2386			
		167	23	322	2210			
		150	1368	452	1966	5,416,623	3,561,442	8,978,065
		100	367	190	1029	610,835	500,078	1,110,913
		75	1363	169	1202	2,017,840	2,169,484	4,187,324
		50	220	106	654	204,283	190,527	394,810
		45	61	136	813	72,673	65,671	138,344
		37.5	20	91	482	15,943	12,765	28,709
		25	11	84	283	8,094	4,122	12,216
		15	15	62	382	8,147	7,588	15,735
		10	4	41	255	1,437	1,351	2,787
		7.5	1	31	191	272	253	524
		5	2	20	0	350	0	350
		3	1	10	748	88	991	1,078
		Total	**3829**			**9,902,961**	**7,697,644**	**17,600,605**
	URD	150	3	540	1450	14,191	5,760	19,952
	Transformers	100	4	200	996	7,008	5,276	12,284
		75	1	310	925	2,716	1,225	3,940
		50	18	104	636	16,399	15,160	31,558
		25	2	70	328	1,226	869	2,095
		Total	**28**			**41,540**	**28,289**	**69,829**
	Pad Mounted	1000	22	1517	9069	292,356	264,203	556,560
	Transformers	500	12	1049	4499	110,271	71,491	181,762
		300	4	625	2557	21,900	13,544	35,444
		225	1	765	1167	6,701	1,545	8,247
		150	8	335	1695	23,477	17,956	41,433
		100	5	157	1246	6,877	8,250	15,126
		Total	**52**			**402,627**	**335,695**	**738,322**
	Grounding		3	1188	-	**31,221**	-	**31,221**
	Transformers							
	Voltage	100	110	315	1445	303,534	210,483	514,017
	Regulators	75	16	255	1590	35,741	33,688	69,429
		50	6	205	835	10,775	6,634	17,409
		Total	**132**			**350,050**	**250,805**	**600,855**
	Primary	300	213	12	10	22,391	2,821	25,211
	Capacitors	100	1	12	10	105	13	118
		15	7	12	10	736	93	829
		Total	**221**			**23,232**	**2,926**	**26,158**
						Brooklyn Total Radial Losses:		**19,066,989**
						No Load	**Load**	**Total Losses**
					Total	**10,751,630**	**8,315,359**	**19,066,989**

2007 Queens Equipment Data

Estimated Annual System Energy Losses For 2007								
Queens								
				Avg Losses (Watts)		Annual Losses (Kilowatt - Hours)		
System	Equipment	kVA Class	Units	No Load	Load	No Load	Load	Total
Network	Transformers	2500	200	2971	10318	5,205,192	1,949,207	7,154,399
		2000	45	2955	6055	1,164,861	257,371	1,422,232
		1000	1102	2011	6722	19,413,229	6,997,011	26,410,239
		500	4547	1128	2947	44,930,180	12,657,197	57,587,377
		(300, 167, 150	179	437	1216	685,963	205,629	891,591
		, 100, 50)	**6073**			**71,399,425**	**22,066,413**	**93,465,838**
	Network	2800	144	-	970	-	131,937	131,937
	Protectors	2000	35	-	495	-	16,365	16,365
		1120	199	-	767	-	144,172	144,172
		1000	817	-	611	-	471,515	471,515
		500	4012	-	153	-	579,809	579,809
		Total	**5207**				**1,343,798**	**1,343,798**
	Shunt	1000	13	5500	-	626,340	-	626,340
	Reactors	600	41	4000	-	1,436,640	-	1,436,640
		300	15	3500	-	459,900	-	459,900
		Total	**69**			**2,522,880**		**2,522,880**
							Queens Total Network Losses:	97,332,516
						No Load	Load	Total Losses
					Total	73,922,305	23,410,211	97,332,516

