

ANEXO 6

6.1 Costos Asociados a las Unidades Constructivas Típicas

6.2 Pérdidas Técnicas Eficientes

6.3 Datos Usados para la Estimación de Pérdidas

ANEXO 6. PÉRDIDAS EN ACOMETIDAS

El cálculo de las pérdidas en acometidas se realiza a partir de la identificación del conductor típico utilizado en las acometidas. Para esto se revisaron las normas de los diferentes operadores y se encontró que existe un amplio rango de conductores utilizados: entre No. 2 y No. 12 AWG en cobre aislado.

Para efectos del cálculo se tomó como el conductor más utilizado el No. 8 AWG. Conocida la carga para los circuitos típicos seleccionados se calculan las pérdidas por usuario equivalente, considerando en todos los casos el conductor de acometida indicado.

Los resultados de las pérdidas obtenidas en las acometidas se muestran en la siguiente tabla.

COSTOS UNITARIOS DE MATERIALES

ITEM	UNIDAD	CONSTRUCCIÓN/2011	COTIZACIONES	PRESUPUESTO CON COL	CODENSA/01	COTIZACIONES	E-CAQUETA	EPISA	ECARBE	EMULA	COTIZACIONES	COTIZACIONES CENTELSA	COTIZACIONES	PROMEDIO
						C SIEMENS					SIERRA	VARIOS	VARIOS	COSTO UNITARIO
POSTES														
Concreto 10m 510 kg	UN	\$186,760.00	\$184,483.00	\$195,374.13	\$184,714.40			\$182,908.00		\$218,500.00		\$184,483.00		\$188,872.38
Concreto 12m 510 kg	UN	\$361,920.00		\$327,455.33	\$263,910.66					\$391,000.00				\$336,071.50
Concreto 12m 750 kg	UN	\$375,840.00		\$377,618.49	\$306,736.98					\$448,500.00				\$377,173.87
Concreto 12m 1050 kg	UN	\$462,840.00	\$418,333.33	\$358,856.27	\$358,856.27						\$360,000.00	\$495,000.00	\$400,000.00	\$413,343.20
Madera inmunizada 10m liviano	UN	\$145,000.00	\$149,284.33	\$67,003.49	\$67,003.49								\$149,284.33	\$120,429.27
Madera inmunizada 10m pesado	UN	\$145,000.00		\$89,407.05	\$89,407.05									\$107,938.03
Madera inmunizada 10m extrapesado	UN			\$147,241.67	\$147,241.67									\$147,241.67
Madera inmunizada 12m liviano	UN			\$90,513.36	\$90,513.36									\$90,513.36
Madera inmunizada 12m pesado	UN			\$101,821.09	\$101,821.09									\$101,821.09
Madera inmunizada 12m extrapesado	UN	\$195,000.00	\$202,000.00	\$215,473.21	\$215,473.21								\$202,000.00	\$204,157.74
CONDUCTORES														
Al desnudo Nº 4	ML	\$580.32	\$548.16	\$646.22	\$646.22							\$548.16		\$581.57
Al desnudo Nº 1	ML	\$1,121.64	\$1,059.84	\$600.57	\$600.57							\$1,059.84		\$927.35
Al desnudo Nº 1/0	ML	\$1,415.44	\$1,337.28	\$945.92	\$945.92							\$1,337.28		\$1,232.88
Al desnudo Nº 2/0	ML	\$1,573.78	\$1,692.48	\$945.92	\$945.92							\$1,692.48		\$1,404.06
Al aislado Nº 1	ML	\$2,029.56	\$1,917.60									\$1,917.60		\$1,973.58
Al aislado Nº 2	ML	\$2,993.00	\$3,064.00									\$3,064.00		\$3,028.50
Al aislado Nº 4	ML	\$1,041.56	\$984.00	\$570.13	\$570.13							\$984.00		\$865.23
Al aislado Nº 1/0	ML	\$2,374.84	\$2,244.00									\$2,244.00		\$2,305.42
Al aislado Nº 2/0	ML	\$2,896.40	\$2,736.48	\$2,218.46	\$2,218.46							\$2,736.48		\$2,617.11
Al aislado Nº 4/0	ML	\$4,492.28	\$4,244.64	\$2,583.72	\$2,583.72							\$4,244.64		\$3,773.55
Cu aislado Nº 2 THW	ML	\$3,673.00	\$3,997.76	\$2,673.68	\$2,967.71		\$2,545.00		\$2,290.00	\$2,892.00		\$3,997.76	\$3,997.76	\$3,448.15
Cu aislado Nº 4 THW	ML	\$4,930.00	\$2,574.52	\$1,984.90	\$1,948.03					\$2,021.76		\$2,574.52	\$2,574.52	\$2,681.84
Cu aislado Nº 8 THW	ML	\$2,075.00	\$1,084.20	\$1,825.00						\$1,825.00		\$1,084.20	\$1,084.20	\$1,702.30
Cu aislado Nº 1/0 THW	ML	\$11,930.00	\$6,230.64	\$4,212.78	\$4,870.09		\$2,272.44		\$4,753.00	\$4,955.60		\$6,230.64	\$6,230.64	\$5,603.51
Cu aislado Nº 2/0 THW	ML	\$14,915.00	\$7,790.12	\$5,040.08	\$5,175.64		\$3,567.00		\$5,368.00	\$6,049.68		\$7,790.12	\$7,790.12	\$6,843.65
Cu aislado Nº 4/0 THW	ML	\$23,375.00	\$12,207.52	\$9,183.48	\$9,095.12		\$8,422.32		\$10,033.00			\$12,207.52	\$10,584.00	\$12,052.74
ACSR Nº 4	ML	\$776.88	\$694.56	\$548.69	\$412.08		\$698.00			\$536.00		\$694.56		\$673.38
ACSR Nº 1	ML	\$514.80	\$470.40	\$873.00						\$873.00		\$470.40		\$619.40
ACSR Nº 1/0	ML	\$1,708.20	\$1,614.24	\$1,127.80	\$1,142.60		\$1,113.00					\$1,614.24		\$1,483.41
ACSR Nº 2/0	ML	\$2,086.24	\$1,970.88	\$2,017.57	\$1,202.70		\$3,364.00		\$1,486.00			\$1,970.88		\$2,024.90
ACSR Nº 4/0	ML	\$3,361.28	\$3,175.20	\$3,035.49	\$1,933.99				\$4,137.00			\$3,175.20		\$3,128.59
Al Desnudo 4/0	ML	\$2,515.24	\$2,676.48	\$1,516.05	\$1,516.05							\$2,676.48		\$2,055.95
Cable trenzado BT cuadruplex 3x1/0+2 AWG AL/ACSR XLPE (3"70mm+50mm)	ML		\$7,292.20									\$7,292.20		\$7,292.20
Cable trenzado BT cuadruplex 3x2/0+1/0 AWG AL/ACSR XLPE (3"70mm+50mm)	ML			\$7,553.92	\$7,220.84					\$7,887.00				\$7,553.92
Cable trenzado BT cuadruplex 3x4/0+2/0 AWG AL/ACSR XLPE (3"95mm+50mm)	ML			\$9,626.61	\$9,626.61									\$9,626.61
Cable trenzado BT triplex 2x1/0+2 AWG AL/ACSR XLPE	ML		\$5,828.88	\$6,871.00	\$6,871.00							\$5,828.88		\$6,349.94
PERCHAS Y DUCTOS														
Percha de 1 puestos	UN		\$2,284.00	\$5,334.37	\$8,378.66					\$2,290.08		\$2,284.00		\$3,809.18
Percha de 2 puestos	UN		\$4,569.00	\$7,002.89	\$9,755.39					\$4,250.40		\$4,569.00		\$5,785.95
Percha de 3 puestos	UN		\$7,069.00	\$14,132.76	\$14,132.76							\$7,069.00		\$10,600.88
Percha de 4 puestos	UN		\$9,741.00	\$13,437.02	\$21,564.18		\$10,022.40			\$8,724.48		\$9,741.00		\$11,589.01
Percha de 5 puestos	UN		\$12,457.00	\$16,497.95	\$27,156.58		\$11,232.00			\$11,105.28		\$12,457.00		\$14,477.48
Estructura de paso red trenzada	UN			\$4,654.68	\$4,654.68									\$4,654.68
Estructura de retención red trenzada	UN			\$13,191.38	\$13,191.38									\$13,191.38
Cámara de inspección sencilla con marco y tapa	UN	\$258,593.00												\$258,593.00
Canalización subterránea 4"4" (4m de ducto)	UN	\$50,893.00												\$50,893.00
Ducto eléctrico pesado de 4"	ML	\$16,245.00												\$16,245.00

COSTOS UNITARIOS DE MATERIALES

ITEM	UNIDAD	CONSTRUDATA/2001	COTIZACIONES	PRESUPUESTO CONCOL	CODENSA/01	COTIZACIONES	E.CAQUETA	EP&A	ECARIEE	EHULA	COTIZACIONES	COTIZACIONES CENTELSA	COTIZACIONES	PROMEDIO
						C.SIEMENS					SIERRA	VARIOS	VARIOS	COSTO UNITARIO
TRANSFORMADORES EN ACEITE														
TRIFASICOS														
15 kVA	UN		\$2,073,599.33	\$1,777,691.44	\$1,777,691.44	\$2,242,350.00					\$2,050,000.00	\$1,928,448.00	\$2,187,815.63	\$1,925,645.38
20 kVA	UN		\$2,250,000.00	\$2,518,359.59	\$2,518,359.59						\$2,250,000.00			\$2,384,179.80
30 kVA	UN		\$2,264,159.33	\$2,597,728.70	\$1,889,804.09	\$2,377,650.00	\$2,484,720.00			\$3,418,662.00	\$2,370,000.00	\$2,044,828.00	\$2,320,046.25	\$2,430,844.02
45 kVA	UN		\$2,694,371.33	\$3,010,086.59	\$1,930,259.76	\$2,845,700.00	\$3,300,000.00				\$3,800,000.00	\$2,790,000.00	\$2,447,414.00	\$2,852,228.96
50 kVA	UN			\$3,760,406.60	\$3,760,406.60									\$3,760,406.60
75 kVA	UN		\$3,349,109.67	\$4,409,204.12	\$3,798,552.35	\$3,535,950.00	\$4,426,560.00			\$5,002,500.00	\$3,470,000.00	\$3,041,379.00	\$3,450,016.96	\$3,879,156.89
100 kVA	UN			\$5,000,000.00						\$5,000,000.00				\$5,000,000.00
112.5 kVA	UN		\$4,285,945.33	\$5,116,816.06	\$3,484,441.17	\$4,595,250.00	\$5,471,720.00			\$6,394,287.00	\$4,310,000.00	\$3,952,586.00	\$4,483,819.95	\$4,701,380.70
150 kVA	UN	\$5,459,059.00	\$5,019,561.00	\$5,216,213.31	\$5,216,213.31	\$5,359,200.00					\$5,090,000.00	\$4,609,483.00	\$5,229,119.78	\$5,231,611.10
MONOFASICOS														
10 kVA	UN		\$1,053,844.00	\$1,164,547.00	\$995,094.00	\$1,133,550.00	\$1,334,000.00					\$974,138.00	\$1,105,928.78	\$1,109,195.50
15 kVA	UN	\$1,268,582.00	\$1,134,519.00	\$1,431,373.33	\$1,075,590.00	\$1,219,900.00	\$1,437,240.00			\$1,781,290.00		\$1,049,138.00	\$1,190,075.54	\$1,278,158.11
25 kVA	UN		\$1,340,602.50	\$1,703,841.67	\$1,280,237.00	\$1,441,550.00	\$1,733,040.00			\$2,098,248.00		\$1,239,655.00	\$1,406,452.91	\$1,522,222.08
30 kVA	UN			\$1,760,000.00	\$1,760,000.00									\$1,760,000.00
37.5 kVA	UN		\$1,707,605.00	\$2,325,836.00		\$1,835,900.00	\$2,158,760.00			\$2,492,912.00		\$1,579,310.00	\$1,791,123.79	\$2,016,720.50
50 kVA	UN	\$1,212,203.30	\$1,993,933.00	\$2,529,960.00		\$2,143,900.00	\$2,529,960.00					\$1,843,966.00	\$2,091,647.91	\$1,912,032.10
75 kVA	UN		\$2,520,717.00			\$2,710,400.00						\$2,331,034.00	\$2,644,612.30	\$2,520,717.00
100 kVA	UN	\$3,897,124.00	\$3,326,400.00	\$2,574,539.82	\$2,574,539.82	\$3,326,400.00							\$3,245,660.55	\$3,266,021.27
PROTECCIONES														
Pararrayos 10kV, 10kA	UN	\$120,640.00	\$87,000.00	\$94,501.46	\$65,044.92		\$123,958.00				\$87,000.00			\$100,713.82
Pararrayos 13.2 kV, 10 kA	UN			\$120,350.00			\$120,350.00							\$120,350.00
Pararrayos 34.5 kV, 10 kA	UN			\$2,436,000.00			\$2,436,000.00							\$2,436,000.00
Pararrayos 12 kV, 10 kA	UN		\$94,828.00	\$101,074.00	\$71,048.00					\$131,100.00		\$94,828.00		\$97,951.00
Cortacircuitos 15kV, 100A, para el interior	UN		\$88,965.50	\$101,262.40	\$74,460.81		\$128,064.00				\$90,000.00	\$87,931.00		\$86,556.54
Fusible tipo H 3 A	UN		\$1,876.00	\$1,735.07	\$1,735.07							\$2,200.00	\$1,552.00	\$1,805.53
Fusible tipo H 5 A	UN		\$1,876.00	\$1,735.07	\$1,735.07							\$2,200.00	\$1,552.00	\$1,805.53
Fusible tipo H 8 A	UN		\$1,876.00	\$1,735.07	\$1,735.07							\$2,200.00	\$1,552.00	\$1,805.53
Fusible tipo H 10 A	UN		\$1,876.00	\$1,735.07	\$1,735.07							\$2,200.00	\$1,552.00	\$1,805.53
Fusible tipo H 15 A	UN		\$1,876.00	\$1,735.07	\$1,735.07							\$2,200.00	\$1,552.00	\$1,805.53
Fusible tipo H 20 A	UN		\$2,433.50		\$2,516.82							\$2,970.00	\$1,897.00	\$2,475.16
S/E TIPO PEDESTAL														
45 kVA	UN		\$5,734,000.31										\$5,734,000.31	\$5,734,000.31
75 kVA	UN		\$5,986,440.57										\$5,986,440.57	\$5,986,440.57
112.5 kVA	UN	\$4,440,136.25	\$6,767,803.30										\$6,767,803.30	\$6,767,803.30
150 kVA	UN		\$7,657,354.71										\$7,657,354.71	\$7,657,354.71
225 kVA	UN		\$8,474,780.33										\$8,474,780.33	\$8,474,780.33
300 kVA	UN		\$10,854,931.40										\$10,854,931.40	\$10,854,931.40
400 kVA	UN		\$12,658,076.15										\$12,658,076.15	\$12,658,076.15
500 kVA	UN		\$13,415,396.94										\$13,415,396.94	\$13,415,396.94
630 kVA	UN		\$18,283,887.77										\$18,283,887.77	\$18,283,887.77
800 kVA	UN		\$21,517,527.35										\$21,517,527.35	\$21,517,527.35
1000 kVA	UN		\$22,142,617.53										\$22,142,617.53	\$22,142,617.53

UNIDADES CONSTRUCTIVAS PARA REDES URBANAS

COSTOS UNIDADES CONSTRUCTIVAS RED URBANA						CONDUCTOR	POSTE	ESTRUCTURA	MATERIALES	km - RED	CON FI
CONFIG.	CONDUCTOR	TIPO	VANOS	L_VANO	L-TOTAL	TOTAL (\$)	TOTAL (\$)	TOTAL (\$)	TOTAL (\$)	TOTAL (\$)	TOTAL (\$)
BIFASICO	4	AI SLADO	4	51	204	348,918	737,932	31,104	1,117,954	5,480,166	9,316,282
		DE SNUDO	4	51	204	335,474	737,932	31,104	1,104,510	5,414,262	9,204,246
		ACSR	4	51	204	335,801	737,932	31,104	1,104,837	5,415,867	9,206,973
	1/0	AI SLADO	4	34	136	915,552	737,932	31,104	1,684,588	12,386,674	21,057,345
DE SNUDO		4	34	136	385,936	737,932	31,104	1,154,971	8,492,435	14,437,140	
ACSR		4	34	136	460,142	737,932	31,104	1,229,177	9,038,069	15,364,718	
TRENZADO		4	34	136	792,728	737,932	31,104	1,561,764	11,483,558	19,522,048	
TRIFASICO	1	AI SLADO	5	32	160	1,227,264	922,415	68,514	2,218,193	13,863,703	23,568,295
		DE SNUDO	5	32	160	384,362	922,415	68,514	1,375,291	8,595,567	14,612,463
		ACSR	5	32	160	301,056	922,415	68,514	1,291,985	8,074,903	13,727,335
	1/0	AI SLADO	8	29	232	2,082,432	1,475,864	109,622	3,667,918	15,809,990	26,876,982
		DE SNUDO	8	29	232	877,814	1,475,864	109,622	2,463,300	10,617,672	18,050,042
		ACSR	8	29	232	1,046,597	1,475,864	109,622	2,632,083	11,345,184	19,286,813
		TRENZADO	8	29	232	1,691,791	1,475,864	56,945	3,224,605	13,899,158	23,628,568
	2/0	AI SLADO	5	36	180	1,597,295	922,415	68,514	2,588,223	14,379,017	24,444,329
		DE SNUDO	5	36	180	681,063	922,415	68,514	1,671,991	9,288,841	15,791,029
		ACSR	5	36	180	1,419,034	922,415	68,514	2,409,962	13,388,678	22,760,753
		TRENZADO	5	36	180	1,359,705	922,415	42,985	2,325,106	12,917,253	21,959,330
	4/0	AI SLADO	5	35	175	1,808,605	922,415	68,514	2,799,533	15,997,333	27,195,466
		DE SNUDO	5	35	175	1,061,234	922,415	68,514	2,052,162	11,726,642	19,935,292
		ACSR	5	35	175	2,124,845	922,415	68,514	3,115,774	17,804,421	30,267,515
		TRENZADO	5	35	175	1,684,658	922,415	42,985	2,650,058	15,143,187	25,743,417
FACTOR DE INSTALACIÓN			1.7								

UNIDADES CONSTRUCTIVAS REDES RURALES

COSTO UNIDADES CONSTRUCTIVAS RED RURAL						CONDUCTOR	POSTE	ESTRUCTURA	TOTAL M	TOTAL /KM	CON FI
CONFIG.	CONDUCTOR	TIPO	VANOS	L_VANO	L-TOTAL	TOTAL	TOTAL	TOTAL	MATERIAL		
MONOFASICO	1/0	AI SLADO	5	97	485	2,176,680	922,415	25,130	3,124,225	6,441,700	10,950,890
		DE SNUDO	5	97	485	917,543	922,415	25,130	1,865,087	3,845,541	6,537,420
		ACSR	5	97	485	1,093,965	922,415	25,130	2,041,509	4,209,297	7,155,805
BIFASICO	1	AI SLADO	4	92	368	2,117,030	737,932	31,104	2,886,066	7,842,571	13,332,370
		DE SNUDO	4	92	368	663,025	737,932	31,104	1,432,060	3,891,468	6,615,496
		ACSR	4	92	368	519,322	737,932	31,104	1,288,357	3,500,971	5,951,650
	2	AI SLADO	4	67	268	2,406,372	737,932	31,104	3,175,408	11,848,536	20,142,511
		DE SNUDO	4	67	268	1,368,408	737,932	31,104	2,137,444	7,975,536	13,558,411
		ACSR	4	67	268	689,620	737,932	31,104	1,458,656	5,442,745	9,252,666
	1/0	AI SLADO	4	33	132	888,624	737,932	31,104	1,657,660	12,558,027	21,348,646
		DE SNUDO	5	142	710	2,014,811	922,415	38,880	2,976,105	4,191,698	7,125,886
		ACSR	5	142	710	2,402,211	922,415	38,880	3,363,505	4,737,332	8,053,464
TRIFASICO	1	AI SLADO	2	52	104	797,722	368,966	21,430	1,188,118	11,424,210	19,421,156
		DE SNUDO	2	52	104	249,835	368,966	21,430	640,232	6,156,073	10,465,324
		ACSR	2	52	104	195,686	368,966	21,430	586,083	5,635,410	9,580,196
	1/0	AI SLADO	7	37	259	2,324,784	1,291,381	75,006	3,691,171	14,251,624	24,227,761
		DE SNUDO	7	37	259	979,974	1,291,381	75,006	2,346,360	9,059,307	15,400,821
		ACSR	7	37	259	1,168,399	1,291,381	75,006	2,534,786	9,786,819	16,637,591
	2/0	AI SLADO	9	35	315	2,795,265	1,660,347	96,436	4,552,048	14,450,947	24,566,610
		DE SNUDO	9	35	315	1,191,860	1,660,347	96,436	2,948,643	9,360,771	15,913,310
		ACSR	9	35	315	2,483,309	1,660,347	96,436	4,240,092	13,460,609	22,883,035
FACTOR DE INSTALACIÓN			1.7								

UNIDADES CONSTRUCTIVAS REDES RURALES

COSTO UNIDADES CONSTRUCTIVAS TRANSFORMADOR URBANO							
TIPO	CAPACIDAD	TRAFO	PARARRAYOS	CORTACIRCUITOS + FUSIBLES	ESTRUCTURAS + HERRAJES	TOTAL MATERIAL	VALOR TOTAL CON FI
	KVA	\$	\$	\$	\$	\$	\$
MONFASICO	10	1,053,844	174,000	181,401	105,384	1,516,547	1,956,346
BIFASICO	15	1,134,519	174,000	181,401	113,452	1,603,973	2,069,125
	25	1,340,603	174,000	181,401	134,060	1,830,534	2,361,389
	30	1,760,000	174,000	181,401	176,000	2,294,394	2,959,768
	37.5	1,707,605	174,000	181,401	170,761	2,235,469	2,883,755
	50	1,212,203	174,000	181,401	121,220	1,689,683	2,179,690
	75	2,520,717	174,000	180,365	252,072	3,129,397	4,036,922
TRIFASICO	15	1,777,691	261,000	271,553	177,769	2,489,931	3,212,011
	30	2,264,159	261,000	271,553	226,416	3,023,728	3,900,610
	45	2,694,371	261,000	271,553	269,437	3,496,831	4,510,912
	50	3,760,407	261,000	271,553	376,041	4,671,244	6,025,904
	75	3,349,110	261,000	271,553	334,911	4,217,519	5,440,600
	100	5,000,000	261,000	271,553	500,000	6,033,680	7,783,448
	112.5	4,285,945	261,000	271,553	428,595	5,249,311	6,771,611
	150	5,019,561	261,000	272,588	501,956	6,056,051	7,812,305
TIPO	CAPACIDAD	TRAFO	MALLA TIERRA	OBRA CIVIL	ESTRUCTURAS	TOTAL MATERIAL	VALOR TOTAL CON FI
	KVA	\$	\$	\$	\$	\$	\$
S/E LOCAL	45 kVA	5,734,000	102,582	176,865	589,551	6,602,998	8,517,867
TRIFASICA	75 kVA	5,986,441	107,098	184,652	615,506	6,893,696	8,892,868
	112.5 kVA	4,440,136	100,256	172,854	576,181	5,289,427	6,823,361
	150 kVA	7,657,355	136,991	236,191	787,303	8,817,840	11,375,013
	225 kVA	8,474,780	151,615	261,404	871,348	9,759,148	12,589,301
	300 kVA	10,854,931	194,196	334,820	1,116,067	12,500,015	16,125,019
	400 kVA	12,658,076	226,454	390,438	1,301,461	14,576,429	18,803,594
	500 kVA	13,415,397	240,003	413,798	1,379,326	15,448,523	19,928,595
	630 kVA	18,283,888	327,100	563,966	1,879,888	21,054,842	27,160,746
	800 kVA	21,517,527	384,951	663,708	2,212,360	24,778,545	31,964,323
	1000 kVA	22,142,618	396,133	682,989	2,276,629	25,498,369	32,892,896
FACTOR DE INSTALACIÓN		1.29					

