Annex 4.4 Loss Recovery Energy and Outage Energy

Annex 4.4 Loss Recovery Energy and Outage Energy

List of Substations Covered by SCADA(Loss and Outage Enegy Study)

Ranga Reddy

No.	North South	Name	11kV feeder						Loss Data No	Loss Recovery	Recovery Rate (%)	Outage (m)	Outage Energy (kWh)	Total (kWh)	Average per feeder
			No	Data No	Max Load(A)	Length (km)	Loss(kWh/Y)	L.L. Loss(kWh/Y)							
1	N	Gachibowli(GACH)	4	4	120	36	111,983	92,080	4	19,903	17.8	123.0	9,590	29,493	7,373
2	N	I I I T(Indian Institute of Information Tehnology)	4	4	32	16	8,640	8,640	2	0	0.0	5.0	204	204	51
3	N	Aliabad(ALIA)	7 (rural 2)	7	570	111	4,071,906	3,050,392	6	1,021,513	25.1	260.0	70,736	1,092,250 0	156,036
4	N	Chandanagar(CHAN)	4	4	630	75	4,891,035	4,461,253	4	429,782	8.8	720.0	259,253	689,035	172,259
5	N	Dommarapochampally(DOMM)	4	4	464	105	3,368,752	3,368,752	4	0	0.0	180.0	47,384	47,384	11,846
6	N	ESCI	3	0		26	0	0				180.0		0	0
7	N	Gundlapochampally(GPPL)	4	0		52	0	0				255.0		0	0
8	N	Jeedimetla-1(JEED)	7	7	985	30.5	1,637,419	1,447,846	7	189,572	11.6	635.0	189,990	379,563	54,223
9	N	Jeedimetla-2(JEEI)	6	6	730	23.2	1,063,045	823,955	6	239,090	22.5	761.0	219,985	459,075	76,513
10	N	Kukatpally(KUKA)	7	7	765	72	3,252,417	2,650,719	6	601,698	18.5	395.0	125,489	727,187	103,884
11	N	Medchal(MEC)	8 (rural 3)	8	837	190	7,891,370	6,900,848	8	990,522	12.6	1035.0	320,830	1,311,352 0	163,919
12	N	Medicity(MEDI)	3 (rural 3)	0		40.05	0	0				205.0		0 0	0
13	N	Charlapally(CHER)	6	6	770	36	1,824,576	1,729,289	6	95,287	5.2	345.0	105,878	201,165	33,527
14	N	Gatkesar(GATK)	8	8	415	113	2,068,684	2,068,684	6	0	0.0	62.0	7,459	7,459	932
15	N	Keesara(KEES)	3	3	360	41	1,859,346	1,757,734	3	101,612	5.5	0.0	0	101,612	33,871
16	N	Malkajgiri(MLKJ)	4	4	590	15	838,792	782,546	4	56,246	6.7	90.0	23,692	79,938	19,985
17	N	Mallapur(MALL)	4	4	315	20	343,322	343,322	4	0	0.0	180.0	40,809	40,809	10,202
18	N	Moulali(MOUL)	8	8	940	33	1,544,260	1,488,630	8	55,630	3.6	140.0	28,226	83,856	10,482
