6.6 FUND PLANNING

(1) Funds Required

Yearly required funds, classified into domestic and foreign currencies, are presented on Table II-6-18. When they are transformed into present value by an annual rate of 8%, it will be 1,493.2 million yen for domestic currencies and 1,437.1 million yen for foreign currencies. As for additional construction cost, it is classified into F-C and D-C by its ratio to construction cost. 5% of administration cost and 30% of maintenance repairs cost are estimated each on F-C.

Table II-6-18 Funds Required (Domestic, Foreign Currencies)

(Unit: 10^6 Yen)

	Construction Cost		Additional Construction Cost		Administration & Maintenance R.C.		Purchased-energy Cost	Total	
	F.C.	D.C.	F.C.	D.C.	F.C.	D.C.	D.C.	F.C.	D.C.
1980	405.6	108.9			0.3	4.8		405.9	113.7
81	580.1	186.4			0.6	12.2		580.7	198.6
82	353.4	178.2			0.9	17.2	11.2	354.3	206.6
83	18.9	19.5	55.5	21.9	1.0	18.3	32.7	75.4	92.4
84			55.5	21.9	1.0	19.1	38.7	56.5	79.7
85			3.4	1.4	1.0	19.1	44.6	4.4	65.1
86			3.8	1.5	8.9	37.5	48.0	12.7	87.0
87			6.7	2.5	8.9	37.7	51.0	15.6	91.2
88			8.1	3.0	9.0	37.8	54.2	17.1	95.0
89			9.1	3.3	9.0	38.1	57.7	18.1	99.1
90			6.2	2.0	9.0	38.3	61.4	15.2	101.7
91			6.7	2.2	9.1	38.4	65.4	15.8	106.0
92			23.8	6.0	9.2	39.0	69.7	33.0	114.7
93			7.1	2.4	9.3	39.1	74.2	16.4	115.7
94			7.5	2.5	9.3	39.3	79.1	16.8	120.9
95			7.9	2.7	9.4	39.5	84.3	17.3	126.5
96			42.6	10.4	9.6	40.5	89.7	52.2	140.6
97			8.3	2.8	9.6	40.8	95.4	17.9	139.0
98			9.0	3.1	9.7	40.9	101.5	18.7	145.5
99			9.5	3.2	9.7	41.2	108.0	19.2	152.4
2000			9.9	3.4	9.8	41.4	114.9	19.7	159.7
1			48.1	11.9	10.1	42.5	122.0	58.2	176.4
2			10.8	3.7	10.1	42.9	129.6	21.0	176.2
3			45.9	11.5	10.4	43.9	137.6	56.3	193.0
4			11.9	4.0	10.5	44.1	146.1	22.4	194.2

(2) Depreciation

a. For initial investment, 535 million yen is distributed to construction cost for six items, namely, temporary facilities, spare parts, contingency, engineering fee, administrative expenses and survey and measuring according to their ratios to construction cost in F-C and D-C.

b. Depreciation rates are set to be as follows (from TANESCO Annual Report):

33 kV	2-4/7
11 kV, low-tension lines, service lines, street lights	3-1/4
transformers, substations	4-3/4
vehicles	22-1/2

c. Life-over worth to be 10% is estimated.

d. Yearly depreciation expenses according to the calculation method is shown on Table II-6-19.

Table II-6-19 Yearly Depreciation Expenses

Year	Depreciation Expenses	Year	Depreciation Expenses
1980	24.5	1993	82.2
81	56.5	94	82.5
82	73.8	95	82.9
83	76.6	96	85.0
84	78.9	97	85.4
85	79.0	98	85.8
86	79.2	99	86.2
87	79.5	2000	86.6
88	79.8	1	89.0
89	80.2	2	89.5
90	80.5	3	91.8
91	80.7	4	92.3
92	81.9		

(Unit: 10^6 Yen)

(3) Service Line Charge

a. TANESCO has a system to collect construction cost allotment charge for service line installation from a new consumer subscription. There are two different rates, one for single-phase and the other for three-phase.

	(Single-phase)	(Three-phase)
For the first 60 meters	400 T.shs.	1,000 T.shs.
each meter up to 200 meters	10	20
pole	250	250

b. Both single-phase and three-phase are calculated with their minimum charges.

c. Among the 1,650 consumers for initial construction, the number of consumers for the single-phase is set to be 1,300 consumers and for the three-phase to be 350. Later, among the cases increased, 20% of Tariffs 3 and 4 and Tariff 2 are set to be three-phase. And as for the ratio of composition among the Tariffs, the ratio used in initial demand is employed as it is.

(Single-phase)

$$\frac{3,717 + 1,321 \times 0.8 + 375}{5,624} = 0.916 \fallingdotseq 0.92$$

(Three-phase)

$$1 - 0.92 = 0.08$$

d. Yearly service line charges obtained through the method are shown on Table II-6-20.

Table II-6-20 Yearly Service Line Charges

Year	Number of consumers increased (consumers)	Single-phase	Three-phase	Service line Charge (10^3 Yen)
1980	245	193	52	3,230
81	378	298	80	4,980
82	995	784	211	13,115
83	1,858	1,705	153	20,875
84	1,826	1,680	146	20,450
85	76	70	6	850
86	84	77	7	945
87	84	77	7	945
88	92	85	7	1,025
89	92	85	7	1,025
1990	113	104	9	1,265
91	123	113	10	1,380
92	118	109	9	1,315
93	131	121	10	1,460
94	136	125	11	1,525
95	144	132	12	1,620
96	150	138	12	1,680
97	149	137	12	1,670
98	168	155	13	1,875
99	173	159	14	1,940
2000	188	173	15	2,105
1	197	181	16	2,210
2	206	190	16	2,300
3	218	201	17	2,435
4	223	205	18	2,500

(4) Repayment Planning

a. The repayment period and interests for fund raising are assumed to be as follows:
   Interest rate: 1.5%, 3%, 5% per year
   Method of repayment: 30 years including moratorium period of 10 years

b. If the total amount of initial construction cost is assumed to be financed by foreign aid (annual rate of 1.5%) and additional construction cost and others to be raised by TANESCO itself, yearly net income and cash balance will be as shown on Table II-6-21~22 (case I). The amount of maximum cumulative deficit will be 38.5 million yen in 1983, and the year the balance goes into the black will be 1985.

c. Cash balance, when annual rates of 3% and 5% are set as a condition of investment is shown on Table II-6-24~25 (case II), 27~28 (case III). The amount of cumulative deficit will be 129.9 million yen (1984) with an annual rate of 3%, and the year the balance goes into the black will be 1987. With an annual rate of 5%, the amount of cumulative deficit will be 480.9 million yen (1996), and the balance does not go into the black before 2004.

Table II-6-21 Statement of Income (Case I)

(Unit; 10^6 Yen)

Year	Revenue Sale of Energy (A)	Expense			Total Operating Cost (B)	Operating Income (A-B=C)	Interest (1.5%) (D)	Net Income (C – D)
		Operation & maintenance	Depreciation	Perchased energy				
1980		5.1	24.5		29.6	-29.6	7.7	-37.3
1981		12.8	56.5		69.3	-69.3	19.2	-88.5
1982	48.5	18.1	73.8	11.2	103.1	-54.6	27.2	-81.8
1983	129.3	19.3	76.6	32.7	128.6	0.7	27.8	-27.1
1984	161.5	20.1	78.9	38.7	137.7	23.8	27.8	-4.0
1985	193.8	20.1	79.0	44.6	143.7	50.1	27.8	22.3
1986	186.2	46.4	79.2	48.0	173.6	12.6	27.8	-15.2
1987	196.0	46.6	79.5	51.0	177.1	18.9	27.8	-8.9
1988	206.0	46.8	79.8	54.2	180.8	25.2	27.8	-2.6
1989	216.3	47.1	80.2	57.7	185.0	31.3	27.8	3.5
1990	227.2	47.3	80.5	61.4	189.2	38.0	27.8	10.2
1991	239.8	47.5	80.7	65.4	193.6	46.2	27.4	18.8
1992	252.1	48.2	81.9	69.7	199.8	52.3	26.4	25.9
1993	266.8	48.4	82.2	74.2	204.8	62.0	25.1	36.9
1994	280.2	48.6	82.5	79.1	210.2	70.0	23.7	46.3
1995	295.0	48.9	82.9	84.3	216.1	78.9	22.3	56.6
1996	310.1	50.1	85.0	89.7	224.8	85.3	20.9	64.4
1997	326.0	50.4	85.4	95.4	231.2	94.8	19.6	75.2
1998	342.6	50.6	85.8	101.5	237.9	104.7	18.1	86.6
1999	360.0	50.9	86.2	108.0	245.1	114.9	16.7	98.2
2000	378.3	51.2	86.6	114.9	252.7	125.6	15.4	110.2
2001	396.6	52.6	89.0	122.0	263.6	133.0	14.0	119.0
2002	415.9	53.0	89.5	129.6	272.1	143.8	12.6	131.2
2003	435.8	54.3	91.8	137.6	283.7	152.1	11.2	140.9
2004	456.7	54.6	92.3	146.1	293.0	163.7	9.8	153.9

Table II-6-22 Statement of Cash Flow (Case I)

(Unit; 10^6 Yen)

	Cash Receipt					Cash Disbursement					
	Operating Income	Depreciation	Exterior Borrowing	Service line charge	Sub-total (A)	Construction expenditure	(1.5%) Interest	Amortization of debt	Sub-total (B)	Cash Balance (A) − (B)	Accumulated Total
1980	-29.6	24.5	514.5	3.2	512.6	514.5	7.7		522.2	-9.6	-9.6
1981	-69.3	56.5	766.5	5.0	758.7	766.5	19.2		785.7	-27.0	-36.6
1982	-54.6	73.8	531.6	13.1	563.9	531.6	27.2		558.8	5.1	-31.5
1983	0.7	76.6	38.4	20.9	136.6	115.8	27.8		143.6	-7.0	-38.5
1984	23.8	78.9		20.5	123.2	77.4	27.8		105.2	18.0	-20.5
1985	50.1	79.0		0.9	130.0	4.8	27.8		32.6	97.4	76.9
1936	12.6	79.2		0.9	92.7	5.3	27.8		33.1	59.6	136.5
1987	18.9	79.5		0.9	99.3	9.2	27.8		37.0	62.3	198.8
1988	25.2	79.8		1.0	106.0	11.1	27.8		38.9	67.1	265.9
1989	31.3	80.2		1.0	112.5	12.4	27.8		40.2	72.3	338.2
1990	38.0	80.5		1.3	119.8	8.3	27.8	25.7	61.8	58.0	396.2
1991	46.2	80.7		1.4	128.3	8.9	27.4	64.0	100.3	28.0	424.2
1992	52.3	81.9		1.3	135.5	29.8	26.4	90.6	146.8	-11.3	412.9
1993	62.0	82.2		1.5	145.7	9.5	25.1	92.5	127.1	18.6	431.5
1994	70.0	82.5		1.5	154.0	10.0	23.7	92.5	126.2	27.8	459.3
1995	78.9	82.9		1.6	163.4	10.6	22.3	92.5	125.4	38.0	497.3
1996	85.3	85.0		1.7	172.0	53.0	20.9	92.5	166.4	5.6	502.9
1997	94.8	85.4		1.7	181.9	11.1	19.6	92.5	123.2	58.7	561.6
1993	104.7	85.8		1.9	192.4	12.1	18.1	92.5	122.7	69.7	631.3
1999	114.9	86.2		1.9	203.0	12.7	16.7	92.5	121.9	81.1	712.4
2000	125.6	86.6		2.1	214.3	13.3	15.4	92.5	121.1	93.1	805.5
2001	133.0	89.0		2.2	224.2	60.0	14.0	92.5	166.5	57.7	863.2
2002	143.8	89.5		2.3	235.6	14.6	12.6	92.5	119.7	115.9	979.1
2003	152.1	91.8		2.4	246.3	57.4	11.2	92.5	161.1	84.2	1,064.3
2004	163.7	92.3		2.5	258.5	15.9	9.8	92.5	118.2	140.3	1,204.6

Note: 1 Total amount of Initial Construction Cost is financed by Foreign Aid.

2 Loan Condition ... Interest of 1.5% per year
Repayment period of 30 years including moratorium period of 10 years.

Table II-6-23 Amortization Schedule (Case I)

(Unit: 10^6 Yen)

		Borrowing	Redamption			
		Construction Cost	Principal	Interest	Total	Outstanding Balance
1	1980	514.5		7.7	7.7	514.5
2	1981	766.5		19.2	19.2	1,281.0
3	1982	531.6		27.2	27.2	1,282.6
4	1983	38.4		27.8	27.8	1,851.0
5	1984			27.8	27.8	1,851.0
6	1985			27.8	27.8	1,851.0
7	1986			27.8	27.8	1,851.0
8	1987			27.8	27.8	1,851.0
9	1988			27.8	27.8	1,851.0
10	1989			27.8	27.8	1,851.0
11	1990		25.7	27.8	53.5	1,825.3
12	1991		64.0	27.4	91.4	1,761.3
13	1992		90.6	26.4	117.0	1,670.7
14	1993		92.5	25.1	117.6	1,578.2
15	1994		92.5	23.7	116.2	1,485.7
16	1995		92.5	22.3	114.8	1,393.2
17	1996		92.5	20.9	113.4	1,300.7
18	1997		92.5	19.6	112.1	1,208.2
19	1998		92.5	18.1	110.6	1,115.7
20	1999		92.5	16.7	109.2	1,023.2
21	2000		92.5	15.4	107.9	930.7
22	2001		92.5	14.0	106.5	838.2
23	2002		92.5	12.6	105.1	745.7
24	2003		92.5	11.2	103.7	653.2
25	2004		92.5	9.8	102.3	560.7
26	2005		92.5	8.4	100.9	468.2
27	2006		92.5	7.0	99.5	375.7
28	2007		92.5	5.6	98.1	283.2
29	2008		92.5	4.2	96.7	190.7
30	2009		92.5	2.9	95.4	98.2
31	2010		65.8	1.5	67.3	32.4
32	2011		29.5	0.5	30.0	2.9
33	2012		2.9	0.0	2.9	0.0

Table II-6-24 Statement of Income (Case II)

(Unit: 10^6 Yen)

Year	Revenue Sale of Energy (A)	Expense Operation & maintenance	Depreciation	Perchased energy	Total Operating Cost (B)	Operating Income (A – B = C)	Interest (3.0%) (D)	Net Income (C – D)
1980		5.1	24.5		29.6	–29.6	15.4	–45.0
1981		12.8	56.5		69.3	–69.3	38.4	–107.7
1982	48.5	18.1	73.8	11.2	103.1	–54.6	54.3	–108.9
1983	129.3	19.3	76.6	32.7	128.6	0.7	55.5	–54.8
1984	161.5	20.1	78.9	38.7	137.7	23.8	55.5	–31.7
1985	193.8	20.1	79.0	44.6	143.7	50.1	55.5	–5.4
1986	186.2	46.4	79.2	48.0	173.6	12.6	55.5	–42.9
1987	196.0	46.6	79.5	51.0	177.1	18.9	55.5	–36.6
1988	206.0	46.8	79.8	54.2	180.8	25.2	55.5	–30.3
1989	216.3	47.1	80.2	57.7	185.0	31.3	55.5	–24.2
1990	227.2	47.3	80.5	61.4	189.2	38.0	55.5	–17.5
1991	239.8	47.5	80.7	65.4	193.6	46.2	54.8	–8.6
1992	252.1	48.2	81.8	69.7	199.8	52.3	52.8	–0.5
1993	266.8	48.4	82.2	74.2	204.8	62.0	50.2	11.8
1994	280.2	48.6	82.5	79.1	210.2	70.0	47.4	22.6
1995	295.0	48.9	82.9	84.3	216.1	78.9	44.6	34.3
1996	310.1	50.1	85.0	89.7	224.8	85.3	41.9	43.4
1997	326.0	50.4	85.4	95.4	231.2	94.8	39.0	55.8
1998	342.6	50.6	85.8	101.5	237.9	104.7	36.4	68.3
1999	360.0	50.9	86.2	108.0	245.1	114.9	33.5	81.4
2000	578.3	51.2	86.6	114.9	252.7	125.6	30.8	94.8
2001	396.6	52.6	89.0	122.0	263.6	133.0	28.0	105.0
2002	415.9	53.0	89.5	129.6	272.1	143.8	25.2	118.6
2003	435.8	54.3	91.8	137.6	283.7	152.1	22.4	129.7
2004	456.7	54.6	92.3	146.1	293.0	163.7	19.6	144.1

Table II-6-25 Statement of Cash Flow (Case II)

(Unit: 10^6 Yen)

	Cash Receipt					Cash Disbursment					
	Operating Income	Depreciation	Exterior Borrowing	Service line charge	Sub-total (A)	Construction expenditure	(3.0%) Interest	Amortization of debt	Sub-total (B)	Cash Balance (A) – (B)	Accumulated Total
1980	-29.6	24.5	514.5	3.2	512.6	514.5	15.4		529.9	-17.3	-17.3
1981	-69.3	56.5	766.5	5.0	758.7	766.5	38.4		804.9	-46.2	-63.5
1982	-54.6	73.8	531.6	13.1	563.9	531.6	54.3		585.9	-22.0	-85.5
1983	0.7	76.6	38.4	20.9	136.6	115.8	55.5		171.3	-34.7	-120.2
1984	23.8	78.9		20.5	123.2	77.4	55.5		132.9	-9.7	-129.9
1985	50.1	79.0		0.9	130.0	4.8	55.5		60.3	69.7	-60.2
1986	12.6	79.2		0.9	92.7	5.3	55.5		60.8	31.9	-28.3
1987	18.9	79.5		0.9	99.3	9.2	55.5		64.7	34.6	6.3
1988	25.2	79.8		1.0	106.0	11.1	55.5		66.6	39.4	45.7
1989	31.3	80.2		1.0	112.5	12.4	55.5		67.9	44.6	90.3
1990	38.0	80.5		1.3	119.8	8.3	55.5	25.7	89.5	30.3	120.6
1991	46.2	80.7		1.4	128.3	8.9	54.8	64.0	127.7	0.6	121.2
1992	52.3	81.9		1.3	135.5	29.8	52.8	90.6	173.2	-37.7	83.5
1993	62.0	82.2		1.5	145.7	9.5	50.2	92.5	152.2	-6.5	77.0
1994	70.0	82.5		1.5	154.0	10.0	47.4	92.5	149.9	4.1	81.1
1995	78.9	82.9		1.6	163.4	10.6	44.6	92.5	147.7	15.7	96.8
1996	85.3	85.0		1.7	172.0	53.0	41.9	92.5	187.4	15.4	112.2
1997	94.8	85.4		1.7	181.9	11.1	39.0	92.5	142.6	39.3	151.5
1998	104.7	85.8		1.9	192.4	12.1	36.4	92.5	141.0	51.4	202.9
1999	114.9	86.2		1.9	203.0	12.7	33.5	92.5	138.7	64.3	267.2
2000	125.6	86.6		2.1	214.3	13.3	30.8	92.5	136.6	77.7	344.9
2001	133.0	89.0		2.2	224.2	60.0	28.0	92.5	180.5	43.7	388.6
2002	143.8	89.5		2.3	235.6	14.6	25.2	92.5	132.3	103.3	491.9
2003	152.1	91.8		2.4	246.3	57.4	22.4	92.5	172.3	74.0	565.9
2004	16.37	92.3		2.5	258.5	15.9	19.6	92.5	128.0	130.5	696.4

Note: 1 Total amount of Initial Construction Cost is financed by Foreign Aid.
2 Loan Condition ... Interest of 3% per year
Payment period of 30 years including moratorium period of 10 years.

Table II-6-26 Amortization Schedule (Case II)

(Unit: 10^6 Yen)

		Borrowing Construction Cost	Redamption			Outstanding Balance
			Principal	Interest	Total	
1	1980	514.5		15.4	15.4	514.5
2	1981	766.5		38.4	38.4	1,281.0
3	1982	531.6		54.3	54.3	1,282.6
4	1983	38.4		55.5	55.5	1,851.0
5	1984			55.5	55.5	1,851.0
6	1985			55.5	55.5	1,851.0
7	1986			55.5	55.5	1,851.0
8	1987			55.5	55.5	1,851.0
9	1988			55.5	55.5	1,851.0
10	1989			55.5	55.5	1,851.0
11	1990		25.7	55.5	81.2	1,825.3
12	1991		64.0	54.8	111.8	1,761.3
13	1992		90.6	52.8	143.4	1,670.7
14	1993		92.5	50.2	142.7	1,578.2
15	1994		92.5	47.4	139.9	1,485.7
16	1995		92.5	44.6	137.1	1,393.2
17	1996		92.5	41.9	134.4	1,300.7
18	1997		92.5	39.0	131.5	1,208.2
19	1998		92.5	36.4	128.9	1,115.7
20	1999		92.5	33.5	126.0	1,023.2
21	2000		92.5	30.8	123.3	930.7
22	2001		92.5	28.0	120.5	838.2
23	2002		92.5	25.2	117.7	745.7
24	2003		92.5	22.4	114.9	653.2
25	2004		92.5	19.6	112.1	560.7
26	2005		92.5	16.8	109.3	468.2
27	2006		92.5	14.0	106.5	375.7
28	2007		92.5	11.3	103.8	283.2
29	2008		92.5	8.5	101.0	190.7
30	2009		92.5	5.7	98.2	98.2
31	2010		65.8	2.9	68.7	32.4
32	2011		29.5	1.0	30.5	2.9
33	2012		2.9	0.1	3.0	0.0

Table II-6-27 Statement of Income (Case III)

(Unit: 10^6 Yen)

Year	Revenue Sale of Energy (A)	Expense Operation & maintenance	Expense Depreciation	Expense Perchased energy	Total Operating Cost (B)	Operating Income (A – B = C)	Interest (5.0%) (D)	Net Income (C – D)
1980		5.1	24.5		29.6	-29.6	25.7	-55.3
1981		12.8	56.5		69.3	-69.3	64.0	-133.3
1982	48.5	18.1	73.8	11.2	103.1	-54.6	90.6	-145.2
1983	129.3	19.3	76.6	32.7	128.6	0.7	92.5	-91.8
1984	161.5	20.1	78.9	38.7	137.7	23.8	92.5	-68.7
1985	193.8	20.1	79.0	44.6	143.7	50.1	92.5	-42.4
1986	186.2	46.4	79.2	48.0	173.6	12.6	92.5	-79.9
1987	196.0	46.6	79.5	51.0	177.1	18.9	92.5	-73.6
1988	206.0	46.8	79.8	54.2	180.8	25.2	92.5	-67.3
1989	216.3	47.1	80.2	57.7	185.0	31.3	92.5	-61.2
1990	227.2	47.3	80.5	61.4	189.2	38.0	92.5	-54.5
1991	239.8	47.5	80.7	65.4	193.6	46.2	91.2	-45.0
1992	252.1	48.2	81.9	69.7	199.8	52.3	88.1	-35.8
1993	266.8	48.4	82.2	74.2	204.8	62.0	83.6	-21.6
1994	280.2	48.6	82.5	79.1	210.2	70.0	78.9	-8.9
1995	295.0	48.9	82.9	84.3	216.1	78.9	74.3	4.6
1996	310.1	50.1	85.0	89.7	224.8	85.3	69.7	15.6
1997	326.0	50.4	85.4	95.4	231.2	94.8	64.9	29.9
1998	342.6	50.6	85.8	101.5	237.9	104.7	60.3	44.4
1999	360.0	50.9	86.2	108.0	245.1	114.9	55.9	59.0
2000	378.3	51.2	86.6	114.9	252.7	125.6	51.2	74.0
2001	396.6	52.6	89.0	122.0	263.6	133.0	46.6	86.4
2002	415.9	53.0	89.5	129.6	272.1	143.8	42.0	101.8
2003	455.8	54.3	91.8	137.6	283.7	152.1	37.3	114.8
2004	456.7	54.6	92.3	146.1	293.0	163.7	32.6	131.1

Table II-6-28 Statement of Cash Flow (Case III)

(Unit: 10^6 Yen)

	Cash Receipt					Cash Disbursment					
	Operating Income	Depreciation	Borrowing Exterior	Service line charge	Sub-total (A)	Construction expenditure	(50%) Interest	Amortization of debt	Sub-total (B)	Cash Balance (A) – (B)	Accumulated Total
1980	-29.6	24.5	514.5	3.2	512.6	514.5	25.7		540.2	-27.6	-27.6
1981	-69.3	56.5	766.5	5.0	758.7	766.5	64.0		830.5	-71.8	-99.4
1982	-54.6	73.8	531.6	13.1	563.9	531.6	90.6		622.2	-58.3	-157.7
1983	0.7	76.6	38.4	20.9	136.6	115.8	92.5		208.3	-71.7	-229.4
1984	23.8	78.9		20.5	123.2	77.4	92.5		169.9	-46.7	-276.1
1985	50.1	79.0		0.9	130.0	4.8	92.5		97.3	32.7	-243.4
1986	12.6	79.2		0.9	92.7	5.3	92.5		97.8	-5.1	-248.5
1987	18.9	79.5		0.9	99.3	9.2	92.5		101.7	-2.4	-250.9
1988	25.2	79.8		1.0	106.0	11.1	92.5		103.6	2.4	-248.5
1989	31.3	80.2		1.0	112.5	12.4	92.5		104.9	7.6	-240.9
1990	83.0	80.5		1.3	119.8	8.3	92.5	25.7	126.5	-6.7	-247.6
1991	46.2	80.7		1.4	128.3	8.9	91.2	64.0	164.1	-35.8	-283.4
1992	52.3	81.9		1.3	135.5	29.8	88.1	90.6	208.5	-73.0	-356.4
1993	62.0	82.2		1.5	145.7	9.5	83.6	92.5	185.6	-39.9	-396.3
1994	70.0	82.5		1.5	154.0	10.0	78.9	92.5	181.4	-27.4	-423.7
1995	78.9	82.9		1.6	163.4	10.6	74.3	92.5	177.4	-14.0	-437.7
1996	85.3	85.0		1.7	172.0	53.0	69.7	92.5	215.2	-43.2	-480.9
1997	94.8	85.4		1.7	181.9	11.1	64.9	92.5	168.5	13.4	-467.5
1998	104.7	85.8		1.9	192.4	12.1	60.3	92.5	164.9	27.5	-440.0
1999	114.9	86.2		1.9	203.0	12.7	55.9	92.5	161.1	41.9	-398.1
2000	126.5	86.6		2.1	214.3	13.3	51.2	92.5	157.0	57.3	-340.8
2001	133.0	89.0		2.2	224.2	60.0	46.6	92.5	199.1	25.1	-315.7
2002	143.8	89.5		2.3	235.6	14.6	42.0	92.5	149.1	86.5	-229.2
2003	152.1	91.8		2.4	246.3	57.4	37.3	92.5	187.2	59.1	-170.1
2004	163.7	92.3		2.5	258.5	15.9	32.6	92.5	141.0	117.5	-52.6

Note: 1 Total amount of Initial Construction Cost is financed by Foreign Aid.