2007 Queens Equipment Data

Estimated Annual System Energy Losses For 2007								
Queens								
				Avg Losses (Watts)		Annual Losses (Kilowatt - Hours)		
System	Equipment	kVA Class	Units	No Load	Load	No Load	Load	Total
Radial	O.H.	225	583	484	2404	2,471,827	1,855,920	4,327,747
	Transformers	167	7	283	1988	17,354	18,428	35,781
		150	3152	499	1827	13,778,148	7,625,722	21,403,871
		100	681	183	1046	1,091,697	943,268	2,034,965
		75	1824	171	1233	2,732,279	2,978,133	5,710,412
		50	238	107	634	223,082	199,812	422,895
		45	66	129	845	74,583	73,851	148,434
		37.5	23	91	486	18,335	14,802	33,137
		25	72	84	283	52,980	26,982	79,963
		20	1	62	382	543	506	1,049
		15	27	44	248	10,407	8,867	19,274
		10	4	31	191	1,086	1,012	2,098
		Total	**6678**			**20,472,321**	**13,747,303**	**34,219,624**
	URD	150	2	499	1827	8,742	4,839	13,581
	Transformers	100	28	200	996	49,056	36,930	85,986
		50	27	104	636	24,598	22,739	47,337
		Total	**57**			**82,397**	**64,507**	**146,904**
	Pad Mounted	2000	1	3383	13162	29,635	17,429	47,064
	Transformers	1500	3	1995	15654	52,429	62,187	114,616
		1000	59	1560	9073	806,270	708,858	1,515,128
		500	55	949	4790	457,228	348,863	806,091
		300	10	430	2930	37,668	38,799	76,467
		150	2	311	1473	5,449	3,901	9,350
		100	18	157	1246	24,756	29,699	54,455
		50	7	98	782	6,009	7,249	13,258
		Total	**155**			**1,419,444**	**1,216,986**	**2,636,430**

2007 Queens Equipment Data

Radial	Grounding	31.5 Amps, 13kV	4	1188	-	**41,628**	-	**41,628**
	Transformers							
	Voltage	125	5	500	1535	21,900	10,163	32,063
	Regulators	100	131	315	1445	361,481	250,666	612,147
		75	23	255	1590	51,377	48,426	99,804
		50	2	205	835	3,592	2,211	5,803
		Total	**161**			**438,350**	**311,467**	**749,817**
	Primary	900	1	12	10	105	13	118
	Capacitors	300	204	12	10	21,444	2,701	24,146
		100	53	12	10	5,571	702	6,273
		Total	**258**			**27,121**	**3,416**	**30,537**
							Queens Total Radial Losses:	**37,824,940**
						No Load	**Load**	**Total Losses**
					Total	**22,481,261**	**15,343,679**	**37,824,940**

2007 Staten Island Equipment Data

Estimated Annual System Energy Losses For 2007								
Staten Island								
				Avg Losses (Watts)		**Annual Losses (Kilowatt - Hours)**		
System	**Equipment**	**kVA Class**	**Units**	**No Load**	**Load**	**No Load**	**Load**	**Total**
Network	Transformers	2500	33	2778	10045	803,064	313,110	1,116,174
		2000	10	2955	6055	258,858	57,193	316,051
		1000	85	1884	6038	1,402,826	484,780	1,887,606
		500	118	1171	3019	1,210,439	336,494	1,546,933
		(300, 167, 100)	15	461	1284	60,585	18,199	78,784
		Total	**261**			**3,735,773**	**1,209,776**	**4,945,548**
	Network	2800	18	-	970	-	16,492	16,492
	Protectors	2000	2	-	495	-	935	935
		1120	19	-	767	-	13,765	13,765
		1000	66	-	611	-	38,091	38,091
		500	82	-	153	-	11,851	11,851
		Total	**187**				**81,134**	**81,134**
	Shunt	1500	6	6500	-	341,640	-	341,640
	Reactors	1000	3	5500	-	144,540	-	144,540
		600	8	4000	-	280,320	-	280,320
		Total	**17**			**766,500**		**766,500**
				Staten Island Total Network Losses:				**5,793,182**
						No Load	**Load**	**Total Losses**
					Total	**4,502,273**	**1,290,909**	**5,793,182**