19	N	Nacharam(NARC)	7	7	705	22.5	995,016	911,539	7	83,478	8.4	80.0	9,522	93,000	13,286
20	N	NGRI(NGRI)	6	6	730	13	799,946	678,521	6	121,425	15.2	241.0	67,562	188,987	31,498
21	N	Sainikpuri(SAIN)	7	7	1080	58	3,140,074	3,140,074	7	0	0.0	485.0	151,788	151,788	21,684
22	N	Uppal(UPPA)	7	7	580	34	1,355,304	1,355,304	5	0	0.0	155.0	44,437	44,437	6,348
23	S	Kothapet(KOTH)	4	4	370	36.31	1,407,531	1,407,531	4	0	0.0	359.0	124,355	124,355	31,089
24	S	Katedan(KATE)	5	5	880	39.8	3,481,466	2,956,261	5	525,205	15.1	1017.0	479,148	1,004,352	200,870
25	S	AP Police Academy(APPA)	3	3	217	43.4	2,422,612	2,422,612	3	0	0.0	75.0	25,234	25,234	8,411
26	S	Champapet(CHAMP)	5	5	510	41.9	1,480,331	1,480,331	5	0	0.0	421.0	110,661	110,661	22,132
27	S	Gaganpahad(GAGA)	6	6	620	52.16	1,630,836	1,526,059	6	104,777	6.4	1376.0	319,243	424,020	70,670
28	S	Hayatnagar(HAYAT)	7	7	550	72	1,470,164	1,470,164	7	0	0.0	219.0	43,541	43,541	6,220
29	S	Ibrahimbagh(IBRA)	5	5	500	118	4,111,471	4,056,799	5	54,673	1.3	556.0	136,326	190,999	38,200
30	S	Mamidipally(MAMI)	4 (rural 1)	4	430	82	3,981,444	3,755,748	4	225,696	5.7	240.0	83,716	309,412	77,353
31	S	NationalPoliceAcademy(NPPA)	5 (rural 1)	5	433	35.5	1,246,000	1,181,285	5	64,716	5.2	180.0	43,428	108,144	21,629
32	S	Shamshabad(SHAM)	5 (rural 3)	5	600	69.2	3,045,884	2,585,814	5	460,071	15.1	1248.0	377,373	837,444	167,489
33	S	Turkayamjal(TURK)	2	2	240	12.3	424,719	424,719	2	0	0.0	1484.0	403,741	403,741	201,870
34	S	Vanastalipuram(VANA)	4	4	590	79.2	4,651,842	4,131,842	4	520,001	11.2	2452.0	828,816	1,348,817	337,204
35	S	Bandlaguda(BAND)(132/33/11kV)	3	3	265	30	1,376,885	1,050,168	3	326,716	23.7	271.0	74,522	401,239	133,746
		North Total	121	111	11618	1162	41,065,886	37,060,129	103	4,005,757	9.8	6532.0	1,722,836	5,728,593	47,344
		South Total	58	58	6205	711.8	30,731,187	28,449,334	58	2,281,853	7.4	9898.0	3,050,105	5,331,958	91,930
		Gross Total	179	169	17823	1874	71,797,073	65,509,463	161	6,287,610	8.8	16430.0	4,772,941	11,060,551	61,791