UNIDADES CONSTRUCTIVAS REDES RURALES

COSTO UNIDADES CONSTRUCTIVAS TRANSFORMADOR RURAL							
TIPO	CAPACIDAD	TRAFO	PARARRAYOS	CORTACIRCUITOS + FUSIBLES	ESTRUCTURAS + HERRAJES	TOTAL MATERIAL	VALOR TOTAL CON FI
	KVA	\$	\$	\$	\$	\$	\$
MONFASICO	10	1,053,844	174,000	181,401	105,384	1,516,547	2,123,166
BIFASICO	15	1,134,519	174,000	181,401	113,452	1,603,973	2,245,562
	25	1,340,603	174,000	181,401	134,060	1,830,534	2,562,748
	30	1,760,000	174,000	181,401	176,000	2,294,394	3,212,152
	37.5	1,707,605	174,000	181,401	170,761	2,235,469	3,129,656
	50	1,212,203	174,000	181,401	121,220	1,689,683	2,365,556
	75	2,520,717	174,000	180,365	252,072	3,129,397	4,381,156
TRIFASICO	15	1,777,691	261,000	271,553	177,769	2,489,931	3,485,903
	30	2,264,159	261,000	271,553	226,416	3,023,728	4,233,220
	45	2,694,371	261,000	271,553	269,437	3,496,831	4,895,564
	50	3,760,407	261,000	271,553	376,041	4,671,244	6,539,741
	75	3,349,110	261,000	271,553	334,911	4,217,519	5,904,527
	100	5,000,000	261,000	271,553	500,000	6,033,680	8,447,152
	112.5	4,285,945	261,000	271,553	428,595	5,249,311	7,349,035
	150	5,019,561	261,000	272,588	501,956	6,056,051	8,478,471
TIPO	CAPACIDAD	TRAFO	MALLA TIERRA	OBRA CIVIL	ESTRUCTURAS	TOTAL MATERIAL	VALOR TOTAL CON FI
	KVA	\$	\$	\$	\$	\$	\$
S/E LOCAL	45 kVA	5,734,000	102,582	176,865	589,551	6,602,998	9,244,197
TRIFASICA	75 kVA	5,986,441	107,098	184,652	615,506	6,893,696	9,651,174
	112.5 kVA	4,440,136	100,256	172,854	576,181	5,289,427	7,405,198
	150 kVA	7,657,355	136,991	236,191	787,303	8,817,840	12,344,976
	225 kVA	8,474,780	151,615	261,404	871,348	9,759,148	13,662,807
	300 kVA	10,854,931	194,196	334,820	1,116,067	12,500,015	17,500,021
	400 kVA	12,658,076	226,454	390,438	1,301,461	14,576,429	20,407,001
	500 kVA	13,415,397	240,003	413,798	1,379,326	15,448,523	21,627,933
	630 kVA	18,283,888	327,100	563,966	1,879,888	21,054,842	29,476,779
	800 kVA	21,517,527	384,951	663,708	2,212,360	24,778,545	34,689,963
	1000 kVA	22,142,618	396,133	682,989	2,276,629	25,498,369	35,697,717
FACTOR DE INSTALACIÓN		1.4					

**DETERMINACIÓN DEL COSTO DE LA UNIDAD CONSTRUCTIVA
(\$COL/2001)**

SUBESTACIÓN CAPSULADA

ELEMENTOS	CONSTRUDATA/2001
Celda de maniobras	2,075,044
Interruptor tripolar bajo carga (*)	3,165,539
Celda de protección del transformador	1,826,040
Interruptor tripolar bajo carga con fusibles (*)	5,515,129
Celda del transformador	663,443
Transformador 150 kVA	5,231,611
Malla de puesta a tierra	307,675
Obra civil	300,000
Estructuras	150,000
VALOR TOTAL	19,234,481
FACTOR DE INSTALACION	1.29
VALOR FINAL	24,812,481

(*) Se obtuvieron precios de 1996. Actualizados a 2001

SUBESTACIÓN DE LOCAL

ELEMENTOS	CONSTRUDATA/2001
Obra civil	600,000
Protecciones	3,165,539
Malla de puesta a tierra	221,358
VALOR TOTAL	3,986,897
FACTOR DE INSTALACION	1.29
VALOR FINAL	5,143,097

NOTA: No se incluye el precio del transformador

6.1 Costos Asociados a las Unidades Constructivas Típicas

UNIDADES CONSTRUCTIVAS PARA REDES URBANAS

COSTOS UNIDADES CONSTRUCTIVAS RED SUBTERRANEA						CONDUCTOR	DUCTOS	ESTRUCTURA	MATERIALES	km - RED	CON FI
CONFIG.	CONDUCTOR	TIPO	VANOS	L_VANO	L-TOTAL	TOTAL (\$)	TOTAL (\$)	TOTAL (\$)	TOTAL (\$)	TOTAL (\$)	TOTAL (\$)
BIFASICO	2	CuTHW	1	20	20	160,421	254,465	258,593	673,479	33,673,931	58,592,641
URBANO	4	CuTHW	9	7	65	387,055	827,011	560,285	1,774,351	27,297,708	47,498,012
	8	CuTHW	30	2	60	195,156	763,395	517,186	1,475,737	24,595,617	42,796,373
BIFASICO	2	CuTHW	2	2.5	5	40,105	63,616	258,593	362,314	72,462,881	128,259,300
RURAL											
TRIFASICO	2	CuTHW	35.5	2	71	759,324	903,351	612,003	2,274,678	32,037,725	55,745,642
URBANO	4	CuTHW	21.5	2	43	256,052	547,100	370,650	1,173,801	27,297,708	47,498,012
	1/0	CuTHW	5	25	125	2,106,391	1,590,406	1,077,471	4,774,268	38,194,143	66,457,808
	2/0	CuTHW	1	18	18	362,886	229,019	258,593	850,497	47,249,845	82,214,730
FACTOR DE INSTALACIÓN RED URBANA			1.74								

DETERMINACIÓN DEL FACTOR DE INSTALACIÓN RED AÉREA URBANA

ITEM	FACTOR	ACUMULADO
COSTO DEL SUBSISTEMA	1	1
Transporte marítimo	0	1
Seguros marítimos	0	1
CIF DEL SUBSISTEMA	1	1
Bodegaje del subsistema	0	1
Aranceles del subsistema	0	1
Transporte terrestre o aéreo del subsistema (nacional)	0.01	1.01
Seguros del transporte terrestre o aéreo del subsistema (nacional)	0.01	1.02
IVA De materiales del subsistema	0.16	1.18
DDP DEL SUBSISTEMA	1.17	1.18
Montaje, pruebas y puesta en marcha del subsistema	0.08	1.26
Obras civiles del subsistema	0.1	1.36
Gestión ambiental del subsistema	0.04	1.4
Servidumbre y/o lotes del subsistema	0	1.4
COSTO DIRECTO DEL SUBSISTEMA	1.39	1.4
Costos de ingeniería del subsistema	0.02	1.42
Costos de interventoría del subsistema	0.03	1.45
Costos de administración de la ejecución del subsistema	0.03	1.48
Imprevistos	0.1	1.58
Costos financieros	0.12	1.7
COSTO INDIRECTO DEL SUBSISTEMA		
COSTO TOTAL DEL SUBSISTEMA		
FACTOR DE INSTALACION RED URBANA		1.7

DETERMINACIÓN DEL FACTOR DE INSTALACIÓN RED AÉREA RURAL

ITEM	FACTOR	ACUMULADO
COSTO DEL SUBSISTEMA	1	1
Transporte marítimo	0	1
Seguros marítimos	0	1
CIF DEL SUBSISTEMA	1	1
Bodegaje del subsistema	0	1
Aranceles del subsistema	0	1
Transporte terrestre o aéreo del subsistema (nacional)	0.02	1.02
Seguros del transporte terrestre o aéreo del subsistema (nacional)	0.02	1.04
IVA De materiales del subsistema	0.16	1.2
DDP DEL SUBSISTEMA	1.17	1.2
Montaje, pruebas y puesta en marcha del subsistema	0.08	1.28
Obras civiles del subsistema	0.1	1.38
Gestión ambiental del subsistema	0.08	1.46
Servidumbre y/o lotes del subsistema	0.01	1.47
COSTO DIRECTO DEL SUBSISTEMA	1.39	1.47
Costos de ingeniería del subsistema	0.02	1.49
Costos de interventoría del subsistema	0.03	1.52
Costos de administración de la ejecución del subsistema	0.03	1.55
Imprevistos	0.1	1.65
Costos financieros	0.12	1.77
COSTO INDIRECTO DEL SUBSISTEMA		
COSTO TOTAL DEL SUBSISTEMA		

FACTOR DE INSTALACION RED RURAL

1.77

**DETERMINACIÓN DEL FACTOR DE INSTALACIÓN
RED SUBTERRÁNEA URBANA**

ITEM	FACTOR	ACUMULADO
COSTO DEL SUBSISTEMA	1	1
Transporte marítimo	0	1
Seguros marítimos	0	1
CIF DEL SUBSISTEMA	1	1
Bodegaje del subsistema	0	1
Aranceles del subsistema	0	1
Transporte terrestre o aéreo del subsistema (nacional)	0.01	1.01
Seguros del transporte terrestre o aéreo del subsistema (nacional)	0.01	1.02
IVA De materiales del subsistema	0.16	1.18
DDP DEL SUBSISTEMA	1.17	1.18
Montaje, pruebas y puesta en marcha del subsistema	0.08	1.26
Obras civiles del subsistema	0.1	1.36
Gestión ambiental del subsistema	0.08	1.44
Servidumbre y/o lotes del subsistema	0	1.44
COSTO DIRECTO DEL SUBSISTEMA	1.39	1.44
Costos de ingeniería del subsistema	0.02	1.46
Costos de interventoría del subsistema	0.03	1.49
Costos de administración de la ejecución del subsistema	0.03	1.52
Imprevistos	0.1	1.62
Costos financieros	0.12	1.74
COSTO INDIRECTO DEL SUBSISTEMA		
COSTO TOTAL DEL SUBSISTEMA		

FACTOR DE INSTALACION RED URBANA

1.74

**DETERMINACIÓN DEL FACTOR DE INSTALACIÓN
RED SUBTERRÁNEA RURAL**

ITEM	FACTOR	ACUMULADO
COSTO DEL SUBSISTEMA	1	1
Transporte marítimo	0	1
Seguros marítimos	0	1
CIF DEL SUBSISTEMA	1	1
Bodegaje del subsistema	0	1
Aranceles del subsistema	0	1
Transporte terrestre o aéreo del subsistema (nacional)	0.02	1.02
Seguros del transporte terrestre o aéreo del subsistema (nacional)	0.02	1.04
IVA De materiales del subsistema	0.16	1.2
DDP DEL SUBSISTEMA	1.17	1.2
Montaje, pruebas y puesta en marcha del subsistema	0.08	1.28
Obras civiles del subsistema	0.1	1.38
Gestión ambiental del subsistema	0.08	1.46
Servidumbre y/o lotes del subsistema	0.01	1.47
COSTO DIRECTO DEL SUBSISTEMA	1.39	1.47
Costos de ingeniería del subsistema	0.02	1.49
Costos de interventoría del subsistema	0.03	1.52
Costos de administración de la ejecución del subsistema	0.03	1.55
Imprevistos	0.1	1.65
Costos financieros	0.12	1.77
COSTO INDIRECTO DEL SUBSISTEMA		
COSTO TOTAL DEL SUBSISTEMA		

FACTOR DE INSTALACION RED RURAL

1.77

**DETERMINACIÓN DEL FACTOR DE INSTALACIÓN
TRANSFORMADOR URBANO DE DISTRIBUCIÓN**

ITEM	FACTOR	ACUMULADO
COSTO DEL SUBSISTEMA	1	1
Transporte marítimo	0	1
Seguros marítimos	0	1
CIF DEL SUBSISTEMA	1	1
Bodegaje del subsistema	0	1
Aranceles del subsistema	0	1
Transporte terrestre o aéreo del subsistema (nacional)	0.01	1.01
Seguros del transporte terrestre o aéreo del subsistema (nacional)	0.01	1.02
IVA De materiales del subsistema	0.16	1.18
DDP del subsistema	1.17	1.18
Montaje, pruebas y puesta en marcha del subsistema	0.01	1.19
Obras civiles del subsistema	0.01	1.2
Gestión ambiental del subsistema	0.01	1.21
Servidumbre y/o lotes del subsistema	0	1.21
COSTO DIRECTO DEL SUBSISTEMA	1.39	1.21
Costos de ingeniería del subsistema	0.02	1.23
Costos de interventoría del subsistema	0.03	1.26
Costos de administración de la ejecución del subsistema	0.03	1.29
Imprevistos	0	1.29
Costos financieros	0	1.29
COSTO INDIRECTO DEL SUBSISTEMA		
COSTO TOTAL DEL SUBSISTEMA		

FACTOR DE INSTALACION TRANSFORMADOR DE DISTRIBUCION

1.29

**DETERMINACIÓN DEL FACTOR DE INSTALACIÓN
TRANSFORMADOR RURAL DE DISTRIBUCIÓN**

ITEM	FACTOR	ACUMULADO
COSTO DEL SUBSISTEMA	1	1
Transporte marítimo	0	1
Seguros marítimos	0	1
CIF DEL SUBSISTEMA	1	1
Bodegaje del subsistema	0	1
Aranceles del subsistema	0	1
Transporte terrestre o aéreo del subsistema (nacional)	0.02	1.02
Seguros del transporte terrestre o aéreo del subsistema (nacional)	0.02	1.04
IVA De materiales del subsistema	0.16	1.2
DDP del subsistema	1.17	1.2
Montaje, pruebas y puesta en marcha del subsistema	0.02	1.22
Obras civiles del subsistema	0.02	1.24
Gestión ambiental del subsistema	0.04	1.28
Servidumbre y/o lotes del subsistema	0	1.28
COSTO DIRECTO DEL SUBSISTEMA	1.39	1.28
Costos de ingeniería del subsistema	0.04	1.32
Costos de interventoría del subsistema	0.03	1.35
Costos de administración de la ejecución del subsistema	0.03	1.38
Imprevistos	0.02	1.4
Costos financieros	0	1.4
COSTO INDIRECTO DEL SUBSISTEMA		
COSTO TOTAL DEL SUBSISTEMA		

FACTOR DE INSTALACION TRANSFORMADOR DE DISTRIBUCION

1.4

COSTOS DE INVERSION DE LAS UNIDADES CONSTRUCTIVAS

ITEM	UNIDAD	CONSTRUDATA/2001	COTIZACIONES	PRESUPUESTO CONCOL	PROMEDIO COSTO UNITARIO
POSTES					
Concreto 10m 510 kg	UN	\$186,760.00		\$224,946.87	\$205,853.43
Madera inmunizada 10m liviano	UN			\$188,986.34	\$188,986.34
CONDUCTORES					
AL desnudo N° 2/0	ML	\$3,444.00	\$3,526.00	\$1,417.68	\$2,795.89
AL desnudo N° 1/0	ML	\$2,722.00	\$2,786.00		\$2,754.00
AL desnudo N° 1	ML	\$513.00	\$2,208.00		\$1,360.50
AL desnudo N° 2	ML	\$1,072.00	\$1,742.00		\$1,407.00
AL desnudo N° 4	ML	\$1,116.00	\$1,142.00	\$596.92	\$951.64
AL desnudo N° 6	ML	\$585.00	\$791.00		\$688.00
AL desnudo N° 8	ML	\$500.00			\$500.00
AL aislado N° 1	ML			\$2,329.48	\$2,329.48
AL aislado N° 2/0	ML	\$5,570.00			\$5,570.00
AL aislado N° 4/0	ML	\$8,639.00			\$8,639.00
Cu aislado N° 2	ML	\$7,654.00		\$4,400.88	\$6,027.44
Cu desnudo N° 2	ML	\$13,034.00	\$6,868.00	\$5,791.00	\$8,564.33
Cu desnudo N° 6	ML	\$2,995.00	\$3,009.00		\$3,002.00
Cu desnudo N° 1/0	ML	\$10,825.00	\$10,872.00		\$10,848.50
ACSR N° 1	ML	\$2,150.00			\$2,150.00
ACSR N° 2	ML		\$2,165.00	\$1,387.54	\$1,776.27
ACSR N° 4	ML	\$1,116.00	\$1,447.00	\$953.72	\$1,172.24
ACSR N° 8	ML			\$1,044.61	\$1,044.61
ACSR N° 1/0	ML		\$3,363.00	\$1,906.15	\$2,634.57
ACSR N° 2/0	ML		\$4,106.00	\$2,200.16	\$3,153.08
Cable trenzado BT cuadruplex 3x1/0+2 AWG AL/ACSR PE/PVC (3*70mm+50 mm)	ML			\$19,076.00	\$19,076.00
Cable trenzado BT cuadruplex 3x2+4 AWG AL/ACSR PE/PVC (3*35mm+50mm)	ML				\$5,869.50
Cable trenzado BT cuadruplex 3x2/0+1/0 AWG AL/ACSR PE/PVC (3*70mm+50mm)	ML			\$20,276.00	\$20,276.00
Cable trenzado de AL 3x2/0 + 1x1/0 XLPE	ML			\$9,204.51	\$9,204.51
Cable de cobre trenzado 600v THVV 3X2 + 1X4 AWG	ML			\$11,005.71	\$11,005.71
PERCHAS					
Percha de 1 puesto	UN			\$4,342.65	\$4,342.65
Percha de 2 puesto	UN			\$9,667.71	\$9,667.71
Percha de 3 puesto	UN			\$15,604.98	\$15,604.98
Percha de 4 puesto	UN			\$19,642.49	\$19,642.49
Percha de 5 puesto	UN			\$23,877.34	\$23,877.34
Estructura de paso red trenzada	UN			\$4,605.24	\$4,605.24
Estructura de retención red trenzada	UN			\$18,220.98	\$18,220.98

COSTOS DE INVERSION DE LAS UNIDADES CONSTRUCTIVAS

ITEM	UNIDAD	CONSTRUDATA/2001	COTIZACIONES	PRESUPUESTO CONCOL	PROMEDIO COSTO UNITARIO
TRANSFORMADORES EN ACEITE					
<i>TRIFASICOS</i>					
15 kVA	UN		\$3,100,500.00	\$2,665,939.92	\$2,883,219.96
20 kVA	UN			\$2,948,227.84	\$2,948,227.84
30 kVA	UN		\$3,346,500.00	\$2,976,233.52	\$3,161,366.76
45 kVA	UN		\$3,982,000.00	\$3,652,913.45	\$3,817,456.72
50 kVA	UN			\$4,262,157.54	\$4,262,157.54
75 kVA	UN		\$4,949,500.00	\$4,641,522.33	\$4,795,511.16
100 kVA	UN			\$5,532,000.00	\$5,532,000.00
112.5 kVA	UN		\$6,332,500.00	\$5,898,161.31	\$6,115,330.66
150 kVA	UN	\$11,373,040.00	\$7,417,000.00	\$6,795,533.49	\$8,528,524.50
<i>MONOFASICOS</i>					
10 kVA	UN		\$2,061,000.00	\$1,353,087.83	\$1,707,043.92
15 kVA	UN	\$2,642,880.00	\$2,218,000.00	\$1,565,083.90	\$2,141,987.97
30 kVA	UN			\$1,511,047.59	\$1,511,047.59
25 kVA	UN		\$2,621,000.00	\$1,862,992.81	\$2,241,996.41
37.5 kVA	UN		\$3,338,000.00	\$2,325,836.00	\$2,831,918.00
50 kVA	UN	\$4,591,680.00	\$3,898,000.00	\$2,529,960.00	\$3,673,213.33
75 kVA	UN		\$4,928,000.00		\$4,928,000.00
100 kVA	UN	\$7,085,680.00	\$6,048,000.00		\$6,566,840.00
PROTECCIONES					
Pararrayos 10kV , 10kA	UN		\$87,000.00	\$123,958.00	\$105,479.00
Pararrayo 13.2 kV , 10 kA	UN			\$120,350.00	\$120,350.00
Pararrayo 34.5 kV , 10 kA	UN			\$2,436,000.00	\$2,436,000.00
Pararrayos 12 kV, 10 kA	UN			\$131,100.00	\$131,100.00
Cortacircuitos 15kV, 100A, para la zona costera	UN		\$156,000.00		\$156,000.00
Fusible tipo H 3 A	UN			\$1,735.54	\$1,735.54
Fusible tipo H 5 A	UN			\$1,735.54	\$1,735.54
Fusible tipo H 8 A	UN			\$1,877.31	\$1,877.31
Fusible tipo H 10 A	UN			\$1,877.31	\$1,877.31
Fusible tipo H 15 A	UN			\$1,743.01	\$1,743.01
Fusible tipo H 20 A	UN			\$2,517.51	\$2,517.51