2 Loan Condition ... Interest of 5% per year
Payment period of 30 years including moratorium period of 10 years.

Table II-6-29 Amortization Schedule (Case III)

(Unit: 10^6 Yen)

		Borrowing Construction Cost	Redamption Principal	Interest	Total	Outstanding Balance
1	1980	514.5		25.7	25.7	514.5
2	1981	766.5		64.0	64.0	1,281.0
3	1982	531.6		90.6	90.6	1,282.6
4	1983	38.4		92.5	92.5	1,851.0
5	1984			92.5	92.5	1,851.0
6	1985			92.5	92.5	1,851.0
7	1986			92.5	92.5	1,851.0
8	1987			92.5	92.5	1,851.0
9	1988			92.5	92.5	1,851.0
10	1989			92.5	92.5	1,851.0
11	1990		25.7	92.5	118.2	1,825.3
12	1991		64.0	91.2	155.2	1,761.3
13	1992		90.6	88.1	178.7	1,670.7
14	1993		92.5	83.6	176.1	1,578.2
15	1994		92.5	78.9	171.4	1,485.7
16	1995		92.5	74.3	166.8	1,393.2
17	1996		92.5	69.7	162.2	1,300.7
18	1997		92.5	64.9	157.4	1,208.2
19	1998		92.5	60.3	152.8	1,115.7
20	1999		92.5	55.9	148.4	1,023.2
21	2000		92.5	51.2	143.7	930.7
22	2001		92.5	46.6	139.1	838.2
23	2002		92.5	42.0	134.5	745.7
24	2003		92.5	37.3	129.8	653.2
25	2004		92.5	32.6	125.1	560.7
26	2005		92.5	28.0	120.5	468.2
27	2006		92.5	23.4	115.9	375.7
28	2007		92.5	18.8	111.3	283.2
29	2008		92.5	14.2	106.7	190.7
30	2009		92.5	9.5	102.0	98.2
31	2010		65.8	4.9	70.7	32.4
32	2011		29.5	1.6	31.1	2.9
33	2012		2.9	0.1	3.0	0.0

CHAPTER 7

ECONOMIC ANALYSIS

CHAPTER 7 ECONOMIC ANALYSIS

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CHAPTER 7 ECONOMIC ANALYSIS

7.1 METHOD OF ANALYSIS

As opposed to the discussion of financial evaluation in the previous chapter, examination on several aspects of economic analysis is to be discussed in this one. It is meant to evaluate a project in view of national economy and termed as "economic evaluation" or "economic cost benefit analysis" as financial evaluation is termed "private cost benefit analysis", which is to apply financial evaluation from a point of view of an individual commercial enterprise.

The fundamental difference between private cost benefit analysis and economic cost benefit analysis lies in the fact that while the former simply employs the market price in evaluation, the latter reevaluates a matter by transforming the market price to the economic price to present the real economic value of the matter.

In this chapter, the following procedure in the application of economic analysis is followed.

Firstly, execution of rural electrification is assumed with an intention to come up with a minimum-cost plan which is most economical and cost-saving when carried out. Specifically, a comparison between the cost for a rural electrification program, that is, installation of transmission and distribution lines and a alternative plan, that is, the installation of diesel engine generators, which is considered to be the most economical alternative plan is studied. The method is termed as "cost-effectiveness analysis"; and since both plans share the same benefit, the cost of one can be understood as the benefit of the other.

Secondly, economic analysis of the minimum-cost plan obtained through cost-effectiveness analysis is undertaken. Since the economic cost of the minimum-cost plan is already obtained through cost-effectiveness analysis, it is here to determin how to measure the benefit.

Although various types of benefit accompanying rural electrification can be conceived, the fact that many of them are intangible and the lack of information present difficulties to have the exact measurement of them; therefore, for the sake of simplification, the consumers(1) "willingness to pay" is regarded as a means for measurement. In this way, the benefit tends to be underestimated.

Generally, consumers' willingness to pay is estimated by the sales revenue, and this disregards consumers' surplus(2) when there is not perfect competition in the market. And since electricity service is a regional monopoly in nature, the elasticity of price is not infinate; and, therefore, the demand curve should drop to the right. This means that the benefit presumably to come with the execution of the Project should be measured by the part under the demand curve. Since this is the first electricity service in the area and the estimation of the demand curve presents difficulty, here the sales revenue is to be regarded as the sole measurement of the benefit by simply ignoring consumers' surplus. And it is never to be forgotten that the benefit is being underestimated.

The economic benefit obtained thus, together with the economic cost obtained from cost-effectiveness analysis, provides us with the internal earning rate of the minimum-cost plan. And the economic internal earning rate makes it possible for us to judge on the feasibility of the Project according to the minimum-cost plan.(3) Here, special consideration should be given to the opportunity cost for the investment funds provided externally since there is only a little internal reserves at TANESCO, and it depends heavily on external funds.

The next step to be taken is social cost benefit analysis, which transforms the economic price indicator of the benefit and the net benefit obtained from economic analysis to the social price indicator for re-evaluation. But we would like to leave out the analysis due to the absence of intratemporal evaluation of the benefit and intertemporal evaluation of the net benefit

(=savings=investment).(4)

Finally, analysis and presentation of development effects of the Project from various angles are carried out.

Note (1) Consumers of electricity; therefore, includes intermediate consumers with demand as well as the final consuming public.

(2) Consumers' surplus is understood as the final consumers' surplus and the producers' surplus of intermediate consumers; furthermore, the producers' surplus of the latter is partly transformed into the consumers' surplus of the final consumers with demand.

(3) Social rate of time preference is not obtainable because the fund market is imperfect; therefore, it has to be done with IRR, not with NPV, in the process of evaluation.

(4) The intratemporal evaluation of benefit and the intertemporal evaluation of net benefit concerns a nation's fundamental political evaluation; therefore, if it should be done by foreign nationals, it should be done with great discretion. It may be assumed that since the two sets of evaluation are in a trade-off relationship with each other, the value of intertemporal would be higher if we are to emphasize growth, and the value would fall highly on the "poor" of the intratemporal evaluation if we are to emphasize fair equity.

7.2 ANALYSIS OF ALTERNATIVE COST VALUATION

7.2.1 Proposition of Alternative Plan

(1) Method of Analysis

The Project under discussion is planned at four districts; namely, Hai, Rombo, North Pare, and South Pare, and it is to seek its power supply from the Coastal Grid System. In case execution of this Electrification Project is cancelled, the electrification of the areas is to depend on the supply produced by diesel engine generators. Although an alternative plan with diesel engine generators was examined during the course of the study undertaken, it has been dismissed from such districts as Hai and Rombo because distribution lines are already installed in nearby areas and mere expansion of them will procure the power source. On the other hand, districts such as North Pare and South Pare are located fairly far from the existing transmission lines and service areas. And the fact the areas with demand in the districts are composed of several separate groups makes the alternative plan with diesel engine generators worth some discussion.

It is now to analyze the economics of the Project, the transmission-line plan, by comparing it to a plan which is to use auto-generators for South Pare, where areas with demand are scattered around, therefore, need great expansion of transmission lines.

(2) Cost Estimation of Alternative Plan

a. Basic Policy

- Considering the regular inspection and maintenance procedures or technical difficulties presented by diesel engine generators, there arises need to have stand-by machines as reserves in order to provide the same service as the transmission-line plan. Here, two cases are estimated: one with installation of reserves of the same capacity and the other, without reserves although it may present less efficient service. The capacity of the diesel engine generators is assumed to be accorded with the capacity of the pole mounted transformers of each area.
- All the distribution lines are to be 11 kV lines, and low tension lines, service lines, meters, street lighting and pole mounted transformers are assumed to be the same types as in the case of the transmission line plan.
- Standard of Diesel Engine Generator

[Diesel Engine]

Type: Vertical, Air-cooling, 4 Cycle
Number of Cylinders: 6
Revolving Speed: 750 R.P.M.
Fuel: Type-B Fuel Oil
Lubricating Oil: Over GRANDE DM
Compressed-air Starting System
Water-cooling Type
Airless Oil Injection
[Generator]
400V 750 R.P.M. Direct-Coupled Type
Power Factor : 80% Revolving-field Type
400/11kV Step-Up Transformer attached

b. Establishment of Service Areas of Power Generation Facilities
– We divide South Pare into five smaller units and install a diesel power plant in each.
– In dividing the district, villages within 2–3 km distance are considered to be one unit.

c. Cost of Generators
In determining the cost, the record of performance in Japan as well as that of Rural Electrification Project in Tanzania are quoted, and it is calculated at a presumed 1980 price paying cosideration to a raise in the price of the product.

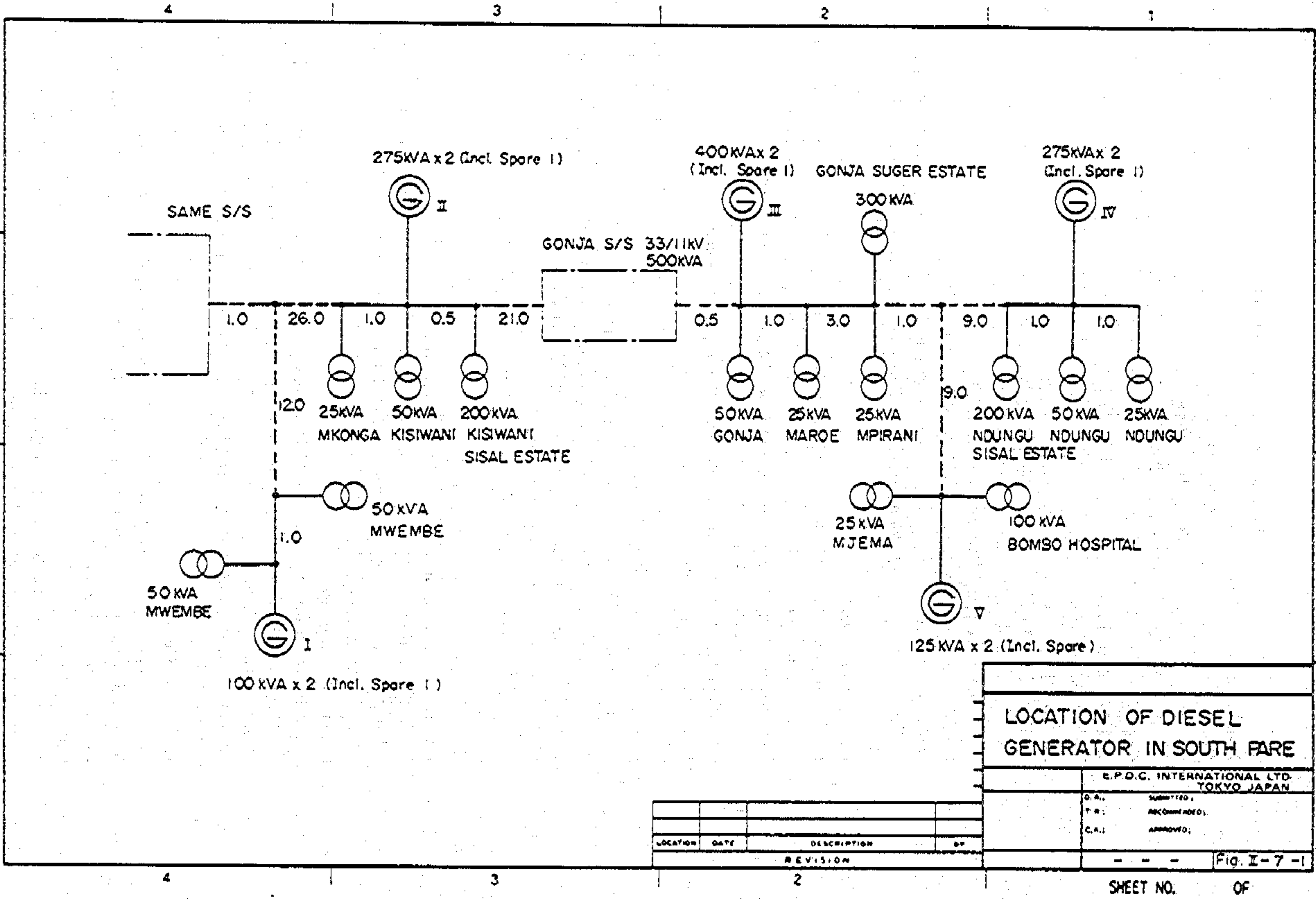
d. Construction Cost of Diesel Power Plant
Consideration was given to the following items for initial investment.
• Diesel engine generator
• Others include price of land, buildings, control boards, AC-DC cables, oil tanks, piping, pumps, earthing devices, fire extinguishing devices, alarms, transportation cost, insurance cost, related expenses, reserve fund, etc.
– As for the cost of additional investment and renovation of the facilities, 20% of the cost of machinery is placed on the cost of Diesel engine generators as installation, transportation, and removal expenses.

e. The initial construction and the cost of it other than the diesel power plant is set as follows:
– accessory 11 kV transmission lines
Length: 8.5 km Unit Cost: 2,300x10³ yen/km
– Since the following items are also used in the transmission-line plan, the cost is calculated in the same manner: pole mounted transformers, low-tension lines, service lines, street lighting, vehicles, machine tools.

f. Fuel Cost Estimation
The estimation on the cost of fuel is made by varying the rate of utility capacity of the facilities and thermal efficiency on a yearly basis. At this time, 20% on the cost of lubricating oil and maintenance, and a 30% increase in the price of oil are estimated until 1980. The results of the calculation on the fuel cost are shown on Table II-7-2.

g. Additional Construction Cost
The treatments on the cost of additional construction for low-tension lines, service lines and pole mounted transformers are done in the same way as they were done the distribution-line plan.

h. Operation Cost
The payment for the engineers involved in the power plant is set to be a 30% extra to the one for those in the line distribution work. If two individuals work on two


SAME S/S
275kVA x 2 (Incl. Spare 1)
II
GONJA S/S 33/11kV 500kVA
400kVA x 2 (Incl. Spare 1)
III
GONJA SUGER ESTATE
300kVA
275kVA x 2 (Incl. Spare 1)
IV
1.0
26.0
1.0
0.5
21.0
0.5
1.0
3.0
1.0
9.0
1.0
1.0
12.0
9.0
25kVA MKONGA
50kVA KISIWANI
200kVA KISIWANI SISAL ESTATE
50kVA GONJA
25kVA MAROE
25kVA MPIRANI
200kVA NDUNGU SISAL ESTATE
50kVA NDUNGU
25kVA NDUNGU
50kVA MWEMBE
1.0
50kVA MWEMBE
I
100kVA x 2 (Incl. Spare 1)
25kVA MJEMA
100kVA BOMBO HOSPITAL
V
125kVA x 2 (Incl. Spare)
LOCATION OF DIESEL GENERATOR IN SOUTH PARE
E.P.D.C. INTERNATIONAL LTD. TOKYO JAPAN
Fig. II-7-1
SHEET NO. OF

shifts, this will amount to 4,485.000 yen per year.

i. Administration Expenses and Maintenance Repairs Expenses

- For the maintenance and repairs expenses of the diesel power plant, 4% of the cumulative construction cost (exclusive of renovation) is estimated yearly.
- As for other facilities, 1% of the cumulative construction cost for administration expenses and 1.3% for maintenance and repairs expenses are allocated from 1986 on each.

j. The results of the cost presented by the diesel plan based on the above conditions are shown Table II-7-3~4.

Table II-7-1 South Pare Diesel Power Plant Construction Cost

(Unit: 10^3 Yen)

District				Machinery Cost	Others	Total
I		Initial Investment	80kW x 2	61,000	45,360	106,360
(80kW)	1998	Renewal	80kW x 2	61,000	12,200	73,200
	2003	Additional Investment	80kW x 1	30,500	6,100	36,600
II						
(220kW)		Initial Investment	220kW x 2	78,000	45,360	123,360
	1993	Renewal	220kW x 1	39,000	7,800	46,800
	1998	Additional Investment	220kW x 2	78,000	15,600	93,600
III		Initial Investment	320kW x 2	91,000	45,360	136,360
(320kW)	1996	Renewal	320kW x 1	45,500	9,100	54,600
	1998	Additional Investment	320kW x 2	91,000	18,200	109,200
IV		Initial Investment	220kW x 2	78,000	45,360	123,360
(220kW)	1998	Renewal	220kW x 2	78,000	7,800	93,600
	2002	Additional Investment	220kW x 1	39,000	15,600	46,800
V		Initial Investment	100kW x 2	64,000	45,360	109,360
(100kW)	1998	Renewal	100kW x 2	64,000	12,800	76,800
	1998	Additional Investment	100kW x 1	32,000	6,400	38,400

Table II-7-2 South Pare Diesel Engine Generation Fuel Cost

(Unit: 10^3 Yen)

Year	Energy Consumption	Facility Capacity	Utilization Factor of Facility	Thermal Efficiency	Fuel Cost
	(MWh)	(kW)	(%)	(%)	
1983	995	940	8	20.4	25,820
84	1,141	"	12	20.6	29,324
85	1,287	"	16	20.8	32,762
86	1,365	"	17	21.1	34,254
87	1,449	"	18	21.1	36,362
88	1,539	"	19	21.1	38,620
89	1,634	"	20	21.1	41,004
1990	1,736	"	21	21.3	43,155
91	1,845	"	22	21.3	45,864
92	1,962	"	24	21.3	48,733
93	2,086	1,160	21	21.3	51,855
94	2,226	"	22	21.3	55,336
95	2,375	"	23	21.3	59,040
96	2,534	1,480	20	21.1	63,589
97	2,704	"	21	21.3	67,218
98	2,886	1,580	21	21.3	71,742
99	3,067	"	22	21.3	76,242
2000	3,259	"	24	21.3	81,015
1	3,463	"	25	21.5	85,285
2	3,680	1,800	23	21.3	91,480
3	3,910	1,880	24	21.3	97,198
4	4,151	"	25	21.5	102,229

Table II-7-3 South Pare Diesel Power Plant Plan Cost (with reserves)

(Unit: 10^6 Yen)

	Diesel Power Plant					Other Facilities		
	Construction Cost	Operation Cost	Repairs Cost	Fuel Cost	Initial Construction Cost	Additional Construction Cost	Administration Maintenance & Repairs Cost	Total
1980	113.0		4.5		27.5		0.3	145.3
81	255.4		14.7		9.9		0.4	280.4
82	230.4	4.5	24.0	8.2	50.7		0.9	318.7
83		4.5	24.0	25.8	2.4	11.6	1.0	69.3
84		4.5	24.0	29.3		11.6	1.1	70.5
85		4.5	24.0	32.8		0.7	1.1	63.1
86		4.5	24.0	34.3		0.8	2.6	66.2
87		4.5	24.0	36.4		1.4	2.7	69.0
88		4.5	24.0	38.6		1.7	2.7	71.5
89		4.5	24.0	41.0		1.9	2.8	74.2
1990		4.5	24.0	43.2		1.2	2.8	75.7
91		4.5	24.0	45.9		1.3	2.8	78.5
92		4.5	24.0	48.3		1.5	2.9	81.5
93	46.8	4.5	25.8	51.9		1.4	2.9	133.3
94		4.5	25.8	55.3		1.5	2.9	90.0
95		4.5	25.8	59.0		1.6	3.0	93.9
96	54.6	4.5	28.0	63.6		1.7	3.0	155.4
97		4.5	28.0	67.2		1.7	3.0	104.4
98	484.8	4.5	29.5	71.7		1.8	3.1	595.4
99		4.5	29.5	76.2		1.9	3.1	115.2
2000		4.5	29.5	81.0		2.0	3.2	120.2
1		4.5	29.5	85.3		2.1	3.2	124.6
2	46.8	4.5	31.4	91.5		2.2	3.3	179.7
3	36.6	4.5	32.9	97.2		2.3	3.3	176.8
4		4.5	32.9	102.2		2.4	3.4	145.4

Table II-7-4 South Pare Diesel Power Plant Plan Cost (with reserves)

(Unit: 10^6 Yen)

	Diesel Power Plant					Other Facilities		
	Construction Cost	Operation Cost	Repairs Cost	Fuel Cost	Initial Construction Cost	Additional Construction Cost	Administration Maintenance & Repairs Cost	Total
1980	77.9		3.1		27.5		0.3	108.8
81	176.1		10.2		9.9		0.4	196.6
82	158.8	4.5	16.5	8.2	50.7		0.9	239.6
83		4.5	16.5	25.8	2.4	11.6	1.0	61.8
84		4.5	16.5	29.3		11.6	1.1	63.0
85		4.5	16.5	32.8		0.7	1.1	55.6
86		4.5	16.5	34.3		0.8	2.6	58.7
87		4.5	16.5	36.4		1.4	2.7	61.5
88		4.5	16.5	38.6		1.7	2.7	64.0
89		4.5	16.5	41.0		1.9	2.8	66.7
1990		4.5	16.5	43.2		1.2	2.8	68.2
91		4.5	16.5	45.9		1.3	2.8	71.0
92		4.5	16.5	48.8		1.3	2.9	74.0
93	46.8	4.5	18.4	51.9		1.4	2.9	125.9
94		4.5	18.4	55.3		1.5	2.9	82.6
95		4.5	18.4	59.0		1.6	3.0	36.5
96	54.6	4.5	20.6	63.6		1.7	3.0	148.0
97		4.5	20.6	67.2		1.7	3.0	97.0
98	261.6	4.5	22.1	71.7		1.8	3.1	364.8
99		4.5	22.1	76.2		1.9	3.1	107.3
2000		4.5	22.1	81.0		2.0	3.2	112.8
1		4.5	22.1	85.3		2.1	3.2	117.2
2	46.8	4.5	24.0	91.5		2.2	3.3	172.3
3	36.6	4.5	25.9	97.2		2.3	3.3	169.3
4		4.5	25.4	102.2		2.4	3.4	137.9

7.2.2 Cost Analysis of Alternative Plan and Proposed Project

(1) Introduction of Economic Price

In undertaking economic analysis, economic prices instead of market prices are employed as mentioned formerly. For the present reserch, economic prices are applied to the following items. To be specific, there are two types of numeraire for a economic price indicator; namely, domestic consumption and foreign exchange. Here, the latter OECD method is disregarded and the former UNIDO method is employed since export of electric power is not conceivable at present.

a. Economic Price of Foreign Currency

Generally, developing countries adopt strict exchange control policy due to the lack of foreign currency holding. Foreign exchange allocation would mean excess demand of foreign currency; and, therefore, it should be assumed that for developing nations, the real value of foreign exchange is much higher than the official exchange rate (OER). The case of Tanzania is no exception. World Bank sets 0.7 as its standard conversion factor for the exchange of domestic currency to the border price and adopts a rate of 1 US$=12 (T.shs.) as a shadow exchange rate(1). Since, as foreign nationals, we should not have a right to carelessly assume the foreign exchange effective rate of Tanzania, we would like to follow World Bank in this matter.

b. Economic Cost Concerning Employment of Unskilled Labour

According to data from KIDP, there is a high unemployment rate (including disguised unemployment) among towns and villages in Kilimanjaro Region. If the unskilled labour needed for the Project is procured from villages during the slack farming season and from towns during the busy farming season, there will be no need for housing construction and also no need to sacrifice the crops during the busy farming season. Since their marginal productivity is none, the cost concerning employment of unskilled labour can be considered to be none also.

c. Economic Price of Domestic Transportation

Since the domestic transportation cost includes vehicles, fuel and other items which use foreign currencies or include taxes; the figure 1.2 is set in accordance with a road planning report in Kilimanjaro Region.

d. Taxation

Since the proposed Project is entirely exempted from taxation, it needs not be considered.

e. Economic Price of Electricity Purchase Cost

Since the generation depends on hydraulic power, it has over-supply capability; and if there is no need for opportunity cost with the use of water, the marginal cost of the generation is to be none. Therefore, the cost required by this Project may only be that of administration.

(2) Cost Analysis of Transmission-line Plan

a. Initial Construction Cost

– The cost of materials and domestic transportation was estimated in previous chapter.

– For the D-C portion of labour cost, it is classified into the skilled labour and the unskilled labour depending on the percentage the payment of unskilled labour has on TANESCO's standard gang composition, transportation cost, miscellaneous expenses, materials management, etc, according to the category.

b. Additional Construction Cost

For the items which require additional construction, such as substations, low-tension lines, service lines, and pole mounted transformers, are all estimated according to the percentage each item holds on the initial construction cost.

Note (1) Mwanza/Shinyanga Rural Development Project, 1978.

c. Administration and Maintenance Repairs Cost

As for the administration and maintenance repairs cost, the ratios of composition are as follows:

	Administration Cost	Maintenance Repairs Cost
Foreign currency	5 (%)	30 (%)
Domestic currency	95	70
(Unskilled labour)	10	20

d. Electricity Purchase Cost

The power supply unit price by economic calculation is to be 2.6 Cent/kWh specially for administration cost. It is composed of 100% domestic currency and 20% of it is of unskilled labour.

(3) Cost Analysis of Diesel Power Plant Plan

a. Diesel Power Station Construction Cost

– Cost of machinery is to be all in F.C.