Average per feeder

Area	11kV feeder					
	No	Data No	Max Load(A)	Length(km)	Loss(kWh/Y)	Loss(kWh/Y)
North			110.6	9.9	398,698	359,807
South			107.0	12.3	529,848	490,506
Gross			109.3	10.7	445,945	406,891

Hyderabad City

No.	North Central South	Name	11kV feeder						Loss Data No	Loss Recovery	Recovery Rate (%)	Outage (m)	Outage Energy (kWh)	Total (kWh)	Average per feeder
			No	Data No	Max Load(A)	Length(km)	Loss(kWh/Y)	Loss(kWh/Y)							
1	N	Gunrock(132/33)(City-V)	1	1	130	7.7	312,041	312,041	1	0	0.0	42.0	12,379	12,379	12,379
		Gunrock(132/33)(City-VI)	7	5	610	65.41	3,190,893	3,190,893	5	0	0.0	445.0	130,159	130,159	18,594
2	N	Jubilee Hills(132/33)(City-IV)	5	5	200	17.76	158,154	158,154	5	0	0.0	12.0	2,177	2,177	435
		Jubilee Hills(132/33)	3							0	#DIV/0!			0	0
3	N	Air Port(City-IV)	6	6	700	15.46	989,350	933,439	6	55,911	5.7	127.0	45,185	101,096	16,849
4	N	Allwyn SS(City-IV)	8	7	470	16.61	316,595	316,595	7	0	0.0	247.0	30,222	30,222	3,778
5	N	Banjara Hills Road No.12(City-I)	1	1	125	4.45	166,730	248,161	1	(81,431)	-48.8	421.0	119,311	37,880	37,880
		Banjara Hills Road No.12(City-I	5	3	245	9.24	330,434	245,581	3	84,853	25.7	943.0	225,619	310,473	62,095
6	N	Banjara Hills Road No.2(City-IV	6	4	335	15.43	230,408	230,408	4	0	0.0	112.0	20,847	20,847	3,474
7	N	Begumpet SS(City-IV)	8	6	805	21.33	880,633	880,633	6	0	0.0	188.0	71,972	71,972	8,996
8	N	Bowenpally(City-VI)	6	5	660	43.72	2,275,957	1,826,680	5	449,278	19.7	199.0	65,964	515,241	85,874
9	N	Clock Tower(City-V)	4	4	755	8.5	756,873	726,536	4	30,337	4.0	144.0	65,182	95,518	23,880
10	N	Film Nagar(City-IV)	6	6	260	12.88	78,254	78,254	6	0	0.0	49.0	6,076	6,076	1,013
11	N	Greenland SS(City-IV)	4	4	780	10.62	969,942	968,341	4	1,601	0.2	73.0	32,251	33,852	8,463
12	N	H.A.L(City-VI)	5	5	460	16.5	518,881	420,244	5	98,637	19.0	150.0	61,668	160,305	32,061
		H.A.L	1	0						0				0	0
13	N	H.M.T(City-VI)	3	2	190	8.74	264,888	264,888	2	0	0.0	362.0	73,525	73,525	24,508
		H.M.T	2	0						0				0	0
14	N	Hakimpet(City-VI)	4	3	245	33.56	590,392	590,392	3	0	0.0	200.0	41,025	41,025	10,256
15	N	I.D.P.L(City-VI)	6	6	730	57.9	2,279,294	2,207,908	6	71,386	3.1	186.0	52,848	124,234	20,706
		I.D.P.L	3	0						0				0	0
16	N	James Street(City-V)	4	4	590	6.44	435,749	335,973	4	99,776	22.9	121.0	25,823	125,599	31,400
		James Street	2	0						0				0	0
17	N	Kalyan Nagar(City-IV)	8	6	600	20.49	698,658	698,658	6	0	0.0	0.0	0	0	0
18	N	Lalaguda(City-V)	5	5	540	21.3	994,249	917,276	5	76,973	7.7	675.0	247,169	324,142	64,828
19	N	Madhhapur(City-IV)	4	3	220	15.08	152,277	152,277	3	0	0.0	266.0	37,998	37,998	9,500
		Madhhapur	1	0						0				0	0
20	N	Maredpally(City-V)	3	3	435	19.4	987,463	978,075	3	9,388	1.0	97.0	30,641	40,029	13,343
		Maredpally(City-VI)	3	3	115	23.47	227,290	227,290	2	0	0.0	20.0	2,528	2,528	843
21	N	Mytrivanam(City-IV)	6	6	550	9.74	337,478	262,109	6	75,369	22.3	269.0	86,425	161,794	26,966
22	N	NIMS(City-I)	2	2	160	6.83	109,026	109,026	2	0	0.0	1658.0	316,318	316,318	158,159
		NIMS(City-IV)	7	5	545	11.17	468,194	468,194	5	0	0.0	1100.0	422,286	422,286	60,327
23	N	Osmania University(City-II)	1	1	140	6.5	305,495	273,640	1	31,855	10.4	116.0	36,819	68,674	68,674
		Osmania University(City-V)	3	3	230	11	227,083	250,238	3	(23,155)	-10.2	159.0	41,932	18,777	6,259
24	N	Patigadda	6	6	659					0		558.0	217,002	217,002	36,167
25	N	Praga Tools(City-VI)	4	4	460	23.39	784,844	779,887	4	4,957	0.6	514.0	164,983	169,940	42,485