CIRCUITOS TÍPICOS
CARGA POR USUARIO EQUIVALENTE

Código Trafo	Cantidad Trafos	Capacidad [kVA]	Usuarios por Ramal	Long. por Ramal	Calibre Conductor		Material Conductor		Total Estruct.	Long Vano	Zona	Fases	Ramales por Trafo	Tipo Estruct	Carga Prom kVA	kVA/Us
					Caibre	Cantidad	Material	Cantidad								
por Medias																
37.5 U M	1	37.5	3	64	8	2	Al-D	2	2	41.0	U	M	3	PC	7.200	1.200
10 U B	1	10	1	20	1/0	1	AL-A-Tr	1	2	10.0	U	B	1	PC	0.000	0.000
15 U B	8	15	5	159	4	7	ACSR	9	4	51.0	U	B	2	PC	3.016	0.377
25 U B	6	25	11	115	1/0	8	AL-A-Tr	5	4	35.0	U	B	2	PC	9.710	1.214
37.5 U B	16	37.5	14	105	1/0	18	AL-A-Tr	21	3	32.0	U	B	2	PC	14.250	2.375
50 U B	21	50	13	102	1/0	22	AL-A-Tr	24	3	37.0	U	B	2	PC	17.486	2.914
75 U B	24	75	15	139	1/0	25	AL-A-Tr	28	4	30.0	U	B	2	PC	18.989	2.374
10 R M	2	10	2	275	1/0	3	ACSR	3	3	145.0	R	M	2	PM	2.205	0.368
10 R B	37	10	2	331	1	47	ACSR	56	3	90.0	R	B	2	PM	3.385	0.564
15 R B	92	15	3	340	1	73	ACSR	151	4	94.0	R	B	3	PM	6.121	0.510
25 R B	42	25	6	267	2	45	ACSR	46	4	67.0	R	B	3	PC	9.947	0.829
30 R B	3	30	7	613	1/0	6	ACSR	6	6	110.0	R	B	3	PC	8.277	0.460
37.5 R B	27	37.5	10	149	1/0	35	AL-A-Tr	29	4	37.0	R	B	2	PC	13.652	1.707
50 R B	29	50	14	142	1/0	50	AL-A-Tr	34	4	34.0	R	B	3	PC	19.770	1.648
75 R B	17	75	14	143	1/0	33	AL-A-Tr	32	4	27.0	R	B	3	PC	20.067	1.672
100 R B	1	100	7	903	1	4	ACSR	4	7	130.0	R	B	4	PM	10.200	0.364
15 U T	7	15	5	156	1	8	ACSR	8	5	32.0	U	T	2	PM	4.751	0.475
20 U T	1	20	2	30	2	1	Cu-A-Tr	1	1	30.0	U	T	1	PC	7.375	7.375
30 U T	8	30	8	168	2/0	5	ACSR	5	5	52.0	U	T	2	PC	6.573	0.657
45 U T	9	45	18	238	1/0	11	ACSR	17	8	29.0	U	T	2	PC	18.728	1.171
75 U T	27	75	17	160	2/0	33	ACSR	22	5	34.0	U	T	2	PC	25.659	2.566
100 U T	4	100	18	161	2/0	9	Al-A	5	5	27.0	U	T	3	PC	45.165	3.011
112.5 U T	24	112.5	17	126	2/0	24	Al-D	22	4	30.0	U	T	2	PC	32.537	4.067
150 U T	17	150	29	147	4/0	17	Al-A	20	5	35.0	U	T	3	PC	47.158	3.144
15 R T	8	15	2	131	1	7	ACSR	12	2	52.0	R	T	2	PC	5.740	1.435
30 R T	19	30	7	240	1/0	11	ACSR	30	6	48.0	R	T	2	PC	10.145	0.845
45 R T	9	45	12	171	1/0	9	Al-D	15	5	36.0	R	T	2	PC	14.794	1.479
50 R T	2	50	28	239	1/0	2	Al-D	4	9	28.0	R	T	2	PC	26.340	1.463
75 R T	14	75	19	295	2/0	12	ACSR	14	8	36.0	R	T	2	PC	26.842	1.678
112.5 R T	13	112.5	36	286	2/0	11	Al-A	10	9	34.0	R	T	2	PC	41.906	2.328
150 R T	1	150	104	480	2/0	2	Al-D	2	16	30.0	R	T	2	PC	64.800	2.025

CÁLCULO DE PÉRDIDAS CON MEDICIONES DE CARGA

Trafo Típico	Capacidad del Trafo (kVA)	Ramales por trafo	Pérdidas totales en la red (kW)	Pérdidas totales en la red (kVAR)	Pérdidas totales en la red (kVA)	Pérdidas en la red / ramal (kW)	Pérdidas en la red / ramal (kVAR)	Pérdidas en la red / ramal (kVA)	Pérdidas en el trafo (kW)	Po Pérdidas en vacío (kW) *	Pc Pérdidas con carga (kW) *	Pcu Pérdidas en el Cu (kW)	Factor de Utilización	Carga Promedio (kVA)	kVA por estructura (usuario eq.)	kW por estructura (usuario eq.)	kVAR por estructura (usuario eq.)	Regulación (%)	Pérdidas Totales (kW)
37.5 U M	37.5	3	0.04647	0.01605	0.04916	0.01549	0.00535	0.01639	0.150	0.135	0.405	0.015	0.192	7.200	1.200	1.14000	0.37470	0.80580	0.156400
10 U B	10	1	0.00179	0.00091	0.00201	0.00179	0.00091	0.00201	0.066	0.050	0.140	0.016	0.339	3.385	1.693	1.60788	0.52848	0.07039	0.067832
15 U B	15	2	0.01476	0.00348	0.01516	0.00738	0.00174	0.00758	0.078	0.070	0.195	0.008	0.201	3.016	0.377	0.35818	0.11773	0.65586	0.092645
25 U B	25	2	0.03900	0.01990	0.04378	0.01950	0.00995	0.02189	0.144	0.100	0.290	0.044	0.388	9.710	1.214	1.15311	0.37901	0.58937	0.182751
37.5 U B	37.5	2	0.06432	0.03282	0.07221	0.03216	0.01641	0.03610	0.193	0.135	0.405	0.058	0.380	14.250	2.375	2.25622	0.74158	0.63493	0.257800
50 U B	50	2	0.11256	0.05744	0.12637	0.05628	0.02872	0.06318	0.222	0.160	0.510	0.062	0.350	17.486	2.914	2.76862	0.91000	0.90164	0.334935
75 U B	75	2	0.12908	0.06588	0.14492	0.06454	0.03294	0.07246	0.256	0.210	0.710	0.046	0.253	18.989	2.374	2.25496	0.74117	0.98980	0.384594
10 R M	10	2	0.00864	0.01156	0.01443	0.00432	0.00578	0.00722	0.057	0.050	0.140	0.007	0.221	2.205	0.368	0.34913	0.11475	0.67731	0.065447
10 R B	10	2	0.01152	0.00650	0.01323	0.00576	0.00325	0.00661	0.066	0.050	0.140	0.016	0.338	3.385	0.564	0.53594	0.17616	0.48459	0.077561
15 R B	15	3	0.03072	0.01734	0.03528	0.01024	0.00578	0.01176	0.102	0.070	0.195	0.032	0.408	6.121	0.510	0.48459	0.15928	0.75067	0.133193
25 R B	25	3	0.09327	0.03384	0.09922	0.03109	0.01128	0.03307	0.146	0.100	0.290	0.046	0.398	9.947	0.829	0.78746	0.25883	1.29438	0.239179
30 R B	30	3	0.09546	0.05163	0.10853	0.03182	0.01721	0.03618	0.136	0.111	0.335	0.025	0.276	8.277	0.460	0.43682	0.14358	1.72686	0.231958
37.5 R B	37.5	2	0.08222	0.04196	0.09231	0.04111	0.02098	0.04615	0.189	0.135	0.405	0.054	0.364	13.652	1.707	1.62118	0.53285	0.87776	0.270897
50 R B	50	3	0.10605	0.05412	0.11906	0.03535	0.01804	0.03969	0.240	0.160	0.510	0.080	0.395	19.770	1.648	1.56513	0.51443	0.78051	0.345784
75 R B	75	3	0.08619	0.04398	0.09676	0.02873	0.01466	0.03225	0.261	0.210	0.710	0.051	0.268	20.067	1.672	1.58867	0.52217	0.62781	0.347020
100 R B	100	4	0.14268	0.08060	0.16387	0.03567	0.02015	0.04097	0.269	0.260	0.900	0.009	0.102	10.200	0.364	0.34607	0.11375	2.11262	0.412044
15 U T	15	2	0.01246	0.00736	0.01447	0.00623	0.00368	0.00724	0.111	0.080	0.310	0.031	0.317	4.751	0.475	0.45132	0.14834	0.40414	0.123555
20 U T	20	1	0.02292	0.01309	0.02639	0.02292	0.01309	0.02639	0.152	0.100	0.380	0.052	0.369	7.375	7.375	7.00625	2.30284	0.34707	0.174591
30 U T	30	2	0.03202	0.02210	0.03891	0.01601	0.01105	0.01945	0.160	0.135	0.515	0.025	0.219	6.573	0.657	0.62444	0.20524	0.76986	0.191742
45 U T	45	2	0.27248	0.15418	0.31308	0.13624	0.07709	0.15654	0.303	0.180	0.710	0.123	0.416	18.728	1.171	1.11199	0.36550	2.23778	0.575459
75 U T	75	2	0.33118	0.22846	0.40234	0.16559	0.11423	0.20117	0.393	0.265	1.090	0.128	0.342	25.659	2.566	2.43758	0.80119	1.98169	0.723758
100 U T	100	3	0.46278	0.30528	0.55440	0.15426	0.10176	0.18480	0.614	0.330	1.392	0.284	0.452	45.165	3.011	2.86045	0.94018	1.57310	1.076731
112.5 U T	112.5	2	0.34142	0.22522	0.40901	0.17071	0.11261	0.20451	0.494	0.365	1.540	0.129	0.289	32.537	4.067	3.86373	1.26995	1.57392	0.835234
150 U T	150	3	0.41202	0.40743	0.57945	0.13734	0.13581	0.19315	0.644	0.450	1.960	0.194	0.314	47.158	3.144	2.98670	0.98168	1.46306	1.055748
15 R T	15	2	0.01884	0.00994	0.01955	0.00842	0.00497	0.00978	0.125	0.080	0.310	0.045	0.383	5.740	1.435	1.36325	0.44808	0.39679	0.142234
30 R T	30	2	0.10272	0.05812	0.11802	0.05136	0.02906	0.05901	0.194	0.135	0.515	0.059	0.338	10.145	0.845	0.80315	0.26398	1.54689	0.296615
45 R T	45	2	0.12514	0.06746	0.14216	0.06257	0.03373	0.07108	0.257	0.180	0.710	0.077	0.329	14.794	1.479	1.40539	0.46193	1.25895	0.381973
50 R T	50	2	0.50650	0.27310	0.57544	0.25325	0.13655	0.28772	0.412	0.197	0.775	0.215	0.527	26.340	1.463	1.39017	0.45693	2.92133	0.918577
75 R T	75	2	0.56478	0.38962	0.68613	0.28239	0.19481	0.34307	0.405	0.265	1.090	0.140	0.358	26.842	1.678	1.59376	0.52384	3.29739	0.969359
112.5 R T	112.5	2	1.27622	0.84190	1.52890	0.63811	0.42095	0.76445	0.579	0.365	1.540	0.214	0.373	41.906	2.328	2.21173	0.72696	4.65940	1.854907
150 R T	150	2	5.05214	3.33280	6.05241	2.52607	1.66640	3.02621	0.816	0.450	1.960	0.366	0.432	64.800	2.025	1.92375	0.63231	11.11331	5.867923

* Valores tomados de las Normas ICONTEC 818 y 819: Transformadores monofásicos y trifásicos autorefrigerados y sumergidos en aceite. Pérdidas, corriente sin carga y tensión de corto circuito.

Los valores para los transformadores bifásicos son los reportados en la norma para transformadores monofásicos.

Factor de potencia = 0.95

CÁLCULO DE PÉRDIDAS CON LA DEMANDA MÁXIMA DIVERSIFICADA

Trafo Típico	Capacidad del Trafo (kVA)	Ramales por trafo	Usuarios por Ramal	Usuarios por Trafo	Pérdidas en la red totales (kW)	Pérdidas en la red totales (kVAR)	Pérdidas en la red totales (kVA)	Pérdidas en la red / ramal (kW)	Pérdidas en la red / ramal (kVAR)	Pérdidas en la red / ramal (kVA)	Pérdidas en el trafo (kW)	Po Pérdidas en vacío (kW) *	Pc Pérdidas con carga (kW) *	Pcu Pérdidas en el Cu (kW)	Factor de Utilización	Carga DMD (kVA)	kVA por estructura (usuario eq.)	kW por estructura (usuario eq.)	kVAR por estructura (usuario eq.)	Regulación (%)	Pérdidas Totales
37.5 U M	37.5	3	3	9	0.38184	0.13197	0.40400	0.12728	0.04399	0.13467	0.252	0.135	0.405	0.117	0.537	20.143	3.357	3.18937	1.04830	2.28176	0.634
10 U B	10	1	1	1	0.00266	0.00135	0.00298	0.00266	0.00135	0.00298	0.074	0.050	0.140	0.024	0.412	4.118	2.059	1.95584	0.64285	0.08574	0.076
15 U B	15	2	5	10	0.82268	0.19462	0.84539	0.41134	0.09731	0.42269	0.472	0.070	0.195	0.402	1.435	21.525	2.691	2.55613	0.84016	4.76488	1.294
25 U B	25	2	11	22	0.59072	0.30148	0.66320	0.29536	0.15074	0.33160	0.736	0.100	0.290	0.636	1.480	37.009	4.626	4.39487	1.44452	2.26780	1.326
37.5 U B	37.5	2	14	28	0.66628	0.34004	0.74803	0.33314	0.17002	0.37402	0.720	0.135	0.405	0.585	1.202	45.067	7.511	7.13557	2.34535	2.02409	1.386
50 U B	50	2	13	26	0.69380	0.35410	0.77894	0.34690	0.17705	0.38947	0.532	0.160	0.510	0.372	0.854	42.723	7.120	6.76445	2.22337	2.21772	1.226
75 U B	75	2	15	30	0.83492	0.42612	0.93737	0.41746	0.21306	0.46869	0.493	0.210	0.710	0.283	0.631	47.340	5.918	5.62163	1.84774	2.49280	1.328
10 R M	10	2	2	4	0.25826	0.34536	0.43124	0.12913	0.17268	0.21562	0.237	0.050	0.140	0.187	1.157	11.573	1.929	1.83234	0.60226	3.68208	0.496
10 R B	10	2	2	4	0.13598	0.07680	0.15617	0.06799	0.03840	0.07808	0.237	0.050	0.140	0.187	1.157	11.573	1.929	1.83234	0.60226	1.64944	0.373
15 R B	15	3	3	9	0.35031	0.19785	0.40232	0.11677	0.06595	0.13411	0.422	0.070	0.195	0.352	1.343	20.143	1.679	1.59469	0.52415	2.50306	0.772
25 R B	25	3	6	18	1.03698	0.37638	1.10317	0.34566	0.12546	0.36772	0.579	0.100	0.290	0.479	1.285	32.126	2.677	2.54329	0.83594	4.23116	1.616
30 R B	30	3	7	21	2.02944	1.09749	2.30719	0.67648	0.36583	0.76906	0.588	0.111	0.335	0.477	1.193	35.785	1.988	1.88863	0.62076	7.68916	2.617
37.5 R B	37.5	2	10	20	0.54474	0.27802	0.61159	0.27237	0.13901	0.30579	0.479	0.135	0.405	0.344	0.921	34.546	4.318	4.10234	1.34837	2.23989	1.023
50 R B	50	3	14	42	1.04136	0.53148	1.16915	0.34712	0.17716	0.38972	0.916	0.160	0.510	0.756	1.217	60.857	5.071	4.81782	1.58354	2.42060	1.957
75 R B	75	3	14	42	0.81699	0.41697	0.91724	0.27233	0.13899	0.30575	0.677	0.210	0.710	0.467	0.811	60.857	5.071	4.81782	1.58354	1.91694	1.494
100 R B	100	4	7	28	3.25692	1.83944	3.74046	0.81423	0.45986	0.93512	0.443	0.260	0.900	0.183	0.451	45.067	1.610	1.52905	0.50257	9.66895	3.700
15 U T	15	2	5	10	0.26370	0.15574	0.30626	0.13185	0.07787	0.15313	0.718	0.080	0.310	0.638	1.435	21.525	2.153	2.04491	0.67213	1.84102	0.982
20 U T	20	1	2	2	0.02093	0.01196	0.02411	0.02093	0.01196	0.02411	0.147	0.100	0.380	0.047	0.353	7.055	7.055	6.70203	2.20285	0.33171	0.168
30 U T	30	2	8	16	0.69564	0.47992	0.84513	0.34782	0.23996	0.42256	0.637	0.135	0.515	0.502	0.987	29.620	2.962	2.81389	0.92488	3.51911	1.333
45 U T	45	2	18	36	2.46106	1.39252	2.82771	1.23053	0.69626	1.41385	1.192	0.180	0.710	1.012	1.194	53.735	3.358	3.19054	1.04868	6.55566	3.653
75 U T	75	2	17	34	1.38260	0.95382	1.67969	0.69130	0.47691	0.83984	0.775	0.265	1.090	0.510	0.684	51.285	5.129	4.87209	1.60138	4.00119	2.157
100 U T	100	3	18	54	1.36404	0.89982	1.63410	0.45468	0.29994	0.54470	1.147	0.330	1.392	0.817	0.766	76.621	5.108	4.85265	1.59499	2.68230	2.511
112.5 U T	112.5	2	17	34	0.86860	0.57300	1.04057	0.43430	0.28650	0.52029	0.685	0.365	1.540	0.320	0.456	51.285	6.411	6.09011	2.00172	2.49549	1.554
150 U T	150	3	29	87	2.82237	2.79084	3.96920	0.94079	0.93028	1.32307	1.711	0.450	1.960	1.261	0.802	120.335	8.022	7.62121	2.50497	3.78401	4.534
15 R T	15	2	2	4	0.06954	0.04108	0.08077	0.03477	0.02054	0.04038	0.265	0.080	0.310	0.185	0.772	11.573	2.893	2.74851	0.90339	0.80325	0.334
30 R T	30	2	7	14	0.78010	0.44140	0.89632	0.39005	0.22070	0.44816	0.554	0.135	0.515	0.419	0.902	27.061	2.255	2.14236	0.70416	4.19761	1.334
45 R T	45	2	12	24	0.92538	0.49894	1.05132	0.46269	0.24947	0.52566	0.724	0.180	0.710	0.544	0.875	39.395	3.940	3.74254	1.23011	3.38017	1.650
50 R T	50	2	28	56	5.22318	2.81628	5.93406	2.61159	1.40814	2.96703	2.146	0.197	0.775	1.949	1.586	79.283	4.405	4.18440	1.37534	9.05372	7.369
75 R T	75	2	19	38	2.70774	1.86802	3.28958	1.35387	0.93401	1.64479	0.877	0.265	1.090	0.612	0.749	56.178	3.511	3.33559	1.09635	7.07346	3.584
112.5 R T	112.5	2	36	72	8.56370	5.64934	10.25924	4.28185	2.82467	5.12962	1.593	0.365	1.540	1.228	0.893	100.469	5.582	5.30252	1.74285	11.59512	10.157

* Valores tomados de las Normas ICONTEC 818 y 819: Transformadores monofásicos y trifásicos autorefrigerados y sumergidos en aceite. Pérdidas, corriente sin carga y tensión de corto circuito.

Los valores para los transformadores bifásicos son los reportados en la norma para transformadores monofásicos.

Factor de potencia = 0.95

La demanda máxima diversificada fue tomada para el estrato 4 (medio)

COMPARACIÓN DE LOS FACTORES DE CARGA Y PÉRDIDAS OBTENIDOS CON MEDICIONES DE CARGA Y DEMANDA MÁXIMA DIVERSIFICADA

Tipos Trafos	Capacidad del Trafo (kVA)	Energía / mes	Energía / año	Carga DMD (kVA)	Carga Medida (kVA)	Factor de Carga con DMD (FC)	Factor de Carga con Carga medida (FC)	Factor de Pérdidas con DMD (FP)	Factor de Pérdidas con Carga medida (FP)	Factor de Demanda con DMD. (FD)	Factor de Demanda con Carga medida. (FD)
37.5_U_M	37.5	2993.500	35922.000	20.143	7.200	0.204	0.570	0.090	0.398	0.537	0.192
10_U_B	10	0.000	0.000	4.118	3.385	0.000	0.000	0.000	0.000	0.412	0.339
15_U_B	15	1544.900	18538.800	21.525	3.016	0.098	0.702	0.036	0.555	1.435	0.201
25_U_B	25	2779.667	33356.000	37.009	9.710	0.103	0.392	0.038	0.225	1.480	0.388
37.5_U_B	37.5	5425.640	65107.680	45.067	14.250	0.165	0.522	0.069	0.347	1.202	0.380
50_U_B	50	8068.258	96819.100	42.723	17.486	0.259	0.632	0.124	0.469	0.854	0.350
75_U_B	75	8277.962	99335.538	47.340	18.989	0.240	0.597	0.112	0.429	0.631	0.253
10_R_M	10	526.250	6315.000	11.573	2.205	0.062	0.327	0.021	0.173	1.157	0.221
10_R_B	10	953.804	11445.652	11.573	3.385	0.113	0.386	0.043	0.220	1.157	0.338
15_R_B	15	886.744	10640.929	20.143	6.121	0.060	0.198	0.021	0.087	1.343	0.408
25_R_B	25	3251.677	39020.123	32.126	9.947	0.139	0.448	0.055	0.275	1.285	0.398
30_R_B	30	2983.000	35796.000	35.785	8.277	0.114	0.494	0.043	0.319	1.193	0.276
37.5_R_B	37.5	3361.432	40337.179	34.546	13.652	0.133	0.337	0.052	0.181	0.921	0.364
50_R_B	50	6494.661	77935.930	60.857	19.770	0.146	0.450	0.059	0.277	1.217	0.395
75_R_B	75	5766.711	69200.533	60.857	20.067	0.130	0.394	0.051	0.227	0.811	0.268
100_R_B	100	2010.000	24120.000	45.067	10.200	0.061	0.270	0.021	0.132	0.451	0.102
15_U_T	15	1430.000	17160.000	21.525	4.751	0.091	0.412	0.033	0.243	1.435	0.317
20_U_T	20	2157.600	25891.200	7.055	7.375	0.419	0.401	0.249	0.233	0.353	0.369
30_U_T	30	1509.500	18114.000	29.620	6.573	0.070	0.315	0.024	0.164	0.987	0.219
45_U_T	45	6620.063	79440.750	53.735	18.728	0.169	0.484	0.071	0.309	1.194	0.416
75_U_T	75	8725.205	104702.460	51.285	25.659	0.233	0.466	0.108	0.292	0.684	0.342
100_U_T	100	15461.500	185538.000	76.621	45.165	0.276	0.469	0.136	0.295	0.766	0.452
112.5_U_T	112.5	12193.970	146327.635	51.285	32.537	0.326	0.513	0.172	0.339	0.456	0.289
150_U_T	150	19087.464	229049.571	120.335	47.158	0.217	0.554	0.098	0.382	0.802	0.314
15_R_T	15	733.167	8798.000	11.573	5.740	0.087	0.175	0.031	0.074	0.772	0.383
30_R_T	30	1579.094	18949.125	27.061	10.145	0.080	0.213	0.028	0.096	0.902	0.338
45_R_T	45	3724.314	44691.771	39.395	14.794	0.130	0.345	0.051	0.187	0.875	0.329
50_R_T	50	7837.000	94044.000	79.283	26.340	0.135	0.408	0.053	0.239	1.586	0.527
75_R_T	75	6402.591	76831.091	56.178	26.842	0.156	0.327	0.064	0.173	0.749	0.358
112.5_R_T	112.5	11296.500	135558.000	100.469	41.906	0.154	0.369	0.063	0.206	0.893	0.373
150_R_T	150	25413.000	304956.000	286.035	64.800	0.122	0.537	0.047	0.363	1.907	0.432