– For the others, the ratios of composition are as follows:

	(Initial)	(Additional and Renewal)
Foreign currency	67.5 (%)	14 (%)
Domestic currency	32.5	86
Skilled labour	18	42
Unskilled labour	2	18
Domestic Transportation Cost	5	5

b. Operation cost is to be all in D.C.

c. The ratios of composition for repairs cost, fuel cost, administration and maintenance

	Repairs Cost	Fuel Cost	Administration Cost	Maintenance Repairs Cost
Foreign currency	14 (%)	80 (%)	5 (%)	30 (%)
Domestic currency	86	20	95	70
Unskilled labour	18		10	20
Domestic Transportation Unit	5		10	

repairs cost are as follows:

d. The initial construction cost of facilities other than diesel power stations, could be refered to the cost of Transmission line Plan.

e. Since the additional construction cost except for the diesel power plant shares the same items as the distribution-line plan, the results mentioned formerly are used here.

(4) Economic Evaluation

The annual economic cost of the proposed Project (transmission-line plan) and the diesel power plant plan as alternative plan in South Pare are now to be estimated according to the conditions specified formerly (Table II-7-7).

When the economic cost is transformed into present value by a discount rate of 10%–30%, it is noted as can be seen in Table II-7-8 that the diesel power plant plan costs much more than the distribution-line plan. Now the cost of the diesel power plant plan is considered as the benefit (B) of the proposed plan, and the difference from the cost of the proposed Project (C) is calculated to obtain net present value (NPV=B–C). The results together with the benefit cost ratios (B/C) are shown on Table II-7-9. The figures show the economic feasibility of the proposed Project in the South Pare area; and since the distribution-line plan is apparently advantageous to the diesel power plan in other three districts, the economic value of this Project as a whole can be considered very high.

Table II-7-5 South Pare Transmission-line Plan Annual Cost

(Unit: 10^6 Yen)

		1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Total		109.6	165.8	149.6	23.6	16.8	6.0	12.0	12.6	13.1	13.4	12.8	13.0	13.1	13.4	13.5	13.7	14.0	14.1	14.3	14.7	14.9	37.7	15.9	16.3	16.5
Initial Construction Cost		108.5	163.1	145.2	7.0																					
	Unskilled Labour	12.1	10.3	10.2	0.5																					
	Imported materials	79.3	120.3	103.5	3.7																					
	Domestic Transportation	0.0	7.3	6.3	0.4																					
	Others	17.1	25.2	25.2	2.4																					
Addition Construction Cost					11.6	11.6	0.7	0.8	1.4	1.7	1.9	1.2	1.3	1.3	1.4	1.5	1.6	1.7	1.7	1.8	1.9	2.0	24.1	2.2	2.3	2.4
	Unskilled Labour				1.0	1.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	1.2	0.2	0.2	0.2
	Imported materials				8.3	8.3	0.6	0.6	1.1	1.2	1.4	0.9	0.9	1.0	1.1	1.2	1.2	1.2	1.2	1.3	1.5	1.5	19.8	1.6	1.7	1.8
	Domestic Transportation				0.5	0.5	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1.1	0.1	0.1	0.1
	Others				1.8	1.8	0.1	0.2	0.1	0.3	0.3	0.1	0.2	0.1	0.1	0.1	0.2	0.3	0.3	0.3	0.2	0.2	2.0	0.3	0.3	0.3
Administration and Maintenance Repairs Cost		1.1	2.7	4.2	4.4	4.5	4.5	10.3	10.3	10.4	10.4	10.5	10.5	10.5	10.6	10.6	10.6	10.7	10.7	10.7	10.8	10.8	11.4	11.4	11.5	11.5
	Unskilled Labour	0.1	0.3	0.4	0.4	0.4	0.4	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.8	1.8	1.8	1.8
	Imported materials	0.1	0.1	0.2	0.2	0.2	0.2	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.1	2.1	2.1	2.2	2.2	2.2	2.2
	Others	0.9	2.3	3.6	3.8	3.9	3.9	6.7	6.7	6.8	6.8	6.9	6.9	6.9	6.9	6.9	6.9	7.0	7.0	6.9	7.0	7.0	7.4	7.4	7.5	7.5
Electricity Purchase Cost				0.2	0.6	0.7	0.8	0.9	0.9	1.0	1.1	1.1	1.2	1.3	1.4	1.4	1.5	1.6	1.7	1.8	2.0	2.1	2.2	2.3	2.5	2.6
	Unskilled Labour			0.0	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.5	0.5	0.5
	Others			0.2	0.5	0.6	0.6	0.7	0.7	0.8	0.9	0.9	1.0	1.0	1.1	1.1	1.2	1.3	1.4	1.4	1.6	1.7	1.8	1.8	2.0	2.1

Table II-7-6 South Pare Diesel Power Plant Plan Annual Cost (with reserves)

(Unit: 10^6 Yen)

			1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Total			145.3	280.4	318.7	69.3	70.5	63.1	66.2	69.0	71.5	74.2	75.7	78.5	81.5	133.3	90.0	93.9	155.4	104.4	595.4	115.2	120.2	124.6	179.7	176.8	145.4
Power Plant Related Cost	Power Plant Construction Cost		113.0	255.4	230.4											46.8			54.6		484.8				46.8	36.6	
		Unskilled Labour	0.9	1.9	1.8											1.4			1.6		14.5				1.4	1.1	
		Imported materials	99.1	224.0	202.0											40.1			46.8		415.3				40.1	31.4	
		Domestic Transportation	2.1	4.8	4.4											0.4			0.5		4.1				0.4	0.3	
		Others	10.9	24.7	22.2											4.9			5.7		50.9				4.9	3.8	
	Fuel Cost				8.2	25.8	29.3	32.8	34.3	36.4	38.6	41.0	43.2	45.9	48.8	51.9	55.3	59.0	63.6	67.2	71.7	76.2	81.0	85.3	91.5	97.2	102.2
		Imported materials			6.6	20.6	23.4	26.2	27.4	29.1	30.9	32.8	34.6	36.7	39.0	41.5	44.2	47.2	50.9	53.8	57.4	61.0	64.8	68.2	73.2	77.8	81.8
		Domestic Transportation			0.8	2.6	2.9	3.3	3.4	3.6	3.9	4.1	4.3	4.6	4.9	5.2	5.5	5.9	6.4	6.7	7.2	7.6	8.1	8.5	9.2	9.7	10.2
		Others			0.8	2.6	3.0	3.3	3.5	3.7	3.8	4.1	4.3	4.6	4.9	5.2	5.6	5.9	6.3	6.7	7.1	7.6	8.1	8.6	9.1	9.7	10.2
	Operation Cost				4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
		Domestic Currency			4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
	Repairs Cost		4.5	14.7	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	25.8	25.8	25.8	25.8	28.0	29.5	29.5	29.5	29.5	31.4	32.9	32.9
		Unskilled Labour	0.8	2.6	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.6	4.6	4.6	5.0	5.0	5.3	5.3	5.3	5.3	5.6	5.9	5.9
		Imported materials	0.6	2.1	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.6	3.6	3.6	3.9	3.9	4.1	4.1	4.1	4.1	4.4	4.6	4.6
		Domestic Transportation	0.2	0.7	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.3	1.3	1.3	1.4	1.4	1.5	1.5	1.5	1.5	1.6	1.7	1.7
		Others	2.9	9.3	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	16.3	16.3	16.3	17.7	17.7	18.6	18.6	18.6	18.6	19.8	20.7	20.7
Other Facilities Related Cost	Initial Construction Cost		27.5	9.9	50.7	2.4																					
		Unskilled Labour	1.5	0.2	3.2	0.5																					
		Imported materials	23.9	8.6	38.5	0.6																					
		Domestic Transportation	0.1	0.1	2.3	0.4																					
		Others	2.0	1.0	6.7	0.9																					
	Additional Construction Cost					11.6	11.6	0.7	0.8	1.4	1.7	1.9	1.2	1.3	1.3	1.4	1.5	1.6	1.7	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4
		Unskilled Labour				1.0	1.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.2	0.2	0.2
		Imported materials				8.3	8.3	0.6	0.6	1.1	1.2	1.4	0.9	0.9	1.0	1.1	1.2	1.2	1.2	1.2	1.3	1.5	1.5	1.6	1.6	1.7	1.8
		Domestic transportation				0.5	0.5	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
		Others				1.8	1.8	0.1	0.2	0.1	0.3	0.3	0.1	0.2	0.1	0.1	0.1	0.2	0.3	0.3	0.3	0.2	0.2	0.3	0.3	0.3	0.3
	Administration Maintenance and Repairs Cost		0.3	0.4	0.9	1.0	1.1	1.1	2.6	2.7	2.7	2.8	2.8	2.8	2.9	2.9	2.9	3.0	3.0	3.0	3.1	3.1	3.2	3.2	3.3	3.3	3.4
		Unskilled Labour	0.0	0.0	0.0	0.1	0.1	0.1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
		Imported materials	0.0	0.0	0.1	0.1	0.1	0.1	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
		Others	0.3	0.4	0.8	0.8	0.9	0.9	1.7	1.8	1.8	1.9	1.9	1.9	2.0	1.8	1.8	1.9	1.9	1.9	2.0	2.0	2.1	2.1	2.2	2.2	2.3

Table II-7-7 South Pare Transmission-line Plan・Diesel Power Plant Plan Annual Economic Cost

Year	Distribution-line Plan	Diesel Power Plant Plan	
		With reserves	Without reserves
1980	131.4	195.5	144.0
81	208.3	377.4	260.1
82	184.8	418.6	309.6
83	27.1	78.5	71.8
84	19.1	81.1	74.4
85	5.8	72.6	65.0
86	11.4	76.0	69.3
87	12.1	79.7	73.0
88	12.6	83.0	76.3
89	13.0	86.7	80.0
1990	12.2	88.8	82.1
91	12.4	92.5	85.8
92	12.4	96.6	89.9
93	12.7	165.2	158.6
94	12.8	107.2	100.6
95	13.0	112.5	105.9
96	13.3	194.1	187.4
97	13.4	125.8	119.1
98	13.6	782.6	477.0
99	14.0	139.7	133.0
2000	14.1	146.4	139.7
1	43.7	152.5	145.8
2	15.0	225.5	218.9
3	15.4	220.3	213.6
4	15.7	179.1	172.4

(Unit: 10^6 Yen)

Table II-7-8 South Pare Comparison of Economic Cost and Present Value

Transmission-line Plan Economic Cost

(Unit: 10^6 Yen)

Item \ Discount Rate	10%	15%	20%	30%
Initial Construction Cost	473.1	451.5	432.2	399.4
Additional Construction Cost	35.1	25.4	19.7	13.5
Administration, Maintenance and Repairs Cost	66.0	43.4	30.8	18.3
Electricity Supply Cost	7.0	4.2	2.8	1.5
Total	581.2	524.5	485.5	432.7

Diesel Power Plant Economic Cost

(Unit: 10^6 Yen)

Item \ Discount Rate	10%	15%	20%	30%
Power Plant Construction Cost	898.9	774.1	702.7	620.9
	(607.4)	(523.9)	(475.8)	(420.4)
Operation Cost	36.3	25.0	18.5	11.5
Repairs Cost	197.1	138.1	104.4	69.2
	(138.1)	(96.1)	(72.3)	(47.7)
Fuel Cost	469.3	282.8	188.1	100.3
Initial Construction Cost	103.4	98.1	93.5	85.7
Additional Construction Cost	31.2	23.8	19.1	13.3
Administration, Maintenance and Repairs Cost	16.5	10.7	7.5	4.3
Total	1,752.7	1,352.6	1,133.8	905.2
	(1,402.2)	(1,060.4)	(874.8)	(683.2)

*Figures in parentheses are the results without reserves.

Table II-7-9 South Pare Cost Benefit Analysis

		10%	15%	20%	30%
C: Transmission-line Plan Cost	(10^6 Yen)	581.2	524.5	485.5	432.7
B_1: Diesel Power Plant Plan Cost (with reserves)	(10^6 Yen)	1,752.7	1,352.6	1,133.8	905.2
B_2: Diesel Power Plant Plan Cost (without reserves)	(10^6 Yen)	1,402.2	1,060.4	874.8	683.2
NPV_1: $B_1 - C$	(10^6 Yen)	1,171.5	828.1	648.3	472.5
NPV_2: $B_2 - C$	(10^6 Yen)	821.0	535.9	339.3	250.5
B_1/C		3.02	2.58	2.34	2.09
B_2/C		2.41	2.02	1.80	1.58

Table II-7-10 Economic Cost and Sales of the Proposed Project

Year	Economic Cost	Sales
1980	639.8	0.0
81	999.8	0.0
82	671.2	48.5
83	157.9	129.3
84	118.1	161.5
85	28.5	193.8
86	53.8	186.2
87	59.2	196.0
88	62.2	206.0
89	64.4	216.3
1990	59.9	227.2
91	61.2	239.8
92	89.8	252.1
93	63.5	266.8
94	64.8	280.2
95	66.2	295.0
96	123.9	310.1
97	69.3	326.0
98	71.5	342.6
99	73.0	360.0
2000	74.6	378.3
1	138.1	396.6
2	79.1	415.9
3	137.6	435.3
4	83.8	456.7

(Unit: 10^6 Yen)

7.3 COMPARATIVE ANALYSIS WITH REVENUE

The economic cost and benefit of the proposed Project are seen as on Table II–7-10, and there is a 6.7% internal rate of return (IRR).

A 6.7% internal rate of return can be considered very high when the significance of the project on social development and the fact that the benefit is undervalued in two points are taken into consideration.

7.4 DEVELOPMENT EFFECTS

7.4.1 Impact on Agriculture

The aim of agricultural development in Kilimanjaro Region is to establish efficient productivity in the highlands and expand farming land in the lower areas. Vigorous expansion programs are needed to invite increasing population especially in the lower areas. Since there is little precipitation in the lower areas, the areas need to be provided with irrigation system to supply water. Irrespective of the type of water, whether surface or underground, energetic development programs should be carried out; and electric power, as a power source for the programs has great value. It is also a necessity for the maintenance and repairs of agricultural equipment employed to raise agricultural productivity.

Mainly the industry that accompanies agriculture is the processing industry of agricultural products. It is not a big industry, but the processing of coffee for shipment and maize and rice for consumption is carried out in individual villages. Coffee, for example, goes through the process of gathering from the trees, washing, pulping and drying before it is finally shipped to the factories. The process is carried out at estates or individual villages. The power for the processing presently is sought from three sources; namely, manual labour, diesel engines, and auto-generation. Once electric power is supplied, the improvement of productivity is obvious with the procurement of low-cost, stable power source. And the significance of electric power service as the power source for the processing of food products such as maize, which presently relies on manual labour or maize mills, is also considerable.

7.4.2 Impact on Industry

Big industries of Kilimanjaro Region are located in Moshi Town, and they have a great portion in the total industrial output of the region. As for the number of industries, there are as many industries in the rural areas as there are in the urban areas. For the types of the industries, a great number of them have direct relationships to regional resources such as agricultural products, livestock, forest products, such minerals as clay, etc. As can be seen, the industries of the region are characteristically scattered around in the rural areas on a small scale.

The development of Kilimanjaro Region, and its industry depends heavily on the development of these minor enterprises.

According to the industry research report (1977 ~ 1978) in Kilimanjaro Region, there are 239 factories; and their total yearly output is 916,403.000 T.shs. Among these factories, 92 are located in the districts which have already been electrified; and among the 92 factories, 40 of them use supply from TANESCO as their power source and present output of 898,507,000 T.shs. It stands to reason that the output presented by the factories in Moshi Town is very big when the electrification rate and the number of big factories in the city are taken into account. When Moshi Town is excluded, among the 54 factories with output of 8,744,000 T.shs. in the areas with electric power service, there are 16 (30%) factories with output of 6,622,000 T.shs. (76%) which receive its supply from TANESCO. Since the distribution network is yet insufficient, the ratio to the output should be considered very high although that to the number of the factories is not very much so.

The areas which already have electricity depend little on non-utility generation or diesel engines for their power source. To support the fact with data, analysis of the ratio of operation cost to the output should be considered. The results are as follows, and they show the power source from TANESCO is the most efficient one.

	Rural	Urban	Region (%)
TANESCO	3.0	0.4	0.5
Self-Generation	4.9	2.8	4.4
Diesel-Engine	8.8	2.7	5.6

The areas planned for electrification by the proposed project hold 103 enterprises with the total output of 8,083,000 T.shs. Therefore, by the expansion of electrification creates a possibility that 81% of the enterprises in the whole state and nearly 100% of the total output can be electrified.

Especially, the present plan for distribution network emphasizes service to industries as well as public facilities, when accomplished, great conversion from non-utility generation, diesel engines as well as from manual labour can be presumed.

Moreover, there is a plan for industrial development by 1982 being proposed for the industrial sector program in KIDP; it makes an estimation of 82 projects with 5,716,000 T.shs. possible. Among these, 47 projects with output of 2,502,000 T.shs. are located at the areas planned for electrification by the proposed Project.

The procurement of low-cost, stable power source through the proposed Project has significant effects on creating fundamental bases for industrial development.

7.4.3 Impact on Household Budget

Households without electric power service presently rely heavily on kerosene as their source of energy. In the urban areas, people generally use electricity or kerosene for lighting and charcoal, kerosene, sometimes LP gas and electricity for cooking. In the rural areas, kerosene is the only source of lighting, and the people use fire wood together with kerosene for cooking.

Although there may be some difference depending on the district, in rural areas, the amount of kerosene consumption is 25ℓ ~ 40ℓ/mon. per household. The amount used for lighting is considered to be 10ℓ which amounts to 20 T.shs./mon. on the household expenditure if 2 T.shs./ℓ is assumed to be the retail price of kerosene.

There is not statistical reports as to the household income in this area, but an average monthly income can be imagined to be 300 T.shs. from a hearing at the sites. According to the household budget survey in 1969, the annual income and consumption per household in the rural areas of Arusha, Kilimanjaro and Tanga is:

Income: 1425 T.shs., Consumption: 2188 T.shs.

When the income is varied by a real growth rate until 1979 (an annual rate of 0.2% until 1975 and 2.9% until 1979), the household income will be 1,617 T.shs./yr. And if the consumer price index, 287, is applied, (1969 end of 1978), the estimated household income in 1979 will be 4,641 T.shs/yr. ≒ 390 T.shs/mon.

According to calculation, if 390 T.shs/mon. is assumed to be cash income, the ratio of the price of kerosene (20 T.shs.) to the household budget will be 5.1%, which is a fairly high percentage. (As reference, among the constituting items of a consumer price index, fuel, light and water take up a percentage of 6.6; and in Japan, ratios of lighting and heating expenses, and electricity charges to the living cost is 5.27% and 1.24% in 1951 and 3.99% and 1.70% in 1976, respectively).

When kerosene usage and electricity usage are compared, electricity usage is much cheaper when calculated; the minimum charge (up to 10 kwh) of electricity is 13 T.shs., whereas the price of kerosene is 20 T.shs. A hearing in rural areas reveals that the people realize this, and this must be one of the reasons that they yearn for electric power service. But at the same time, it should be kept in mind that there is a system of charge of construction cost to be paid by consumer, as service line charge, whose minimum rate is 400 T.shs.; and if 200 T.shs is estimated for wiring service of the house, there will be a rather big amount of expenditure temporarily.

Therefore, a fair estimation of the households with electric power service immediately after the electrification should be around 8%, but as the handiness, sanitary quality, and efficiency of electricity are demonstrated, together with the growth in income level and a leap in kerosene price, the number should increase considerably.

7.4.4 Improvement of Community Welfare

Rural electrification should bring about many effects on households aside from saving on kerosene cost. The following items can be presented as some of the effects which may be considered to be brought about by the conversion of kerosene lamps to electric lights. Improvement in light together with the fact that electric lights do not produce soot lead to reduced domestic chores such as cleaning lamps, improved sanitation, and prolonged hours for study. And it also gives the people incentives for the improvement of living standard. And since the electricity is not distributed to all of the households in the planned areas, it should be noted that many of the effects are to be observed in the electrification of public facilities. In this sense, the aim of the present project as a social evelopment program is in the electrification of public facilities. Here, some of the main public facilities are taken individually, and the effects of electrification on them will be listed.

(1) Government Office, Police Station, Post Office, etc.

The electrification of these public facilities leads to improved working conditions, therefore, to improved community service.

(2) Hospitals, Health Center, Dispensary

Even in rural areas of Kilimanjaro Region, there are some well-equipped hospitals which operate on non-utility generation. But due to the lack in power generation capacity, wear, or the restriction on the supply, they cannot provide sufficient medical care. There is evidence that at Kibongoto Hospital in Hai district, various kinds of advanced medical equipment are left unattended in its storehouse. Distribution of electric power for these hospitals has great significance in protecting the health and lives of the community people. Presently, the health centers and dispensaries cannot use medical equipment because they are not equipped even with diesel engine generators. Therefore, the electrification of these medical facilities has as important effects as the electrification of hospitals.

(3) Schools

Providing electric power service to schools creates a great possibility for the introduction of new school materials, especially audio-visual aids. As for the vocational schools, electrification makes it possible to use machine tools in the process of lectures and drills. For example, there is an incident reported of a vocational training school in North Pare Usangi that because of troubles of the diesel engine generators, tools and machines were left unattended. Furthermore, such programs as vocational training and adult schools are made possible through the use of school facilities during the night.

(4) Water Supply

A great portion of water supply in Kilimanjaro Region naturally is provided by gravity system, but there are some areas which rely on pumps. As we start development plans for the lowland, there is a great possibility that we may have t o seek water source from underground or from areas where it may not be easy to acquire a source. Therefore, conversion of trouble-prone pumping by diesel engines to the stable power source of electricity for water supply can be considered to improve the basic conditions of the lives of the people in many ways.

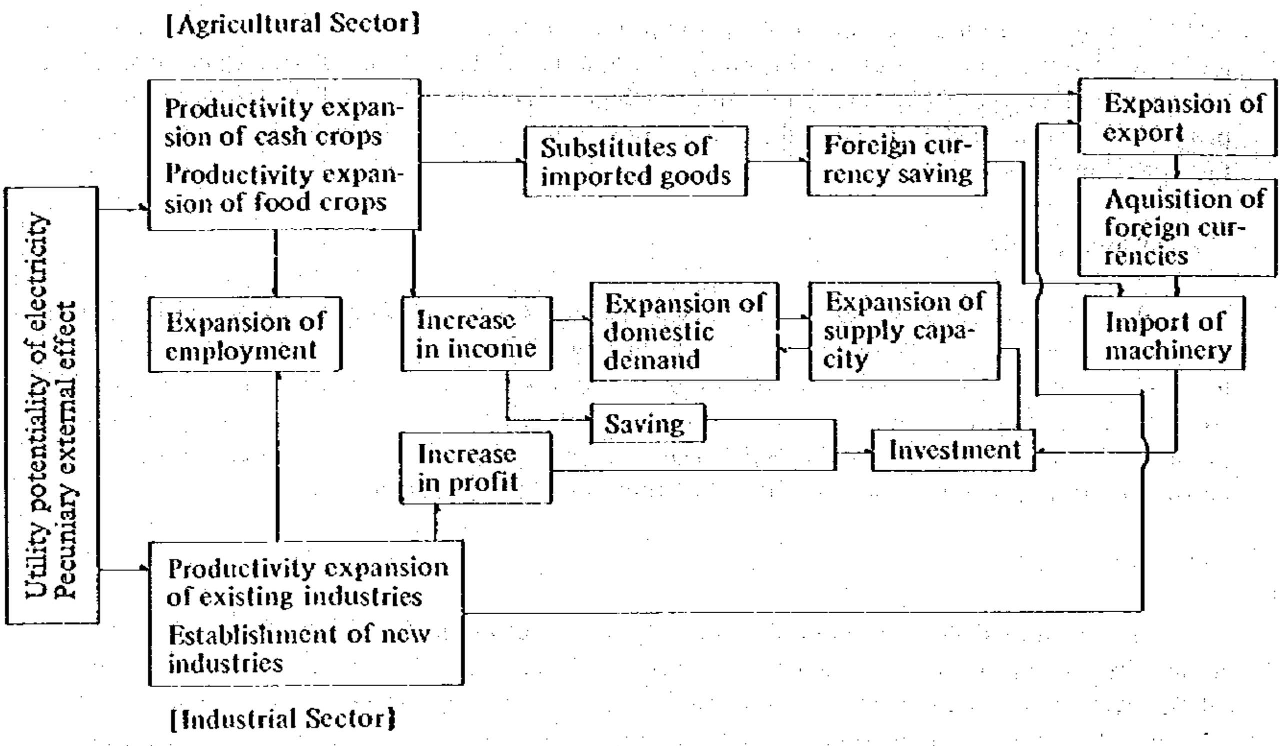
(5) Street Lighting

The proposed Project emphasizes the importance of public lighting system. This is to bring about the prevention of crime and traffic accidents, which may be understood as a direct effect of the Project; and also, lighting of the streets may change the impression of the villages, and it may well become one of the symbols of the community.

As for other facilities, the electrification of shops would mean introduction of refrigerators which makes preservation of food and chaine enterprises for refrigeration business possible. Its contribution to the community life and economy is considerable by the transformation of economic circulation it may bring about. It also brings a urban atmosphere by lighting up the show windows and villages. According to the administrative division of these public facilities, they stand at such administrative levels as district, division, ward, and village. And among these facilities, division centers seem to have traditionally had an important position. Although public facilities planned for the future may differ from each other as to their type and quality, the infrastructure consolidation policy of KIDP also puts division centers in an important position in the community. The proposed project plans electrification of all of 3 centers at Hai District, 3 of 4 centers at Rombo District, 2 of 2 centers at North Pare District, and 3 of 5 centers at South Pare District.

7.4.5 Collective Effects

When the social economic effects of each sector discussed formerly, with a point of view of rural development, are studied, it is noted that the effects are basically brought about by the introduction of the utility potentiality of electricity and pecuniary external effects in the process of establishing cumulative industrialization mechanism to farming villages. The co-relationships among the items on a chart will look like this:



As a result, the electrification of villages creates increased employment opportunity and income for the people; and with its social effects, it also prevents the flow of people into cities.

Also, the conversion of kerosene usage to electric lights in households, and from diesel engines or diesel engine generators to electric power from TANESCO in industries provides Tanzania with great foreign currency saving effects because as far as the source of energy is concerned, the conversion takes place from petroleum products which depends heavily on import to water, which is infinately available within the country.