2007 Staten Island Equipment Data

Estimated Annual System Energy Losses For 2007								
Staten Island				Avg Losses (Watts)		Annual Losses (Kilowatt - Hours)		
System	**Equipment**	**kVA Class**	**Units**	**No Load**	**Load**	**No Load**	**Load**	**Total**
Radial	O.H.	225, 200	175	552	2416	846,216	559,875	1,406,091
	Transformers	167	7	296	1838	18,151	17,037	35,188
		150	501	370	2204	1,623,841	1,462,196	3,086,037
		100	823	186	1106	1,340,963	1,205,344	2,546,308
		75	3082	160	1001	4,319,731	4,085,290	8,405,022
		50	2313	109	630	2,208,545	1,929,623	4,138,168
		45	470	123	869	506,416	540,846	1,047,262
		38	705	90	507	555,822	473,318	1,029,140
		25	161	74	339	104,367	72,274	176,641
		15	17	62	382	9,233	8,599	17,832
		10	8	62	382	4,345	4,047	8,392
		7.5	11	31	191	2,987	2,782	5,769
		5	10	21	127	1,840	1,682	3,521
		Total	**8283**			**11,542,456**	**10,362,914**	**21,905,371**
	URD	150	6	540	1450	28,382	11,521	39,903
	Transformers	100	1126	200	996	1,972,752	1,485,094	3,457,846
		75	8	310	925	21,725	9,799	31,524
		50	740	104	636	674,170	623,225	1,297,395
		25	44	70	328	26,981	19,111	46,092
		Total	**1924**			**2,724,010**	**2,148,750**	**4,872,760**
	Pad Mounted	2000	3	2604	15223	68,433	60,475	128,908
	Transformers	1000	64	1628	8258	912,722	699,860	1,612,582
		500	142	1053	4587	1,309,848	862,528	2,172,376
		300	99	703	2634	609,670	345,308	954,978
		150	82	419	1731	300,976	187,961	488,937
		75	8	332	606	23,267	6,420	29,686
		50	317	92	727	255,477	305,176	560,652
		25	17	75	304	11,169	6,844	18,013
		Total	**732**			**3,491,561**	**2,474,571**	**5,966,132**
		167	33	500	1535	144,540	67,078	211,618
		100	1	315	1445	2,759	1,913	4,673
	Voltage	75	25	255	1590	55,845	52,637	108,482
	Regulators	50	13	205	835	23,345	14,374	37,720
		Total	**72**			**226,490**	**136,003**	**362,493**
		900	204	12	10	21,444	2,701	24,146
		450	105	12	10	11,038	1,390	12,428
	Primary	300	281	12	10	29,539	3,721	33,260
	Capacitors	100	11	12	10	1,156	146	1,302
		Total	**601**			**63,177**	**7,958**	**71,136**
						Staten Island Total Radial Losses:		**33,177,891**
						No Load	**Load**	**Total Losses**
					Total	**18,047,694**	**15,130,197**	**33,177,891**

2007 Westchester Equipment Data

Estimated Annual System Energy Losses For 2007								
Westchester	Westchester							
				Avg Losses (Watts)		Annual Losses (Kilowatt - Hours)		
System	Equipment	kVA Class	Units	No Load	Load	No Load	Load	Total
Network	Transformers	2500	133	3163	10797	3,685,148	1,356,398	5,041,546
		2000	32	2955	6055	828,346	183,019	1,011,365
		1000	385	2114	7370	7,129,676	2,680,160	9,809,836
		500	915	1195	3107	9,578,403	2,685,312	12,263,715
		(300,167,150,	180	390	1093	614,829	185,915	800,744
		100,75,50,25)	**1645**			**21,836,402**	**7,090,804**	**28,927,206**
	Network	2800	102	-	970	-	93,455	93,455
	Protectors	2000	68	-	495	-	31,794	31,794
		1120	97	-	767	-	70,275	70,275
		1000	328	-	611	-	189,299	189,299
		500	863	-	153	-	124,720	124,720
		Total	**1458**				509,542	509,542
							1,019,085	**1,019,085**
						Westchester Total Network Losses:		**29,946,291**
						No Load	**Load**	**Total Losses**
					Total	**21,836,402**	**8,109,889**	**29,946,291**