Horas del Año: 8760

$$FC = \frac{E}{P_{pico} \cdot 8760}$$

$$FP = 0.7 \cdot FC^2 + 0.3 \cdot FC$$

ANÁLISIS ESTADÍSTICO DE LOS FACTORES DE PÉRDIDAS Y DE CARGA

<i>Factor de Carga con DMD (FC)</i>	
Media	0.151327875
Error típico	0.015680513
Mediana	0.133291866
Moda	#N/A
Desviación estándar	0.087305402
Varianza de la muestra	0.007622233
Curtosis	1.865851345
Coefficiente de asimetría	1.170143079
Rango	0.41895311
Mínimo	0
Máximo	0.41895311
Suma	4.691164124
Cuenta	31
Mayor (1)	0.41895311
Menor(1)	0
Nivel de confianza(95.0%)	0.032023847

<i>Factor de Carga con Carga medida (FC)</i>	
Media	0.409881822
Error típico	0.026212407
Mediana	0.407578452
Moda	#N/A
Desviación estándar	0.145944508
Varianza de la muestra	0.021299799
Curtosis	0.984606055
Coefficiente de asimetría	-0.559954934
Rango	0.701633276
Mínimo	0
Máximo	0.701633276
Suma	12.70633649
Cuenta	31
Mayor (1)	0.701633276
Menor(1)	0
Nivel de confianza(95.0%)	0.053532823

<i>Factor de Pérdidas con DMD (FP)</i>	
Media	0.066591899
Error típico	0.009179999
Mediana	0.052424265
Moda	#N/A
Desviación estándar	0.051112071
Varianza de la muestra	0.002612444
Curtosis	4.468895429
Coefficiente de asimetría	1.880408344
Rango	0.248551129
Mínimo	0
Máximo	0.248551129
Suma	2.064348865
Cuenta	31
Mayor (1)	0.248551129
Menor(1)	0
Nivel de confianza(95.0%)	0.01874804

<i>Factor de Pérdidas con Carga medida (FP)</i>	
Media	0.254995619
Error típico	0.021880353
Mediana	0.238557672
Moda	#N/A
Desviación estándar	0.12182465
Varianza de la muestra	0.014841245
Curtosis	0.23982279
Coefficiente de asimetría	0.281134477
Rango	0.555092461
Mínimo	0
Máximo	0.555092461
Suma	7.904864183
Cuenta	31
Mayor (1)	0.555092461
Menor(1)	0
Nivel de confianza(95.0%)	0.044685596

<i>Factor de Demanda con DMD. (FD)</i>	
Media	0.982208665
Error típico	0.067978255
Mediana	0.902044889
Moda	1.435022222
Desviación estándar	0.378486907
Varianza de la muestra	0.143252339
Curtosis	-0.27450959
Coefficiente de asimetría	0.335743511
Rango	1.554159444
Mínimo	0.352738333
Máximo	1.906897778
Suma	30.44846863
Cuenta	31
Mayor (1)	1.906897778
Menor(1)	0.352738333
Nivel de confianza(95.0%)	0.138829976

<i>Factor de Demanda con Carga medida. (FD)</i>	
Media	0.333214795
Error típico	0.01563864
Mediana	0.342116543
Moda	#N/A
Desviación estándar	0.087072264
Varianza de la muestra	0.007581579
Curtosis	0.783093272
Coefficiente de asimetría	-0.51566143
Rango	0.4248
Mínimo	0.102
Máximo	0.5268
Suma	10.32965864
Cuenta	31
Mayor (1)	0.5268
Menor(1)	0.102
Nivel de confianza(95.0%)	0.031938331

CÁLCULO DEL FACTOR DE CARGA Y FACTOR DE PÉRDIDAS

Tipos Trafos	Energía / mes	Energía / año	Carga DMD (kVA)	Factor de Carga (FC)	Factor de Pérdidas (FP)
37.5_U_M	2993.500	35922.000	20.143	0.204	0.090
10_U_B	0.000	0.000	4.118	0.000	0.000
15_U_B	1544.900	18538.800	21.525	0.098	0.036
25_U_B	2779.667	33356.000	37.009	0.103	0.038
37.5_U_B	5425.640	65107.680	45.067	0.165	0.069
50_U_B	8068.258	96819.100	42.723	0.259	0.124
75_U_B	8277.962	99335.538	47.340	0.240	0.112
10_R_M	526.250	6315.000	11.573	0.062	0.021
10_R_B	953.804	11445.652	11.573	0.113	0.043
15_R_B	886.744	10640.929	20.143	0.060	0.021
25_R_B	3251.677	39020.123	32.126	0.139	0.055
30_R_B	2983.000	35796.000	35.785	0.114	0.043
37.5_R_B	3361.432	40337.179	34.546	0.133	0.052
50_R_B	6494.661	77935.930	60.857	0.146	0.059
75_R_B	5766.711	69200.533	60.857	0.130	0.051
100_R_B	2010.000	24120.000	45.067	0.061	0.021
15_U_T	1430.000	17160.000	21.525	0.091	0.033
20_U_T	2157.600	25891.200	7.055	0.419	0.249
30_U_T	1509.500	18114.000	29.620	0.070	0.024
45_U_T	6620.063	79440.750	53.735	0.169	0.071
75_U_T	8725.205	104702.460	51.285	0.233	0.108
100_U_T	15461.500	185538.000	76.621	0.276	0.136
112.5_U_T	12193.970	146327.635	51.285	0.326	0.172
150_U_T	19087.464	229049.571	120.335	0.217	0.098
15_R_T	733.167	8798.000	11.573	0.087	0.031
30_R_T	1579.094	18949.125	27.061	0.080	0.028
45_R_T	3724.314	44691.771	39.395	0.130	0.051
50_R_T	7837.000	94044.000	79.283	0.135	0.053
75_R_T	6402.591	76831.091	56.178	0.156	0.064
112.5_R_T	11296.500	135558.000	100.469	0.154	0.063
150_R_T	25413.000	304956.000	286.035	0.122	0.047

Horas del Año: 8760

$$FC = \frac{E}{P_{pico} \cdot 8760}$$

$$FP = 0.7 \cdot FC^2 + 0.3 \cdot FC$$

CÁLCULO DE PÉRDIDAS DE ENERGÍA

Trafo Típico	Pérdidas en la Red (kW)	Pérdidas del Trafo		Factor de Pérdidas (FP)	PE Pérdidas de Energía (kWH)
		Po Pérdidas en vacío (kW) *	Pcu Pérdidas en el Cu (kW)		
37.5 U M	0.38184	0.135	0.11686	0.090	1576.132
10 U B	0.00266	0.050	0.02374	0.000	438.000
15 U B	0.82268	0.070	0.40156	0.036	1002.080
25 U B	0.59072	0.100	0.63554	0.038	1287.160
37.5 U B	0.66628	0.135	0.58493	0.069	1933.563
50 U B	0.69380	0.160	0.37235	0.124	2563.973
75 U B	0.83492	0.210	0.28287	0.112	2936.540
10 R M	0.25826	0.050	0.18750	0.021	521.579
10 R B	0.13598	0.050	0.18750	0.043	559.262
15 R B	0.35031	0.070	0.35166	0.021	740.099
25 R B	1.03698	0.100	0.47888	0.055	1607.050
30 R B	2.02944	0.111	0.47665	0.043	1924.809
37.5 R B	0.54474	0.135	0.34371	0.052	1590.607
50 R B	1.04136	0.160	0.75552	0.059	2327.441
75 R B	0.81699	0.210	0.46747	0.051	2410.484
100 R B	3.25692	0.260	0.18279	0.021	2908.619
15 U T	0.26370	0.080	0.63838	0.033	962.353
20 U T	0.02093	0.100	0.04728	0.249	1024.517
30 U T	0.69564	0.135	0.50203	0.024	1438.123
45 U T	2.46106	0.180	1.01241	0.071	3723.947
75 U T	1.38260	0.265	0.50967	0.108	4110.603
100 U T	1.36404	0.330	0.81721	0.136	5497.423
112.5 U T	0.86860	0.365	0.32004	0.172	4988.067
150 U T	2.82237	0.450	1.26141	0.098	7456.275
15 R T	0.06954	0.080	0.18452	0.031	770.478
30 R T	0.78010	0.135	0.41905	0.028	1481.487
45 R T	0.92538	0.180	0.54415	0.051	2228.059
50 R T	5.22318	0.197	1.94861	0.053	5084.167
75 R T	2.70774	0.265	0.61156	0.064	4179.381
112.5 R T	8.56370	0.365	1.22823	0.063	8585.399
150 R T	45383.4344	0.450	7.12707	0.047	18644733.1

$$PE = (PR + Pcu) * FP * 8760 + (Po * 8760)$$

Horas del Año: 8760

* Valores tomados de las Normas ICONTEC 818 y 819: Transformadores monofásicos y trifásicos autorefrigerados y sumergidos en aceite. Pérdidas, corriente sin carga y tensión de corto circuito.

Resumen para Carga medida con Totales (Logaritmo Natural)

Estadísticas de la regresión	
Coefficiente de correlación múltiple	0.875960731
Coefficiente de determinación R^2	0.767307202
R^2 ajustado	0.740458033
Error típico	0.482496782
Observaciones	30

ANÁLISIS DE VARIANZA

	Grados de libertad	Suma de cuadrados	Promedio de los cuadrados	F	Valor crítico de F
Regresión	3	19.95944781	6.653149268	28.57843388	2.17239E-08
Residuos	26	6.052881754	0.232803144		
Total	29	26.01232956			

	Coefficientes	Error típico	Estadístico t	Probabilidad	Inferior 95%	Superior 95%	Inferior 95.0%	Superior 95.0%
Intercepción	5.981785024	0.847134211	7.061201103	1.69078E-07	4.240474574	7.723095474	4.240474574	7.723095474
Carga Medida (kVA)	0.567577662	0.14720845	3.855605168	0.000680538	0.264986161	0.870169164	0.264986161	0.870169164
Usuarios equiv. Totales	0.90852534	0.351225528	2.586729227	0.015638981	0.186570453	1.630480226	0.186570453	1.630480226
Longitud Total	-0.184546944	0.215731467	-0.855447498	0.400118281	-0.627989616	0.258895728	-0.627989616	0.258895728

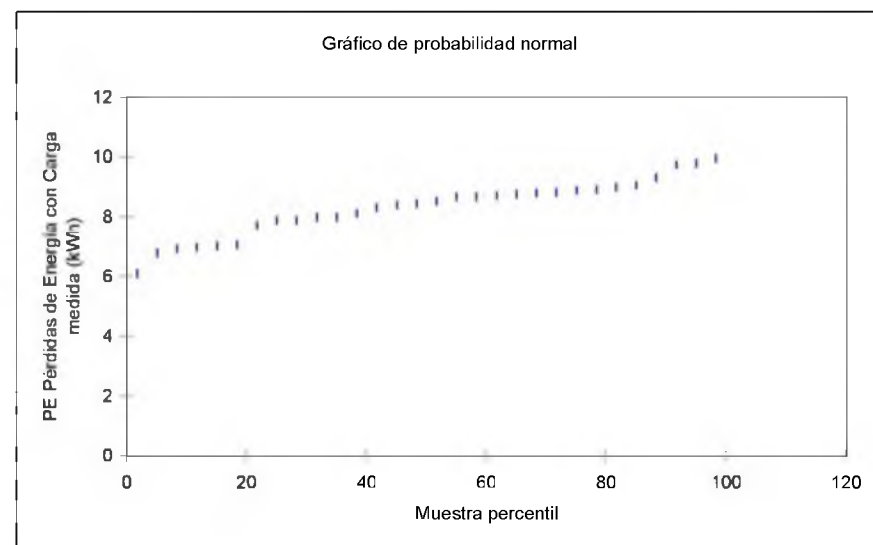
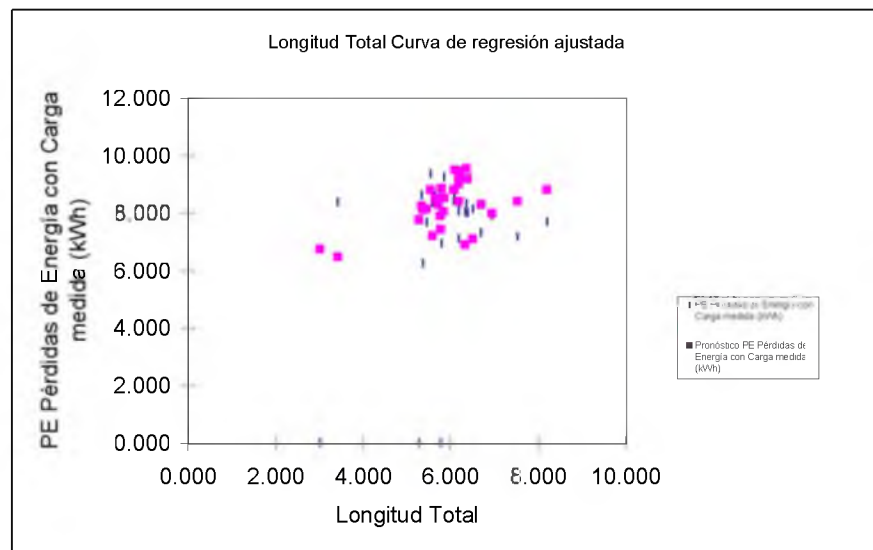
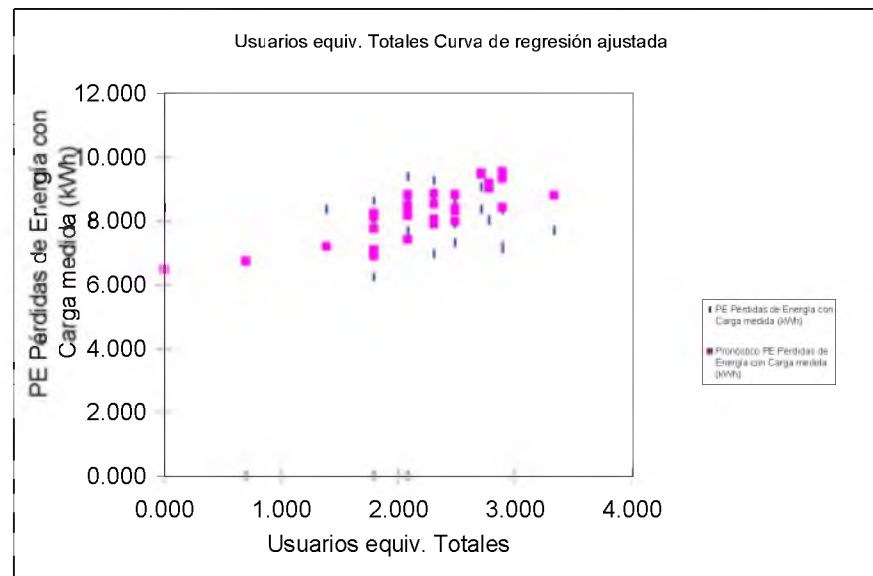
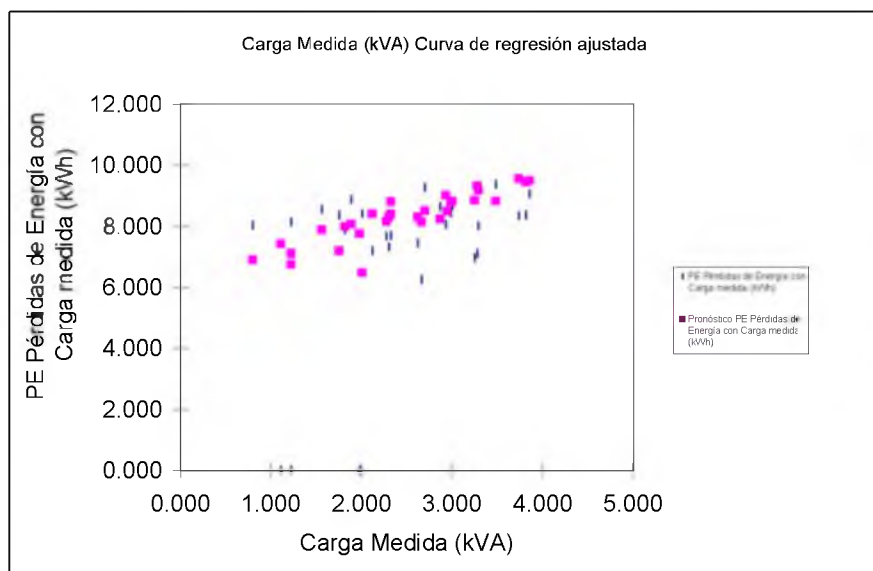
El Coeficiente de Intercepción es: 396.1468691

Análisis de los residuales

Observación	Pronóstico PE Pérdidas de Energía con Carga medida (kWh)	Residuos
1	7.759833495	0.219838098
2	6.750751606	-0.668532696
3	7.434255261	1.355436514
4	8.15764555	-0.057199645
5	8.130758891	0.383407588
6	8.252268154	0.410658902
7	8.503323449	0.202522878
8	6.893967041	0.120980379
9	7.10302431	-0.135409978
10	7.989238618	-0.942769547
11	8.30940432	0.107742376
12	8.420067344	0.563345105
13	8.303212488	-0.443834295
14	8.815803161	-0.157448926
15	8.822981396	-0.436137611
16	8.815500966	-0.074403116
17	7.898341664	-0.027866312
18	6.488179043	0.434483237
19	8.06894375	-0.096615599
20	9.025966963	0.278849129
21	8.850939753	0.024718315
22	9.464267976	-0.414047548
23	8.827085213	-0.013914647
24	9.505570897	0.269561685
25	7.205466433	-0.442367948
26	8.415104971	-0.723982466
27	8.526110142	-0.236982447
28	9.325775077	0.398171837
29	9.190639315	-0.288900086
30	9.556199129	0.390696822

Resultados de datos de probabilidad

Percentil	PE Pérdidas de Energía con Carga medida (kWh)
1.666666667	6.08221891
5	6.763098484
8.333333333	6.922662281
11.666666667	6.967614331
15	7.014947421
18.333333333	7.046469071
21.666666667	7.691122505
25	7.859378193
28.333333333	7.870475352
31.666666667	7.972328151
35	7.979671593
38.333333333	8.100445905
41.666666667	8.289127696
45	8.386843784
48.333333333	8.417146696
51.666666667	8.514166479
55	8.658354235
58.333333333	8.662927056
61.666666667	8.705846327
65	8.741097851
68.333333333	8.789691775
71.666666667	8.813170566
75	8.875658068
78.333333333	8.901739229
81.666666667	8.983412449
85	9.050220428
88.333333333	9.304816092
91.666666667	9.723946915
95	9.775132582
98.333333333	9.946895951



Resumen para Carga Medida con Totales (Lineal)

Estadísticas de la regresión	
Coefficiente de correlación múltiple	0.864385288
Coefficiente de determinación R^2	0.747161926
R^2 ajustado	0.717988302
Error típico	2676.765445
Observaciones	30

ANÁLISIS DE VARIANZA

	Grados de libertad	Suma de cuadrados	Promedio de los cuadrados	F	Valor crítico de F
Regresión	3	550511305.7	183503768.6	25.61087127	6.31629E-08
Residuos	26	186291904.4	7165073.247		
Total	29	736803210.1			

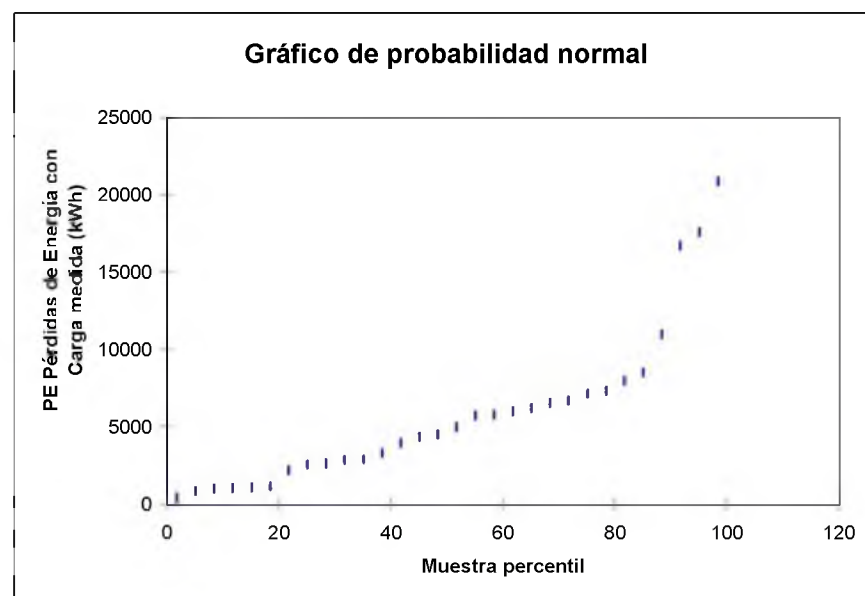
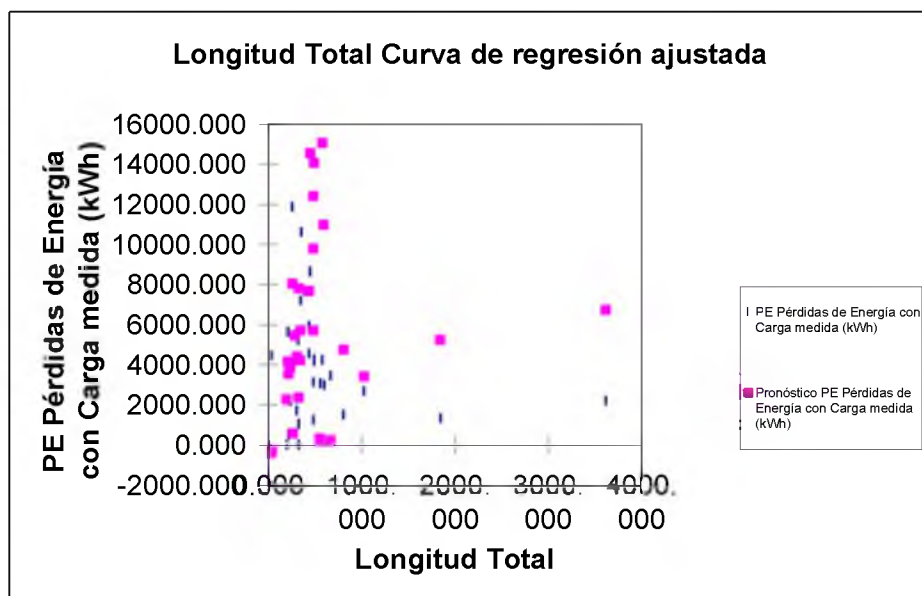
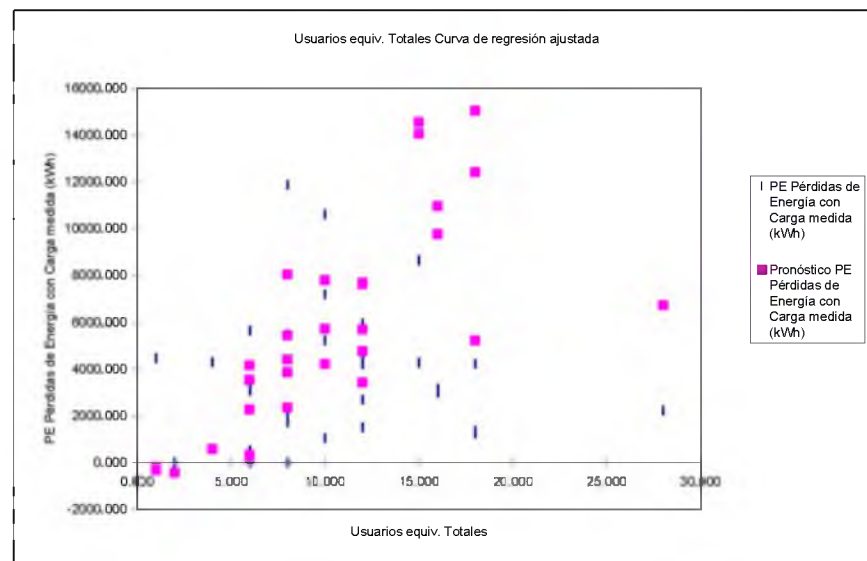
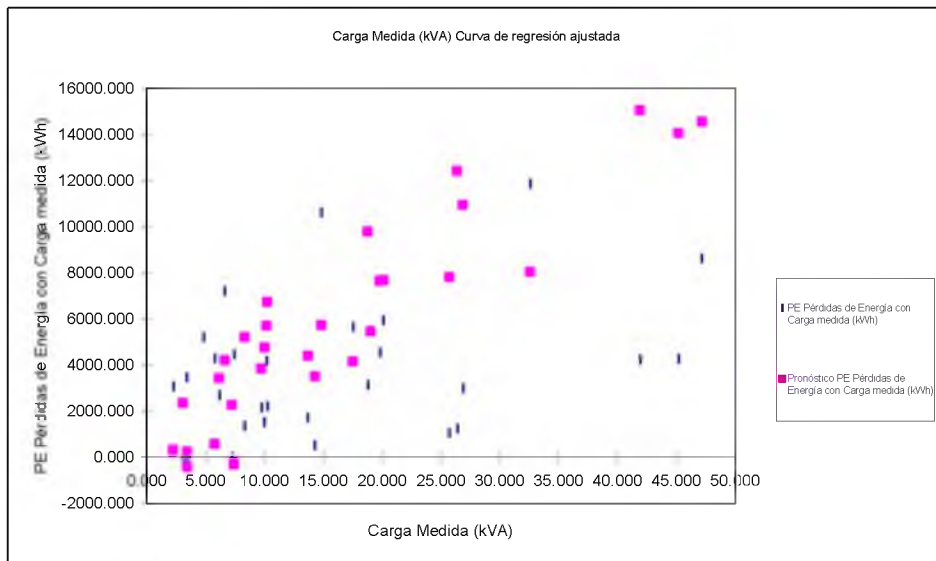
	Coefficientes	Error típico	Estadístico t	Probabilidad	Inferior 95%	Superior 95%	Inferior 95.0%	Superior 95.0%
Intercepción	-2230.807059	1152.523087	-1.935585574	0.063863866	-4599.853745	138.239626	-4599.853745	138.239626
Carga Medida (kVA)	186.4402666	58.1998045	3.203451767	0.003572049	66.80877669	306.0717564	66.80877669	306.0717564
Usuarios equiv. Totales	616.7464375	194.7214944	3.167325925	0.003906184	216.4904111	1017.002464	216.4904111	1017.002464
Longitud Total	-2.822591839	1.4975416	-1.884816982	0.070679398	-5.9008347	0.255651022	-5.9008347	0.255651022