PART III

APPENDIX

APPENDIX

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A-1

MATERIALS OBTAINED IN TANZANIA

List of Materials and Drawings Obtained in TANZANIA

1. TANESCO's Annual Report, 1977
2. Tanzania Power Sector Study, Feb. '78, by ACRES Int'l
3. Feasibility Study of Rural Electrification in Tanzania, May '75, by OSKAR von MILLER GMBH
4. TANESCO's Annual Report, 1973 – 1976
5. Feasibility Study of Four Districts in Kilimanjaro, TANESCO
6. Feasibility Study – Twenty Years Analysis, TANESCO
7. Budget Estimate, '79, TANESCO
8. Finance Manager Report, 1975 – 1977, TANESCO
9. Monthly Report, Jan. '78 – Nov. '78
10. Distribution by Tariff Category, TANESCO
11. Economic Survey, '77 – '78, Tanzania Gov't
12. Economic & Operations Report, Bank of Tanzania
13. Survey of Employment & Earnings, 1972, Government
14. The Annual Plan, 1978 – 1979, Tanzania Gov't
15. 1969 Household Budget Survey, vol 2 Housing Conditions, 1971
16. Minimum Wage Act
17. Speech of Minister, Ministry of Finance, June 1978
18. TANESCO's Tariffs, 1976
19. The Third Five-Years Development Plan, vol 1
20. TANESCO's Organization Chart
21. Standards of SCOPO
22. Population & Households of Whole Villages in Kilimanjaro Region, as of 1978
23. Population Structure by Age and Sex of Five Districts (Hai, Rombo, Pare, Moshi Rural, Moshi Urban)
24. Urban Development Plan (Drwg) (Rombo, Boma La Ngombe)
25. kW & kWH Record of Kiyungi Substation
26. TANESCO's plan of Four Districts Electrification
27. Single Line Diagram of TANESCO Power System
28. Single Line Diagram of Moshi System
29. Tax Revenue by Category
30. Tax Rate
31. Survey of Employment and Earnings, '73 – '74
32. Satistical Abstract, 1973
33. Bibliography of Economic and Statistical Publication, 1975
34. Migration Statistics, 1970
35. Schedule for Casual Labor required for Various Works

36. Appraisal of Makmbako Electrification Schedule with future capital expenditure to cover potential consumers and load growth
37. Minimum Safety Factor – Assumed Working Conditions – Spanning and clearance – wood poles – Design Data
38. Estimates of Capital Expenditure – 33 kV – per km
39. Ditto – 500 kVA, 33/.4/.23 kV, s/s
40. East African Railway and Harbours – Electric Power Line crossing Railway Lines operating at voltage not exceeding 66 kV, Mar '60
41. Line Diagram of National Grid System, (Drwg 3619)
42. Proposed 5 mVA 33/11 kV Substation MBEZI Estate – general layout cross section site plan and schematic diagram (Drwg 3599)
43. Ditto, Foundation Details (Drwg 3599/1)
44. As-Fitted Drawing – City Center Substation – control and protection (Drwg 2138)
45. Electrification of Njombe/Makambako, Kondoa and Babti Townships – Tender for Supply of Distribution Line Materials, Transformers, Switchgear, and Others, Feb. '79
46. Moshi Township (distribution line route, Drwg 4325)
47. Test Record Formats
48. Actual Voltage Record – 33 kV bus at Kiyungi
49. List of TANESCO's Distribution Facilities
50. TANESCO's Standard for Clearance – against telephone
51. The Map of Kilimanjaro Region

A-2

BASIC DATA FOR LOAD FORECASTS

A-2. BASIC DATA FOR LOAD FORECASTS

A-2-1	Maximum Power Demands of Domestic Consumers
Table III-2-15	Characteristics of Area
Table III-2-16	Villages and Estate Farms Load Forecasted
Table III-2-17	Estimated Maximum Demand by Distribution Network
Table III-2-18	Maximum Demand of Estate Farms
Table III-2-19	Breakdown of Potential Consumer and Estimated Maximum Demand in KW
Table III-2-20	Sold Energy in GWh (1970 – 1978) by Tariff Group
Draw. III-2-1	Boma Ngombe Urban Development Plan
Draw. III-2-2(1)	Rombo Urban Development Plan
Draw. III-2-2(2)	Ditto
Draw. III-2-3	Mwanga Urban Development Plan

A-2-1
MAXIMUM POWER DEMANDS OF DOMESTIC CONSUMERS

The types of domestic consumers were divided into the three categories of large houses, medium houses and small houses according to the classification of TANESCO, and the respective maximum power demands were estimated as follows:

1. Large Houses: Houses with 6 or more rooms including living room, kitchen, bedrooms, bathroom

Electric Appliances Anticipated

Light	420 W	60 W x 5 = 300 W 40 W x 3 = 120 W
Ceiling fan	200 W	
Iron	500 W	
Refrigerator	800 W	(incl. refrigerator, vacuum cleaner, washing machine, etc.)
Radio	40 W	
Total	1,960 W	

Installed demand: 1,960 W
Demand factor: 0.4
Maximum demand = 1,960 W x 0.4 = 784 W

2. Medium Houses: Houses with 3 to 5 rooms including living room, bedroom, etc.

Electric Appliances Anticipated

Light	280 W	60 W x 2 = 120 W 40 W x 4 = 160 W
Iron	500 W	
Radio	40 W	
Total	820 W	

Installed demand: 820 W
Demand factor: 0.4
Maximum demand = 820 W x 0.4 = 328 W

3. Small Houses: Houses with 1 to 2 rooms

Electric Appliances Anticipated

Light	140 W	60 W x 1 = 60 W 40 W x 2 = 80 W
Radio	40 W	
Total	180 W	

Installed demand: 180 W
Demand factor: 0.4
Maximum demand = 180 W x 0.4 = 72 W

As described in the main part of the chapter, the compositions of the three types of consumers are approximately 10%, 25% and 65% for large, medium and small, respectively, at the Hai District, and approximately 5%, 20% and 75% for Rombo, North Pare and South Pare. Therefore, the maximum power demand per domestic consumer by weighted average is 784 W x 0.1 + 328 W x 0.25 + 72 W x 0.65 = 207.2 W for the Hai Distribution Network, and 784 W x 0.05 + 328 W x 0.2 + 72 W x 0.75 = 158.8 W for the Rombo, North Pare and South Pare Distribution Networks.

Table III-2-15 Characteristics of Areas

Items		Hai	Rombo	North Pare	South Pare
Area	(km^2)	2,109.8	1,435.0	1,492.3	6,407.7
Population	(1978)	172,317	157,736	72,183	135,981
Population Density	(per km^2)	81.7	109.9	48.4	21.2
No. of Households		32,791	28,218	12,864	24,946
No. of Villages		62	56	45	69
Average Population of Village		2,779	2,817	1,604	1,971
Altitude*	(m)	800–1,600	1,200–2,000	1,000–1,800	1,600–2,000
Annual Rainfall*	(mm)	800–1,000	1,000–2,000	800–1,000	800–1,000
Temperature	(°C)	Max. 35 – 40			
Rainy Month		Mar. – Jun.	Apr. – May Dec. – Nov.	Mar. – May	Mar. – May

* The values of high population density zones

SOURCE: Bureau of Statistics DAR ES SALAAM Kilimanjaro IDP JICA

Table III-2-16 Villages and Estate Farms Load – Forecasted

(1) Villages:

Hai		Rombo		North Pare		South Pare	
Villages	Population	Villages	Population	Villages	Population	Villages	Population
Sanya Juu	3,634	Komakunai*	1,780	Kisangara	2,990	Mwembe	2,894
Komboko	2,506	Kotela*	1,298	Mwanga	2,303	Mteke	1,240
Nrao Kisangara	1,777	Kimangara*	3,193	Masumbeni	3,019	Mtunguja	1,692
Samaki Maini	3,096	Kiria*	1,718	Kisanjuni	2,728	Mukonga	1,589
Mae	3,205	Mkolowoni*	2,350	Raa	1,611	Kisiwani	3,165
Kyengia	2,391	Msae Nganyen*	2,140	Msangeni	1,834	Maore	4,389
Wandri	3,305	Kinyamvuo*	3,164	Mamba	1,073	Mpirani	1,385
Kashashi	2,091	Kondeni*	2,619	Mruma	1,505	Udungu	4,784
Lwkani	3,488	Lekura*	1,616	Simbomli	1,248	Misufini	1,516
Kyuu	1,534	Lole Marera*	3,994	Lambo	1,587	Mjema	1,278
Losaa	1,021	Maringa*	2,326	Shighajin	2,020	Bombo	1,648
Lguni	2,267	Kimangaro*	3,921	Ndanda	1,662	Mvaa	1,279
Nkwansira	1,788	Mrimbo Uuwo*	3,822	Kiriche	969		
Lemira Kati	1,269	Mengwe Juu	2,556	Kilaweni	1,496		
Isuki	1,673	Mansera Juu	1,917	Kighare	1,375		
Mroma	1,681	Manda Juu	1,687	Vuanga	847		
Mbweera	4,073	Manda Chini	2,236	Kirongaya	1,096		
Mbosho	1,701	Mengwe Chini	2,849	Chomuu	1,387		
Kware	2,707	Kitasha	2,992	Lomwe	1,404		
Mudio	5,010	Mengweni Chini	2,512	Mshewa	1,832		
Saawe	2,018	Aleni Chini	3,276				
Shari	3,586	Machame Aleni	2,844				
Kyeeri	2,461	Mashami	2,144				
Sonu	2,722	Mashao	2,358				
Ngira	1,815	Simbi Kati	3,914				
Roo	4,043	Mahoro	2,834				
Nronga	2,771	Makiidi	3,833				
Foo	4,351	Ikuini	1,175				
Boma La Ngombe	1,766	Ubaa	1,420				
Liwati	2,723	Mokala	2,970				
(OLDONYOMUPUAK)		Kelamfua	2,764				
		Ushiri	3,228				
		Keryo	2,877				
		Mrao	3,798				
		Kirua	2,737				
		Keni	3,570				
		Mrere	4,392				
		Katangara	4,377				
		Kisare	2,882				
		Mahorosho	2,199				
		Kilema	2,658				
		Kitowo	2,624				
30 villages	78,473	42 villages	115,564	20 villages	33,986	12 villages	26,859
		(13)	(33,941)				

* Villages belong to Moshi Rural District and their population amounts to 33,941, those indicate the figures in parenthesis in the above table.

(2) Estate Farms:

Hai	Rombo	North Pare	South Pare
Estate Farms	Estate Farms	Estate Farms	Estate Farms
Mwanza		Kisangara	Kisiwani
Garagwa			Gonja
Lerongo			Udungu
Kifufu			
Pongo			
Leoni			
Molomo			
Msingi			
Kifaru			
Annahof			
Pirita			
Bondeni			
Boloti			
Nkwansira			
Mbosho			
Uwau			
Kibohehe			
Kikafu			
Mukufi			
Mokoa			
20 estate farms	–	1 estate farm	3 estate farms

Table III-2-17 Estimated Maximum Demand (in kW) by Distribution Network

Distribution Network, Population & Household		Anticipated Load by Tariff Group		Quantity	Maximum Demand
Hai					
Population :	78,473	T-1	Residential	1,158	240.0
Household :		T-2	Commercial	318	246.3
		T-3	L. Industrial	126	1,210.8
		T-4	Industrial	5	660.0
		T-5	Public Lighting	117	11.7
			Total:	1,724	2,368.8
Rombo					
Population :	115,564	T-1	Residential	1,646	261.4
Household :		T-2	Commercial	400	159.6
		T-3	L. Industrial	42	193.4
		T-4	Industrial	–	–
		T-5	Public Lighting	164	16.4
			Total:	2,252	630.8
North Pare					
Population :	33,986	T-1	Residential	469	74.5
Household :		T-2	Commercial	303	161.9
		T-3	L. Industrial	21	114.3
		T-4	Industrial	1	210.0
		T-5	Public Lighting	48	4.8
			Total:	842	565.5
South Pare					
Population :	26,859	T-1	Residential	444	70.5
Household :		T-2	Commercial	300	117.9
		T-3	L. Industrial	12	50.4
		T-4	Industrial	4	500.0
		T-5	Public Lighting	46	4.6
			Total:	806	743.4

Note: Figures of population and household in this table are amounts of target villages of electrification.

Table III-2-18 Maximum Demand of ESTATE Farm

Hai			Rombo			North Pare			South Pare		
Distribution Network			Distribution Network			Distribution Network			Distribution Network		
Estate Farm	Tariff	M.D.	Estate Farm	Tariff	M.D.	Estate Farm	Tariff	M.D.	Estate Farm	Tariff	M.D.
Mwanza	T-3	20.0				Kisangara	T-4	210.0	Kisiwani	T-4	150.0
Gararagwa	T-3	80.0							Gonja	T-4	200.0
Lerongo	T-3	40.0							Ndungu	T-4	100.0
Kifufu	T-4	80.0									
Pongo	T-3	20.0									
Leoni	T-3	20.0									
Molomo	T-3	40.0									
Msingi	T-3	20.0									
Kifaru	T-3	20.0									
Annahof	T-3	20.0									
Pirita	T-4	80.0									
Bondeni	T-4	50.0									
Boloti	T-3	30.0									
Nkwansira	T-3	80.0									
Mbosho	T-3	50.0									
Uwau	T-3	40.0									
Kibohehe	T-4	400.0									
Kikafu	T-3	40.0									
Mukufi	T-3	20.0									
Mokoa	T-3	40.0									

Table III-2-19 Breakdown of Potential Consumer and Estimated Maximum Demand in kW

Village Group	Population & Household	Potential Consumer by Tariff Group	Quantity	Maximum Demand (kW)	Breakdown of Potential Consumer	Quantity	Maximum Demand (kW)
(1) Hai Distribution Network							
Sanya Juu	3,634	T-1 Domestic	80	16.6	T-1 Large houses		
	536	T-2 Commercial	17	13.7	〃 Medium houses	80	16.6
		T-3 L. Industrial	–	–	〃 Small houses		
		T-4 Industrial	–	–	T-2 Police station	1	1.0
		T-5 Public Lighting	8	0.8	〃 Gov. office	1	2.0
		Total	105	31.1	〃 Post office	1	0.5
					〃 Primary schools	3	1.2
					〃 Mission	1	1.0
					〃 Bars	3	1.5
					〃 Shops	4	0.8
					〃 Court	1	0.5
					〃 Hotel	1	2.0
					〃 Workshop	1	3.2
					T-5 Public Lighting	8	0.8
					Total	105	31.1

Village Group	Population & Household	Potential Consumer by Tariff Group	Quantity	Maximum Demand (kW)	Breakdown of Potential Consumer	Quantity	Maximum Demand (kW)
Komboko	7,379	T-1 Domestic	104	21.5	T-1 Large houses		
Nrao Kisangara	1,300	T-2 Commercial	22	17.9	〃 Medium houses	104	21.5
Samaki Maini		T-3 L. Industrial	6	22.2	〃 Small houses		
		T-4 Industrial	–	–	T-2 Prim. schools	6	2.4
		T-5 Public Lighting	10	1.0	〃 Sec. School	1	7.5
		Total	142	62.6	〃 Health centre	1	0.5
					〃 Missions	4	4.0
					〃 Bars	5	2.5
					〃 Shops	5	1.0
					T-3 Maize mills	6	22.2
					T-5 Public Lighting	10	1.0
					Total	142	62.6
Mae	6,896	T-1 Domestic	80	16.5	T-1 Large houses		
Kyengia	998	T-2 Commercial	28	16.1	〃 Medium houses	80	16.5
		T-3 L. Industrial	7	36.6	〃 Small houses		
		T-4 Industrial	1	50.0	T-2 Hotel	1	0.5
		T-5 Public Lighting	8	0.8	〃 Petrol station	1	1.0
		Total	124	120.0	〃 Missions	6	6.0
					〃 Masque	1	0.5
					〃 Court	1	0.5
					〃 Prim. schools	6	2.4
					〃 Bars	4	2.0
					〃 Shops	6	1.2
					〃 Gov. offices	2	2.0
					T-3 Maize mills	7	36.6
					T-4 Hospital (200 beds)	1	50.0
					T-5 Public Lighting	8	0.8
					Total	124	120.0

Village Group	Population & Household	Potential Consumer by Tariff Group	Quantity	Maximum Demand (kW)	Breakdown of Potential Consumer	Quantity	Maximum Demand (kW)
Wandri	3,305	T-1 Domestic	48	9.9	T-1 Large houses		
	602	T-2 Commercial	23	35.4	〃 Medium houses	48	9.9
		T-3 L. Industrial	11	72.8	〃 Small houses		
		T-4 Industrial	–	–	T-2 Missions	3	3.0
		T-5 Public Lighting	5	0.5	〃 Prim. schools	4	1.6
		Total	87	118.6	〃 Carpentries	4	2.0
					〃 Gov. offices	5	5.0
					〃 Bars	3	1.5
					〃 Shops	3	0.6
					〃 Hotel	1	0.5
					T-3 Maize Mills	5	21.2
					〃 Coffee pulperies	4	26.3
					〃 Water pumps	2	46.5
					T-5 Public Lighting	5	0.5
					Total	87	118.6
Kashashi	5,579	T-1 Domestic	79	16.4	T-1 Large houses		
Lwkani	992	T-2 Commercial	21	8.8	〃 Medium houses	79	16.4
		T-3 L. Industrial	13	60.8	〃 Small houses		
		T-4 Industrial	–	–	T-2 Carpentry	1	0.5
		T-5 Public Lighting	8	0.8	〃 Dispensary	1	0.5
		Total	121	86.8	〃 Missions	5	2.5
					〃 Prim. schools	5	2.0
					〃 Bars	3	1.5
					〃 Shops	4	0.8
					〃 Market	1	0.5
					〃 Veterinary	1	0.5
					T-3 Maize mills	9	46.0
					〃 Coffee pulperies	4	14.8
					T-5 Public Lighting	8	0.8
					Total	121	86.8

Village Group	Population & Household	Potential Consumer by Tariff Group	Quantity	Maximum Demand (kW)	Breakdown of Potential Consumer	Quantity	Maximum Demand (kW)
Kyuu	4,822	T-1 Domestic	69	14.3	T-1 Large houses		
Losaa	867	T-2 Commercial	23	16.1	〃 Medium houses	69	14.3
Lguni		T-3 L. Industrial	7	57.2	〃 Small houses		
		T-4 Industrial	–	–	T-2 Prim. schools	4	1.6
		T-5 Public Lighting	7	0.7	〃 Missions	2	2.0
		Total	106	88.3	〃 Carpentries	3	1.5
					〃 Dispensary	1	0.5
					〃 Gov. offices	2	2.0
					〃 Training school	1	5.0
					〃 Bars	5	2.5
					〃 Shops	5	1.0
					T-3 Maize mills	7	57.2
					T-5 Public Lighting	7	0.7
					Total	106	88.3
Nkwansira	1,788	T-1 Domestic	25	5.2	T-1 Large houses		
	316	T-2 Commercial	8	3.7	〃 Medium houses	25	5.2
		T-3 L. Industrial	3	14.0	〃 Small houses		
		T-4 Industrial	–	–	T-2 Prim. schools	2	0.8
		T-5 Public Lighting	3	0.3	〃 Mission	1	1.0
		Total	40	23.2	〃 Carpentry	1	0.5
					〃 Bars	2	1.0
					〃 Shops	2	0.4
					T-3 Maize mills	3	14.0
					T-5 Public Lighting	3	0.3
					Total	40	23.2

Village Group	Population & Household	Potential Consumer by Tariff Group	Quantity	Maximum Demand (kW)	Breakdown of Potential Consumer	Quantity	Maximum Demand (kW)
Lemira Kati	2,942	T-1 Domestic	43	8.9	T-1 Large houses		
Isuki	540	T-2 Commercial	11	15.4	〃 Medium houses	43	8.9
		T-3 L. Industrial	7	32.5	〃 Small houses		
		T-4 Industrial	—	—	T-2 Prim. schools	2	0.8
		T-5 Public Lighting	4	0.4	〃 Missions	3	3.0
		Total	65	57.2	〃 Carpentry	1	0.5
					〃 Dispensary	1	10.0
					〃 Bars	1	0.5
					〃 Shops	3	0.6
					T-3 Maize mills	6	24.6
					〃 Coffee pulpery	1	7.9
					T-4 Public Lighting	4	0.4
					〃 Total	65	57.2
Mroma	5,754	T-1 Domestic	86	17.8	T-1 Large houses		
Mbweera	1,069	T-2 Commercial	28	194	〃 Medium houses	86	17.8
		T-3 L. Industrial	7	53.7	〃 Small houses		
		T-4 Industrial	—	—	T-2 Bars	8	4.0
		T-5 Public Lighting	9	0.9	〃 Shops	5	1.0
		Total	130	91.8	〃 Bank agency	1	0.5
					〃 Library	1	0.5
					〃 Post office	1	0.5
					〃 Gov. office	1	1.0
					〃 Petrol station	1	1.0
					〃 Hotels	2	1.0
					〃 Prim. school	1	0.4
					〃 Carpentries	2	1.0
					〃 Dispensary	1	1.0
					〃 Missions	2	2.0
					〃 Technical school	1	5.0
					〃 Mosque	1	0.5
					T-3 Maize mills	6	50.5
					〃 Coffee pulpery	1	3.2
					T-5 Public Lighting	9	0.9
					Total	130	91.8

Village Group	Population & Household	Potential Consumer by Tariff Group	Quantity	Maximum Demand (kW)	Breakdown of Potential Consumer	Quantity	Maximum Demand (kW)
Mbosho	1,701	T-1 Domestic	25	5.2	T-1 Large houses		
	309	T-2 Commercial	8	3.7	〃 Medium houses	25	5.2
		T-3 L. Industrial	3	14.0	〃 Small houses		
		T-4 Industrial	–	–	T-2 Prim. schools	2	0.8
		T-5 Public Lighting	3	0.3	〃 Mission	1	1.0
		Total	39	23.2	〃 Carpentry	1	0.5
					〃 Bars	2	1.0
					〃 Shops	2	0.4
					T-3 Maize mills	3	14.0
					T-5 Public Lighting	3	0.3
					Total	39	23.2
Kware	2,707	T-1 Domestic	38	7.9	T-1 Large houses		
	472	T-2 Commercial	10	4.4	〃 Medium houses	38	7.9
		T-3 L. Industrial	4	18.7	〃 Small houses		
		T-4 Industrial	–	–	T-2 Prim. schools	2	0.8
		T-5 Public Lighting	4	0.4	〃 Mission	1	1.0
		Total	56	31.4	〃 Carpentry	1	0.5
					〃 Bars	3	1.5
					〃 Shops	3	0.6
					T-3 Maize mills	4	18.7
					T-5 Public Lighting	4	0.4
					Total	56	31.4

Village Group	Population & Household	Potential Consumer by Tariff Group	Quantity	Maximum Demand (kW)	Breakdown of Potential Consumer	Quantity	Maximum Demand (kW)
Mudio	5,010	T-1 Domestic	72	14.9	T-1 Large houses		
	898	T-2 Commercial	14	7.6	〃 Medium houses	72	14.9
		T-3 L. Industrial	3	14.4	〃 Small houses		
		T-4 Industrial	–	–	T-2 Prim. schools	3	1.2
		T-5 Public Lighting	7	0.7	〃 Missions	2	2.0
		Total	96	37.6	〃 Masque	1	0.5
					〃 Bars	3	1.5
					〃 Shops	2	0.4
					〃 Health centre	1	0.5
					〃 Court	1	0.5
					〃 Gov. office	1	1.0
					T-3 Maize mills	3	14.4
					T-5 Public Lighting	7	0.7
					Total	96	37.6
Saawe	8,065	T-1 Domestic	120	24.9	T-1 Large houses		
Shari	1,495	T-2 Commercial	18	16.7	〃 Medium houses	120	24.9
Kyeeri		T-3 L. Industrial	12	106.3	〃 Small houses		
		T-4 Industrial	–	–	T-2 Bars	8	4.0
		T-5 Public Lighting	12	1.2	〃 Shops	9	1.8
		Total	162	149.1	〃 Market	1	0.5
					〃 Dispensaries	2	1.0
					〃 Missions	4	4.0
					〃 Carpentries	4	2.0
					〃 Gov. office	1	1.0
					〃 Prim. schools	6	2.4
					T-3 Maize mills	9	40.6
					〃 Coffee pulperies	3	65.7
					T-5 Public Lighting	12	1.2
					Total	162	149.1

Village Group	Population & Household	Potential Consumer by Tariff Group	Quantity	Maximum Demand (kW)	Breakdown of Potential Consumer	Quantity	Maximum Demand (kW)
Sonu	4,537	T-1 Domestic	64	13.3	T-1 Large houses		
Ngira	804	T-2 Commercial	23	12.1	〃 Medium houses	64	13.3
		T-3 L. Industrial	7	31.7	〃 Small houses		
		T-4 Industrial	–	–	T-2 Prim. schools	4	1.6
		T-5 Public Lighting	6	0.6	〃 Bars	6	3.0
		Total	100	57.7	〃 Shops	5	1.0
					〃 Sec. school	1	1.0
					〃 Missions	3	3.0
					〃 Gov. office	1	1.0
					〃 Carpentries	3	1.5
					T-3 Maize mills	4	18.2
					〃 Coffee pulperies	3	13.5
					T-5 Public Lighting	6	0.6
					Total	100	57.7
Roo	4,043	T-1 Domestic	54	11.2	T-1 Large houses		
	681	T-2 Commercial	12	4.9	〃 Medium houses	54	11.2
		T-3 L. Industrial	7	38.2	〃 Small houses		
		T-4 Industrial	–	–	T-2 Bars	3	1.5
		T-5 Public Lighting	5	0.5	〃 Shops	5	1.0
		Total	78	54.8	〃 Mosque	1	0.5
					〃 Veterinary	1	0.5
					〃 Prim. school	1	0.4
					〃 Sec. school	1	1.0
					T-3 Maize mills	3	20.0
					〃 Coffee pulperies	4	18.2
					T-5 Public Lighting	5	0.5
					Total	78	54.8