2007 Westchester Equipment Data

Estimated Annual System Energy Losses For 2007								
Westchester	Westchester			Avg Losses (Watts)		Annual Losses (Kilowatt - Hours)		
System	Equipment	kVA Class	Units	No Load	Load	No Load	Load	Total
Radial	O.H.	225	785	556	2391	3,823,390	2,485,452	6,308,842
	Transformers	200	3	468	2386	12,299	9,479	21,778
		167	224	362	1860	710,331	551,718	1,262,049
		150	1595	389	2149	5,435,186	4,538,928	9,974,114
		100	512	191	1132	856,658	767,490	1,624,148
		75	3989	178	1063	6,219,968	5,615,049	11,835,016
		50	8088	109	629	7,722,746	6,736,712	14,459,458
		45	2041	124	878	2,217,016	2,372,978	4,589,994
		38	6928	90	506	5,462,035	4,642,101	10,104,136
		30	58	62	382	31,501	29,339	60,840
		25	1882	74	339	1,219,988	844,842	2,064,830
		20	12	62	382	6,517	6,070	12,588
		15	197	61	378	105,269	98,608	203,877
		10	105	62	382	57,028	53,114	110,142
		7.5	64	62	382	34,760	32,374	67,134
		5	97	31	191	26,341	24,534	50,875
		3	15	44	248	5,782	4,926	10,708
		Total	**26595**			**33,946,813**	**28,813,715**	**62,760,529**
	URD	167	20	279	1548	48,881	40,997	89,878
	Transformers	150	30	540	1450	141,912	57,603	199,515
		100	299	200	996	523,848	394,354	918,202
		75	22	310	925	59,743	26,948	86,691
		50	714	104	636	650,483	601,328	1,251,811
		25	175	70	328	107,310	76,010	183,320
		Total	**1260**			**1,532,177**	**1,197,240**	**2,729,417**
	Pad Mounted	2000	130	2407	15746	2,741,092	2,710,627	5,451,719
	Transformers	1500	2	1995	15654			
		1000	373	1433	9790	4,682,299	4,835,571	9,517,870
		500	785	1112	4623	7,646,779	4,805,624	12,452,403
		300	458	704	2692	2,824,504	1,632,664	4,457,168
		225	2	765	1167	13,403	3,091	16,494
		167	24	260	1728	54,662	54,918	109,580
		150	302	406	1925	1,074,081	769,828	1,843,909
		100	1013	179	1098	1,588,425	1,472,882	3,061,307
		75	158	332	606	459,515	126,790	586,305
		50	2028	93	724	1,652,171	1,944,298	3,596,469
		25	799	75	288	524,943	304,716	829,659
		Total	**6074**			**23,261,873**	**18,661,008**	**41,922,882**
	Grounding	31.5 Amps, 13kV	96	1188	-	**999,060**	-	**999,060**
	Transformers							
	Voltage	167	31	500	1535	135,780	63,012	198,792
	Regulators	100	92	315	1445	253,865	176,040	429,905
		75	117	255	1590	261,355	246,342	507,697
		50	28	205	835	50,282	30,960	81,242
		Total	**268**			**701,282**	**516,355**	**1,217,637**
	Primary	900	144	12	10	15,137	1,907	17,044
	Capacitors	450	18	12	10	1,892	238	2,131
		300	281	12	10	29,539	3,721	33,260
		100	48	12	10	5,046	636	5,681
		Total	**491**			**51,614**	**6,502**	**58,116**
						Westchester Total Radial Losses:		**109,687,640**
						No Load	Load	Total Losses
					Total	**60,492,819**	**49,194,821**	**109,687,640**

Part of Distribution Equipment
Con Edison Distribution Unit Substation Losses
For the period of January 1 – December 31, 2007

Distribution Engineering

1. Methodology.

The following method was used to calculate energy loss in Unit Substation Transformers during 2007:

a) To calculate the Total No-Load Loss Energy (kWh): No-Load Loss (Core Loss) from manufacturer's test* (kW) was multiplied by 8760 hours. Here the assumption is made that every transformer is always energized throughout the year:

$$E_{TotalNo-LoadLoss}[kWh] = P_{TestNo-LoadLoss} \times 8760[h]$$

b) To calculate Load Loss: Half Hour Load Averages** in kVA are accessible through the Unit Station Automation (USA). Ideally there are 17520 values. Test Load Loss* (kW) is reported at transformer's Base Rating (kVA) in manufacturer's test sheets, therefore:

$$E_{LoadLoss}[kWh] = 0.5[h] \times P_{TestLoadLoss}[kW] \times \left(\frac{P_{HalfHourAverage}[kVA]}{P_{BaseTransformerRating}[kVA]} \right)^2$$

All 17520 half -hour values are summed together to arrive to Total Load Loss Energy in kWh for the year for each transformer:

$$E_{TotalLoadLoss}[kWh] = \sum^{17520} E_{LoadLoss}[kWh]$$

* Note: Not every transformer had it manufacturer's test report available for this study. In these instances, the No-Load Loss and the Load Loss values were substituted by the highest values found in the population of similar transformers.

* * Note: The availability of 17520 values is an ideal case of Unit Station Automation reporting. In reality, several 10s to several 100s of Half Hour Average points might be missing. This results in missing Load Loss Energy values as well. To resolve this problem, the missing Load Loss Energy values are replaced by the average calculated from the available Load Loss Energy values. The attached Spreadsheet
Loss Calculation Data.xls indicates these values in bold italic.

c) The total energy loss is calculated by adding the Total No-Load Loss Energy (kWh) with the Total Load Loss Energy (kWh), and then summing all 261 values:

$$E_{TotalLosses}[kWh] = \sum^{261} \left(E_{TotalLoadLoss}[kWh] + E_{TotalNo-LoadLoss}[kWh] \right)$$

2. Results.

The results are summarized in a table below. The resulting Total for all Unit Substations is shown in bold.