No.	North Central South	Name	11kV feeder						Loss Data No	Loss Recovery	Recovery Rate (%)	Outage (m)	Outage Energy (kWh)	Total (kWh)	Average per feeder
			No	Data No	Max Load(A)	Length(km)	Loss(kWh/Y)	Loss(kWh/Y)							
26	N	R.P. Nilayam(City-VI)	4	3	310	39.4	1,010,862	1,006,439	3	4,422	0.4	185.0	40,809	45,232	11,308
27	N	Seethaphal Mandi(City-II)	1	1	155	3.51	202,211	202,211	1	0	0.0	9.0	3,163	3,163	3,163
		Seethaphal Mandi(City-V)	4	4	360	16	357,050	357,050	4	0	0.0	64.0	16,641	16,641	4,160
28	N	Srinagar Colony(City-IV)	5	5	720	14.42	810,696	789,433	5	21,262	2.6	120.0	37,862	59,124	11,825
		Srinagar Colony	1	0						0				0	0
29	N	Yousufguda(City-IV)	5	5	385	18.91	530,635	478,936	5	51,699	9.7	773.0	211,959	263,659	52,732
		Yousufguda	1	0						0				0	0
30	N	Gymkhana(City-V)	4	4	620	22.4	1,537,881	1,477,859	4	60,022	3.9	321.0	125,500	185,523	46,381
31	C	AC Guards(City-I)	1	1	115	3.94	124,947	159,668	1	(34,721)	-27.8	75.0	19,554	(15,166)	-15,166
		AC Guards(City-VII)	5	5	425	32.63	1,074,212	943,286	4	130,926	12.2	512.0	101,808	232,734	46,547
		AC Guards	1	0						0				0	0
32	C	Amberpet(City-II)	6	6	610	27.46	875,745	875,745	6	0	0.0	388.0	114,062	114,062	19,010
33	C	Asif Nagar(City-VII)	9	9	950	76.15	3,345,931	2,978,210	9	367,721	11.0	742.0	162,784	530,505	58,945
		Asif Nagar	1	0						0				0	0
34	C	Chikalguda(City-I)	2	2	195	6.24	132,353	132,353	2	0	0.0	54.0	12,243	12,243	6,121
		Chikalguda(City-II)	2	2	260	9.78	362,321	362,321	2	0	0.0	11.0	3,378	3,378	1,689
		Chikalguda(City-V)	3	3	250	9.8	167,435	167,435	3	0	0.0	159.0	29,711	29,711	9,904
35	C	Exibtion Ground(City-I)	2	2	245	4.57	254,178	254,178	2	0	0.0	136.0	49,198	49,198	24,599
		Exibtion Ground(City-VII)	1	1	150	5.74	309,691	309,691	1	0	0.0	93.0	31,627	31,627	31,627
		Exibtion Ground	4	0						0				0	0
36	C	Golconda(City-VII)	6	6	510	51.23	1,725,187	1,375,182	5	350,006	20.3	0.0	0	350,006	58,334
		Golconda	1	0						0				0	0
37	C	Hussain Sagar(City-I)	8	8	820	26.22	1,026,638	920,346	7	106,291	10.4	413.0	97,602	203,894	25,487
		Hussain Sagar(City-VII)	1	1	130	6.75	273,543	323,621	1	(50,079)	-18.3	26.0	7,663	(42,416)	-42,416
38	C	Hyderguda(city-I)	5	5	780	9.76	619,720	569,552	5	50,168	8.1	308.0	110,820	160,989	32,198
39	C	Indira Park(City-I)	8	8	855	31.51	984,154	983,576	7	578	0.1	229.0	63,402	63,980	7,998
40	C	Industrial Area(City-II)	7	7	770	42.31	1,412,990	1,331,646	7	81,344	5.8	387.0	92,909	174,253	24,893
41	C	Lakeview(City-I)	2	2	245	6.25	222,600	222,600	2	0	0.0	95.0	23,964	23,964	11,982
42	C	Narayanguda(City-I)	2	2	230	7.96	282,846	282,846	2	0	0.0	161.0	39,324	39,324	19,662
		Narayanguda(City-II)	2	2	150	8.25	128,471	128,471	2	0	0.0	177.0	36,309	36,309	18,155
43	C	Public Garden(city-I)	2	2	340	4.58	344,255	344,255	2	0	0.0	60.0	22,218	22,218	11,109
44	C	S.D. Hospital(City-VII)	5	5	525	35.63	1,267,447	1,267,447	5	0	0.0	1020.0	291,005	291,005	58,201
		S.D. Hospital	1	0						0				0	0
45	S	Asmangadh(City-VIII)	6	6	595	21.78	818,595	818,326	6	270	0.0	88.0	24,508	24,778	4,130
46	S	Attapur(City-III)	4	4	610	23.95	1,596,501	1,335,610	4	260,891	16.3	283.0	102,636	363,526	90,882
47	S	Chanchalguda(City-VIII)	6	5	600	15.46	571,882	533,834	5	38,048	6.7	365.0	103,792	141,840	23,640
48	S	E.N.T(City-IX)	6	5	415	10.82	225,669	224,398	5	1,271	0.6	125.0	29,394	30,665	5,111