Village Group	Population & Household	Potential Consumer by Tariff Group	Quantity	Maximum Demand (kW)	Breakdown of Potential Consumer	Quantity	Maximum Demand (kW)
Nronga	7,122	T-1 Domestic	106	22.0	T-1 Large houses		
Foo	1,330	T-2 Commercial	32	14.7	〃 Medium houses	106	22.0
		T-3 L. Industrial	11	48.2	〃 Small houses		
		T-4 Industrial	–	–	T-2 Prim. schools	6	2.4
		T-5 Public Lighting	11	1.1	〃 Missions	3	3.0
		Total	160	86.0	〃 Carpentries	4	2.0
					〃 Post office	1	0.5
					〃 Gov. office	1	1.0
					〃 Bars	6	3.0
					〃 Shops	9	1.8
					〃 Veterinary	1	0.5
					〃 Dispensary	1	0.5
					T-3 Maize mills	10	43.7
					〃 Saw mill	1	4.5
					T-5 Public Lighting	11	1.1
					Total	160	86.0
Boma La Ngombe	1,766	T-1 Domestic	30	6.2	T-1 Large houses		
	372	T-2 Commercial	9	10.5	〃 Medium houses	30	6.2
		T-3 L. Industrial	–	–	〃 Small houses		
		T-4 Industrial	–	–	T-2 Prim. school	1	0.4
		T-5 Public Lighting	3	0.3	〃 Petrol station	1	2.0
		Total	42	17.0	〃 Gov. office	1	5.0
					〃 Mission	1	1.0
					〃 Dispensary	1	1.0
					〃 Bars	2	1.0
					〃 Shops	2	0.4
					T-5 Public Lighting	3	0.3
					Total	42	17.0

Village Group	Population & Household	Potential Consumer by Tariff Group	Quantity	Maximum Demand (kW)	Breakdown of Potential Consumer	Quantity	Maximum Demand (kW)
Liwati	2,723	T-1 Domestic	35	7.3	T-1 Large houses		
	436	T-2 Commercial	11	5.2	〃 Medium houses	35	7.3
		T-3 L. Industrial	2	9.5	〃 Small houses		
		T-4 Industrial	–	–	T-2 Prim. school	1	0.4
		T-5 Public Lighting	4	0.4	〃 Mission	1	1.0
		Total	52	22.4	〃 Petrol station	1	1.0
					〃 Bars	2	1.0
					〃 Shops	4	0.8
					〃 Market	1	0.5
					〃 KNCU Godowns	2	0.5
					T-3 Maize mills	2	9.5
					T-4 Public Lighting	4	0.4
					Total	52	22.4
(2) Rombo Distribution Network							
Komakunai	7,989	T-1 Domestic	156	24.8	T-1 Large houses		
Kotela	1,952	T-2 Commercial	47	18.6	〃 Medium houses	156	24.8
Kimangara		T-3 L. Industrial	5	19.2	〃 Small houses		
Kiria		T-4 Industrial	–	–	T-2 Prim. schools	3	1.2
Mkolowoni		T-5 Public Lighting	16	1.6	〃 Missions	2	2.0
		Total	224	64.2	〃 Gov. offices	2	2.0
					〃 Dispensary	1	1.0
					〃 Bars	10	5.0
					〃 Shops	27	5.4
					〃 Workshops	2	2.0
					T-3 Maize mills	5	19.2
					T-4 Public Lighting	16	1.6
					Total	224	64.2

Village Group	Population & Household	Potential Consumer by Tariff Group	Quantity	Maximum Demand (kW)	Breakdown of Potential Consumer	Quantity	Maximum Demand (kW)
Msae Nganyen	9,539	T-1 Domestic	134	21.3	T-1 Large houses		
Kinyamrrio	1,674	T-2 Commercial	53	17.1	〃 Medium houses	134	21.3
Kondeni		T-3 L. Industrial	4	18.8	〃 Small houses		
Lekura		T-4 Industrial	–	–	T-2 Gov. office	1	1.0
		T-5 Public Lighting	13	1.3	〃 Prim. schools	4	1.6
		Total	204	58.5	〃 Mission	1	1.0
					〃 Hospital	1	1.0
					〃 Bars	11	5.5
					〃 Shops	35	7.0
					T-3 Maize mills	4	18.8
					T-4 Public Lighting	13	1.3
					Total	204	58.3
Lole Marera	14,063	T-1 Domestic	184	29.2	T-1 Large houses		
Maringa	2,304	T-2 Commercial	46	17.7	〃 Medium houses	184	29.2
Kimangaro		T-3 L. Industrial	6	19.0	〃 Small houses		
Mrimbo Uuwo		T-4 Industrial	–	–	T-2 Prim. schools	6	2.4
		T-5 Public Lighting	18	1.8	〃 Market	1	0.5
		Total	254	67.7	〃 Bars	10	5.0
					〃 Shops	24	4.8
					〃 Missions	3	3.0
					〃 Gov. offices	2	2.0
					T-3 Maize mills	6	19.0
					T-5 Public Lighting	18	1.8
					Total	254	67.7

Village Group	Population & Household	Potential Consumer by Tariff Group	Quantity	Maximum Demand (kW)	Breakdown of Potential Consumer	Quantity	Maximum Demand (kW)
Mengwe Juu	11,245	T-1 Domestic	178	28.3	T-1 Large houses		
Mansera Juu	2,223	T-2 Commercial	23	11.2	〃 Medium houses	178	28.3
Manda Juu		T-3 L. Industrial	3	9.6	〃 Small houses		
Manda Chini		T-4 Industrial	–	–	T-2 Prim. schools	8	3.2
Mengwe Chini		T-5 Public Lighting	18	1.8	〃 Mission	1	1.0
		Total	222	50.9	〃 Bars	4	2.0
					〃 Shops	5	1.0
					〃 Gov. offices	2	2.0
					〃 Court	1	0.5
					〃 Rest house	1	0.5
					〃 Dispensary	1	1.0
					T-3 Maize mills	3	9.6
					T-5 Public Lighting	18	1.8
					Total	222	50.9
Kitasha	13,768	T-1 Domestic	193	30.6	T-1 Large houses		
Mengeni Chini	2,416	T-2 Commercial	45	10.5	〃 Medium houses	193	30.6
Aleni Chini		T-3 L. Industrial	2	10.7	〃 Small houses		
Machame Aleni		T-4 Industrial	–	–	T-2 Prim. schools	10	2.0
Mashami		T-5 Public Lighting	19	1.9	〃 Dispensary	1	0.5
		Total	259	53.7	〃 Gov. office	1	1.0
					〃 Mission	1	0.8
					〃 Bars	4	1.6
					〃 Shops	28	4.6
					T-4 Maize mills	2	10.7
					T-5 Public Lighting	19	1.9
					Total	45	53.7

Village Group	Population & Household	Potential Consumer by Tariff Group	Quantity	Maximum Demand (kW)	Breakdown of Potential Consumer	Quantity	Maximum Demand (kW)
Mashao	12,939	T-1 Domestic	174	27.6	T-1 Large houses		
Simbi Kati	2,178	T-2 Commercial	58	27.0	〃 Medium houses	174	27.6
Mahoro		T-3 L. Industrial	1	7.5	〃 Small houses		
Makiidi		T-4 Industrial	–	–	T-2 Prim. schools	10	4.0
		T-5 Public Lighting	17	1.7	〃 Market	1	0.5
		Total	250	63.8	〃 Court	1	0.5
					〃 Rest house	1	0.2
					〃 Hospital	1	1.0
					〃 Bars	8	4.0
					〃 Shops	24	4.8
					〃 Gov. offices	2	2.0
					〃 Dispensaries	2	2.0
					〃 Missions	5	5.0
					〃 Sec. school	1	1.0
					〃 Trade schools	2	2.0
					T-3 Maize mill	1	7.5
					T-4 Public Lighting	17	1.7
					Total	250	63.8
Ikuini	1,175	T-1 Domestic	20	3.2	T-1 Large houses		
	252	T-2 Commercial	8	5.5	〃 Medium houses	20	3.2
		T-3 L. Industrial	1	40.0	〃 Small houses		
		T-4 Industrial	–	–	T-2 Bar	1	0.5
		T-5 Public Lighting	2	0.2	〃 Shops	3	0.6
		Total	31	48.9	〃 Prim. school	1	0.4
					〃 Bank	1	2.0
					〃 Gov. offices	2	2.0
					T-3 Hospital	1	40.0
					T-5 Public Lighting	2	0.3
					Total	31	48.9

Village Group	Population & Household	Potential Consumer by Tariff Group	Quantity	Maximum Demand (kW)	Breakdown of Potential Consumer	Quantity	Maximum Demand (kW)
Ubaa	10,382	T-1 Domestic	146	23.2	T-1 Large houses		
Mokala	1,830	T-2 Commercial	25	12.1	〃 Medium houses	146	23.2
Kelamfua		T-3 L. Industrial	6	19.1	〃 Small houses		
Ushiri		T-4 Industrial	–	–	T-2 Prim. schools	5	2.0
		T-5 Public Lighting	15	1.5	〃 Dispensary	1	1.0
		Total	192	55.9	〃 Police station	1	1.0
					〃 Gov. offices	2	2.0
					〃 Bars	6	3.0
					〃 Shops	8	1.6
					〃 Guest house	1	0.5
					〃 Workshop	1	1.0
					T-3 Maize mills	6	19.1
					T-5 Public Lighting	15	1.5
					Total	192	55.9
Keryo	12,982	T-1 Domestic	184	29.2	T-1 Large houses		
Mrao	2,302	T-2 Commercial	29	12.0	〃 Medium houses	184	29.2
Kirua		T-3 L. Industrial	4	12.8	〃 Small houses		
Keni		T-4 Industrial	–	–	T-2 Prim. schools	3	1.2
		T-5 Public Lighting	18	1.8	〃 Gov. office	1	1.0
		Total	235	55.8	〃 Mission	1	1.0
					〃 Bars	7	3.5
					〃 Shops	14	2.8
					〃 Sec. school	1	1.0
					〃 Workshop	1	1.0
					〃 Rest house	1	0.5
					T-3 Maize mills	4	12.8
					T-5 Public Lighting	18	1.8
					Total	235	55.8

Village Group	Population & Household	Potential Consumer by Tariff Group	Quantity	Maximum Demand (kW)	Breakdown of Potential Consumer	Quantity	Maximum Demand (kW)
Mrere	8,769	T-1 Domestic	128	20.3	T-1 Large houses		
Katangara	1,596	T-2 Commercial	40	16.0	〃 Medium houses	128	20.3
		T-3 L. Industrial	6	23.9	〃 Small houses		
		T-4 Industrial	–	–	T-2 Prim. schools	2	0.8
		T-5 Public Lighting	13	1.3	〃 Bank	1	0.5
		Total	187	61.5	〃 Market	1	0.5
					〃 Dispensary	1	1.0
					〃 Mission	1	1.0
					〃 Petrol station	1	1.0
					〃 Rest houses	4	2.0
					〃 Bars	6	3.0
					〃 Shops	21	4.2
					〃 Sec. schools	2	2.0
					T-3 Trade school	1	10.0
					〃 Maize mills	5	15.9
					T-5 Public Lighting	13	1.3
					Total	187	61.5
Kisare	10,363	T-1 Domestic	149	23.7	T-1 Large houses		
Mahorosho	1,865	T-2 Commercial	26	11.9	〃 Medium houses	149	23.7
Kilema		T-3 L. Industrial	4	12.8	〃 Small houses		
Kitowo		T-4 Industrial	–	–	T-2 Prim. schools	6	2.4
		T-5 Public Lighting	15	1.5	〃 Court	1	0.5
		Total	194	49.9	〃 Gov. offices	3	3.0
					〃 Bars	3	1.5
					〃 Shops	10	2.0
					〃 Rest house	1	0.5
					〃 Workshop	1	1.0
					T-3 Maize mills	4	12.8
					T-5 Public Lighting	15	1.5
					Total	194	49.9

Village Group	Population & Household	Potential Consumer by Tariff Group	Quantity	Maximum Demand (kW)	Breakdown of Potential Consumer	Quantity	Maximum Demand (kW)
(3) North Pare Distribution Network							
Kisangara	2,990	T-1 Domestic	51	8.1	T-1 Large houses		
	636	T-2 Commercial	40	18.3	〃 Medium houses	51	8.1
		T-3 L. Industrial	3	14.1	〃 Small houses		
		T-4 Industrial	–	–	T-2 Dispensaries	2	2.0
		T-5 Public Lighting	5	0.5	〃 Primary schools	3	1.2
		Total	99	41.0	〃 Hotels	3	3.0
					〃 Bars	4	2.0
					〃 Shops	23	4.6
					〃 Petrol station	1	2.0
					〃 Mosque	1	0.5
					〃 Workshops	3	3.0
					T-3 Maize mills	3	14.1
					T-5 Public Lighting	5	0.5
					Total	99	41.0
Mwanga	2,303	T-1 Domestic	32	5.0	T-1 Large houses		
	406	T-2 Commercial	53	27.4	〃 Medium houses	32	5.1
		T-3 L. Industrial	2	6.4	〃 Small houses		
		T-4 Industrial	–	–	T-2 Prim. school	1	0.4
		T-5 Public Lighting	4	0.4	〃 Dispensary	1	1.0
		Total	91	39.3	〃 Hotels	6	3.0
					〃 Gov. offices	10	10.0
					〃 Bars	4	2.0
					〃 Shops	25	5.0
					〃 Post office	1	0.5
					〃 Petrol station	1	2.0
					〃 Workshops	3	3.0
					〃 Mosque	1	0.5
					T-3 Maize mills	2	6.4
					T-5 Public Lighting	4	0.4
					Total	91	39.3

Village Group	Population & Household	Potential Consumer by Tariff Group	Quantity	Maximum Demand (kW)	Breakdown of Potential Consumer	Quantity	Maximum Demand (kW)
Masumbeni	7,358	T-1 Domestic	93	14.8	T-1 Large houses		
Kisanjuni	1,165	T-2 Commercial	40	21.7	″ ″ Medium houses	93	14.8
Raa		T-3 L. Industrial	6	19.0	″ Small houses		
		T-4 Industrial	–	–	T-2 Prim. schools	5	2.0
		T-5 Public Lighting	9	0.9	″ Gov. office	1	1.0
		Total	148	56.4	″ Mission	1	1.0
					″ Sec. school	1	1.0
					″ Hospital	1	10.0
					″ Dispensaries	2	1.0
					″ Veterinary	1	0.5
					″ Bars	4	2.0
					″ Shops	14	2.8
					T-3 Maize mills	6	19.0
					T-5 Public Lighting	9	0.9
					Total	148	56.4
Msangeni	2,907	T-1 Domestic	39	6.2	T-1 Large houses		
Mamba	488	T-2 Commercial	23	9.8	″ Medium houses	39	6.2
		T-3 L. Industrial	2	6.4	″ Small houses		
		T-4 Industrial	–	–	T-2 Prim. schools	2	0.8
		T-5 Public Lighting	4	0.4	″ Market	1	0.5
		Total	68	22.8	″ Court	1	0.5
					″ Rest house	1	0.5
					″ Gov. offices	2	2.0
					″ Mission	1	1.0
					″ Dispensary	1	0.5
					″ Mosque	1	0.5
					″ Bars	3	1.5
					″ Shops	10	2.0
					T-3 Maize mills	2	6.4
					T-5 Public Lighting	4	0.4
					Total	68	22.8

Village Group	Population & Household	Potential Consumer by Tariff Group	Quantity	Maximum Demand (kW)	Breakdown of Potential Consumer	Quantity	Maximum Demand (kW)
Mruma	4,340	T-1 Domestic	62	9.8	T-1 Large houses		
Simbomu	780	T-2 Commercial	21	9.3	〃 Medium houses	62	9.8
Lambo		T-3 L. Industrial	4	18.8	〃 Small houses		
		T-4 Industrial	–	–	T-2 Prim. schools	2	0.8
		T-5 Public Lighting	6	0.6	〃 Mission	1	1.0
		Total	93	38.5	〃 Dispensary	1	1.0
					〃 Bars	4	2.0
					〃 Shops	10	2.0
					〃 Carpentry	1	0.5
					〃 Workshops	2	2.0
					T-3 Maize mills	4	18.8
					T-5 Public Lighting	6	0.6
					Total	93	38.5
Shighajin	4,651	T-1 Domestic	63	10.0	T-1 Large houses		
Ndanda	792	T-2 Commercial	47	27.5	〃 Medium houses	63	10.0
Kiriche		T-3 L. Industrial	2	6.4	〃 Small houses		
		T-4 Industrial	–	–	T-2 Prim. schools	4	1.6
		T-5 Public Lighting	6	0.6	〃 Gov. office	1	1.0
		Total	118	44.5	〃 Sec. schools	2	2.0
					〃 Rest houses	2	1.0
					〃 Bars	7	3.5
					〃 Shops	27	5.4
					〃 Workshops	1	1.0
					〃 Hospital	1	12.0
					T-3 Maize mills	2	6.4
					T-5 Public Lighting	6	0.6
					Total	118	44.5

Village Group	Population & Household	Potential Consumer by Tariff Group	Quantity	Maximum Demand (kW)	Breakdown of Potential Consumer	Quantity	Maximum Demand (kW)
Kilaweni	3,718	T-1 Domestic	55	8.7	T-1 Large houses		
Kighare	691	T-2 Commercial	52	39.4	"" Medium houses	55	8.7
Uuanga		T-3 L. Industrial	1	22.5	" Small houses		
		T-4 Industrial	–	–	T-2 Primary schools	6	2.4
		T-5 Public Lighting	6	0.6	" Gov. offices	3	3.0
		Total	114	71.2	" Post office	1	0.5
					" Mission	1	1.0
					" Sec. school	1	1.0
					" Hospital	1	5.0
					" Market	1	0.5
					" Bars	6	3.0
					" Shops	20	4.0
					" Rest houses	5	2.5
					" Petrol Stations	2	2.0
					" Court	1	0.5
					" Mosques	2	1.0
					" Workshops	2	2.0
					T-3 Flour mill	1	22.5
					T-5 Public Lighting	6	0.6
					Total	114	71.2
Kirongaya	5,719	T-1 Domestic	74	11.8	T-1 Large houses		
Chomuu	919	T-2 Commercial	27	8.5	" Medium houses	74	11.8
Mshewa		T-3 L. Industrial	1	40.0	" Small houses		
		T-4 Industrial	–	–	T-2 Primary schools	4	1.6
		T-5 Public Lighting	8	0.8	" Sec. school	1	1.0
		Total	110	61.1	" Bars	5	2.5
					" Shops	17	3.4
					T-3 Training school	1	40.0
					T-5 Public Lighting	8	0.8
					Total	110	61.1

Village Group	Population & Household	Potential Consumer by Tariff Group	Quantity	Maximum Demand (kW)	Breakdown of Potential Consumer	Quantity	Maximum Demand (kW)
(4) South Pare Distribution Network							
Mwembe	5,826	T-1 Domestic	80	12.7	T-1 Large houses		
Mteke	1,001	T-2 Commercial	36	15.9	〃 Medium houses	80	12.7
Mtunguja		T-3 L. Industrial	4	18.8	〃 Small houses		
		T-4 Industrial	–	–	T-2 Gov. office	1	1.0
		T-5 Public Lighting	8	0.8	〃 Missions	2	2.0
		Total	128	48.2	〃 Prim. schools	8	3.2
					〃 Dispensary	1	1.0
					〃 Rest houses	2	1.0
					〃 Bars	2	1.0
					〃 Shops	16	3.2
					〃 Workshops	3	3.0
					〃 Mosque	1	0.5
					T-3 Maize mills	4	18.8
					T-5 Public Lighting	8	0.8
					Total	128	48.2
Mukonga	4,754	T-1 Domestic	87	13.8	T-1 Large houses		
Kisiwani	1,093	T-2 Commercial	56	24.5	〃 Medium houses	87	13.8
		T-3 L. Industrial	4	18.8	〃 Small houses		
		T-4 Industrial	–	–	T-2 Gov. office	1	1.0
		T-5 Public Lighting	9	0.9	〃 Post office	1	0.5
		Total	156	58.0	〃 Missions	3	3.0
					〃 Prim. schools	3	1.2
					〃 Dispensary	1	1.0
					〃 Rest houses	9	4.5
					〃 Bars	10	5.0
					〃 Shops	24	4.8
					〃 Workshops	3	3.0
					〃 Mosque	1	0.5
					T-3 Maize mills	4	18.8
					T-5 Public Lighting	9	0.9
					Total	156	58.0

Village Group	Population & Household	Potential Consumer by Tariff Group	Quantity	Maximum Demand (kW)	Breakdown of Potential Consumer	Quantity	Maximum Demand (kW)
Maore	4,389	T-1 Domestic	78	12.4	T-1 Large houses		
	981	T-2 Commercial	66	23.8	〃 Medium houses	78	12.4
		T-3 L. Industrial	4	12.8	〃 Small houses		
		T-4 Industrial	–	–	T-2 Gov. office	1	1.0
		T-5 Public Lighting	8	0.8	〃 Post office	1	0.5
		Total	156	49.8	〃 Mission	1	1.0
					〃 Mosque	1	0.5
					〃 Prim. schools	3	1.2
					〃 Dispensary	1	1.0
					〃 Rest houses	5	2.5
					〃 Bars	4	2.0
					〃 Shops	43	8.6
					〃 Veterinary	1	0.5
					〃 Workshops	4	4.0
					〃 Police station	1	1.0
					T-3 Maize mills	4	12.8
					T-5 Public Lighting	8	0.8
					Total	156	49.8
Mpirani	1,385	T-1 Domestic	29	4.6	T-1 Large houses		
	359	T-2 Commercial	34	11.7	〃 Medium houses	29	4.6
		T-3 L. Industrial	–	–	〃 Small houses		
		T-4 Industrial	–	–	T-2 Primary schools	2	0.8
		T-5 Public Lighting	3	0.3	〃 Rest houses	2	1.0
		Total	66	16.6	〃 Bars	4	2.0
					〃 Shops	22	4.4
					〃 Workshops	3	3.0
					〃 Market	1	0.5
					T-5 Public Lighting	3	0.3
					Total	66	16.6

Village Group	Population & Household	Potential Consumer by Tariff Group	Quantity	Maximum Demand (kW)	Breakdown of Potential Consumer	Quantity	Maximum Demand (kW)
Ndungu	6,300	T-1 Domestic	115	18.3	T-1 Large houses		
Misufini	1,433	T-2 Commercial	64	24.3	〃 Medium houses	115	18.3
		T-3 L. Industrial	–	–	〃 Small houses		
		T-4 Industrial	–	–	T-2 Gov. offices	2	2.0
		T-5 Public Lighting	12	1.2	〃 Post office	1	0.5
		Total	191	43.8	〃 Mission	1	1.0
					〃 Court	1	0.5
					〃 Prim. schools	3	1.2
					〃 Health centre	1	0.5
					〃 Rest houses	6	3.0
					〃 Bars	4	2.0
					〃 Shops	38	7.6
					〃 Workshops	4	4.0
					〃 Petrol station	1	1.0
					〃 Mosques	2	1.0
					T-5 Public Lighting	12	1.2
					Total	191	43.8
Mjema	4,205	T-1 Domestic	55	8.7	T-1 Large houses		
Bombo	689	T-2 Commercial	44	17.7	〃 Medium houses	55	8.7
Mvaa		T-3 L. Industrial	–	–	〃 Small houses		
		T-4 Industrial	1	50.0	T-2 Gov. office	1	1.0
		T-5 Public Lighting	6	0.6	〃 Mission	1	1.0
		Total	106	77.0	〃 Prim. schools	5	2.0
					〃 Rest houses	11	5.5
					〃 Bars	2	1.0
					〃 Shops	21	4.2
					〃 Workshops	3	3.0
					T-4 Hospital	1	50.0
					T-5 Public Lighting	6	0.6
					Total	106	77.0

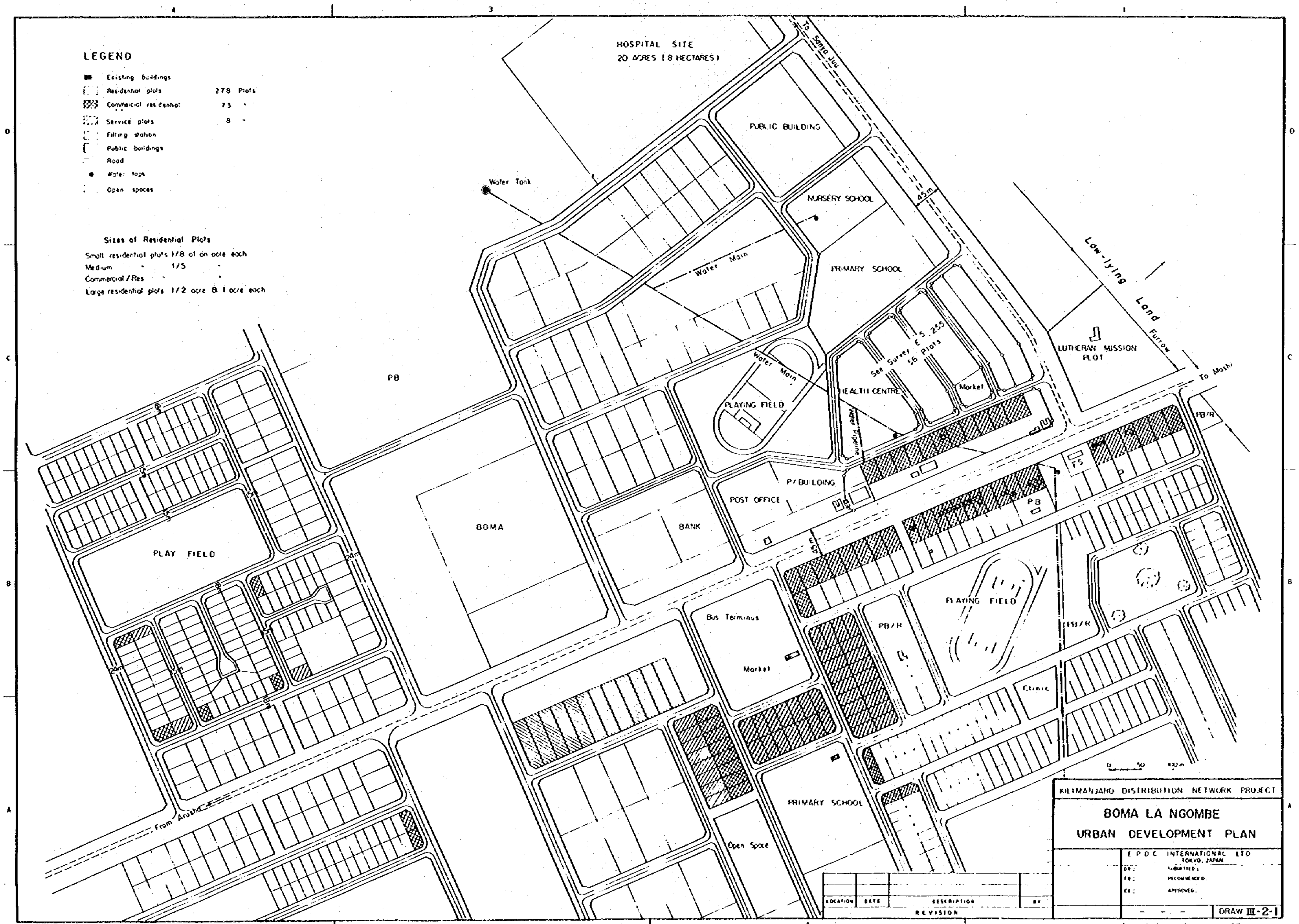
Table III-2-20 Sold Energy in GWh (1970–1978) by Tariff Group