Locality	No-Load Loss (kWh)	Load Loss (kWh)	Total Loss (kWh)	Total Load (kVAh)
Totals for All Unit Substations	13,812,791	20,573,252	***34,386,043***	6,198,812,520

3. Con Edison Losses Due to Electric Meters and Meter Devices

For the Period of January 1, 2007 --- December 31, 2007

Metering Engineering

2007 Con Edison Losses Due to Electric Meters and Meter Devices

1. Introduction

A study was performed on the energy losses due to the electric billing meters and meter devices for 2007.

Revenue metering energy losses can be separated into two categories: (1) losses due to deviation from the 100% accuracy of the watthour meters and (2) the watts loss required to energize the meters and associated metering devices.

2. Methodology

A. The watts losses due to operation of the meters and associated devices were calculated based on the population of these devices, and its associated energy losses for the year (8760 hours).

B. The losses due to deviation from the 100% accuracy of the watthour meters was based on the test results of the electric meters tested in the Con Edison's mandated PSC test program for 2007. The final test accuracy averages of 14,074 meters were calculated. The percentage losses as a result of deviation from 100% were applied to the kWh electric delivered by Con Edison.

3. Results

The overall results are shown below.

	MWh
2007 Losses due to deviation from from 100% Meter Accuracy	64,090
2007 Losses due to energy requirements of meters and metering devices	47,950
Total Losses (MWH)	112,040

2007 Con Edison Losses Due to Electric Meters and Meter Devices

The details for the above losses are in these two tables.

Losses due to 99.89% Calculated Average Registration of Watthour Meters for 2007		
Con Edison Electric Delivered	MWh Delivered December 31, 2007	Annual MWh Loss
Residential/Religious	12,312,000	13,540
Commercial/Industrial	12,918,034	14,210
Retail Access customers	21,532,200	23,690
NYPA, Municipal Agency and other sales	11,499,200	12,650
Total	58,261,434	64,090

Losses due to Operation of Meters and Metering Devices for 2007				
Type of Devices	Number On System	Multiplying Factor	Watts Used	Annual MWh Loss
AC Mechanical Watthour Meters	2,694,213	1.7	4,580,162	40,122
AC Solid-State Watthour Meters	717,194	1	717,194	6,282
Demand Registers	53,069	2.4	127,366	1,116
Solid-State Recorders	1,423	5.8	8,253	72
Relays	2,212	10	22,120	194
Potential Transformers	3,749	5	18,745	164
			Total Losses	47,950

PART IV: UNACCOUNTED LOSSES

1. UNACCOUNTED ENERGY LOSSES DUE TO THEFT OF SERVICES AND OTHER

1. Con Edison Unaccounted Losses Due to Theft of Services and Other

For the Period of January 1, 2007 --- December 31, 2007

Strategic Application

1.0 Introduction

A. **Theft of service:** Con Edison has estimated theft of service in our service territory to be 0.25% of annual electric revenues (which translates to 0.16% of the net generation and purchases) which is well below the industry average of 1 to 2%. The reason for this is that Con Edison was a leader in developing sophisticated meter locking systems and has installed these on 97% of the meters on the system. In addition, Con Edison has an aggressive theft detection process and has, in the past, prosecuted individuals involved in theft of service. A team of 57 employees are dedicated to investigating theft conditions in the field and rebilling accounts as appropriate. These employees utilize a variety of leads to investigate suspected theft, such as computer analysis, employee leads, company information and customer leads. Incentive awards are granted to employees who provide information that leads to verified theft conditions. Theft conditions can be reported through a toll free telephone number, on our intranet or on our website at www.coned.com. In addition, Con Edison utilizes a third-party vendor, to assist in the identification of high risk accounts using specialized software that the Company assisted in developing. These accounts are then screened and analyzed to investigate and bill unmetered services. Algorithms have been and continue to be developed to augment our existing efforts. Con Edison is also a member of IURPA, International Utility Revenue Protection Association. This association meets annually and theft detection strategies are shared amongst the utilities. Con Edison will continue our aggressive work in minimizing theft of service.

B. **Other:** This category accounts results from the nature of the data collection limitations as well as metering accuracy, simplifications of demand curves and rounding errors.