No.	North Central South	Name	11kV feeder						Loss Data No	Loss Recovery	Recovery Rate (%)	Outage (m)	Outage Energy (kWh)	Total (kWh)	Average per feeder
			No	Data No	Max Load(A)	Length(km)	Loss(kWh/Y)	Loss(kWh/Y)							
49	S	Falaknuma(City-III)	4	4	500	20.8	886,693	862,368	4	24,324	2.7	219.0	60,080	84,405	21,101
		Falaknuma	2	0						0				0	0
50	S	Kanchanbagh(City-III)	1	1	55		0	0		0		19.0	2,369	2,369	2,369
		Kanchanbagh(City-VIII)	5	4	205	7.41	112,070	112,070	4	0	0.0	29.0	6,325	6,325	1,265
51	S	Karwan(City-VII)	1	1	140	10.15	477,042	477,042	1	0	0.0	212.0	67,290	67,290	67,290
		Karwan(City-IX)	3	3	500	16.52	1,098,304	1,098,304	3	0	0.0	464.0	173,712	173,712	57,904
52	S	*Khilwath(City-III)*	5	5	770	26.54	1,713,215	1,568,313	5	144,901	8.5	153.0	58,902	203,803	40,761
53	S	Malakpet(City-II)	1	1	150	4.13	222,827	243,177	1	(20,350)	-9.1	147.0	49,991	29,641	29,641
		Malakpet(City-VIII)	7	7	810	21.1	1,041,174	991,398	7	49,775	4.8	3542.0	262,654	312,429	44,633
54	S	Miralam(City-III)	7	7	1020	39.14	2,590,584	2,447,206	7	143,378	5.5	307.0	117,078	260,455	37,208
55	S	Moosarambagh(City-VIII)	6	6	430	20.2	364,809	364,809	6	0	0.0	440.0	69,206	69,206	11,534
56	S	Osmania Hospital(City-III)	1	1	20	2.49	2,388	2,388	1	0	0.0	5.0	227	227	227
		Osmania Hospital(City-IX)	7	5	490	11.93	412,265	410,342	5	1,922	0.5	119.0	17,072	18,994	2,713
57	S	Sarojung(City-III)	7	7	1040	24.59	1,553,475	1,371,589	6	181,886	11.7	332.0	105,968	287,855	41,122
58	S	Santhoshnagar(City-III)	2	2	210	11.59	311,255	311,255	2	0	0.0	163.0	39,449	39,449	19,725
		Santhoshnagar(City-VIII)	5	5	660	15.72	1,080,047	1,080,047	5	0	0.0	238.0	96,038	96,038	19,208
59	S	Seetharam bagh(City-VII)	2	2	180	9.42	230,330	288,907	2	(58,577)	-25.4	14.0	3,129	(55,448)	-27,724
		Seetharam bagh(City-IX)	4	4	460	11.85	497,976	400,270	4	97,706	19.6	253.0	73,548	171,254	42,813
60	S	Sultan Bazar(City-II)	1	1	140	2.91	136,768	204,759	1	(67,991)	-49.7	8.0	2,539	(65,452)	-65,452
		Sultan Bazar(City-IX)	3	3	545	11.155	895,653	784,908	3	110,746	12.4	136.0	56,498	167,244	55,748
61	S	CPRF(City-III)	6	6	566	23.75	748,281	748,281	6	0	0.0	179.0	44,881	44,881	7,480
		Total	367												

North Total	178	146	15494	655.3	24,486,859	23,363,719	139	1,123,141	4.6	10925.0	3,122,267	4,245,408	23,851
Central Total	87	79	8555	406.8	14,934,665	13,932,429	75	1,002,236	6.7	5046.0	1,309,584	2,311,820	26,573
South Total	102	95	11111	363.4	17,587,800	16,679,600	93	908,200	5.2	7838.0	1,567,287	2,475,487	24,269
Gross Total	367	320	35160	1425	57,009,325	53,975,748	307	3,033,577	5.3	23809.0	5,999,138	9,032,715	24,612

Average per feeder

Area	11kV feeder					
	No	Data No	Max Load(A)	Length(km)	Loss(kWh/Y)	Loss(kWh/Y)
North			100.3	4.7	176,164	168,084
Central			100.4	5.0	192,788	179,414
South			116.1	3.9	189,116	179,351
Gross			104.4	4.5	184,260	174,331