Análisis de los residuales

Observación	Pronóstico PE Pérdidas de Energía con Carga medida (kWh)	Residuos
1	2270.103852	650.8677876
2	-422.6657189	860.6657189
3	2367.93069	4198.277305
4	3864.377882	-568.440461
5	3533.661127	1451.228191
6	4153.957332	1630.483961
7	5458.824766	579.2852305
8	328.3468422	784.8012739
9	232.1980283	829.4888656
10	3432.3429	-2283.547641
11	4763.756312	-239.779572
12	5222.986364	2746.795877
13	4407.314592	-1817.40514
14	7653.650138	-1895.599677
15	7700.621929	-3311.67857
16	6744.582189	-489.8234545
18	-323.7414112	1338.760076
19	4213.73833	-1314.13811
20	9785.297685	1205.52709
21	7817.250391	-661.5965668
22	14077.65228	-5557.236427
23	8058.016104	-1335.817414
24	14567.86433	3022.957922
25	566.826759	298.4924653
26	5706.762613	-3517.932456
27	5729.453634	-1749.09304
28	12432.26654	4280.813281
29	10976.29854	-3631.561921
30	15069.15814	5818.128356

Resultados de datos de probabilidad

Percentil	PE Pérdidas de Energía con Carga medida (kWh)
1.666666667	438
5	865.3192242
8.333333333	1015.018665
11.66666667	1061.686894
15	1113.148116
18.33333333	1148.795258
21.66666667	2188.830157
25	2589.909452
28.33333333	2618.810149
31.66666667	2899.60022
35	2920.971639
38.33333333	3295.937421
41.66666667	3980.360595
45	4388.943359
48.33333333	4523.97674
51.66666667	4984.889318
55	5758.050461
58.33333333	5784.441293
61.66666667	6038.109996
65	6254.758735
68.33333333	6566.207995
71.66666667	6722.19869
75	7155.653824
78.33333333	7344.736617
81.66666667	7969.782242
85	8520.415858
88.33333333	10990.82477
91.66666667	16713.07982
95	17590.82225
98.33333333	20887.2865



Resumen para Carga medida con Totales sin Longitud (Logaritmo Natural)

Estadísticas de la regresión	
Coefficiente de correlación múltiple	0.872214354
Coefficiente de determinación R^2	0.76075788
R^2 ajustado	0.743036242
Error típico	0.480094314
Observaciones	30

ANÁLISIS DE VARIANZA

	Grados de libertad	Suma de cuadrados	Promedio de los cuadrados	F	Valor crítico de F
Regresión	2	19.78908469	9.894542347	42.92819087	4.11442E-09
Residuos	27	6.223244865	0.230490551		
Total	29	26.01232956			

	Coefficientes	Error típico	Estadístico t	Probabilidad	Inferior 95%	Superior 95%	Inferior 95.0%	Superior 95.0%
Intercepción	5.317387886	0.33658483	15.79806163	3.64581E-15	4.626773323	6.008002448	4.626773323	6.008002448
Carga Medida (kVA)	0.637421311	0.121882124	5.229817884	1.64324E-05	0.387340017	0.887502605	0.387340017	0.887502605
Usuarios equiv. Totales	0.637838224	0.151664822	4.205577916	0.000256397	0.326647924	0.949028525	0.326647924	0.949028525

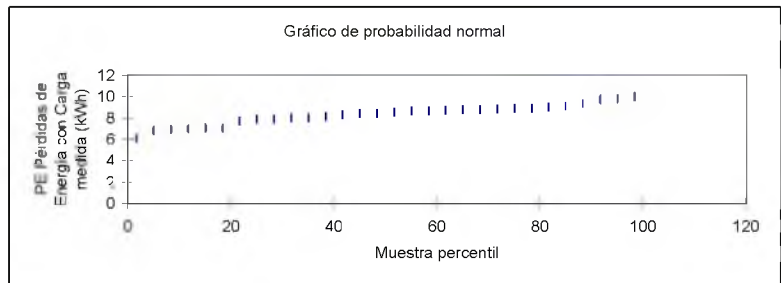
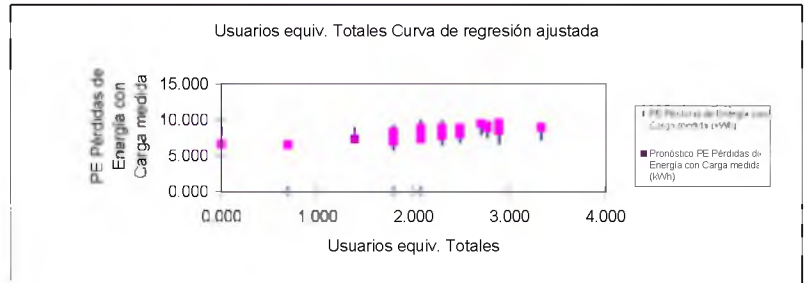
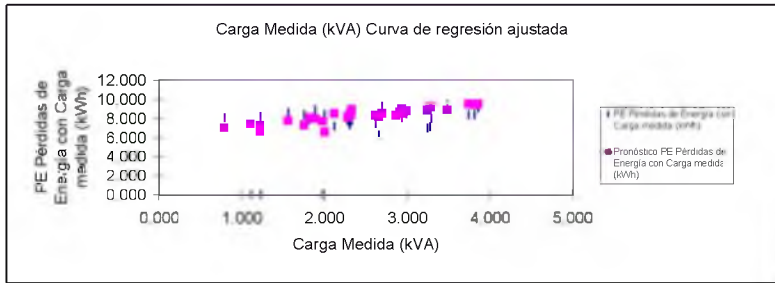
El coeficiente de Intercepción es: 203.8507046

Análisis de los residuales

Observación	Pronóstico PE Pérdidas de Energía con Carga medida (kWh)	Residuos
1	7.71856188	0.261109713
2	6.536745818	-0.454526908
3	7.347457453	1.442234322
4	8.092719702	0.007726203
5	8.153704449	0.36046203
6	8.284158261	0.378768795
7	8.520218996	0.185627332
8	6.964267129	0.050680291
9	7.237464506	-0.269850175
10	8.057208598	-1.010739527
11	8.366679241	0.050467455
12	8.508129369	0.47528308
13	8.309881847	-0.450503654
14	8.804527104	-0.146172869
15	8.814043099	-0.427199315
16	8.923134719	-0.182036868
17	7.779355104	0.091120248
18	6.591016795	0.331645485
19	7.986310101	-0.01398195
20	8.953519316	0.351296776
21	8.854423067	0.021235001
22	9.473466549	-0.423246121
23	8.863470545	-0.050299979
24	9.50097537	0.274135045
25	7.31548716	-0.552388676
26	8.379256121	-0.688133615
27	8.503401762	-0.214274066
28	9.246039121	0.477907794
29	9.182954473	-0.281215244
30	9.542026556	0.404869396

Resultados de datos de probabilidad

Percentil	PE Pérdidas de Energía con Carga medida (kWh)
1.666666667	6.08221891
5	6.763098484
8.333333333	6.922662281
11.66666667	6.967614331
15	7.014947421
18.33333333	7.046469071
21.66666667	7.691122505
25	7.859378193
28.33333333	7.870475352
31.66666667	7.972328151
35	7.979671593
38.33333333	8.100445905
41.66666667	8.289127696
45	8.386843784
48.33333333	8.417146696
51.66666667	8.514166479
55	8.658354235
58.33333333	8.662927056
61.66666667	8.705846327
65	8.741097851
68.33333333	8.789691775
71.66666667	8.813170566
75	8.875658068
78.33333333	8.901739229
81.66666667	8.983412449
85	9.050220428
88.33333333	9.304816092
91.66666667	9.723946915
95	9.775132582
98.33333333	9.946895951



6.2 Pérdidas Técnicas Eficientes

CALCULO DE PERDIDAS EN ACOMETIDAS

Trafo Típico	Capacidad del Trafo (kVA)	Ramales por trafo	Carga Promedio (kVA)	kVA por estructura (usuario eq.)	kW por estructura (usuario eq.)	kVAR por estructura (usuario eq.)	Regulación (%)	Pérdidas Totales (kW)	RESISTENCIA OHMIOS/METRO	PÉRDIDAS I²R (W)
37.5 U M	37.5	3	7.200	1.200	1.14000	0.37470	0.80580	0.196400	3.500	18.1364
10 U B	10	1	3.385	1.693	1.60788	0.52848	0.07039	0.067832	3.500	25.5798
15 U B	15	2	3.016	0.377	0.35818	0.11773	0.65586	0.092645	3.500	5.6983
25 U B	25	2	9.710	1.214	1.15311	0.37901	0.58937	0.182751	3.500	18.3449
37.5 U B	37.5	2	14.250	2.375	2.25622	0.74158	0.63493	0.257800	3.500	35.8943
50 U B	50	2	17.486	2.914	2.76862	0.91000	0.90164	0.334935	3.500	44.0462
75 U B	75	2	18.989	2.374	2.25496	0.74117	0.98980	0.384594	3.500	35.8744
10 R M	10	2	2.205	0.368	0.34913	0.11475	0.67731	0.065447	3.500	5.5543
10 R B	10	2	3.385	0.564	0.53594	0.17616	0.48459	0.077561	3.500	8.5264
15 R B	15	3	6.121	0.510	0.48459	0.15928	0.75067	0.133193	3.500	7.7095
25 R B	25	3	9.947	0.829	0.78746	0.25883	1.29438	0.239179	3.500	12.5278
30 R B	30	3	8.277	0.460	0.43682	0.14358	1.72686	0.231958	3.500	6.9495
37.5 R B	37.5	2	13.652	1.707	1.62118	0.53285	0.87776	0.270897	3.500	25.7914
50 R B	50	3	19.770	1.648	1.56513	0.51443	0.78051	0.345784	3.500	24.8997
75 R B	75	3	20.067	1.672	1.58867	0.52217	0.62781	0.347020	3.500	25.2742
100 R B	100	4	10.200	0.364	0.34607	0.11375	2.11262	0.412044	3.500	5.5057
15 U T	15	2	4.751	0.475	0.45132	0.14834	0.40414	0.123555	3.500	7.5943
20 U T	20	1	7.375	7.375	7.00625	2.30284	0.34707	0.174591	3.500	117.8936
30 U T	30	2	6.573	0.657	0.62444	0.20524	0.76986	0.191742	3.500	10.5073
45 U T	45	2	18.728	1.171	1.11199	0.36550	2.23778	0.575459	3.500	18.7115
75 U T	75	2	25.659	2.566	2.43758	0.80119	1.98169	0.723758	3.500	41.0170
100 U T	100	3	45.165	3.011	2.86045	0.94018	1.57310	1.076731	3.500	48.1326
112.5 U T	112.5	2	32.537	4.067	3.86373	1.26995	1.57392	0.835234	3.500	65.0147
150 U T	150	3	47.158	3.144	2.98670	0.98168	1.46306	1.055748	3.500	50.2570
15 R T	15	2	5.740	1.435	1.36325	0.44808	0.39679	0.142234	3.500	22.9393
30 R T	30	2	10.145	0.845	0.80315	0.26398	1.54689	0.296615	3.500	13.5146
45 R T	45	2	14.794	1.479	1.40539	0.46193	1.25895	0.381873	3.500	23.6484
50 R T	50	2	26.340	1.463	1.39017	0.45693	2.92133	0.918577	3.500	23.3922
75 R T	75	2	26.842	1.678	1.59376	0.52384	3.29739	0.969399	3.500	26.8181
112.5 R T	112.5	2	41.906	2.328	2.21173	0.72696	4.65940	1.854907	3.500	37.2166
150 R T	150	2	64.800	2.025	1.92375	0.63231	11.11331	5.867923	3.500	32.3708

* Valores tomados de las Normas ICONTEC 818 y 819: Transformadores monofásicos y trifásicos autorefrigerados y sumergidos en aceite. Pérdidas, corriente sin carga y tensión de corto circuito.

Los valores para los transformadores bifásicos son los reportados en la norma para transformadores monofásicos.

Factor de potencia = 0.95

Transformador - Urbano Básico																								
Capacidad kVA	Pérdidas (kW)		Rango de Carga kVA Final		Porcentaje de Carga kVA		Costo Total		Caso Anual		Costo Medio		Costo Inv		Costo Mantenm		Costo Pérdidas		Pérdidas [kWh]		% de Pérdidas			
	Pc(Cobre)	Po(Hierro)					Miles de \$		[\$/kW]		[\$/kWh]		Miles \$	Miles \$	Miles \$	Miles \$	Miles \$	Miles \$	Inicial	Final	Inicial	Final		
10	0.140	0.050	2.79	4.64	28%	46%	1,941	2,032	318	333	50,771	31,891	12.88	8.09	1,608.59	1,608.59	187.33	187.33	195	210	460.98	501.84	1.17%	1.27%
15	0.195	0.070	4.64	6.97	31%	46%	2,032	2,267	333	372	31,891	23,718	8.09	6.02	1,712.66	1,712.66	187.33	187.33	264	294	619.52	702.12	1.05%	1.19%
25	0.290	0.100	6.97	11.61	28%	46%	2,267	2,741	372	450	23,718	17,211	6.02	4.37	1,978.51	1,978.51	187.33	187.33	377	422	883.62	1,008.25	0.90%	1.02%
37.5	0.405	0.135	11.61	17.65	31%	47%	2,741	3,474	450	570	17,211	14,348	4.37	3.64	2,451.94	2,451.94	187.33	187.33	510	573	1,195.73	1,372.25	0.81%	0.93%
50	0.510	0.160	17.65	23.68	35%	47%	3,474	4,053	570	665	14,348	12,475	3.64	3.16	2,821.31	2,821.31	187.33	187.33	607	685	1,423.09	1,643.57	0.72%	0.83%
75	0.710	0.210	23.68	35.76	32%	48%	4,053	5,141	665	843	12,475	10,480	3.16	2.66	3,500.86	3,500.86	187.33	187.33	795	908	1,863.55	2,180.87	0.63%	0.74%
100	0.900	0.260	35.76	48.00	36%	48%	5,141	5,607	843	920	10,480	8,516	2.66	2.16	3,570.29	3,570.29	187.33	187.33	988	1,130	2,316.53	2,716.08	0.59%	0.69%

Sistema Típico Básico urbano

Transformador	Calibre Cond.	No.de Usuarios	No. de Vanos	ong. Vano	Inng. Ramal	No. Ramales	Carga [kVA]
15 U_B	4	5	4	51	204	2	3.02
25 U_B	1/0 (A-Tr)	13	4	34	136	2	9.71
37.5 U_B	1/0 (A-Tr)	13	4	34	136	2	14.25
50 U_B	1/0 (A-Tr)	13	4	34	136	2	17.49
75 U_B	1/0 (A-Tr)	13	4	34	136	2	18.99

% Carga	% Costo Rc	% Costo Tr	% Manten	FC	Fp	Fpot	Lavado Aren	Costo Lavado	
0.40	1.00	1.00	2.00		0.45	0.24	0.90	0.00	0

Red de Baja Tensión - Urbano Básico: 4 Usuarios Equivalentes a 51 m cada carga																				
Conductor	Rango de Carga kVA		Costo Total [miles \$]		Costo Anual [miles\$]		Costo Medio [\$/kW]		Costo Medio [\$/kWh]		VP Costo Inv. miles \$	VP Costo Mantenm miles \$	VP Costo Pérdidas miles \$	Pérdidas [kWh]		% de Pérdidas				
			Inicial	Final	Inicial	Final	Inicial	Final	Inicial	Final				Inicial	Final	Inicial	Final	Inicial	Final	
8	1.00	2.91	1,474.21	1,649.26	241.79	270.50	268.654	103,223	51.11	19.64	1,375.25	1,375.25	72.52	72.52	20.93	177.45	58.74	497.98	1.12%	3.25%
6	2.91	2.91	1,649.26	1,649.26	270.50	270.50	103,223	103,223	19.64	19.64	1,375.25	1,463.96	72.52	72.52	177.45	112.79	316.51	316.51	2.07%	2.07%
4	2.91	11.49	1,649.26	2,691.03	270.50	441.36	103,223	42,667	19.64	8.12	1,463.96	1,501.52	72.52	72.52	112.79	1,116.99	201.17	3134.56	1.31%	5.19%
2	11.49	12.92	2,691.03	2,859.04	441.36	468.92	42,667	40,315	8.12	7.67	1,501.52	1,887.57	72.52	72.52	1,116.99	898.96	1995.21	2522.70	3.30%	3.71%
1	12.92	19.00	2,859.04	3,711.05	468.92	608.66	40,315	35,589	7.67	6.77	1,887.57	2,047.27	72.52	72.52	898.96	1,591.27	2065.50	4465.50	3.04%	4.47%
1/0	19.00	21.51	3,711.05	4,046.17	608.66	663.62	35,589	34,287	6.77	6.52	2,047.27	2,390.43	72.52	72.52	1,591.27	1,583.22	3468.88	4442.91	3.47%	3.93%
1/0-Al-A	19.00	21.51	4,429.48	4,776.57	726.49	783.42	42,479	40,476	8.08	7.70	3,189.71	3,189.71	3.64	3.64	1,236.13	1,583.22	3,468.88	4,442.91	3.47%	3.93%
1/0-Al-A-Tr	19.00	21.51	3,991.52	4,338.62	654.66	711.59	38,279	36,765	7.28	6.99	2,751.76	2,751.76	3.64	3.64	1,236.13	1,583.22	3,468.88	4,442.91	3.47%	3.93%
2/0	21.51	33.66	4,046.17	5,890.61	663.62	966.13	34,287	31,889	6.52	6.07	2,390.43	2,698.99	72.52	72.52	1,583.22	3,119.11	3,572.32	8,753.01	3.16%	4.95%
4/0	33.66	46.54	5,890.61	7,683.15	966.13	1,260.13	31,889	30,087	6.07	5.72	2,698.99	3,803.08	72.52	72.52	3,119.11	3,807.55	5,591.21	10,684.94	3.16%	4.37%

Red de Baja Tensión - Urbano Básico: 4 Usuarios Equivalentes a 34 m cada carga																				
Conductor	Rango de Carga kVA	Costo Total [miles \$]		Costo Anual [miles\$]		Costo Medio [\$/kW]		Costo Medio [\$/kWh]		VP Costo Inv. miles \$	VP Costo Mantenm miles \$	VP Costo Pérdidas miles \$	Pérdidas [kWh]		% de Pérdidas					
		Inicial	Final	Inicial	Final	Inicial	Final	Inicial	Final				Inicial	Final	Inicial	Final	Inicial	Final		
8	1.00	2.91	1,267.82	1,384.53	207.94	227.08	231.043	86,654	43.96	16.49	1,201.85	1,201.85	48.34	48.34	13.95	118.30	39.16	331.98	0.75%	2.17%
6	2.91	2.91	1,384.53	1,384.53	227.08	227.08	86,654	86,654	16.49	16.49	1,201.85	1,260.99	48.34	48.34	118.30	75.19	211.01	211.01	1.38%	1.38%
4	2.91	11.49	1,384.53	2,079.03	227.08	340.99	86,654	32,964	16.49	6.27	1,260.99	1,286.03	48.34	48.34	75.19	744.66	134.11	2089.71	0.88%	3.46%
2	11.49	12.92	2,079.03	2,191.05	340.99	359.36	32,964	30,895	6.27	5.88	1,286.03	1,543.40	48.34	48.34	744.66	599.30	1330.14	1681.80	2.20%	2.48%
1	12.92	19.00	2,191.05	2,759.05	359.36	452.52	30,895	26,459	5.88	5.03	1,543.40	1,649.86	48.34	48.34	599.30	1,060.84	1377.00	2977.00	2.03%	2.98%
1/0	19.00	21.51	2,759.05	2,982.47	452.52	489.16	26,459	25,273	5.03	4.81	1,649.86	1,878.64	48.34	48.34	1,060.84	1,055.48	2312.59	2961.94	2.32%	2.62%
1/0-Al-A	19.00	21.51	3,238.00	3,469.40	531.07	569.03	31,052	29,399	5.91	5.59	2,411.49	2,411.49	2.43	2.43	824.08	1,055.48	2,312.59	2,961.94	2.32%	2.62%
1/0-Al-A-Tr	19.00	21.51	2,946.03	3,177.43	483.19	521.14	28,252	26,925	5.38	5.12	2,119.52	2,119.52	2.43	2.43	824.08	1,055.48	2,312.59	2,961.94	2.32%	2.62%
2/0	21.51	33.66	2,982.47	4,212.09	489.16	690.84	25,273	22,802	4.81	4.34	1,878.64	2,084.34	48.34	48.34	1,055.48	2,079.41	2381.55	5835.34	2.11%	3.30%
4/0	33.66	46.54	4,212.09	5,407.12	690.84	886.84	22,802	21,174	4.34	4.03	2,084.34	2,820.41	48.34	48.34	2,079.41	2,538.36	3727.48	7123.29	2.11%	2.91%