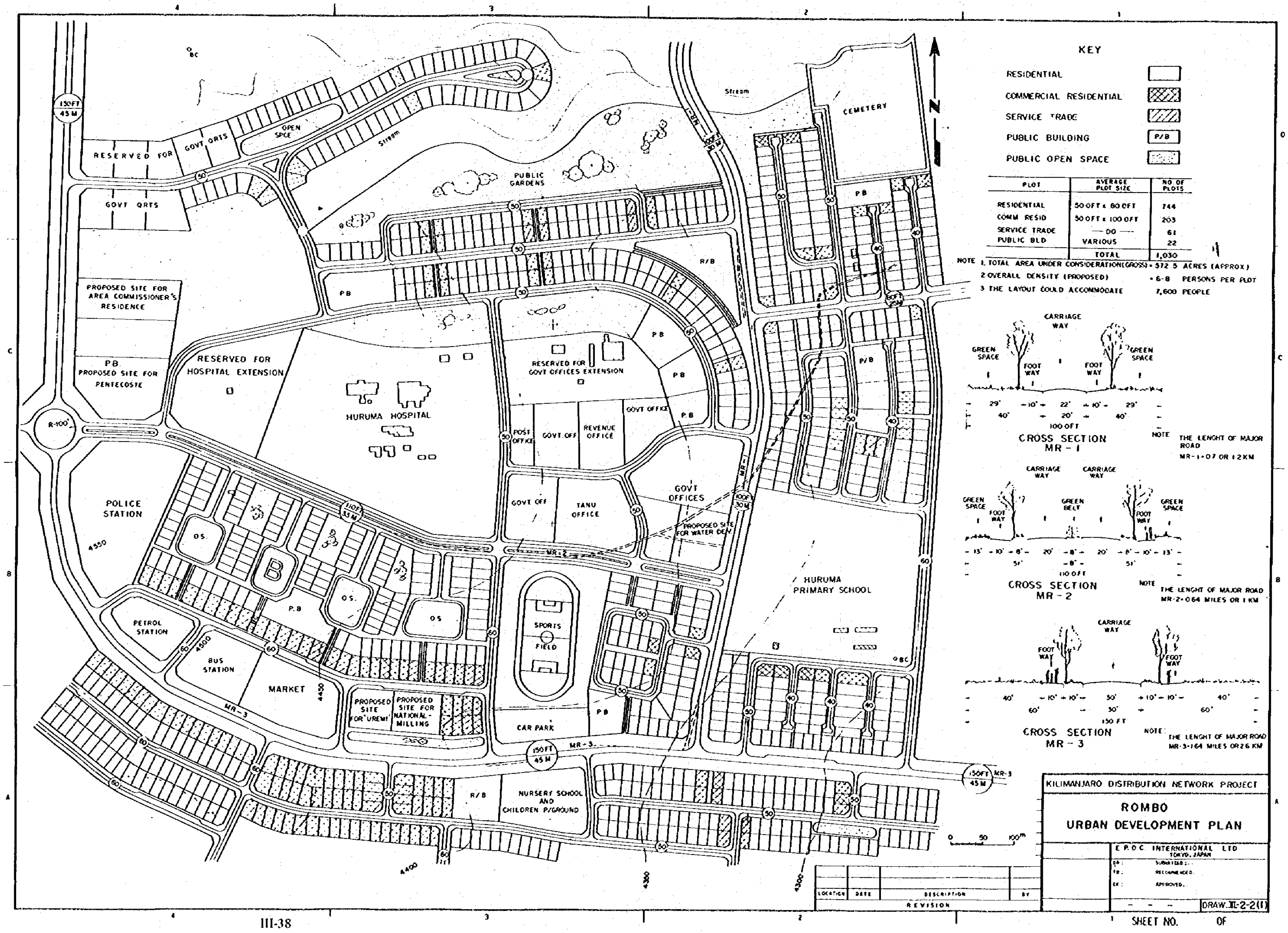
Branches		1970	1971	1972	1973	1974	1975	1976	1977	1978
Bukoba	T-1	0.45	0.47	0.45	0.57	0.65	0.69	0.68	0.75	0.88
	T-2	1.08	0.95	1.03	1.16	1.03	1.00	1.03	0.97	1.06
	T-3	0.41	0.19	0.14	0.22	0.19	0.18	0.19	0.37	0.35
	T-4	1.05	0.34	0.68	0.39	0.57	0.58	0.72	0.71	0.65
	T-5	0.08	0.08	0.09	0.09	0.09	0.08	0.10	0.10	0.08
Dodoma	T-1	0.61	0.71	0.77	0.83	1.00	1.20	1.37	1.46	2.12
	T-2	1.33	1.50	1.62	1.83	1.55	1.65	1.59	1.52	1.73
	T-3	0.20	0.30	0.36	0.38	0.32	0.43	0.53	0.92	1.32
	T-4	1.97	1.91	2.43	1.94	2.98	4.24	4.26	3.30	3.76
	T-5	0.10	0.17	0.13	0.15	0.14	0.18	0.17	0.09	0.08
Iringa	T-1	0.84	0.92	0.89	0.90	0.90	0.99	0.95	1.42	2.39
	T-2	1.14	1.32	1.38	1.49	1.13	1.29	1.33	1.26	1.73
	T-3	0.17	0.28	0.33	0.34	0.33	0.28	0.23	0.26	0.35
	T-4	1.52	1.71	1.57	1.81	2.18	1.77	1.75	2.06	2.12
	T-5	0.16	0.19	0.21	0.20	0.21	0.21	0.30	0.24	0.15
Kigoma	T-1	0.19	0.20	0.23	0.28	0.33	0.44	0.47	0.54	0.61
	T-2	0.75	0.89	0.67	1.07	0.55	0.54	0.59	0.53	0.67
	T-3	0.30	0.38	0.40	0.54	0.32	0.20	0.13	0.18	0.18
	T-4	–	–	–	–	0.26	0.34	0.70	0.64	1.24
	T-5	0.08	0.07	0.07	0.07	0.08	0.09	0.09	0.11	0.10
Lindi	T-1	0.24	0.25	0.23	0.27	0.31	0.37	0.34	0.33	0.41
	T-2	0.33	0.38	0.43	0.47	0.43	0.47	0.48	0.55	0.46
	T-3	0.06	0.08	0.09	0.10	0.13	0.16	0.15	0.20	0.20
	T-4	–	–	0.12	0.28	0.41	0.80	0.62	0.58	0.33
	T-5	0.03	0.06	0.06	0.06	0.07	0.08	0.05	0.04	0.04
Mbeya	T-1	0.90	0.97	0.97	0.92	1.13	1.26	1.26	1.34	1.59
	T-2	1.60	1.73	1.73	2.11	1.79	1.58	1.68	1.62	1.81
	T-3	0.31	0.33	0.39	0.39	0.35	0.30	0.30	0.42	0.46
	T-4	–	–	–	–	0.51	0.56	0.58	2.02	1.09
	T-5	0.07	0.07	0.09	0.11	0.10	0.12	0.12	0.13	0.16
Mafia	T-1	–	–	0.003	0.003	0.01	0.03	0.01	0.03	0.04
	T-2	–	–	0.02	0.02	0.03	0.07	0.07	0.08	0.09
	T-3	–	–	–	–	–	–	0.01	0.02	0.19
	T-4	–	–	–	0.60	0.60	0.55	0.53	0.47	0.37
	T-5	–	–	0.01	0.01	0.008	0.01	0.02	0.02	0.02

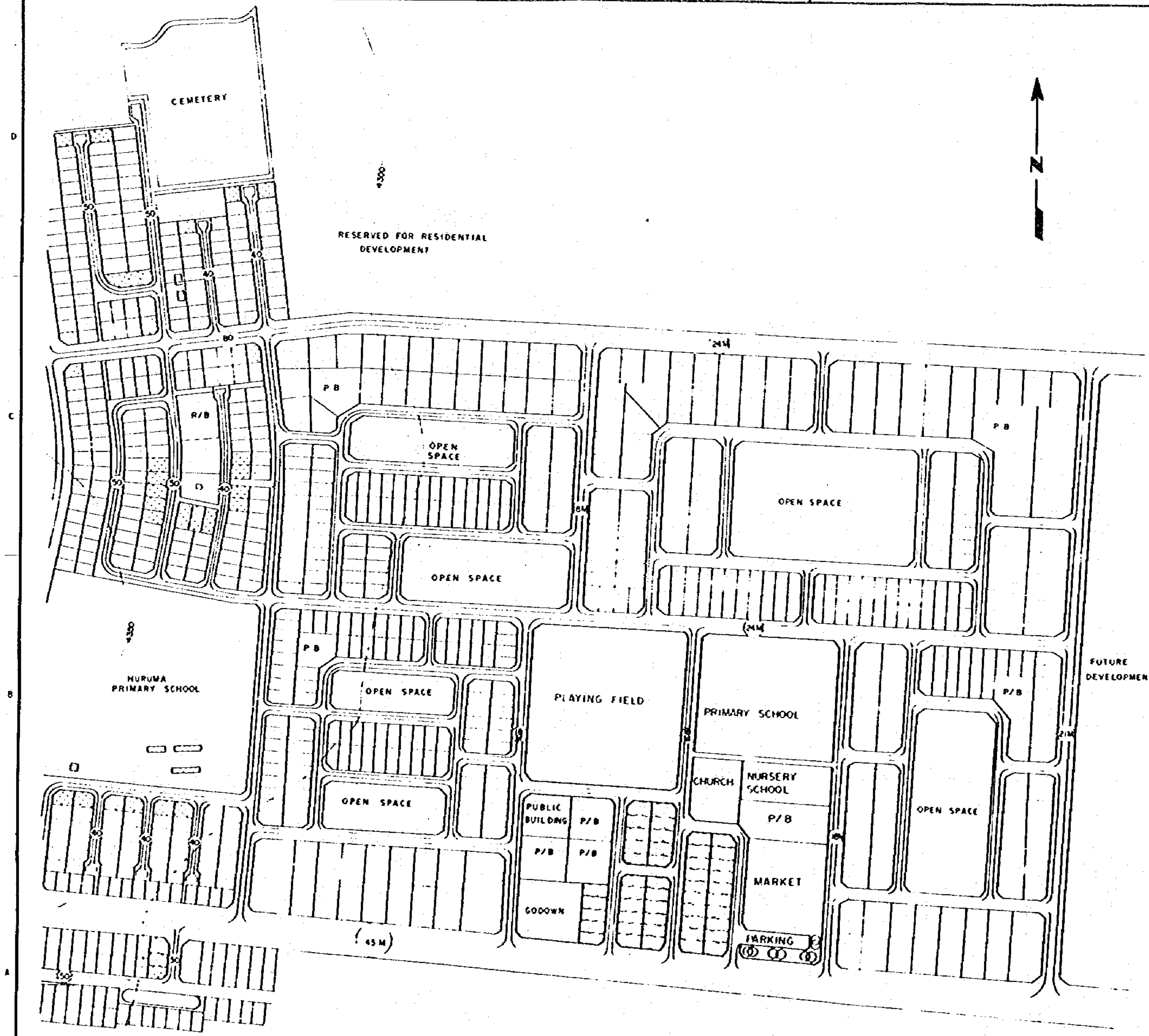
Branches		1970	1971	1972	1973	1974	1975	1976	1977	1978
Morogoro	T-1	1.12	1.01	1.23	1.35	1.55	2.31	2.05	2.50	3.05
	T-2	1.77	2.01	2.00	2.15	2.17	2.57	2.42	2.93	3.14
	T-3	1.13	1.36	1.52	1.75	2.44	2.98	2.26	2.10	2.26
	T-4	10.97	9.66	9.99	10.22	10.33	12.02	11.23	13.33	13.20
	T-5	0.26	0.25	0.22	0.23	0.28	0.27	0.29	0.26	0.28
Moshi	T-1	3.01	3.21	3.33	3.31	3.53	3.48	3.65	3.98	4.68
	T-2	4.20	4.57	4.36	4.11	2.95	2.79	3.07	3.30	3.40
	T-3	1.55	1.93	1.60	1.46	1.36	1.23	1.14	1.15	1.14
	T-4	5.71	2.55	6.83	8.65	8.74	8.29	9.32	7.10	9.41
	T-5	0.21	0.25	0.24	0.21	0.20	0.21	0.22	0.21	0.47
Mpwapwa	T-1	0.07	0.08	0.08	0.09	0.10	0.14	0.09	0.13	0.18
	T-2	0.20	0.24	0.23	0.25	0.21	0.18	0.19	0.19	0.21
	T-3	0.04	0.05	0.04	0.06	0.07	0.07	0.12	0.11	0.12
	T-4	–	–	–	–	–	–	0.02	0.02	0.04
	T-5	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Mtwara	T-1	0.24	0.25	0.30	0.38	0.48	0.59	0.54	0.62	0.75
	T-2	1.06	1.08	1.21	1.25	0.81	0.89	0.91	0.88	0.91
	T-3	0.60	0.55	0.63	0.58	0.32	0.25	0.32	0.49	0.51
	T-4	–	–	–	–	0.82	0.93	1.05	0.85	0.67
	T-5	0.01	0.02	0.02	0.02	0.03	0.04	0.04	0.03	0.04
Musoma	T-1	0.19	0.23	0.24	0.30	0.35	0.42	0.48	0.53	0.66
	T-2	0.49	0.66	0.78	0.95	0.60	0.81	0.95	0.99	1.03
	T-3	0.08	0.15	0.23	0.37	0.42	0.37	0.12	0.17	0.19
	T-4	–	–	–	–	–	0.08	0.89	1.59	1.45
	T-5	0.06	0.06	0.06	0.07	0.08	0.09	0.10	0.10	0.11
Mwanza	T-1	2.38	2.63	2.66	2.65	2.81	3.12	3.13	3.39	4.08
	T-2	3.51	3.96	3.40	3.61	2.48	2.66	2.77	3.03	3.17
	T-3	1.26	1.41	1.18	1.24	1.32	1.55	1.57	1.34	1.55
	T-4	12.92	15.88	16.46	19.52	23.43	24.54	23.47	22.19	14.55
	T-5	0.26	0.27	0.30	0.31	0.36	0.34	0.32	0.30	0.25
Machingwea	T-1	0.05	0.05	0.05	0.08	0.14	0.11	0.10	0.14	0.20
	T-2	0.35	0.44	0.47	0.63	0.49	0.48	0.46	0.48	0.57
	T-3	0.12	0.15	0.15	0.18	0.11	0.23	0.29	0.25	0.32
	T-4	–	–	–	–	–	–	–	–	–
	T-5	0.001	0.003	0.004	0.005	0.01	0.02	0.03	0.02	0.02

Branches		1970	1971	1972	1973	1974	1975	1976	1977	1978
Shinyanga	T-1	0.17	0.24	0.25	0.33	0.37	0.40	0.42	0.53	0.64
	T-2	0.62	0.76	0.76	0.85	0.71	0.73	0.72	0.84	0.84
	T-3	0.17	0.18	0.15	0.20	0.19	0.30	0.33	0.43	0.36
	T-4	0.89	1.26	1.05	1.22	1.27	1.21	0.79	1.12	0.95
	T-5	0.11	0.15	0.16	0.17	0.17	0.15	0.10	0.13	0.12
Singida	T-1	0.12	0.13	0.15	0.17	0.20	0.23	0.27	0.27	0.36
	T-2	0.45	0.60	0.59	0.63	0.30	0.35	0.33	0.34	0.36
	T-3	0.17	0.28	0.23	0.28	0.27	0.25	0.26	0.25	0.29
	T-4	–	–	–	–	–	–	–	–	–
	T-5	0.05	0.05	0.06	0.07	0.08	0.09	0.09	0.11	0.11
Songea	T-1	0.05	0.08	0.11	0.14	0.17	0.23	0.31	0.36	0.45
	T-2	0.21	0.27	0.29	0.36	0.34	0.46	0.56	0.56	0.57
	T-3	0.04	0.04	0.04	0.07	0.09	0.06	0.07	0.11	0.49
	T-4	–	–	–	–	–	–	–	–	–
	T-5	0.01	0.01	0.01	0.01	0.009	0.02	0.03	0.03	0.03
Tabara	T-1	0.62	0.65	0.70	0.86	0.92	1.06	1.11	1.23	1.74
	T-2	1.55	1.80	1.98	1.89	2.08	2.04	2.01	1.81	1.90
	T-3	–	0.30	0.33	0.08	0.05	0.06	0.10	0.37	0.41
	T-4	0.67	0.42	0.35	1.16	1.52	1.50	1.60	1.44	3.20
	T-5	0.11	0.12	0.14	0.14	0.09	0.09	0.13	0.10	0.14
Tukuyu	T-1	0.07	0.07	0.08	0.11	0.11	0.14	0.09	0.10	0.25
	T-2	0.13	0.13	0.13	0.20	0.18	0.15	0.13	0.14	0.20
	T-3	0.004	0.002	0.007	0.002	0.02	0.04	0.07	0.09	0.12
	T-4	0.01	–	–	0.21	0.84	1.01	0.89	0.95	2.67
	T-5	0.02	0.03	0.02	0.02	0.03	0.03	0.02	0.02	0.02
All branches	T-1	11.32	12.15	12.72	13.54	15.06	17.21	17.32	19.65	25.08
	T-2	20.77	23.29	23.08	25.03	19.83	20.71	21.29	22.02	23.85
	T-3	6.61	7.96	7.82	8.24	8.30	8.94	9.57	9.23	10.81
	T-4	33.73	31.93	37.75	43.79	54.46	58.42	57.04	58.37	55.70
	T-5	1.64	1.87	1.91	1.97	2.15	2.14	2.24	2.06	2.24

SOURCE: Finance Manager's Report


LEGEND
Existing buildings
Residential plots 278 Plots
Commercial residential 73
Service plots 8
Filling station
Public buildings
Road
Water taps
Open spaces
Sizes of Residential Plots
Small residential plots 1/8 of an acre each
Medium 1/5
Commercial / Res
Large residential plots 1/2 acre & 1 acre each
HOSPITAL SITE
20 ACRES (8 HECTARES)
To Sanya Juu
PUBLIC BUILDING
NURSERY SCHOOL
PRIMARY SCHOOL
Water Tank
Water Main
45m
Low-lying Land
Furrow
LUTHERAN MISSION PLOT
To Moshi
See Survey E 5 255 56 Plots
HEALTH CENTRE
PLAYING FIELD
Market
Water Pipeline
PB
PB/R
P/BUILDING
POST OFFICE
FS
BANK
BOMA
PLAY FIELD
PLAYING FIELD
Bus Terminus
Market
Clinic
PRIMARY SCHOOL
Open Space
From Arusha
24m
0 50 100m
KILIMANJARO DISTRIBUTION NETWORK PROJECT
BOMA LA NGOMBE
URBAN DEVELOPMENT PLAN
E P D C INTERNATIONAL LTD
TOKYO, JAPAN
SUBMITTED:
RECOMMENDED.
APPROVED.
DRAW III-2-1
SHEET NO. OF
LOCATION DATE DESCRIPTION BY
REVISION


KEY
RESIDENTIAL
COMMERCIAL RESIDENTIAL
SERVICE TRADE
PUBLIC BUILDING
PUBLIC OPEN SPACE
PLOT | AVERAGE PLOT SIZE | NO. OF PLOTS
RESIDENTIAL | 50 OFT x 80 OFT | 744
COMM RESID | 50 OFT x 100 OFT | 203
SERVICE TRADE | — DO — | 61
PUBLIC BLD | VARIOUS | 22
TOTAL | 1,030
NOTE 1. TOTAL AREA UNDER CONSIDERATION (GROSS) = 372.5 ACRES (APPROX)
2. OVERALL DENSITY (PROPOSED) = 6-8 PERSONS PER PLOT
3. THE LAYOUT COULD ACCOMMODATE 7,600 PEOPLE
CROSS SECTION MR-1
NOTE THE LENGHT OF MAJOR ROAD MR-1 = 0.7 OR 1.2 KM
CROSS SECTION MR-2
NOTE THE LENGHT OF MAJOR ROAD MR-2 = 0.64 MILES OR 1 KM
CROSS SECTION MR-3
NOTE: THE LENGHT OF MAJOR ROAD MR-3 = 1.64 MILES OR 2.6 KM
RESERVED FOR GOVT QRTS
GOVT QRTS
OPEN SPACE
PUBLIC GARDENS
Stream
CEMETERY
PROPOSED SITE FOR AREA COMMISSIONER'S RESIDENCE
P.B. PROPOSED SITE FOR PENTECOSTE
RESERVED FOR HOSPITAL EXTENSION
HURUMA HOSPITAL
RESERVED FOR GOVT OFFICES EXTENSION
POST OFFICE
GOVT OFF
REVENUE OFFICE
GOVT OFFICE
GOVT OFFICES
TANU OFFICE
PROPOSED SITE FOR WATER DEV
POLICE STATION
PETROL STATION
BUS STATION
MARKET
PROPOSED SITE FOR 'UREMI'
PROPOSED SITE FOR NATIONAL MILLING
SPORTS FIELD
CAR PARK
HURUMA PRIMARY SCHOOL
NURSERY SCHOOL AND CHILDREN P/GROUND
MR-1
MR-2
MR-3
150FT 45M
110FT 33M
100FT 30M
R-100'
KILIMANJARO DISTRIBUTION NETWORK PROJECT
ROMBO
URBAN DEVELOPMENT PLAN
E.P.D.C. INTERNATIONAL LTD TOKYO, JAPAN
LOCATION | DATE | DESCRIPTION | BY
REVISION
DRAW. III-2-2(1)
SHEET NO. OF

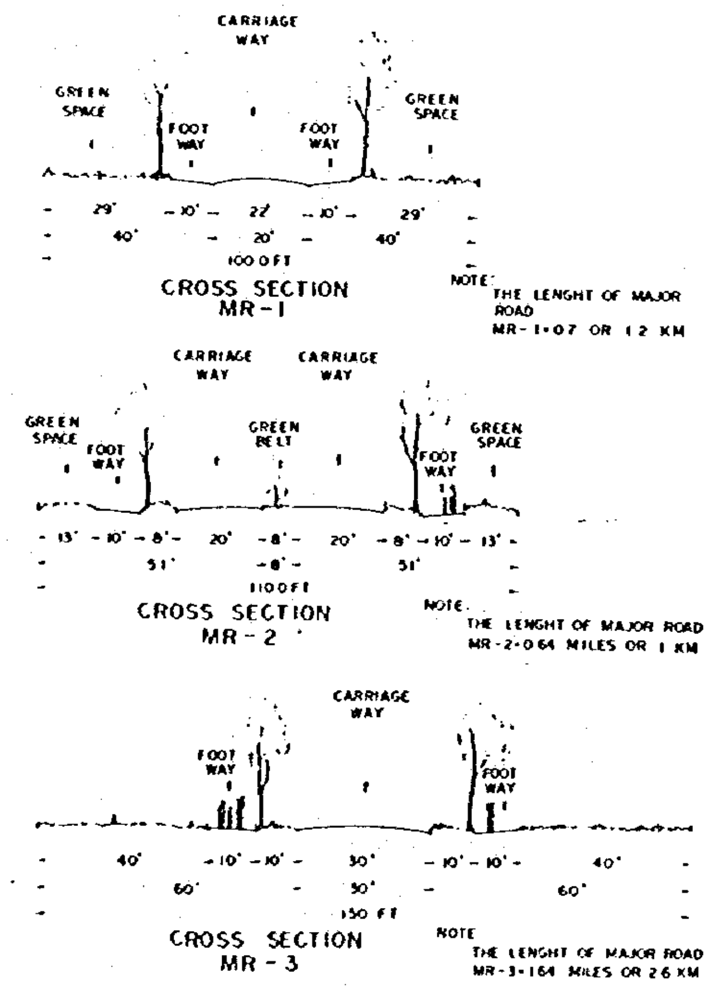


KEY

RESIDENTIAL
COMMERCIAL RESIDENTIAL
SERVICE TRADE
PUBLIC BUILDING — P/B
PUBLIC OPEN SPACE

PLOT	AVERAGE PLOT SIZE	NO OF PLOTS
RESIDENTIAL	50 0FT x 80 0FT	744
COMM RESID	50 0FT x 100 0FT	203
SERVICE TRADE	00 —	61
PUBLIC BLD	VARIOUS	22
	TOTAL	1,030

NOTE 1 TOTAL AREA UNDER CONSIDERATION (GROSS) = 572 5 ACRES (APPROX)
2 OVERALL DENSITY (PROPOSED) = 6-8 PERSONS PER PLOT
3 THE LAYOUT COULD ACCOMMODATE 7,600 PEOPLE



0 50 100m

KILIMANJARO DISTRIBUTION NETWORK PROJECT

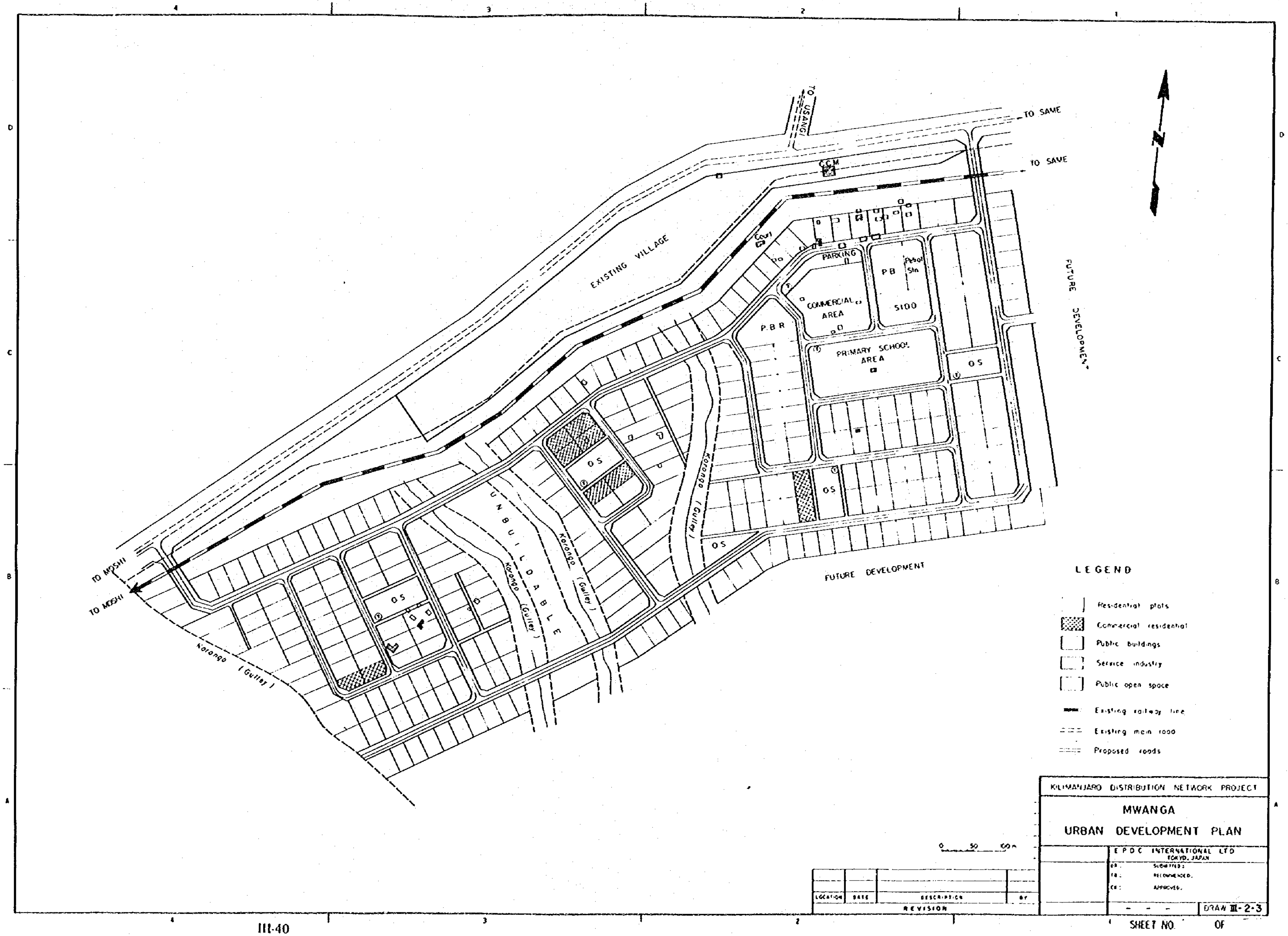
ROMBO
URBAN DEVELOPMENT PLAN

EPDC INTERNATIONAL LTD
TOKYO, JAPAN

LOCATION | DATE | DESCRIPTION | BY
REVISION

DRAW III-2-2(2)

SHEET NO. 01


TO USANGI
TO SAME
TO SAME
N
C.C.M
EXISTING VILLAGE
Court
PARKING
Petrol Stn
PB
COMMERCIAL AREA
SIDO
P.B.R
PRIMARY SCHOOL AREA
OS
FUTURE DEVELOPMENT
Korongo (Gulley)
UNBUILDABLE
TO MOSHI
TO MOSHI
FUTURE DEVELOPMENT
LEGEND
Residential plots
Commercial residential
Public buildings
Service industry
Public open space
Existing railway line
Existing main road
Proposed roads
0 50 100 m
KILIMANJARO DISTRIBUTION NETWORK PROJECT
MWANGA
URBAN DEVELOPMENT PLAN
E P D C INTERNATIONAL LTD
TOKYO, JAPAN
SUBMITTED:
RECOMMENDED.
APPROVED.
LOCATION
DATE
DESCRIPTION
BY
REVISION
DRAW III-2-3
SHEET NO.
OF

A-3

BREAKDOWN OF CONSTRUCTION COST

A-3-1 Construction Cost in each District
A-3-2 Construction Cost of each Work

A-3-1

Construction Cost in each District

CONSTRUCTION COST (Hai)

Item	Q'ty	Material		Con-struction	Inland Transport.	Total		
		F.C.	D.C.	D.C.	D.C.	F.C.	D.C.	Total
		10^6 Yen	10^3 T.shs.	10^3 T.shs.	10^3 T.shs.	10^6 Yen	10^3 T.shs.	10^6 Yen
33 kV Transmission Line	30.5 Km	61		552	160	61	712	79
33 kV Distribution Line								
11 kV Distribution Line	95 Km	172	40	1,732	360	172	2,132	225
Pole mounted Transformer	54	44		131	120	44	251	50
L.V. Line	40 Km	40		664	120	40	784	60
Service Line	650	10		98	40	10	138	13
Street Light	50	1		5		1	5	1
Substation		87		506	200	87	706	104
Total		415	40	3,688	1,000	415	4,728	532

Note: A conversion rate of 1T.sh = 25 yen was used for calculation.

CONSTRUCTION COST (Rombo)

Item	Q'ty	Material		Con-struction	Inland Transport.	Total		
		F.C.	D.C.	D.C.	D.C.	F.C.	D.C.	Total
		10^6 Yen	10^3 T.shs.	10^3 T.shs.	10^3 T.shs.	10^6 Yen	10^3 T.shs.	10^6 Yen
33 kV Transmission Line								
33 kV Distribution Line	33 Km	83		660	200	83	860	105
11 kV Distribution Line								
Pole mounted Transformer	23	29		56	80	29	136	33
L.V. Line	25 Km	25		416	80	25	496	37
Service Line	600	9		90	40	9	130	12
Street Light	50	1		5		1	5	1
Substation								
Total		147		1,227	400	147	1,627	187

Note: A conversion rate of 1T.sh = 25 yen was used for calculation.

CONSTRUCTION COST (North Pare)

Item	Q'ty	Material		Con-struction	Inland Transport.	Total		
		F.C.	D.C.	D.C.	D.C.	F.C.	D.C.	Total
		10^6 Yen	10^3 T.shs.	10^3 T.shs.	10^3 T.shs.	10^6 Yen	10^3 T.shs.	10^6 Yen
33 kV Transmission Line	27 Km	52		478	120	52	598	67
33 kV Distribution Line								
11 kV Distribution Line	30 Km	53		537	120	53	657	70
Pole mounted Transformer	16	13		39	40	13	79	15
L.V. Line	15 Km	15		250	40	15	290	22
Service Line	200	3		30		3	30	4
Street Light	30	1		3		1	3	1
Substation		23		198	120	23	318	31
Total		160		1,535	440	160	1,975	210

Note: A conversion rate of 1T.sh = 25 yen was used for calculation.

CONSTRUCTION COST (South Pare)

Item	Q'ty	Material		Con-struction	Inland Transport.	Total		
		F.C.	D.C.	D.C.	D.C.	F.C.	D.C.	Total
		10^6 Yen	10^3 T.shs.	10^3 T.shs.	10^3 T.shs.	10^6 Yen	10^3 T.shs.	10^6 Yen
33 kV Transmission Line	65 Km	127		1,171	320	127	1,491	164
33 kV Distribution Line								
11 kV Distribution Line	27.5 Km	45		472	80	45	552	59
Pole mounted Transformer	14	15		34	40	15	74	17
L.V. Line	10 Km	10		167	40	10	207	15
Service Line	200	3		30		3	30	4
Street Light	30	1		3		1	3	1
Substation		43		309	40	43	349	52
Total		244		2,186	520	244	2,706	312

Note: A conversion rate of 1T.sh = 25 yen was used for calculation.

A-3-2

Construction Cost of each Work

33 kV LINE CONSTRUCTION COST

Item	Unit Cost	Hai		Rombo		North Pare		South Pare		Total	
		Q'ty	Cost	Q'ty	Cost	Q'ty	Cost	Q'ty	Cost	Q'ty	Cost
MATERIAL (10^6 Yen)											
ACSR 95 mm^2/km	0.257	94	24	101	26	83	21	200	51	478	122
Suspention Pole	0.084	220	18	135	12	200	17	460	39	1,015	86
Light Angle Pole	0.092	35	3	70	6	30	3	80	7	215	19
Medium Angle Pole	0.304	17	5	70	21	12	4	25	8	124	38
Sharp Angle Pole	0.253	10	3	35	9	5	1	20	5	70	18
Section Pole	0.264	25	7	25	7	20	5	60	15	130	34
Terminal Pole	0.160	3		5	1	3		5	1	16	2
Air Breaker Switch	0.777	1	1	2	1	1	1	1	1	5	4
Sub total (10^6 Yen)			61		83		52		127		323
CONSTRUCTION (10^3 T.shs)											
Stringing 3ϕ/Km	11.96	30.5	364.78	33	394.68	27	322.92	65	777.4	155.5	1,859.78
Suspention Pole	0.41	220	90.2	135	55.3	200	82	460	188.6	1,015	416.1
Light Angle Pole	0.56	35	19.6	70	39.2	30	16.8	80	44.8	215	120.4
Medium Angle Pole	1.11	17	18.87	70	77.7	12	13.32	25	27.75	124	137.64
Sharp Angle Pole	1.32	10	13.2	35	46.2	5	6.6	20	26.4	70	92.4
Section Pole	1.67	25	41.75	25	41.75	20	33.4	60	100.2	130	217.1
Terminal Pole	1.11	3	3.33	5	5.55	3	3.33	5	5.55	16	17.76
Sub total			(551.73)		(660.38)		(478.37)		(1,170.7)		(2,861.18)
Total (10^6 Yen)			75		100		64		156		395

Note: This cost is not including inland transportation, spares, contingency, administrative expenses and engineering fee.
A conversion rate of 1 T.sh = 25 Yen was used for calculation.

POLE MOUNTED TRANSFORMER CONSTRUCTION COST

Item		Unit Cost	Hai		Rombo		North Pare		South Pare		Total	
			Q'ty	Cost	Q'ty	Cost	Q'ty	Cost	Q'ty	Cost	Q'ty	Cost
MATERIAL (10^6 Yen)												
	25 kVA	1.057	1	1	9	10			2	2	12	13
33 KV	50	1.338	2	3	11	14	1	1	2	3	16	21
Transformer	100	1.662	1	2	3	5					4	7
	200	2.355							1	2	1	2
	300	2.888					1	3			1	3
	25 kVA	0.548	9	5			9	5	5	3	23	13
	50	0.713	34	24			4	3	1	1	39	28
11 KV	100	0.968	6	6			1	1	1	1	8	8
Transformer	200	1.390							1	1	1	1
	300	1.801							1	2	1	2
	500	2.540	1	3							1	3
Sub Total (10^6 Yen)				44		29		13		15		101
CONSTRUCTION (10^3 T.shs)		2.43	54	131.22	23	55.89	16	38.88	14	34.02	107	260.01
Total (10^6 Yen)				47		31		14		16		108

Note: This cost is not including inland transportation, spares, contingency, administrative expenses and engineering fee.
A conversion rate of 1 T.sh = 25 yen was used for calculation.

11 kV LINE CONSTRUCTION COST

Item	Unit Cost	Hai		Rombo		North Pare		South Pare		Total	
		Q'ty	Cost	Q'ty	Cost	Q'ty	Cost	Q'ty	Cost	Q'ty	Cost
MATERIAL (10^6 Yen)											
ACSR 95 mm^2/km	0.257	292	75			92	23	85	22	469	120
Suspention Pole	0.055	380	21			120	7	170	9	670	37
Light Angle Pole	0.064	190	12			75	5	45	3	310	20
Medium Angle Pole	0.153	165	25			50	7	30	5	245	37
Sharp Angle Pole	0.179	140	25			40	7	15	3	195	35
Section Pole	0.189	45	9			10	2	15	3	70	14
Terminal Pole	0.133	30	4			5	1	5	1	40	6
Oil Switch	0.134	11	1			3		2		16	1
Sub total (10^6 Yen)			172				52		46		270
CONSTRUCTION (10^3 T.shs)											
Stringing 3ϕ/Km	11.61	95	1,103.0			30	348.3	27.5	319.2	152.5	1,770.5
Suspention Pole	0.35	380	133.0			120	42.0	170	59.5	670	234.5
Light Angle Pole	0.46	190	87.4			75	34.5	45	20.7	310	142.6
Medium Angle Pole	0.96	165	158.4			50	48	30	28.8	245	235.2
Sharp Angle Pole	1.11	140	155.4			40	44.4	15	16.7	195	216.5
Section Pole	1.47	45	66.2			10	14.7	15	22.0	70	102.9
Terminal Pole	0.96	30	28.8			5	4.8	5	4.8	40	38.4
Sub total (10^3 T.shs)			(1,732.2)				(536.7)		(471.7)		(2,740.6)
Total (10^6 Yen)			215				66		58		339

Note: This cost is not including inland transportation, spares, contingency, administrative expenses and engineering fee.
A conversion rate of 1 T.sh = 25 Yen was used for calculation.

L.V. LINE CONSTRUCTION COST

Item	Unit Cost	Hai		Rombo		North Pare		South Pare		Total	
		Q'ty	Cost	Q'ty	Cost	Q'ty	Cost	Q'ty	Cost	Q'ty	Cost
MATERIAL (10^6 Yen)											
HAl 55 mm²/Km	0.133	60	8	37.5	5	22.5	3	15	2	135	18
HAl 30 mm²/Km	0.076	40	3	25	2	15	1	10	1	90	7
HAl 22 mm²/Km	0.060	20	1	12.5	1	7.5	1	5		45	3
Suspention Pole	0.034	375	13	235	8	140	5	90	3	840	29
Angle Pole (1°~30°)	0.040	70	3	40	1	25	1	20	1	155	6
Angle Pole (Above 30°)	0.048	50	2	35	2	25	1	15	1	125	6
Terminal Pole	0.038	105	4	65	3	35	1	25	1	230	9
Tee-off	0.009	135	1	85	1	50		35		305	2
Others	0.021	200	4	125	3	75	2	50	1	405	10
Sub Total (10^6 Yen)			39		26		15		10		90
CONSTRUCTION (10^3 T.shs)											
Stringing	10.79	40	431.6	25	269.8	15	161.8	10	107.9	90	971.1
Suspention Pole	0.30	375	112.5	235	70.5	140	42.0	90	27	840	252.0
Angle Pole (1°~30°)	0.43	70	30.1	40	17.2	25	10.8	20	8.6	155	66.7
Angle Pole (Above 30°)	0.55	50	27.5	35	19.25	25	13.75	15	8.25	125	68.75
Terminal Pole	0.43	105	45.2	65	28.0	35	15.0	25	10.7	230	98.9
Tee-off	0.13	135	17.6	85	11.1	50	6.5	35	4.5	305	39.7
Sub Total (10^3 T.shs)			(664.5)		(415.85)		(249.85)		(166.95)		(1,497.15)
Total (10^6 Yen)			56		36		21		14		127

Note: This cost is not including inland transportation, spares, contingency, administrative expenses and engineering fee.
A conversion rate of 1 T.sh = 25 yen was used for calculation.

SERVICE LINE CONSTRUCTION COST

Item	Unit Cost	Hai		Rombo		North Pare		South Pare		Total	
		Q'ty	Cost	Q'ty	Cost	Q'ty	Cost	Q'ty	Cost	Q'ty	Cost
MATERIAL (10^6 Yen)	0.016	650	10	600	9	200	3	200	3	1,650	25
CONSTRUCTION (10^3 T.shs)	0.15	650	98	600	90	200	30	200	30	1,650	248
TOTAL (10^6 Yen)			12		11		4		4		31

STREET LIGHT CONSTRUCTION COST

Item	Unit Cost	Hai		Rombo		North Pare		South Pare		Total	
		Q'ty	Cost	Q'ty	Cost	Q'ty	Cost	Q'ty	Cost	Q'ty	Cost
MATERIAL (10^6 Yen)	0.026	50	1	50	1	30	1	30	1	160	4
CONSTRUCTION (10^3 T.shs)		50	5	50	5	30	3	30	3	160	16
TOTAL (10^6 Yen)			1		1		1		1		4

Note: This cost is not including inland transportation, spares, contingency, administrative expenses and engineering fee.
A conversion rate of 1 T.sh = 25 yen was used for calculation.

SUBSTATION CONSTRUCTION COST

Item	Sanya Juu S.S 2,500 kVA	Machame S.S 2,500 kVA	Nym S.S 1,000 kVA	Mwanga S.S 500 kVA	Gonja S.S 1,000 kVA	Total
MATERIAL (10^3 Yen)						
33 kV Equipments	5,970	5,970	5,970	4,900	4,900	27,710
Main Transformers	17,370	17,370	5,500	4,350	5,500	50,090
11 kV Equipments	12,480	12,480	7,060	5,750	5,750	43,520
Cable & Others	4,350	4,350	3,250	4,560	4,560	21,070
Spare & Superintendent	3,000	3,000	1,600	1,500	1,510	10,610
Sub Total (10^3 Yen)	(43,170)	(43,170)	(23,380)	(21,060)	(22,220)	(153,000)
CONSTRUCTION (10^3 T.shs)						
Electrical Construction	180	180	148	111	113	732
Civil Workes	73	73	50	41	44	281
Sub Total (10^3 T.shs)	(253)	(253)	(198)	(152)	(157)	(1,013)
Total (10^3 Yen)	49,495	49,495	28,330	24,860	26,145	178,325

Note: A conversion rate of 1 T.sh = 25 yen was used for calculation.

A-4

CALCULATION SHEETS

A-4-1 Strength Calculation for Wooden Pole
A-4-2 Safety Factor of Supporting Structure Base
A-4-3 Strength of Stay
A-4-4 Strength of Cross-arm and Arm-tie
A-4-5 Sag Calculation

A-4-1 Strength Calculation for Wooden Pole

(1) Single Pole

(a) Strength without stay

$$\frac{P}{F} \geqq \frac{40DoH^2 - 24H^3 + S(\Sigma 10dh)}{Do^3}$$

Where;

P : Breackdown strength (560 kg/cm²)

F : Safety Factor (4)

K : Coefficient by wind (0.5)

S : Span (100 m)

d : Diameter of overhead conductor or wire (13.5 mm)

h : Clearance of overhead conductor or wire above ground level (9.1 m)

H : Length of pole above ground level (9.2 m)

Do : Diameter of pole at ground level (27.3 cm)

Do = D + 0.9H

D: Diameter of pole at top (19 cm)

$$\frac{560}{4} > 10 \times 0.5 \times \frac{20 \times 27.3 \times 9.2^2 - 12 \times 9.2^3 + 0.5 \times 100 \times 10 \times 13.5 \times 9.1 \times 3}{27.3^3}$$

147.5 > 109 .... OK

(b) Strength with stay

$$\frac{P}{F} \geqq 10K \frac{20DoH^2 - 12H^3 + 0.5S(\Sigma 10dh)}{Do^3}$$

$$\frac{560}{4} > 10 \times 0.5 \times \frac{20 \times 27.3 \times 9.2^2 - 12 \times 9.2^3 + 0.5 \times 100 \times 10 \times 13.5 \times 9.1 \times 3}{27.3^3}$$

147.5 > 54.4 .... OK

(2) H-poles

(a) Strength without stay

$$\frac{P}{F} \geqq 10K \frac{40DoH^2 - 24H^3 + 0.5S(\Sigma 10dh)}{Do^3}$$

$$\frac{560}{4} > 10 \times 0.5 \times \frac{40 \times 27.3 \times 9.2^2 - 24 \times 9.2^3 + 0.5 \times 100 \times 10 \times 13.5 \times 9.1 \times 3}{27.3^3}$$

147.5 > 63.4 .... OK

(b) Strength with stay

$$\frac{P}{F} \geqq 10K \frac{20DoH^2 - 12H^3 + 0.25S(\Sigma 10dh)}{Do^3}$$

$$\frac{560}{4} > 10 \times 0.5 \times \frac{20 \times 27.3 \times 9.2^2 - 12 \times 9.2^3 + 0.25 \times 100 \times 10 \times 13.5 \times 9.1 \times 3}{27.3^3}$$

147.5 > 31.7 .... OK

A-4-2 Safety Factor of Supportng Structure Base

$$F \leq \frac{0.3K(DoQt^4 + AJ)}{P(H + t'o)^2}$$

Where;

F : Safety factor
Do : Diameter of supporting structure at ground level (0.273 m)
t : Length of pole below ground level (1.8 m)
H : Concentrated load point in height above ground level (9.1 m)
P : Load imposed on supporting structure (kg)

$$P = Pp + Pw$$

$$Pp = \frac{1}{6} Wp (2D_1 + D_0) H$$

$$Pw = \ell dcJWp$$

Pp : Wind load imposed on supporting structure (kg)
Pw : Wind load imposed on conductor (kg)
Wp : Wind load (50 kg/m²)
D1 : Diameter of supporting structure at top (0.19 m)
ℓ : Length of conductor (100 m)
d : Outer diameter of conductor (0.0135 m)
N : Number of conductor (3)

$$Pp = \frac{50}{60} \times (2 \times 0.19 + 0.273) \times 9.1 = 49.5 \text{ (kg)}$$

$$Pw = 100 \times 0.0135 \times 3 \times 50 = 202.5 \text{ (kg)}$$

$$P = 49.5 + 202.5 = 252 \text{ (kg)}$$

t'o : Depth from ground surface to rotating center of supporting structure (m)

$$t'o = \frac{2}{3}\left(\frac{t^2 + 3ntc^2}{t + 2ntc}\right)$$

$$n = \frac{A}{A_1}$$

$$A = (L - Do)d$$

tc : Depth from ground surface to center of underground brace (0.3 m)
A : Sectional area of underground brace (m²)
A_1 : Sectional area of supporting structure at ground level (0.49 m²)
L : Depth of underground brace (1.5 m)
d : Diameter of underground brace (0.15 m)

$$A = (1.5 - 0.273) \times 0.15 = 0.18 \text{ (m}^2\text{)}$$

$$n = \frac{0.18}{0.49} = 0.37$$

$$t'o = \frac{2}{3}\left(\frac{1.8^2 + 3 \times 0.37 \times 0.3^2}{1.8 + 2 \times 0.37 \times 0.3}\right) = 1.10 \text{ (m)}$$

Q : Function of $\left(\frac{t}{t'o}\right)$

$$Q = \frac{1}{12}(6m^2 - 8m + 3)$$

$$m = \frac{t'o}{t} = \frac{1.10}{1.8} = 0.61$$

$$Q = \frac{1}{12} \times (6 \times 0.61^2 - 8 \times 0.61 + 3) = 0.03$$

J : Function of depth of rotating center and depth of underground brace

$$J = (t'o - tc)^2\ tc$$
$$= (1.10 - 0.3)^2 \times 0.3 = 0.192$$

K : Soil coefficient (3×10^6 kg/m^4)

$$\therefore F \leqq \frac{0.3 \times 3 \times 10^6 (0.273 \times 0.03 \times 1.8^4 + 0.18 \times 0.192)}{252 \times (9.1 \times 1.10)^2}$$

$F \leqq 4.3$ . . . . OK

Consequently, it satisfies design condition of 2.5.

A-4-3 Strength of Stay Wire

Calculation of strength against horizontal transverse load on the line caused by wind.

(1) Single Pole

$$\frac{P}{F} \geqq \frac{K}{h_o \times 10^3} \left\{ 12.5S\Sigma 10dh + 500DoH^2 - \frac{100}{3} \times 10^3 kH^3 \right\}$$

Where;

- P : Allowable tensile strength of stay wire (2520 kg)
- F : Safety factor of stay wire (2.5)
- ho : Height of supporting point of stay wire on pole above ground level (9 m)
- S : Spna (100 m)
- d : Diameter of overhead conductor (13.5 mm)
- h : Clearance of overhead conductor above ground level (9.1 m)
- H : Height of supporting structure above ground level (9.2 m)
- Do : Diameter of supporting structure at ground level (27.3 cm)
- k : Taper of supporting structure (9/1000)
- K : Coefficient (0.5)

$$\frac{2520}{2.5} \geqq \frac{0.5}{9 \times 10^3} \left\{ 12.5 \times 100 \times 10 \times 13.5 \times 9.1 \times 3 + 500 \times 27.3 \times 9.2^2 - \frac{100}{3} \times 10^3 \times \frac{9}{1000} \times 9.2^3 \right\}$$

$1008 > 307$ . . . . OK

(2) H-poles

$$\frac{P}{F} \geqq \frac{K}{ho \times 10^3} \left\{ 12.5S\Sigma 10dh + 1000DoH^2 - \frac{200}{3} \times 10^3 \times kH^3 \right\}$$

$$\frac{2520}{2.5} \geqq \frac{0.5}{9 \times 10^3} \left\{ 12.5 \times 100 \times 10 \times 13.5 \times 9.1 \times 3 + 1000 \times 27.3 \times 9.2^2 - \frac{200}{3} \times 10^3 \times \frac{9}{1000} \times 9.2^3 \right\}$$

$1008 > 358.4$ . . . . OK

Consequently, it satisfies design condition of 2.5.