Sistema Eficiente Bifásico Urbano

Transformador	No Ram	kVA/Ramal		Calibre Cond		CA Red [k\$]		CA Trafo [k\$]		Costo Total [k\$]		CM [\$kW]		CM [\$kWh]		VP Costo Inv [k\$]		VP Costo Mantenn [k\$]		VP Costo Pérdidas [k\$]		Pérdidas [kWh]		% de Pérdidas	
15	2	2.32	3.48	8	4	503	760	422	427	925	1,187	221,225	189,300	56.12	48.02	4,463.17	4,715.70	664.72	664.72	289	1,633	690	4,459	4.19%	18.04%
25	2	3.48	5.80	4	4	460	600	490	498	950	1,098	151,509	105,049	38.43	26.65	4,500.49	4,550.57	568.03	568.03	467	1,314	1,044	3,513	4.23%	8.53%
37.5	2	5.80	8.82	4	4	460	600	598	610	1,059	1,210	101,316	76,169	25.70	19.32	4,973.92	5,024.00	568.03	568.03	600	1,466	1,356	3,877	3.29%	6.19%
50	2	8.82	11.84	4	2	460	656	682	696	1,142	1,352	71,917	63,426	18.24	16.09	5,343.29	5,908.10	568.03	568.03	697	1,404	1,584	3,659	2.53%	4.35%
75	2	11.84	17.88	2	1	600	781	838	858	1,438	1,639	67,446	50,942	17.11	12.92	6,072.92	6,800.59	568.03	568.03	1,688	2,180	3,458	5,749	4.12%	4.53%

Sistema Eficiente Bifásico Urbano

Transformador	No Ram	kVA/Ramal		Calibre Cond		CA Red [k\$]		CA Trafo [k\$]		Anual Total [k\$]		CM [\$kW]		CM [\$kWh]		VP Costo Inv [k\$]		VP Costo Mantenn [k\$]		VP Costo Pérdidas [k\$]		Pérdidas [kWh]		% de Pérdidas	
15	3	1.55	2.32	8	8	754	800	422	427	1,176	1,227	281,376	195,788	71.38	49.67	5,838.42	5,838.42	809.75	809.75	302	613	725	1,597	4.40%	6.46%
25	3	2.32	3.87	8	4	643	900	490	498	1,133	1,398	180,686	133,759	45.84	33.93	5,584.07	5,836.60	664.72	664.72	402	639	895	4,765	3.62%	11.57%
37.5	3	3.87	5.88	4	4	690	900	598	610	1,289	1,510	123,335	95,057	31.29	24.11	6,234.91	6,310.03	664.72	664.72	645	790	1,235	5,129	3.00%	8.19%
50	3	5.88	7.89	4	4	690	900	682	696	1,372	1,596	86,403	74,879	21.92	19.00	6,604.28	6,679.39	664.72	664.72	742	903	1,462	5,401	2.34%	6.43%
75	3	7.89	11.92	4	2	690	984	838	858	1,528	1,842	71,680	57,227	18.18	14.52	7,283.83	8,131.05	664.72	664.72	930	1,083	1,903	5,204	2.26%	4.10%

Transformador - Urbano Trifásico																								
Capacidad kVA	Pérdidas (kW)		Rango de Carga kVA Final	Porcentaje de Carga kVA	Costo Total		Costo Anual		Costo Medio		Costo Inv		Costo Mantenim		Costo Pérdidas		Pérdidas [kWh]		% de Pérdidas					
	Pc(Cobre)	Po(Hierro)				[Miles de \$]		[\$/kW]	[\$/kWh]	Miles \$	Miles \$	Miles \$	Inicial	Final	Inicial	Final								
15	0.310	0.080	2.79	6.97	19%	46%	3,502	3,767	574	618	91,626	39,418	23.24	10.00	2,666.92	2,666.92	280.99	280.99	308	350	723.42	842.17	1.22%	1.42%
30	0.515	0.135	6.97	14.40	23%	48%	3,767	4,970	618	815	39,418	25,165	10.00	6.38	3,294.46	3,294.46	280.99	280.99	509	595	1,191.99	1,433.37	1.01%	1.21%
45	0.710	0.180	14.40	21.36	32%	47%	4,970	5,998	815	984	25,165	20,467	6.38	5.19	3,849.44	3,849.44	280.99	280.99	683	795	1,601.38	1,915.12	0.90%	1.08%
75	1.090	0.265	21.36	35.76	28%	48%	5,998	7,749	984	1,271	20,467	15,796	5.19	4.01	4,694.05	4,694.05	280.99	280.99	1,003	1,179	2,351.32	2,845.32	0.80%	0.96%
112.5	1.540	0.365	35.76	53.87	32%	48%	7,749	10,067	1,271	1,651	15,796	13,623	4.01	3.46	5,902.57	5,902.57	280.99	280.99	1,386	1,633	3,250.04	3,944.05	0.73%	0.89%
150	1.960	0.450	53.87	71.98	36%	48%	10,067	11,985	1,651	1,966	13,623	12,138	3.46	3.08	6,848.93	6,848.93	280.99	280.99	1,716	2,025	4,027.53	4,896.38	0.68%	0.83%
225	2.890	0.615	71.98	108.00	32%	48%	11,985	13,838	1,966	2,270	12,138	9,340	3.08	2.37	7,496.46	7,496.46	280.99	280.99	2,339	2,805	5,487.47	6,795.40	0.62%	0.77%

Sistema Típico Trifásico urbano

Transformador	Calibre Cond.	No.de Usuarios	No. de Vanos	Long. Vano [m]	Long. Ramal [m]	No. Ramales	Carga [kVA]
15_U_T	1	5	5	32	160	2	4.75
30_U_T	2/0	15	5	36	180	2	6.57
45_U_T	1/0	18	8	29	232	2	18.73
75_U_T	2/0	15	5	36	180	2	27.48
112.5_U_T	2/0	15	5	36	180	2	27.48
150_U_T	4/0 (A - A)	29	5	35	175	3	47.16

% Carga % Costo Re- % Costo Tr % Manten FC Fp Fpot Lavado Aren Costo
 0.40 1.00 1.00 2.00 0.45 0.24 0.9 0.00 0

Red de Baja Tensión Urbano Trifásico: 5 Usuarios Equivalentes a 32 m cada carga																				
Conductor	Rango de Carga kVA	Costo Total [miles \$]		Costo Anual [miles\$]		Costo Medio [\$ /kW]		Costo Medio [\$ /kWh]		VP Costo Inv. miles \$	VP Costo miles \$	VP Costo Pérdidas miles \$	Pérdidas [kWh]		% de Pérdidas					
		Inicial	Final	Inicial	Final	Inicial	Final	Inicial	Final				Inicial	Final	Inicial	Final				
8	1.00	4.77	1,698.89	1,887.01	278.64	309.49	309,599	72,121	58.90	13.72	1,612.82	1,612.82	56.88	56.88	8.62	195.96	24.19	549.92	0.46%	2.19%
6	4.77	4.77	1,887.01	1,887.01	309.49	309.49	72,121	72,121	13.72	13.72	1,612.82	1,705.58	56.88	56.88	195.96	124.55	349.52	349.52	1.39%	1.39%
4	4.77	18.24	1,887.01	2,959.68	309.49	485.43	72,121	29,577	13.72	5.63	1,705.58	1,744.86	56.88	56.88	124.55	1,157.95	222.15	3249.50	0.89%	3.39%
2	18.24	20.58	2,959.68	3,144.00	485.43	515.66	29,577	27,842	5.63	5.30	1,744.86	2,148.57	56.88	56.88	938.56	938.56	2068.38	2633.83	2.16%	2.44%
1	20.58	29.95	3,144.00	3,999.93	515.66	656.04	27,842	24,341	5.30	4.63	2,148.57	2,315.58	56.88	56.88	938.56	1,627.48	2156.49	4567.12	1.99%	2.90%
1/0	29.95	34.63	3,999.93	4,422.03	656.04	725.27	24,341	23,269	4.63	4.43	2,315.58	2,674.44	56.88	56.88	1,627.48	1,690.71	3547.83	4744.57	2.25%	2.61%
1/0-AI-A	29.95	34.63	4,777.40	5,203.86	783.55	853.50	29,072	27,383	5.53	5.21	3,510.29	3,510.29	2.85	2.85	1,264.26	1,690.71	3,547.83	4,744.57	2.25%	2.61%
1/0-AI-A-Tr	29.95	34.63	4,319.41	4,745.87	708.44	778.38	26,285	24,973	5.00	4.75	3,052.30	3,052.30	2.85	2.85	1,264.26	1,690.71	3,547.83	4,744.57	2.25%	2.61%
2/0	34.63	53.37	4,422.03	6,282.44	725.27	1,030.40	23,269	21,452	4.43	4.08	2,674.44	2,997.11	56.88	56.88	1,690.71	3,228.45	3,814.87	9,059.84	2.10%	3.23%
4/0	53.37	76.21	6,282.44	8,413.33	1,030.40	1,379.89	21,452	20,119	4.08	3.83	2,997.11	4,151.72	56.88	56.88	3,228.45	4,204.73	5,787.21	11,799.52	2.06%	2.95%

Red de Baja Tensión Urbano Trifásico: 5 Usuarios Equivalentes a 36 m cada carga																				
Conductor	Rango de Carga	Costo Total [miles \$]		Costo Anual [miles\$]		Costo Medio [\$ /kW]		Costo Medio [\$ /kWh]		VP Costo Inv. miles \$		VP Costo miles \$		VP Costo Pérdidas miles \$		Pérdidas [kWh]		% de Pérdidas		
		Inicial	Final	Inicial	Final	Inicial	Final	Inicial	Final	Inicial	Final	Inicial	Final	Inicial	Final	Inicial	Final	Inicial	Final	
8	1.00	4.77	1,777.64	1,989.28	291.56	326.27	323,951	76,029	61.63	14.47	1,680.82	1,680.82	63.98	63.98	9.70	220.46	27.21	618.66	0.52%	2.47%
6	4.77	4.77	1,989.28	1,989.28	326.27	326.27	76,029	76,029	14.47	14.47	1,680.82	1,785.18	63.98	63.98	220.46	140.12	393.22	393.22	1.57%	1.57%
4	4.77	18.24	1,989.28	3,196.04	326.27	524.19	76,029	31,939	14.47	6.08	1,785.18	1,829.36	63.98	63.98	140.12	1,302.70	249.92	3655.69	1.00%	3.81%
2	18.24	20.58	3,196.04	3,403.40	524.19	558.20	31,939	30,140	6.08	5.73	1,829.36	2,283.54	63.98	63.98	1,302.70	1,055.88	2326.93	2963.06	2.43%	2.74%
1	20.58	29.95	3,403.40	4,366.32	558.20	716.13	30,140	26,570	5.73	5.06	2,283.54	2,471.42	63.98	63.98	1,055.88	1,830.92	2426.05	5138.01	2.24%	3.26%
1/0	29.95	34.63	4,366.32	4,841.19	716.13	794.02	26,570	25,475	5.06	4.85	2,471.42	2,875.15	63.98	63.98	1,830.92	1,902.05	3991.30	5337.64	2.54%	2.93%
1/0-AI-A	29.95	34.63	5,240.97	5,720.74	859.59	938.27	31,893	30,103	6.07	5.73	3,815.47	3,815.47	3.21	3.21	1,422.29	1,902.05	3,991.30	5,337.64	2.54%	2.93%
1/0-AI-A-Tr	29.95	34.63	4,725.73	5,205.50	775.08	853.77	28,757	27,392	5.47	5.21	3,300.23	3,300.23	3.21	3.21	1,422.29	1,902.05	3,991.30	5,337.64	2.54%	2.93%
2/0	34.63	53.37	4,841.19	6,934.14	794.02	1,137.29	25,475	23,677	4.85	4.50	2,875.15	3,238.15	63.98	63.98	1,902.05	3,632.00	4,291.73	10,192.32	2.36%	3.63%
4/0	53.37	76.21	6,934.14	9,331.39	1,137.29	1,530.47	23,677	22,315	4.50	4.25	3,238.15	4,537.09	63.98	63.98	3,632.00	4,730.32	6,510.61	13,274.46	2.32%	3.31%

Red de Baja Tensión Urbano Trifásico: 8 Usuarios Equivalentes a 29 m cada carga																						
Conductor	Rango de Carga kVA		Costo Total [miles \$]		Costo Anual [miles\$]		Costo Medio [\$ /kW]		Costo Medio [\$ /kWh]		VP Costo Inv. miles \$		VP Costo miles \$		VP Costo Pérdidas miles \$		Pérdidas [kWh]		% de Pérdidas			
			Inicial	Final	Inicial	Final	Inicial	Final	Inicial	Final	miles \$	miles \$	miles \$	miles \$	miles \$	miles \$	Inicial	Final	Inicial	Final	Inicial	Final
8	1.00	4.77	2,619.71	2,879.42	429.67	472.26	477.406	110.050	90.83	20.94	2,498.91	2,498.91	82.47	82.47	11.32	257.31	31.76	722.07	0.60%	2.88%		
6	4.77	4.77	2,879.42	2,879.42	472.26	472.26	110.050	110.050	20.94	20.94	2,498.91	2,633.41	82.47	82.47	257.31	163.54	458.94	458.94	1.83%	1.83%		
4	4.77	18.82	2,879.42	4,392.47	472.26	720.42	110.050	42,529	20.94	8.09	2,633.41	2,690.37	82.47	82.47	163.54	1,619.64	291.70	4545.11	1.16%	4.59%		
2	18.82	21.75	4,392.47	4,734.83	720.42	776.57	42,529	39,673	8.09	7.55	2,690.37	3,275.75	82.47	82.47	1,619.64	1,376.62	2893.06	3863.13	2.92%	3.38%		
1	21.75	31.70	4,734.83	5,995.37	776.57	983.32	39,673	34,462	7.55	6.56	3,275.75	3,517.91	82.47	82.47	1,376.62	2,394.99	3163.00	6720.94	2.77%	4.03%		
1/0	31.70	36.39	5,995.37	6,571.63	983.32	1,077.83	34,462	32,911	6.56	6.26	3,517.91	4,038.27	82.47	82.47	2,394.99	2,450.89	5220.96	6877.81	3.13%	3.60%		
1/0-AI-A	31.70	36.39	7,114.86	7,705.27	1,166.93	1,263.76	40,897	38,589	7.78	7.34	5,250.24	5,250.24	4.14	4.14	1,860.47	2,450.89	5,220.96	6,877.81	3.13%	3.60%		
1/0-AI-A-Tr	31.70	36.39	6,450.77	7,041.18	1,058.01	1,154.84	37,079	35,263	7.05	6.71	4,586.15	4,586.15	4.14	4.14	1,860.47	2,450.89	5,220.96	6,877.81	3.13%	3.60%		
2/0	36.39	56.30	6,571.63	9,305.52	1,077.83	1,526.22	32,911	30,122	6.26	5.73	4,038.27	4,506.14	82.47	82.47	2,450.89	4,716.91	5,530.10	13,236.85	2.89%	4.47%		
4/0	56.30	78.21	9,305.52	11,783.73	1,526.22	1,932.68	30,122	28,179	5.73	5.36	4,506.14	6,180.32	82.47	82.47	4,716.91	5,520.94	8,455.38	15,493.16	2.86%	3.87%		

Sistema Eficiente Trifásico Urbano

Transformador	No Ram	kVA/Ramal		Calibre Cond		CA Red [k\$]		CA Trafo [k\$]		Costo Total [k\$]		CM [\$ /kW]		CM [\$ /kWh]		Costo Inv [k\$]		Costo Mantenm [k\$]		Costo Pérdidas [k\$]		Pérdidas [kWh]		% de Pérdidas	
15	2	1.39	3.48	8	8	568	605	634	642	1,202	1,247	479.469	198.873	121.63	50.45	5,892.56	5,892.56	789.49	789.49	318	585	752	1,501	7.61%	6.07%
30	2	3.48	7.20	8	4	595	898	783	798	1,378	1,697	219.835	130.941	55.77	33.22	6,656.10	6,953.19	817.92	817.92	521	2,156	1,225	5,815	4.96%	11.39%
45	2	7.20	10.68	4	4	655	898	914	934	1,569	1,832	121.083	95.283	30.72	24.17	7,419.79	7,508.16	817.92	817.92	851	2,356	1,901	6,297	3.72%	8.31%
75	2	10.68	17.88	4	4	655	898	1,123	1,154	1,778	2,052	92.466	63.772	23.46	16.18	8,264.40	8,352.77	817.92	817.92	1,171	2,740	2,651	7,227	3.50%	5.70%
112.5	2	17.88	26.93	4	1	655	1,213	1,408	1,452	2,063	2,665	64.107	54.968	16.26	13.94	9,472.92	10,845.42	817.92	817.92	1,554	3,827	3,550	10,102	2.80%	5.29%
150	3	17.96	23.99	4	1	983	1,819	1,637	1,692	2,620	3,511	54.032	54.202	13.71	13.75	12,204.46	14,263.20	945.89	945.89	1,968	5,317	4,477	14,134	2.34%	5.53%
45	2	7.20	10.68	4	4	950	1,255	914	934	1,864	2,189	143.850	113.845	36.49	28.88	9,116.27	9,230.17	891.86	891.86	879	2,736	1,951	7,363	3.82%	9.71%

Sistema Eficiente Trifásico Urbano

Transformador	No Ram	kVA/Ramal		Calibre Cond		CA Red [k\$]		CA Trafo [k\$]		Costo Total [k\$]		CM [\$ /kW]		CM [\$ /kWh]		Costo Inv [k\$]		Costo Mantenm [k\$]		Costo Pérdidas [k\$]		Pérdidas [kWh]		% de Pérdidas	
15	3	0.93	2.32	#N/A	8	#N/A	907	634	642	#N/A	1,549	#N/A	247.115	#N/A	62.69	#N/A	7,505.37	#N/A	903.24	#N/A	702	#N/A	1,831	#N/A	7.41%
30	3	2.32	4.80	8	4	893	1,347	783	798	1,676	2,146	267.307	165.601	67.81	42.01	8,336.92	8,782.55	945.89	945.89	526	2,937	1,241	8,006	5.02%	15.67%
45	3	4.80	7.12	4	4	983	1,347	914	934	1,896	2,281	146.364	118.641	37.13	30.10	9,204.97	9,337.52	945.89	945.89	935	3,137	2,051	8,487	4.02%	11.20%
75	3	7.12	11.92	4	4	983	1,347	1,123	1,154	2,105	2,501	109.504	77.726	27.78	19.72	10,049.58	10,182.14	945.89	945.89	1,255	3,521	2,801	9,418	3.70%	7.42%
112.5	3	11.92	17.96	4	4	983	1,347	1,408	1,452	2,391	2,800	74.285	57.744	18.84	14.65	11,258.10	11,390.66	945.89	945.89	1,638	3,975	3,699	10,516	2.92%	5.50%
150	3	17.96	23.99	4	1	983	1,819	1,637	1,692	2,620	3,511	54.032	54.202	13.71	13.75	12,204.46	14,263.20	945.89	945.89	1,968	5,317	4,477	14,134	2.34%	5.53%
45	3	4.80	7.12	4	4	1,425	1,882	914	934	2,339	2,816	180.514	146.484	45.79	37.16	11,749.68	11,920.54	1,056.80	1,056.80	977	3,707	2,126	10,086	4.16%	13.31%

Transformador - Rural Bifásico																									
Capacidad kVA	Pérdidas (kW)		Rango de Carga kVA Final		Porcentaje de Carga kVA		Costo Total [Miles de \$]		Costo Anual		Costo Medio [\$/kW]		Costo Inv Miles \$		Costo Mantenm Miles \$		Costo Pérdidas Miles \$		Pérdidas [kWh] Icial Final		% de Pérdidas Inicial Final				
	Pc(Cobre)	Po(Hierro)																							
10	0.140	0.050	2.79	4.64	28%	46%	2,325	2,416	381	396	60,819	37,920	15.43	9.62	1,832.19	1,832.19	508.25	508.25	195	210	460.98	501.84	1.17%	1.27%	
15	0.195	0.070	4.64	6.97	31%	46%	2,416	2,783	396	456	37,920	29,124	9.62	7.39	2,068.74	2,068.74	508.25	508.25	264	294	619.52	702.12	1.05%	1.19%	
25	0.290	0.100	6.97	11.61	28%	46%	2,783	3,334	456	547	29,124	20,931	7.39	5.31	2,410.43	2,410.43	508.25	508.25	377	422	883.62	1,008.25	0.90%	1.02%	
37.5	0.405	0.135	11.61	17.65	31%	47%	3,334	4,285	547	703	20,931	17,699	5.31	4.49	3,102.73	3,102.73	508.25	508.25	510	573	1,195.73	1,372.25	0.81%	0.93%	
50	0.510	0.160	17.65	23.68	35%	47%	4,285	4,811	703	789	17,699	14,808	4.49	3.76	3,419.00	3,419.00	508.25	508.25	607	685	1,423.09	1,643.57	0.72%	0.83%	
75	0.710	0.210	23.68	35.76	32%	48%	4,811	5,609	789	920	14,808	11,434	3.76	2.90	3,808.32	3,808.32	508.25	508.25	795	908	1,863.55	2,180.87	0.63%	0.74%	
100	0.900	0.260	35.76	48.00	36%	48%	5,609	7,049	920	1,156	11,434	10,705	2.90	2.72	4,851.75	4,851.75	508.25	508.25	988	1,130	2,316.53	2,716.08	0.59%	0.69%	

Sistema Típico Bifásico Rural

Transformador	Calibre Cond.	No.de Usuarios	No. de Vanos	Long. Vano [m]	Long. Ramal [m]	No. Ramales	Carga [kVA]
10 R_B	1	3	4	92	368	3	4.75
15 R_B	1	3	4	92	368	3	4.75
25 R_B	2	6	4	67	268	3	9.95
30 R_B	1/0	4	5	142	710	3	5.24
37.5 R_B	1/0 (A-Tr)	13	4	33	132	3	17.83
50 R_B	1/0 (A-Tr)	13	4	33	132	3	17.83
75 R_B	1/0 (A-Tr)	13	4	33	132	3	17.83

% Carga % Costo Rev % Costo Tr % Manten FC Fp Fpot Lavado Arena Costo

0.40 1.00 1.00 2.00 0.45 0.24 0.9 0.00 0

Red de Baja Tensión - Rural Bifásico: 4 Usuarios Equivalentes a 92 m cada carga																				
Conductor	Rango de Carga kVA		Costo Total [miles \$]		Costo Anual [miles\$]		Costo Medio [\$/kW]		Costo Medio		VP Costo Inv		VP Costo		VP Costo de Pérdidas		Pérdidas [kWh]		% de Pérdidas	
			Inicial	Final	Inicial	Final	Inicial	Final	Inicial	Final	miles \$	miles \$	miles \$	miles \$	miles \$	miles \$	Inicial	Final	Inicial	Final
8	1.00	3.22	2,829.09	3,151.47	464.01	516.88	515.563	178.561	98.09	33.97	1867.30	1867.30	914.11	914.11	37.76	390.60	105.96	1096.11	2.02%	6.48%
6	3.22	3.22	3,151.47	3,151.47	516.88	516.88	178.561	178.561	33.97	33.97	1867.30	2033.91	914.11	914.11	390.60	248.26	696.68	696.68	4.12%	4.12%
4	3.22	12.70	3,151.47	5,033.52	516.88	825.56	178.561	72,250	33.97	13.75	2033.91	2104.45	914.11	914.11	248.26	2458.64	442.80	6899.57	2.62%	10.34%
2	12.70	14.67	5,033.52	5,456.26	825.56	894.90	72,250	67,775	13.75	12.89	2104.45	2829.53	914.11	914.11	2458.64	2089.73	4391.72	5864.30	6.58%	7.61%
1	14.67	21.39	5,456.26	7,023.16	894.90	1,151.89	67,775	59,847	12.89	11.39	2829.53	3129.48	914.11	914.11	2089.73	3635.64	4801.49	10202.52	6.23%	9.08%
1/0	21.39	24.55	7,023.16	7,737.23	1,151.89	1,269.00	59,847	57,444	11.39	10.93	3129.48	3774.02	914.11	914.11	3635.64	3720.49	7925.51	10440.64	7.05%	8.09%
1/0-AI-A	21.39	24.55	7,596.37	8,330.89	1,245.90	1,366.37	64,731	61,851	12.32	11.77	5,275.22	5,275.22	6.57	6.57	2,824.23	3,720.49	7,925.51	10,440.64	7.05%	8.09%
1/0-AI-A-Tr	21.39	24.55	6,773.80	7,508.33	1,110.99	1,231.46	57,722	55,744	10.98	10.61	4,452.65	4,452.65	6.57	6.57	2,824.23	3,720.49	7,925.51	10,440.64	7.05%	8.09%
2/0	24.55	37.58	7,737.23	11,014.44	1,269.00	1,806.51	57,444	53,412	10.93	10.16	3774.02	4353.54	914.11	914.11	3720.49	7012.19	8394.80	19677.96	6.51%	9.96%
4/0	37.58	51.41	11,014.44	14,209.87	1,806.51	2,330.60	53,412	50,376	10.16	9.58	4353.54	6427.25	914.11	914.11	7012.19	8380.90	12569.81	23518.90	6.36%	8.70%

Red de Baja Tensión - Rural Bifásico: 4 Usuarios Equivalentes a 67 m cada carga																				
Conductor	Rango de Carga kVA		Costo Total [miles \$]		Costo Anual [miles\$]		Costo Medio [\$/kW]		Costo Medio		VP Costo Inv		VP Costo		VP Costo de Pérdidas		Pérdidas [kWh]		% de Pérdidas	
			Inicial	Final	Inicial	Final	Inicial	Final	Inicial	Final	miles \$	miles \$	miles \$	miles \$	miles \$	miles \$	Inicial	Final	Inicial	Final
8	1.00	3.22	2,302.24	2,537.01	377.60	416.10	419.551	143,746	79.82	27.35	1601.80	1601.80	665.71	665.71	27.50	284.46	77.16	798.25	1.47%	4.72%
6	3.22	3.22	2,537.01	2,537.01	416.10	416.10	143,746	143,746	27.35	27.35	1601.80	1723.13	665.71	665.71	284.46	180.80	507.36	507.36	3.00%	3.00%
4	3.22	12.70	2,537.01	3,907.64	416.10	640.90	143,746	56,089	27.35	10.67	1723.13	1774.51	665.71	665.71	180.80	1790.53	322.47	5024.69	1.91%	7.53%
2	12.70	14.67	3,907.64	4,215.50	640.90	691.40	56,089	52,363	10.67	9.96	1774.51	2302.56	665.71	665.71	1790.53	1521.87	3198.32	4270.74	4.79%	5.54%
1	14.67	21.39	4,215.50	5,356.61	691.40	878.55	52,363	45,646	9.96	8.68	2302.56	2521.00	665.71	665.71	1521.87	2647.69	3496.73	7430.10	4.53%	6.61%
1/0	21.39	24.55	5,356.61	5,876.64	878.55	963.84	45,646	43,630	8.68	8.30	2521.00	2990.39	665.71	665.71	2647.69	2709.49	5771.84	7603.51	5.13%	5.89%
1/0-AI-A	21.39	24.55	5,774.06	6,308.98	947.02	1,034.75	49,203	46,840	9.36	8.91	4,083.65	4,083.65	4.78	4.78	2,056.78	2,709.49	5,771.84	7,603.51	5.13%	5.89%
1/0-AI-A-Tr	21.39	24.55	5,175.01	5,709.94	848.77	936.50	44,098	42,393	8.39	8.07	3,484.61	3,484.61	4.78	4.78	2,056.78	2,709.49	5,771.84	7,603.51	5.13%	5.89%
2/0	24.55	37.58	5,876.64	8,263.31	963.84	1,355.29	43,630	40,071	8.30	7.62	2990.39	3412.43	665.71	665.71	2709.49	5106.70	6113.60	14330.69	4.74%	7.26%
4/0	37.58	51.41	8,263.31	10,590.41	1,355.29	1,736.96	40,071	37,544	7.62	7.14	3412.43	4922.64	665.71	665.71	5106.70	6103.48	9154.10	17127.90	4.63%	6.34%

Red de Baja Tensión - Rural Bifásico: 5 Usuarios Equivalentes a 142 m cada carga																				
Conductor	Rango de Carga kVA		Costo Total [miles \$]		Costo Anual [miles\$]		Costo Medio [\$/kW]		Costo Medio		VP Costo Inv		VP Costo		VP Costo de Pérdidas		Pérdidas [kWh]		% de Pérdidas	
			Inicial	Final	Inicial	Final	Inicial	Final	Inicial	Final	miles \$	miles \$	miles \$	miles \$	Inicial	Final	Inicial	Final		
8	1.00	3.61	4,847.87	5,547.47	795.11	909.85	883.457	279.938	168.09	53.26	2997.88	2997.88	1763.63	1763.63	68.38	891.78	191.89	2502.57	3.65%	13.18%
6	3.61	3.61	5,547.47	5,547.47	909.85	909.85	279.938	279.938	53.26	53.26	2997.88	3319.32	1763.63	1763.63	891.78	566.81	1590.61	1590.61	8.38%	8.38%
4	3.61	13.09	5,547.47	9,098.77	909.85	1,492.31	279.938	126,661	53.26	24.10	3319.32	3455.42	1763.63	1763.63	566.81	4734.00	1010.97	13284.79	5.33%	19.31%
2	13.09	15.07	9,098.77	9,888.82	1,492.31	1,621.89	126,661	119,614	24.10	22.76	3455.42	4854.35	1763.63	1763.63	4734.00	3991.05	8456.05	11199.90	12.29%	14.14%
1	15.07	21.78	9,888.82	12,793.90	1,621.89	2,098.36	119,614	107,044	22.76	20.37	4854.35	5433.06	1763.63	1763.63	3991.05	6829.66	9170.09	19165.74	11.58%	16.74%
1/0	21.78	25.34	12,793.90	14,323.36	2,098.36	2,349.21	107,044	103,026	20.37	19.60	5,433.06	6,676.59	1,763.63	1,763.63	6,829.66	7,178.55	14,888.31	20,144.82	13.01%	15.13%
1/0-AI-A	21.78	25.34	13,933.62	15,468.74	2,285.29	2,537.07	116,580	111,264	22.18	21.17	9,572.93	9,572.93	12.67	12.67	5,305.41	7,178.55	14,888.31	20,144.82	13.01%	15.13%
1/0-AI-A-Tr	21.78	25.34	12,346.60	13,881.72	2,025.00	2,276.78	103,302	99,849	19.65	19.00	7985.91	7985.91	12.67	12.67	5305.41	7178.55	14888.31	20144.82	13.01%	15.13%
2/0	25.34	39.16	14,323.36	20,859.36	2,349.21	3,421.20	103,026	97,071	19.60	18.47	6676.59	7794.69	1763.63	1763.63	7178.55	13789.42	16197.44	38696.58	12.16%	18.80%
4/0	39.16	51.41	20,859.36	25,998.22	3,421.20	4,264.04	97,071	92,166	18.47	17.54	7794.69	11795.61	1763.63	1763.63	13789.42	15177.92	24718.45	42593.07	12.01%	15.76%

Red de Baja Tensión - Rural Bifásico: 4 Usuarios Equivalentes a 33 m cada carga																				
Conductor	Rango de Carga kVA		Costo Total [miles \$]		Costo Anual [miles\$]		Costo Medio [\$ /kWh]		Costo Medio [\$ /kWh]		VP Costo inv miles \$		VP Costo Mantenm miles \$		VP Costo de Pérdidas miles \$		Pérdidas [kWh]		% de Pérdidas	
			Inicial	Final	Inicial	Final	Inicial	Final	Inicial	Final	Inicial	Final	Inicial	Final	Inicial	Final	Inicial	Final	Inicial	Final
8	1.00	3.22	1,585.71	1,701.35	260.08	279.04	288.974	96.398	54.98	18.34	1240.72	1240.72	327.89	327.89	13.54	140.11	38.01	393.17	0.72%	2.33%
6	3.22	3.22	1,701.35	1,701.35	279.04	279.04	96.398	96.398	18.34	18.34	1240.72	1300.48	327.89	327.89	140.11	89.05	249.89	249.89	1.48%	1.48%
4	3.22	12.70	1,701.35	2,376.43	279.04	389.76	96.398	34,111	18.34	6.49	1300.48	1325.79	327.89	327.89	89.05	881.90	158.83	2474.85	0.94%	3.71%
2	12.70	14.67	2,376.43	2,528.07	389.76	414.63	34,111	31,402	6.49	5.97	1325.79	1585.87	327.89	327.89	881.90	749.58	1575.29	2103.50	2.36%	2.73%
1	14.67	21.39	2,528.07	3,090.10	414.63	506.82	31,402	26,332	5.97	5.01	1585.87	1693.46	327.89	327.89	749.58	1304.09	1722.27	3659.60	2.23%	3.26%
1/0	21.39	24.55	3,090.10	3,346.24	506.82	548.83	26,332	24,844	5.01	4.73	1693.46	1924.65	327.89	327.89	1304.09	1334.53	2842.85	3745.01	2.53%	2.90%
1/0-AI-A	21.39	24.55	3,295.71	3,559.18	540.54	583.75	28,084	26,425	5.34	5.03	2,463.13	2,463.13	2.36	2.36	1,013.04	1,334.53	2,842.85	3,745.01	2.53%	2.90%
1/0-AI-A-Tr	21.39	24.55	3,000.66	3,264.13	492.15	535.36	25,570	24,234	4.86	4.61	2,168.08	2,168.08	2.36	2.36	1,013.04	1,334.53	2,842.85	3,745.01	2.53%	2.90%
2/0	24.55	37.58	3,346.24	4,521.76	548.83	741.63	24,844	21,927	4.73	4.17	1924.65	2132.52	327.89	327.89	1334.53	2515.24	3011.18	7058.40	2.33%	3.57%
4/0	37.58	51.41	4,521.76	5,667.95	741.63	929.62	21,927	20,093	4.17	3.82	2132.52	2876.36	327.89	327.89	2515.24	3006.19	4508.74	8436.13	2.28%	3.12%

4584.442

Sistema Eficiente Bifásico Rural

Transformador	No Ram	kVA/Ramal		Calibre Cond		CA Red [k\$]		CA Trafo [k\$]		Costo Total [k\$]		CM [\$ /kW]		CM [\$ /kWh]		Costo Inv [k\$]		Costo Mantenm [k\$]		Costo Pérdidas [k\$]		Pérdidas [kWh]		% de Pérdidas	
10	3	0.93	1.55	#N/A	8	#N/A	1,934	546	549	#N/A	2,482	#N/A	593,878	#N/A	150.65	#N/A	7,434.10	#N/A	6,501	#N/A	912	#N/A	2,472	#N/A	15.01%
15	3	1.55	2.32	8	8	1,829	1,934	601	606	2,430	2,540	581,471	405,085	147.51	102.76	7,670.65	7,670.65	6,501.14	6,501	332	996	810	2,673	4.92%	10.82%
25	3	2.32	3.87	8	4	1,451	2,056	682	690	2,134	2,746	340,339	262,852	86.34	66.68	7,215.84	7,733.95	5,010.75	5,011	427	3,641	1,022	10,042	4.14%	24.38%
25	3	2.32	3.87	8	4	3,231	4,832	682	690	3,913	5,522	624,172	528,477	158.34	134.06	11,404.06	12,776.68	11,598.27	11,598	500	8,933	1,229	24,892	4.97%	60.43%
37.5	3	3.87	5.88	4	4	989	1,235	830	842	1,819	2,077	174,102	130,755	44.17	33.17	7,004.17	7,080.08	2,983.82	2,984	670	2,159	1,481	5,822	3.60%	9.30%
50	3	5.88	7.89	4	4	989	1,235	904	918	1,893	2,154	119,203	101,031	30.24	25.63	7,320.45	7,396.36	2,983.82	2,984	767	2,271	1,709	6,093	2.73%	7.25%
75	3	7.89	11.92	4	4	989	1,235	1,008	1,028	1,997	2,263	93,677	70,327	23.76	17.84	7,709.77	7,785.68	2,983.82	2,984	955	2,494	2,149	6,630	2.56%	5.23%

Sistema Eficiente Bifásico Rural

Transformador	No Ram	kVA/Ramal		Calibre Cond		CA Red [k\$]		CA Trafo [k\$]		Costo Total [k\$]		CM [\$ /kW]		CM [\$ /kWh]		Costo Inv [k\$]		Costo Mantenm [k\$]		Costo Pérdidas [k\$]		Pérdidas [kWh]		% de Pérdidas	
10	3	0.93	1.55	#N/A	8	#N/A	1,934	546	549	#N/A	2,482	#N/A	593,878	#N/A	150.65	#N/A	7,434.10	#N/A	6,501.14	#N/A	912	#N/A	2,472	#N/A	15.01%
15	3	1.55	2.32	8	8	1,829	1,934	601	606	2,430	2,540	581,471	405,085	147.51	102.76	7,670.65	7,670.65	6,501.14	6,501.14	332	996	810	2,673	4.92%	10.82%
25	3	2.32	3.87	8	4	1,451	2,056	682	690	2,134	2,746	340,339	262,852	86.34	66.68	7,215.84	7,733.95	5,010.75	5,010.75	427	3,641	1,022	10,042	4.14%	24.38%
25	3	2.32	3.87	8	4	3,231	4,832	682	690	3,913	5,522	624,172	528,477	158.34	134.06	11,404.06	12,776.68	11,598.27	11,598.27	500	8,933	1,229	24,892	4.97%	60.43%
37.5	3	3.87	5.88	4	4	989	1,235	830	842	1,819	2,077	174,102	130,755	44.17	33.17	7,004.17	7,080.08	2,983.82	2,983.82	670	2,159	1,481	5,822	3.60%	9.30%
50	3	5.88	7.89	4	4	989	1,235	904	918	1,893	2,154	119,203	101,031	30.24	25.63	7,320.45	7,396.36	2,983.82	2,983.82	767	2,271	1,709	6,093	2.73%	7.25%
75	3	7.89	11.92	4	4	989	1,235	1,008	1,028	1,997	2,263	93,677	70,327	23.76	17.84	7,709.77	7,785.68	2,983.82	2,983.82	955	2,494	2,149	6,630	2.56%	5.23%

Transformador		Rural Trifásico																						
Capacidad kVA	Pérdidas (kW)		Rango de Carga kVA Final		Porcentaje de Carga kVA		Costo Total		Costo Anual		Costo Medio		Costo Inv		Costo Mantenim		Costo Pérdidas		Pérdidas [kWh]		% de Pérdidas			
	Pc(Cobre)	Po(Hierro)																						
15	0.310	0.080	2.79	6.97	19%	46%	3,804	4,068	624	667	99,510	42,571	25.24	10.80	2,894.33	2,894.33	767.17	767.17	308	350	723.42	842.17	1.22%	1.42%
30	0.515	0.135	6.97	14.40	23%	48%	4,068	5,333	667	875	42,571	27,005	10.80	6.85	3,575.39	3,575.39	767.17	767.17	509	595	1,191.99	1,433.37	1.01%	1.21%
45	0.710	0.180	14.40	21.36	32%	47%	5,333	6,416	875	1,052	27,005	21,895	6.85	5.55	4,177.68	4,177.68	767.17	767.17	683	795	1,601.38	1,915.12	0.90%	1.08%
75	1.090	0.265	21.36	35.76	28%	48%	6,416	8,251	1,052	1,353	21,895	16,819	5.55	4.27	5,094.32	5,094.32	767.17	767.17	1,003	1,179	2,351.32	2,845.32	0.80%	0.96%
112.5	1.540	0.365	35.76	53.87	32%	48%	8,251	10,689	1,353	1,753	16,819	14,464	4.27	3.67	6,405.89	6,405.89	767.17	767.17	1,386	1,633	3,250.04	3,944.05	0.73%	0.89%
150	1.960	0.450	53.87	71.98	36%	48%	10,689	12,700	1,753	2,083	14,464	12,862	3.67	3.26	7,432.95	7,432.95	767.17	767.17	1,716	2,025	4,027.53	4,896.38	0.68%	0.83%
225	2.890	0.615	71.98	108.00	32%	48%	12,700	14,617	2,083	2,397	12,862	9,866	3.26	2.50	8,135.69	8,135.69	767.17	767.17	2,339	2,805	5,487.47	6,795.40	0.62%	0.77%

Sistema Típico Trifásico Rural

Transformador	Calibre Cond.	No.de Usuarios	No. de Vanos	Long. Vano [m]	Long. Ramal [m]	No. Radales	Carga [kVA]
15 R T	1	2	2	52	104	2	5.74
30 R T	1/0	16	7	37	259	2	17.09
45 R T	1/0	16	7	37	259	2	17.09
50 R T	1/0	16	7	37	259	2	17.09
75 R T	2/0	28	9	35	315	2	26.84
112.5 R T	2/0 (A - A)	28	9	35	315	2	34.37

% Carga % Costo Re % Costo T % Manten FC Fp Fpot Lavado Arene Costo

0.40 1.00 1.00 2.00 0.45 0.24 0.9 0.00 0

Red de Baja Tensión - Rural Trifásico: 2 Usuarios Equivalentes a 52 m cada carga																				
Conductor	Rango de Carga kVA		Costo Total [miles \$]		Costo Anual [miles\$]		Costo Medio		Costo Medio		VP Costo Inv.		VP Costo		VP Costo Pérdidas		Pérdidas [kWh]		% de Pérdidas	
			Inicial	Final	Inicial	Final	Inicial	Final	Inicial	Final	miles \$	miles \$	miles \$	miles \$	miles \$	miles \$	Inicial	Final	Inicial	Final
8	1.00	4.62	1,098.58	1,222.89	180.18	200.57	200.201	48,235	38.09	9.18	813.29	813.29	258.33	258.33	7.96	169.88	22.33	476.72	0.42%	1.96%
6	4.62	4.62	1,222.89	1,222.89	200.57	200.57	48,235	48,235	9.18	9.18	813.29	876.07	258.33	258.33	169.88	107.97	303.00	303.00	1.25%	1.25%
4	4.62	16.91	1,222.89	1,914.38	200.57	313.98	48,235	20,631	9.18	3.93	876.07	902.65	258.33	258.33	107.97	919.28	192.58	2579.73	0.79%	2.90%
2	16.91	19.50	1,914.38	2,071.73	313.98	339.79	20,631	19,364	3.93	3.68	902.65	1,175.87	258.33	258.33	919.28	777.90	1642.05	2182.98	1.85%	2.13%
1	19.50	28.55	2,071.73	2,666.69	339.79	437.37	19,364	17,020	3.68	3.24	1,175.87	1,288.89	258.33	258.33	777.90	1,365.95	1787.35	3833.20	1.74%	2.55%
1/0	28.55	32.43	2,666.69	2,912.18	437.37	477.63	17,020	16,363	3.24	3.11	1,288.89	1,531.76	258.33	258.33	1,365.95	1,369.15	2977.70	3842.19	1.98%	2.25%
1/0 Al - A	32.43	32.43	2,968.90	3,221.37	486.94	528.35	18,949	18,100	3.61	3.44	2,097.43	2,097.43	1.86	1.86	1,061.10	1,369.15	2,977.70	3,842.19	1.98%	2.25%
1/0 Al - A - Tr	32.43	32.43	2,658.95	2,911.42	436.10	477.51	16,971	16,359	3.23	3.11	1,787.48	1,787.48	1.86	1.86	1,061.10	1,369.15	2,977.70	3,842.19	1.98%	2.25%
2/0	32.43	50.54	2,912.18	4,199.60	477.63	688.79	16,363	15,141	3.11	2.88	1,531.76	1,750.13	258.33	258.33	1,369.15	2,673.59	3,089.31	7,502.77	1.81%	2.82%
4/0	50.54	84.18	4,199.60	6,672.07	688.79	1,094.30	15,141	14,444	2.88	2.75	1,750.13	2,531.53	258.33	258.33	2,673.59	4,737.03	4,792.59	13,293.29	1.80%	3.00%

Red de Baja Tension - Urbano Trifásico: 7 Usuarios Equivalentes a 37 m cada carga																							
Conductor	Rango de Carga kVA	Costo Total [miles \$]				Costo Anual [miles\$]				Costo Medio		Costo Medio		VP Costo Inv. miles \$		VP Costo miles \$		VP Costo Pérdidas miles \$		Pérdidas [kWh]		% de Pérdidas	
		Inicial	Final	Inicial	Final	Inicial	Final	Inicial	Final	Inicial	Final	Inicial	Final	Inicial	Final	Inicial	Final	Inicial	Final	Inicial	Final		
8	1.00	5.27	3,162.01	3,461.54	518.61	567.74	576,232	119,768	109.63	22.79	2,474.82	2,474.82	643.35	643.35	12.94	359.06	36.32	1007.60	0.69%	3.64%			
6	5.27	5.27	3,461.54	3,461.54	567.74	567.74	119,768	119,768	22.79	22.79	2,474.82	2,631.16	643.35	643.35	359.06	228.21	640.42	640.42	2.31%	2.31%			
4	5.27	21.44	3,461.54	5,310.02	567.74	870.91	119,768	45,139	22.79	8.59	2,631.16	2,697.36	643.35	643.35	228.21	2,402.93	407.04	6743.24	1.47%	5.98%			
2	21.44	24.02	5,310.02	5,595.47	870.91	917.73	45,139	42,443	8.59	8.08	2,697.36	3,377.78	643.35	643.35	2,402.93	1,920.99	4292.22	5390.79	3.81%	4.27%			
1	24.02	35.02	5,595.47	7,041.59	917.73	1,154.91	42,443	36,642	8.08	6.97	3,377.78	3,659.26	643.35	643.35	1,920.99	3,342.08	4413.79	9378.71	3.50%	5.10%			
1/0	35.02	40.20	7,041.59	7,710.35	1,154.91	1,264.59	36,642	34,957	6.97	6.65	3,659.26	4,264.09	643.35	643.35	3,342.08	3,420.08	7285.56	9597.61	3.96%	4.54%			
1/0 Al - A	40.20	7.805	7,805.14	8,480.36	1,280.14	1,390.89	40,615	38,448	7.73	7.32	5,672.83	5,672.83	4.62	4.62	2,596.19	3,420.08	7,285.56	9,597.61	3.96%	4.54%			
1/0 Al - A - Tr	35.02	40.20	7,033.24	7,708.45	1,153.54	1,264.28	36,598	34,948	6.96	6.65	4,900.92	4,900.92	4.62	4.62	2,596.19	3,420.08	7,285.56	9,597.61	3.96%	4.54%			
2/0	40.20	62.19	7,710.35	10,845.67	1,264.59	1,778.83	34,957	31,782	6.65	6.05	4,264.09	4,807.92	643.35	643.35	3,420.08	6,582.20	7,716.96	18,471.31	3.65%	5.65%			
4/0	62.19	84.18	10,845.67	13,711.17	1,778.83	2,248.80	31,782	29,683	6.05	5.65	4,807.92	6,753.90	643.35	643.35	6,582.20	7,704.18	11,799.03	21,619.86	3.61%	4.89%			