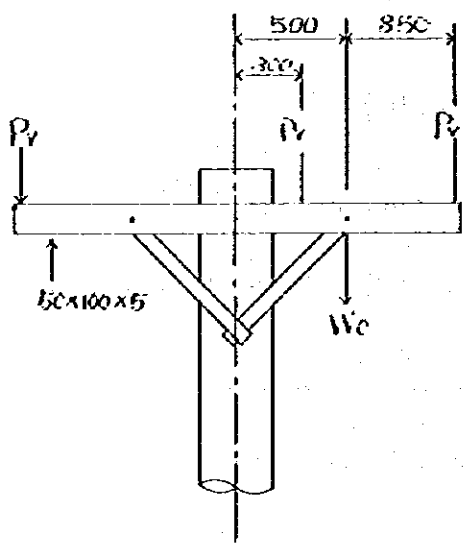
A-4-4 Strength of Cross-arm and Arm-tie

The following calculation is for a cross-arm of 2800 mm length and arm-tie for use of 33 kV line which is the worst case.

F	:	Safety factor (2.5)
dl	:	Outer diameter of conductor (0.0135 m)
wl	:	Weight of conductor (0.3852 kg/m)
T	:	Tensile force on conductor (1000 kg)
Pw	:	Wind load (50 kg/m²)
S	:	Span (100 m)
σ_a	:	Allowable tensile stress intensity

$$\sigma /F = \frac{4100}{2.5} = 1640 \text{ kg/cm}^2$$

(1) Suspension Pole



Pv = wl + wo

wo: Weight of LP insulator (10 kg)

Pv = 0.3852 x 100 + 10

= 49 kg

(a) Cross-arm

Channel steel: 100 x 50 x 5 mm,

Length: 2800 mm

Z_1 : Section modulus (37.8 cm³)

Mmax = Pv x l

= 49 x 850

= 4165 (kg·cm)

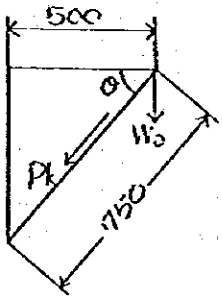
$$Z = Mmax/\sigma_a = \frac{4165}{1640} = 2.54 \text{ (cm}^3)$$

$Z_1 \geqq Z$ (37.8 > 2.54) .... OK

(b) Arm-tie (3 x 40 x 750 mm)

Wo = Pv x 135/50 + Pv x 30/50 = 162 (kg)

Pk: Compression stress imposed on arm-tie



Pk = Wo/sinθ = 217.3 (kg)

Maximum slenderness ratio falls on;

$$\lambda_o = \pi\sqrt{\frac{E}{\sigma_y}} = 91$$

Calculated slenderness ratio becommes;

$\lambda = L/r = 75/0.79 = 95$

$\lambda > \lambda_o$

So, buckling load of a arm-tie, Pko, is calculated as follows;

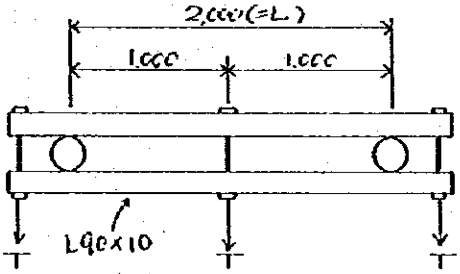
$$Pko = \pi \times E \times I / L^2$$

$$= \frac{\pi^2 \times 2.1 \times 10^5 \times 1.45}{75^2} = 5343 \text{ (kg)}$$

As safety factor is set up as 2.5,

2.5 x Pk = 543.2 (kg) < Pko ········· OK

(2) Termination Pole



Cross-arm

Angle steel : L 90 x 10 mm

Length : 2800 mm

Z_2 : Section modulus (19.5 cm^3)

Mmax = T x L / 4

= 50000 (kg·cm)

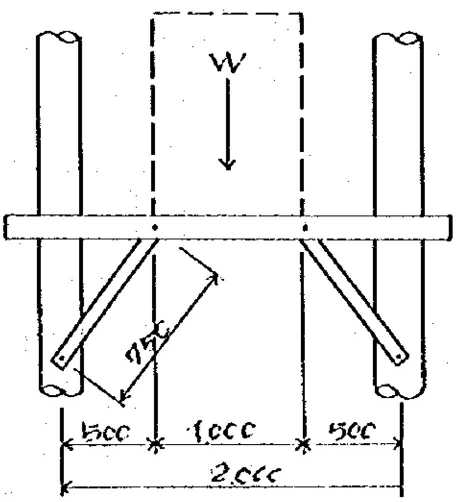
2 x Z = Mmax/σ_a

= 30.5 (cm^3)

∴ Z = 15.3 (cm^3)

Therefore, $Z_1 \geqq Z$ (19.5 > 15.3) ················ OK

(3) Transformer Platform (300 KVA)



W = 2000 kg

Cross-arm

Channel steel: 100x 50 x 5 mm,

Length : 2800 mm

Mmax = W x L / 4

= 50000 (kg·cm)

2 x Z = Mmax/σ_a

= 30.5 (cm^3)

∴ Z = 15.3 (cm^3)

Therefore, $Z_1 \geqq Z$ (37.8 > 15.3) ········ OK

A-4-5 Calculation of Sag

Basic data

Conductor:	ACSR 95 mm^2
Diameter:	13.5 mm
Cross-section:	111.5 mm^2
Weight of conductor:	385.2 kg/km
Modulus of elastisty:	8250 kg/mm^2
Temperature coefficient:	19.0×10^{-6}/deg.
Max. tension:	3180 kg
Wind load at 10°C:	50 kg/m^2
Span:	50 to 150 m
Intervals of span:	10 m
Temperature:	10 to 90° C
Intervals of temperature:	10° C
Safety factor:	3

Erection Sags

Temp. °C / Span m	10		20		30		40		50		60		70		80		90	
	Sag	Tension	S	T	S	T	S	T	S	T	S	T	S	T	S	T	S	T
50	12 cm	1,021 Kg	14	851	18	685	23	529	31	394	41	293	50	227	66	200	84	148
60	17	1,005	20	875	26	677	33	529	43	404	55	313	69	252	87	222	105	164
70	24	986	29	823	35	668	45	529	57	415	71	332	86	274	105	241	125	178
80	32	965	38	805	47	658	58	528	73	424	89	347	105	294	123	259	142	191
90	41	943	49	788	60	648	74	528	90	433	108	362	125	312	143	275	162	203
100	52	918	62	771	75	639	91	528	109	441	128	375	147	327	165	288	184	213
110	65	894	77	752	92	630	110	528	130	447	150	387	170	342	191	301	214	222
120	80	868	94	735	112	620	131	528	153	454	174	397	195	355	216	313	238	231
130	95	858	113	718	133	612	154	526	177	460	200	407	221	367	243	323	267	280
140	115	818	134	701	156	604	179	526	203	464	227	416	255	378	282	333	311	288
150	136	795	158	687	180	602	206	526	230	470	255	424	280	388	305	342	332	296

A-5

THREE PHASE SHORT CIRCUIT CURRENT

Fig. III-3- 6	Three phase short circuit current – East Hai
Fig. III-3- 7	Ditto – Central Hai
Fig. III-3- 8	Ditto – West Hai
Fig. III-3- 9	Ditto – Rombo
Fig. III-3-10	Ditto – North Pare
Fig. III-3-11	Ditto – South Pare

Fig. III-3-6 3 PHASE SHORT CIRCUIT CURRENT

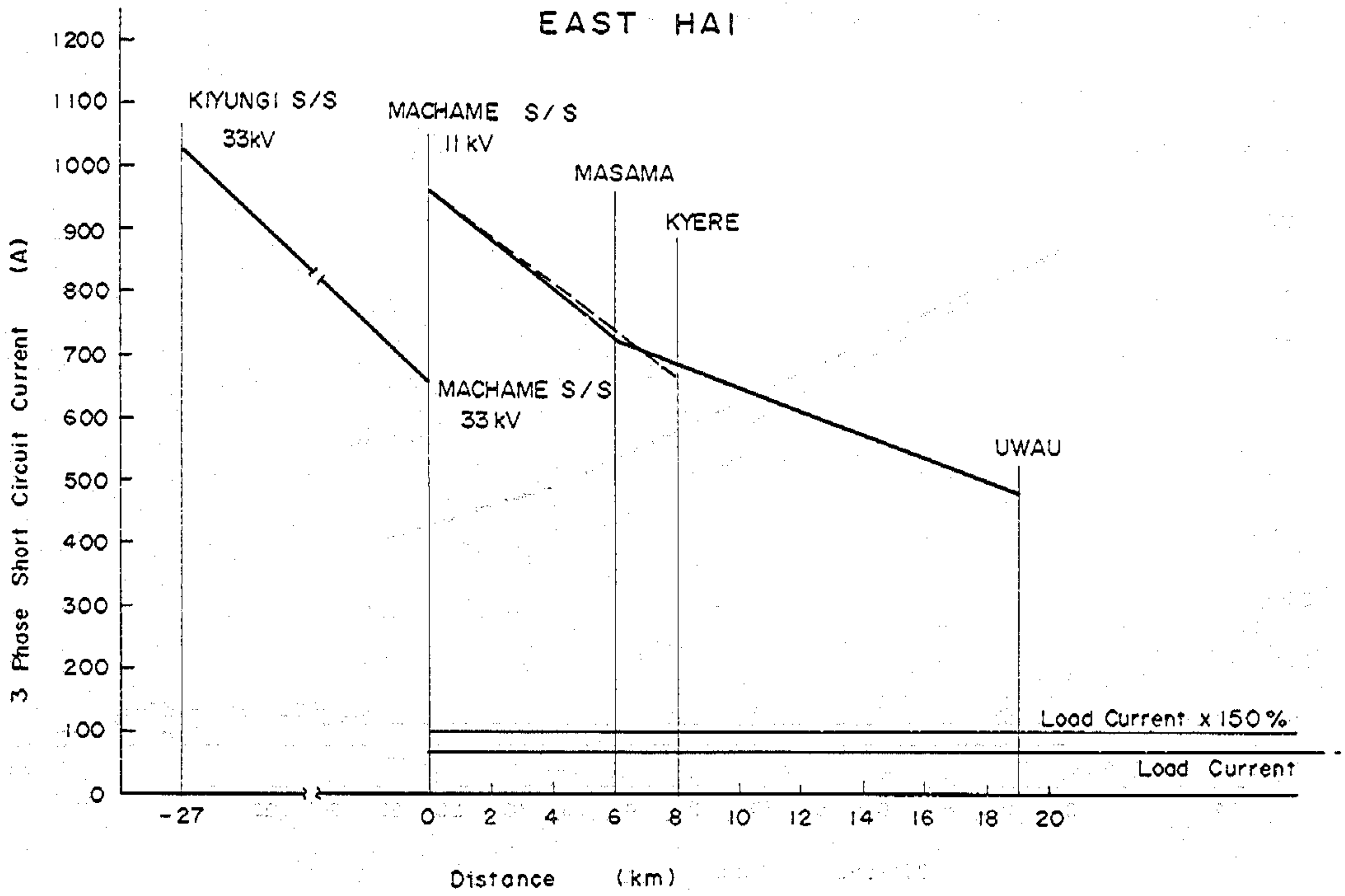


Fig.III-3-7 3 PHASE SHORT CIRCUIT CURRENT

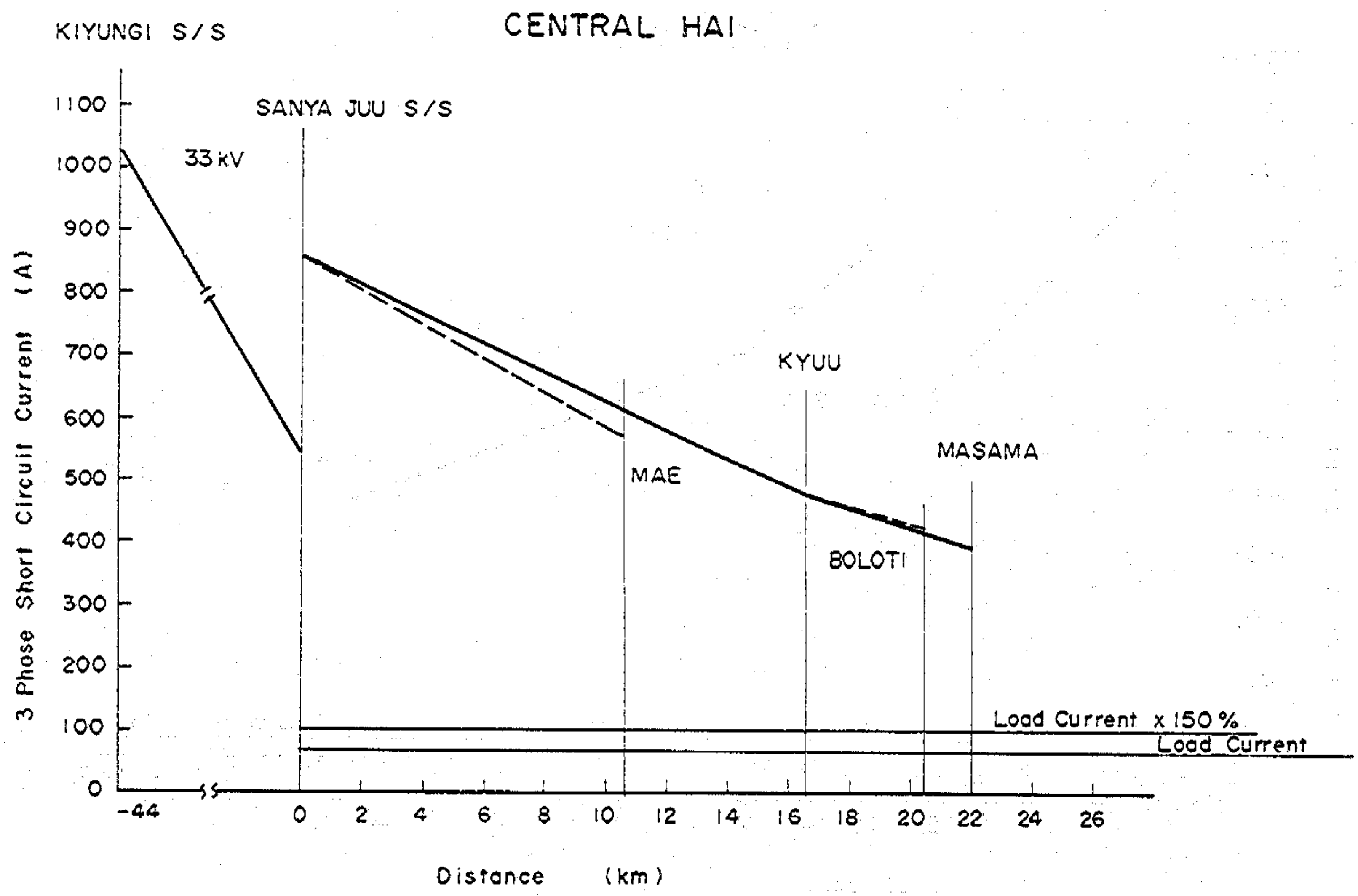


Fig.III-3-8 3 PHASE SHORT CIRCUIT CURERNT

WEST HAI

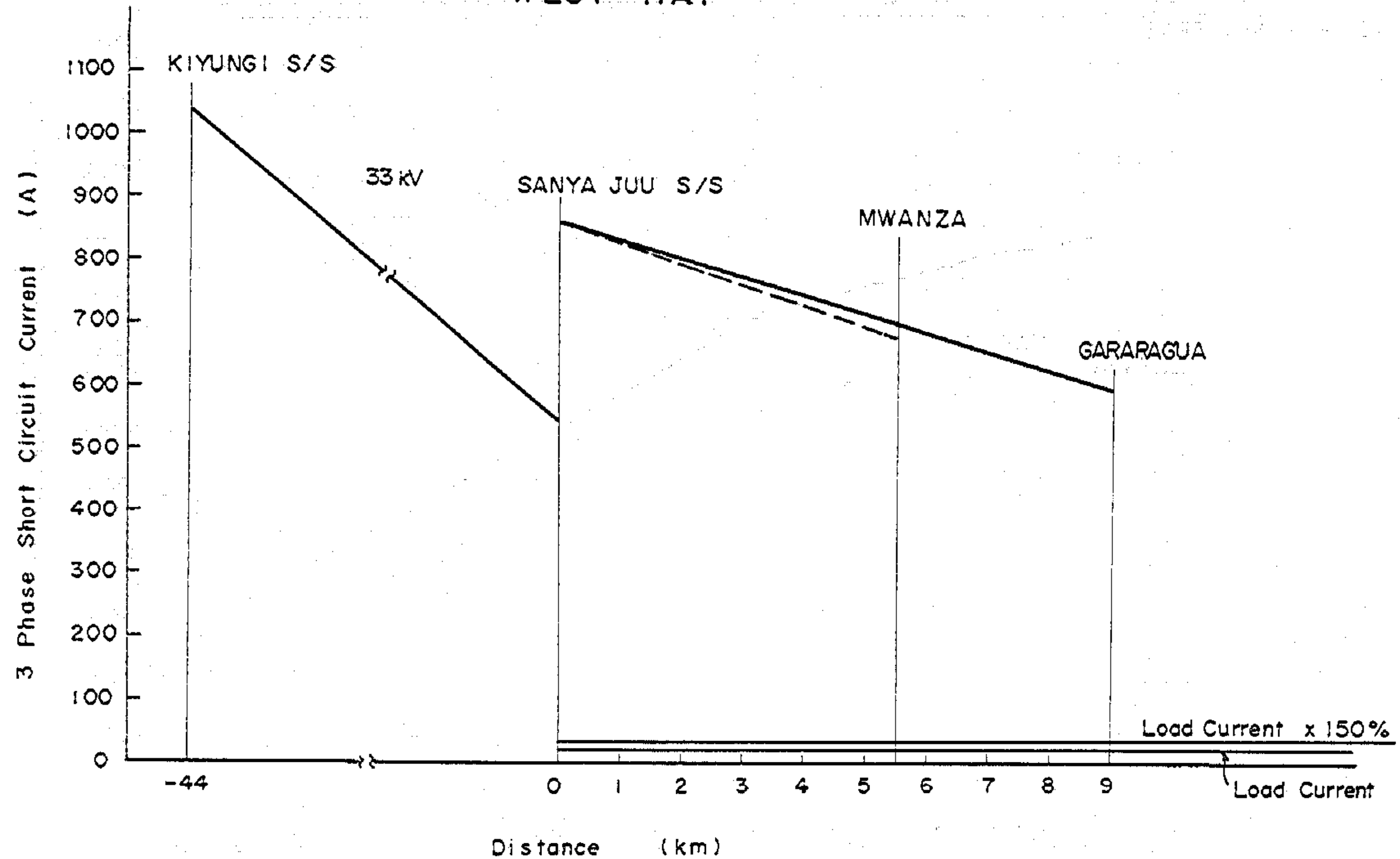


Fig.III - 3 - 9 3 PHASE SHORT CIRCUIT CURRENT

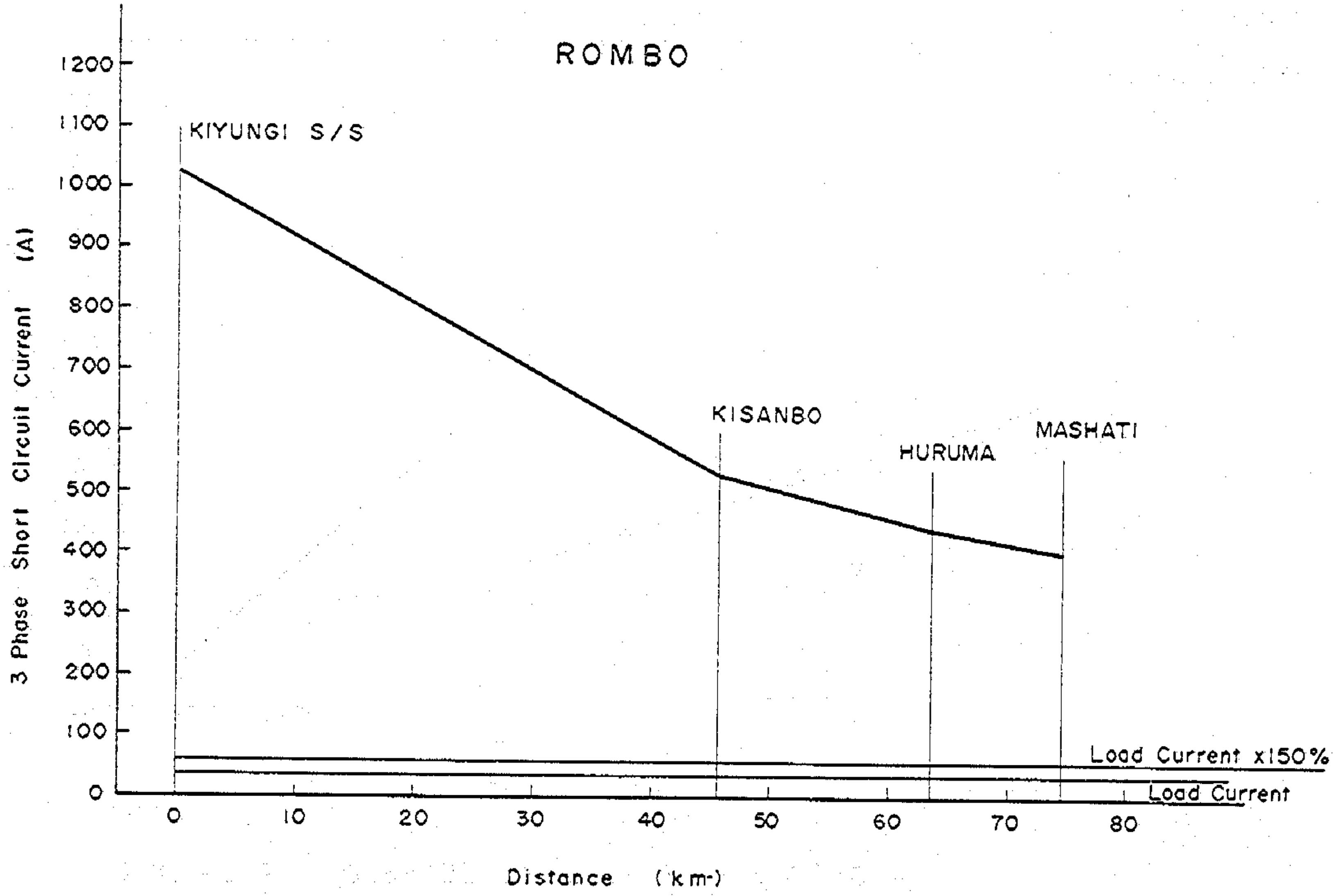


Fig.III-3-10 3 PHASE SHORT CIRCUIT CURRENT

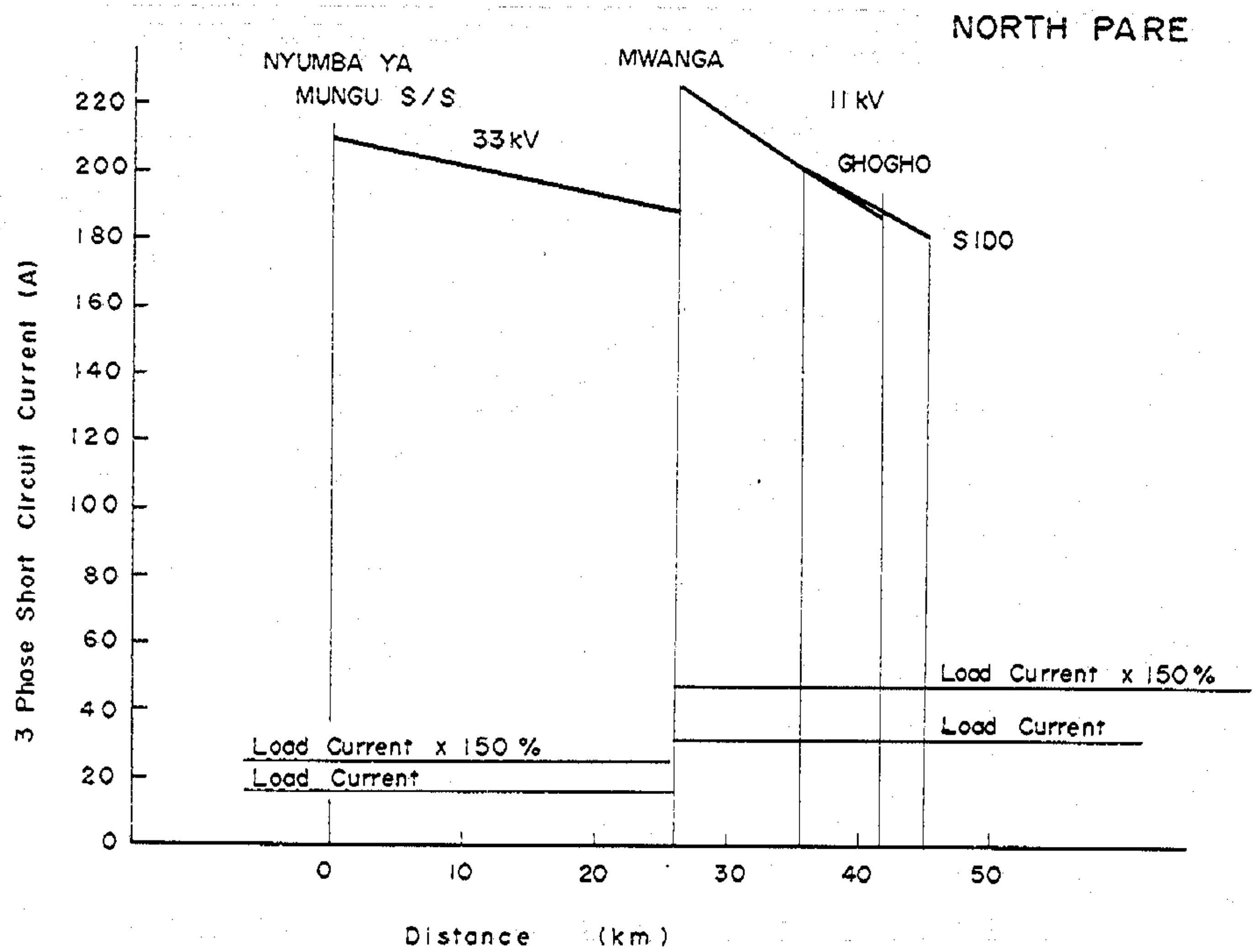


Fig. III-3-11 3 PHASE SHORT CIRCUIT CURRENT

SOUTH PARE