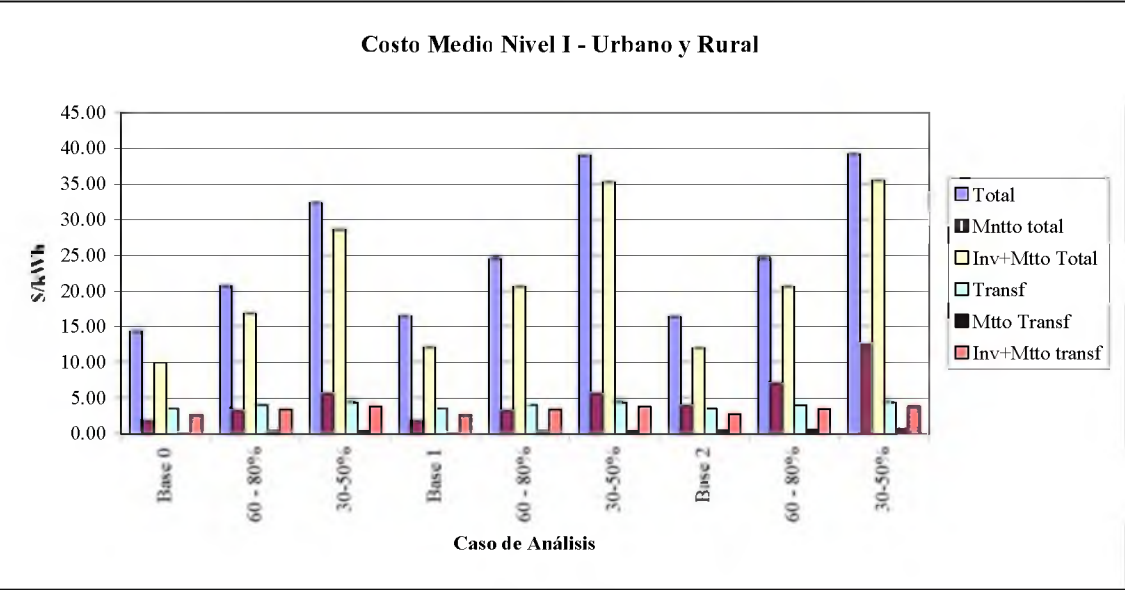
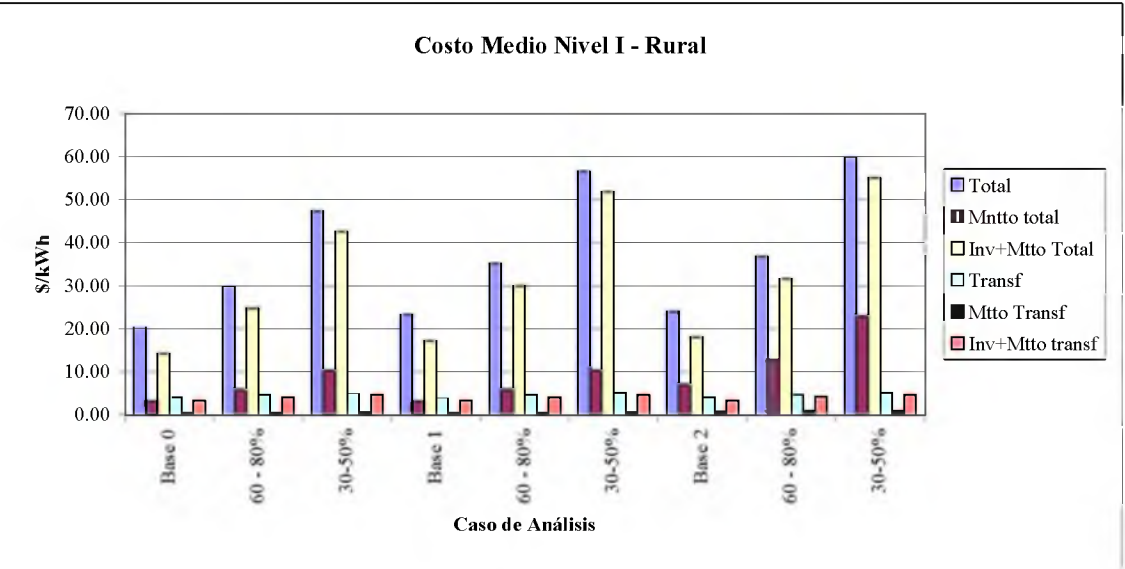
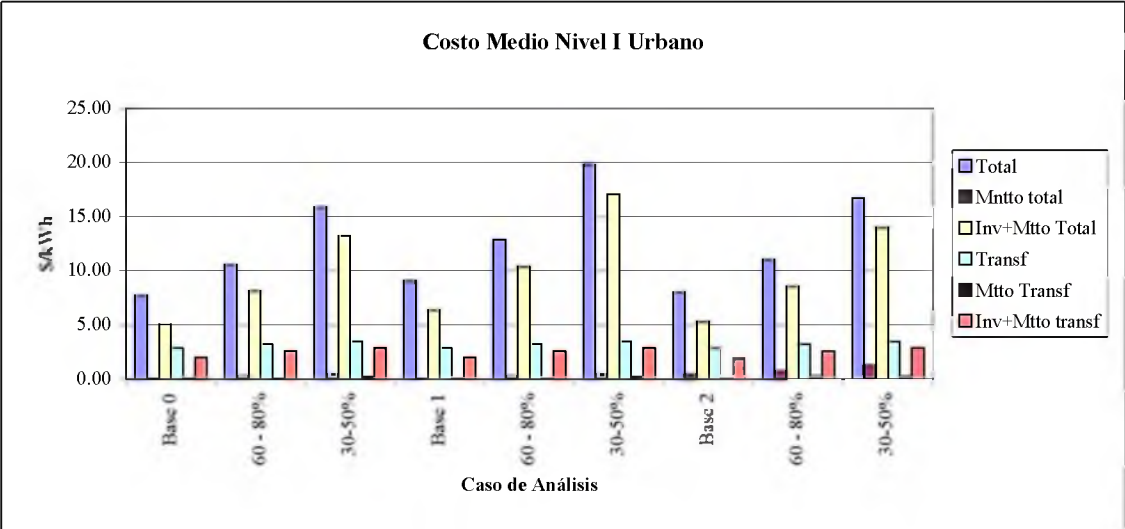
Red de Baja Tension - Urbano Trifásico: 9 Usuarios Equivalentes a 35 m cada carga																							
Conductor	Rango de Carga kVA	Costo Total [miles \$]				Costo Anual [miles\$]				Costo Medio		Costo Medio		VP Costo Inv. miles \$		VP Costo miles \$		VP Costo Pérdidas miles \$		Pérdidas [kWh]		% de Pérdidas	
		Inicial	Final	Inicial	Final	Inicial	Final	Inicial	Final	miles \$	miles \$	miles \$	miles \$	miles \$	miles \$	Inicial	Final	Inicial	Final				
8	1.00	5.91	3,951.71	4,365.46	648.13	715.99	720.145	134,523	137.01	25.59	3,118.19	3,118.19	782.45	782.45	15.08	527.31	42.31	1479.77	0.81%	4.76%			
6	5.91	5.91	4,365.46	4,365.46	715.99	715.99	134,523	134,523	25.59	25.59	3,118.19	3,308.34	782.45	782.45	527.31	335.15	940.53	940.53	3.03%	3.03%			
4	5.91	21.44	4,365.46	6,465.38	715.99	1,060.40	134,523	54,961	25.59	10.46	3,308.34	3,388.85	782.45	782.45	335.15	2,799.21	597.79	7855.30	1.92%	6.97%			
2	21.44	24.67	6,465.38	6,932.89	1,060.40	1,137.08	54,961	51,209	10.46	9.74	3,388.85	4,216.38	782.45	782.45	2,799.21	2,359.91	5000.07	6622.51	4.44%	5.11%			
1	24.67	35.67	6,932.89	8,650.81	1,137.08	1,418.84	51,209	44,199	9.74	8.41	4,216.38	4,558.72	782.45	782.45	2,359.91	4,038.38	5422.28	11332.71	4.18%	6.05%			
1/0	35.67	41.49	8,650.81	9,555.49	1,418.84	1,567.22	44,199	41,971	8.41	7.99	4,558.72	5,294.33	782.45	782.45	4,038.38	4,244.68	8803.46	11911.64	4.70%	5.46%			
1/0 Al - A	35.67	41.49	9,584.26	10,491.98	1,571.94	1,720.82	48,969	46,085	9.32	8.77	7,007.66	7,007.66	5.62	5.62	3,137.09	4,244.68	8,803.46	11,911.64	4.70%	5.46%			
1/0 Al - A - Tr	35.67	41.49	8,645.46	9,553.18	1,417.96	1,566.84	44,172	41,961	8.40	7.98	6,068.86	6,068.86	5.62	5.62	3,137.09	4,244.68	8,803.46	11,911.64	4.70%	5.46%			
2/0	41.49	64.13	9,555.49	13,420.50	1,567.22	2,201.13	41,971	38,138	7.99	7.26	5,294.33	5,955.74	782.45	782.45	4,244.68	8,153.69	9,577.55	22,881.30	4.39%	6.79%			
4/0	64.13	84.18	13,420.50	16,460.11	2,201.13	2,699.67	38,138	35,634	7.26	6.78	5,955.74	8,322.48	782.45	782.45	8,153.69	8,974.71	14,616.03	25,185.30	4.34%	5.69%			

Sistema Eficiente Trifásico Rural

Transformador	No Ram	kVA/Ramal		Calibre Cond		CA Red [k\$]		CA Trafo [k\$]		Costo Total [k\$]		CM [\$/kW]		CM [\$/kWh]		Costo Inv [k\$]		Costo Mantenm [k\$]		Costo Pérdidas [k\$]		Pérdidas [kWh]		% de Pérdidas	
15	2	1.39	3.48	8	8	438	470	849	857	1,287	1,327	513,349	211,627	130.23	53.69	4,520.92	4,520.92	2,567.67	2,567.67	317	554	750	1,414	7.59%	5.72%
30	2	3.48	7.20	8	4	1,236	1,779	1,008	1,023	2,244	2,802	357,965	216,295	90.81	54.87	8,525.03	8,970.11	4,107.74	4,107.74	524	3,475	1,236	9,516	5.00%	18.63%
45	2	7.20	10.68	4	4	1,330	1,779	1,147	1,167	2,477	2,946	191,179	153,246	48.50	38.88	9,440.01	9,572.40	4,107.74	4,107.74	956	3,675	2,089	9,997	4.09%	13.19%
75	2	10.68	17.88	4	4	1,664	2,175	1,369	1,400	3,033	3,576	157,771	111,106	40.02	28.19	11,710.99	11,872.01	4,664.16	4,664.16	1,405	4,534	3,068	12,260	4.05%	9.66%
112.5	2	17.88	26.93	4	1	1,664	2,803	1,673	1,717	3,337	4,520	103,694	93,222	26.31	23.65	13,022.56	15,523.33	4,664.16	4,664.16	1,787	6,473	3,967	17,527	3.13%	9.17%

Sistema Eficiente Bifásico Rural

Transformador	No Ram	kVA/Ramal		Calibre Cond		CA Red [k\$]		CA Trafo [k\$]		Costo Total [k\$]		CM [\$/kW]		CM [\$/kWh]		Costo Inv [k\$]		Costo Mantenm [k\$]		Costo Pérdidas [k\$]		Pérdidas [kWh]		% de Pérdidas	
15	3	0.93	2.32	#N/A	8	#N/A	704	849	857	#N/A	1,562	#N/A	249,084	#N/A	63.19	#N/A	5,334.21	#N/A	3,084.34	#N/A	655	#N/A	1,699	#N/A	6.88%
30	3	2.32	4.80	8	8	1,855	1,957	1,008	1,023	2,862	2,980	456,575	229,991	115.82	58.34	10,999.84	10,999.84	5,394.45	5,394.45	532	1,240	1,257	3,245	5.09%	6.35%
45	3	4.80	7.12	8	4	1,855	2,669	1,147	1,167	3,002	3,836	231,669	199,519	58.77	50.61	11,602.14	12,269.76	5,394.45	5,394.45	706	5,115	1,667	14,038	3.26%	18.52%
75	3	7.12	11.92	4	4	2,497	3,263	1,369	1,400	3,865	4,663	201,057	144,901	51.00	36.76	15,019.33	15,260.86	6,229.06	6,229.06	1,606	6,212	3,426	16,968	4.52%	13.38%
112.5	3	11.92	17.96	4	4	2,497	3,263	1,673	1,717	4,169	4,980	129,554	102,716	32.87	26.06	16,330.90	16,572.43	6,229.06	6,229.06	1,988	6,666	4,325	18,067	3.41%	9.45%



6.3 Datos Usados para la Estimación de Pérdidas

Demanda Máxima Diversificada

LINEAL				
PE Pérdidas de Energía con DMD (kWh)	Carga DMD (kVA)	Ramales por Trafo	Usuarios equiv. por Ramal	Longitud por Ramal
1576.132	20.143	3	2	64
438.000	4.118	1	2	20
1002.080	21.525	2	4	159
1287.160	37.009	2	4	115
1933.563	45.067	2	3	105
2563.973	42.723	2	3	102
2936.540	47.340	2	4	139
521.579	11.573	2	3	275
559.262	11.573	2	3	331
740.099	20.143	3	4	340
1607.050	32.126	3	4	267
1924.809	35.785	3	6	613
1590.607	34.546	2	4	149
2327.441	60.857	3	4	142
2410.484	60.857	3	4	143
2908.619	45.067	4	7	903
962.353	21.525	2	5	156
1024.517	7.055	1	1	30
1438.123	29.620	2	5	168
3723.947	53.735	2	8	238
4110.603	51.285	2	5	160
5497.423	76.621	3	5	161
4988.067	51.285	2	4	126
7456.275	120.335	3	5	147
770.478	11.573	2	2	131
1481.487	27.061	2	6	240
2228.059	39.395	2	5	171
5084.167	79.283	2	9	239
4179.381	56.178	2	8	295
8585.399	100.469	2	9	286
18644733.075	286.035	2	16	480

$\alpha =$ 95%

Demanda Máxima Diversificada

LOGARITMO NATURAL				
PE Pérdidas de Energía con DMD (kWh)	Carga DMD (kVA)	Ramales por Trafo	Usuarios por Ramal	Longitud por Ramal
7.363	3.003	1.099	0.693	4.159
6.082	1.415	0.000	0.693	2.996
6.910	3.069	0.693	1.386	5.069
7.160	3.611	0.693	1.386	4.745
7.567	3.808	0.693	1.099	4.654
7.849	3.755	0.693	1.099	4.625
7.985	3.857	0.693	1.386	4.934
6.257	2.449	0.693	1.099	5.617
6.327	2.449	0.693	1.099	5.802
6.607	3.003	1.099	1.386	5.829
7.382	3.470	1.099	1.386	5.587
7.563	3.578	1.099	1.792	6.418
7.372	3.542	0.693	1.386	5.004
7.753	4.109	1.099	1.386	4.956
7.788	4.109	1.099	1.386	4.963
7.975	3.808	1.386	1.946	6.806
6.869	3.069	0.693	1.609	5.050
6.932	1.954	0.000	0.000	3.401
7.271	3.388	0.693	1.609	5.124
8.223	3.984	0.693	2.079	5.472
8.321	3.937	0.693	1.609	5.075
8.612	4.339	1.099	1.609	5.081
8.515	3.937	0.693	1.386	4.836
8.917	4.790	1.099	1.609	4.990
6.647	2.449	0.693	0.693	4.875
7.301	3.298	0.693	1.792	5.481
7.709	3.674	0.693	1.609	5.142
8.534	4.373	0.693	2.197	5.476
8.338	4.029	0.693	2.079	5.687
9.058	4.610	0.693	2.197	5.656
16.741	5.656	0.693	2.773	6.174

$\alpha =$ 95%

Carga Medida

LINEAL				
PE Pérdidas de Energía con Carga medida (kWh)	Carga Medida (kVA)	Ramales por Trafo	Usuarios equiv. por Ramal	Longitud por Ramal
2920.972	7.200	3	2	64
438.000	3.385	1	2	20
6566.208	3.016	2	4	159
3295.937	9.710	2	4	115
4984.889	14.250	2	3	105
5784.441	17.486	2	3	102
6038.110	18.989	2	4	139
1113.148	2.205	2	3	275
1061.687	3.385	2	3	331
1148.795	6.121	3	4	340
4523.977	9.947	3	4	267
7969.782	8.277	3	6	613
2589.909	13.652	2	4	149
5758.050	19.770	3	4	142
4388.943	20.067	3	4	143
6254.759	10.200	4	7	903
2618.810	4.751	2	5	156
1015.019	7.375	1	1	30
2899.600	6.573	2	5	168
10990.825	18.728	2	8	238
7155.654	25.659	2	5	160
8520.416	45.165	3	5	161
6722.199	32.537	2	4	126
17590.822	47.158	3	5	147
865.319	5.740	2	2	131
2188.830	10.145	2	6	240
3980.361	14.794	2	5	171
16713.080	26.340	2	9	239
7344.737	26.842	2	8	295
20887.287	41.906	2	9	286
144418973.321	64.800	2	16	480

$\alpha =$ 95%

Carga Medida

LOGARITMO NATURAL				
PE Pérdidas de Energía con Carga medida (kWh)	Carga Medida (kVA)	Ramales por Trafo	Usuarios equiv. por Ramal	Longitud por Ramal
7.980	1.974	1.099	0.693	4.159
6.082	1.219	0.000	0.693	2.996
8.790	1.104	0.693	1.386	5.069
8.100	2.273	0.693	1.386	4.745
8.514	2.657	0.693	1.099	4.654
8.663	2.861	0.693	1.099	4.625
8.706	2.944	0.693	1.386	4.934
7.015	0.791	0.693	1.099	5.617
6.968	1.219	0.693	1.099	5.802
7.046	1.812	1.099	1.386	5.829
8.417	2.297	1.099	1.386	5.587
8.983	2.113	1.099	1.792	6.418
7.859	2.614	0.693	1.386	5.004
8.658	2.984	1.099	1.386	4.956
8.387	2.999	1.099	1.386	4.963
8.741	2.322	1.386	1.946	6.806
7.870	1.558	0.693	1.609	5.050
6.923	1.998	0.000	0.000	3.401
7.972	1.883	0.693	1.609	5.124
9.305	2.930	0.693	2.079	5.472
8.876	3.245	0.693	1.609	5.075
9.050	3.810	1.099	1.609	5.081
8.813	3.482	0.693	1.386	4.836
9.775	3.854	1.099	1.609	4.990
6.763	1.747	0.693	0.693	4.875
7.691	2.317	0.693	1.792	5.481
8.289	2.694	0.693	1.609	5.142
9.724	3.271	0.693	2.197	5.476
8.902	3.290	0.693	2.079	5.687
9.947	3.735	0.693	2.197	5.656
18.788	4.171	0.693	2.773	6.174

$\alpha =$ 95%

Carga Medida

LOGARITMO NATURAL CON TOTALES			
PE Pérdidas de Energía con Carga medida (kWh)	Carga Medida (kVA)	Usuarios equiv. Totales	Longitud Total
7.980	1.974	1.792	5.257
6.082	1.219	0.693	2.996
8.790	1.104	2.079	5.762
8.100	2.273	2.079	5.438
8.514	2.657	1.792	5.347
8.663	2.861	1.792	5.318
8.706	2.944	2.079	5.628
7.015	0.791	1.792	6.310
6.968	1.219	1.792	6.495
7.046	1.812	2.485	6.928
8.417	2.297	2.485	6.686
8.983	2.113	2.890	7.517
7.859	2.614	2.079	5.697
8.658	2.984	2.485	6.054
8.387	2.999	2.485	6.061
8.741	2.322	3.332	8.192
7.870	1.558	2.303	5.743
6.923	1.998	0.000	3.401
7.972	1.883	2.303	5.817
9.305	2.930	2.773	6.165
8.876	3.245	2.303	5.768
9.050	3.810	2.708	6.180
8.813	3.482	2.079	5.529
9.775	3.854	2.708	6.089
6.763	1.747	1.386	5.568
7.691	2.317	2.485	6.174
8.289	2.694	2.303	5.835
9.724	3.271	2.890	6.170
8.902	3.290	2.773	6.380
9.947	3.735	2.890	6.349
18.788	4.171	3.466	6.867

$\alpha =$ 95%

Carga Medida

LOGARITMO NATURAL CON TOTALES			
PE Pérdidas de Energía con Carga medida (kWh)	Carga Medida (kVA)	Usuarios equiv. Totales	Longitud entre Usuarios
7.980	1.974	1.792	3.714
6.082	1.219	0.693	2.303
8.790	1.104	2.079	3.932
8.100	2.273	2.079	3.555
8.514	2.657	1.792	3.466
8.663	2.861	1.792	3.611
8.706	2.944	2.079	3.401
7.015	0.791	1.792	4.977
6.968	1.219	1.792	4.500
7.046	1.812	2.485	4.543
8.417	2.297	2.485	4.205
8.983	2.113	2.890	4.700
7.859	2.614	2.079	3.611
8.658	2.984	2.485	3.526
8.387	2.999	2.485	3.296
8.741	2.322	3.332	4.868
7.870	1.558	2.303	3.466
6.923	1.998	0.000	3.401
7.972	1.883	2.303	3.951
9.305	2.930	2.773	3.367
8.876	3.245	2.303	3.526
9.050	3.810	2.708	3.296
8.813	3.482	2.079	3.401
9.775	3.854	2.708	3.555
6.763	1.747	1.386	3.951
7.691	2.317	2.485	3.871
8.289	2.694	2.303	3.584
9.724	3.271	2.890	3.332
8.902	3.290	2.773	3.584
9.947	3.735	2.890	3.526
18.788	4.171	3.466	3.401

$\alpha =$ 95%