Ranga Reddy North

Substation Name	Name of Feeder	Nos of feeder	Max Load (A)	Length (km)	Loss (kWh/year)	L.L. Max Load (A)	Length (km)	Load Leveled Loss (kWh/year)	Loss Data No
Gachibowli (5MVA x2)	University, ALIND	4	30	1	2,158	40	1	3,837	1
	LINGGAMPALLY		50	10	59,948	40	10	38,367	1
	KOTTAGUDA		32	20	49,109	32	20	49,109	1
	GACHIBOWLI(KALAGAYTHY)		8	5	767	8	5	767	1
I I I T(Indian Institute of Information Tchnology) (8MVA New)	STADIUM	4	11	3	870	11	3	870	1
	WIZCRAFT		Open	2		Open	2		0
	SPORT VILLAGE		3	1		3	1		0
	SPORTVILLAGE EXTERNAL LIGHTING		18	10	7,769	18	10	7,769	1
Aliabad(ALIA) 8MVAX2 3.15MVA	Ravileela	7	20	4	3,837	20	4	3,837	1
	Thurkapally		160	35	2,148,535	110	35	1,015,519	1
	Bommarajpet		120	20	690,601	110	20	580,296	1
	Aliabad		80	20	306,934	110	20	580,296	1
	Jaganguda		120	25	863,251	110	25	725,370	1
	H.B.L		70	5	58,749	110	5	145,074	1
	Survanshi			2			2		0
Chandanagar(CHAN) 8MVA 3.15MVA	Taranagar	4	150	18	971,157	157.5	18	1,070,701	1
	Chandanagar		130	10	405,248	157.5	10	594,834	1
	Hifeezpet(S.B)		160	22	1,350,508	157.5	22	1,308,634	1
	Miyapur		190	25	2,164,122	157.5	25	1,487,084	1
Dommarapocham - pally (DOMM) 5MVAX2	Bowrampet	4	115	20	634,249	115	20	634,249	1
	Satyam Computers(S.B)		115	50	1,585,624	115	50	1,585,624	1
	Duridigal IDA		117	10	328,251	117	10	328,251	1
	Gagillapur		117	25	820,628	117	25	820,628	1
ESCI 3MVA	Gachibouli	3		10			10		0
	Nanakramguda			15			15		0
	E.S.C.I			1			1		0

Resitance (Ohm/km)	0.5
a	0.3
Load Factor(F)	0.7
Loss factor (= aF+(1-a)F^2)	0.553
Dispersal L.F.(h)	0.33

Ranga Reddy North

Substation Name	Name of Feeder	Nos of feeder	Max Load(A)	Length (km)	Loss (kWh/year)	L.L. Max Load (A)	Length (km)	Loss (kWh/year)	Loss Data No
Gundlapocham-pally(GPPL) 8MVA	IDA	4		4			4		0
	Gundla Pochampally(S.B)			25			25		0
	Mysammaguda			8			8		0
	Doollapally			15			15		0
Jeedimetla-1(JEED) 8MVAX3	Phase V	7	130	3.2	129,679	140.7	3.2	151,905	1
	Vicchow		180	6.3	489,463	140.7	6.3	299,063	1
	SudershanDrugs		165	3.1	202,378	140.7	3.1	147,158	1
	Phase I		175	4.9	359,838	140.7	4.9	232,605	1
	Subhashnagar		120	4.9	169,197	140.7	4.9	232,605	1
	Shapumagar		140	5.3	249,096	140.7	5.3	251,593	1
	Phase II		75	2.8	37,767	140.7	2.8	132,917	1
Jeedimetla-2 (JEEI) 8MVAX2	Gajularamaram	6	130	3.9	158,047	121.7	3.9	138,510	1
	Kompally		90	2.1	40,789	121.7	2.1	74,582	1
	Surqaram		140	6.5	305,495	121.7	6.5	230,850	1
	Phase III		80	2.7	41,436	121.7	2.7	95,891	1
	Phase V		100	2.8	67,142	121.7	2.8	99,443	1
	Phase IV		190	5.2	450,137	121.7	5.2	184,680	1
Kukatpally (KUKA)	Travels Feeder	7	100	3	71,938	127.5	3	116,943	1
	Hydernagar		140	8	375,994	127.5	8	311,849	1
	Air Force			4			4		0
	Venkateshwara		180	20	1,553,851	127.5	20	779,623	1
	Bhagyanagar		120	10	345,300	127.5	10	389,812	1
	JNTUCF		130	17	688,922	127.5	17	662,680	1
	KPHB		95	10	216,412	127.5	10	389,812	1
Medchal(MEC) 5MVAX2	Yellampet	8	83	30	495,578	83	30	495,578	1
	Ravalkole		150	35	1,888,361	146.3	35	1,796,351	1
	IDA Medchal II(S.B)		125	15	562,012	146.3	15	769,865	1
	Rural Medchal		70	25	293,745	70	25	293,745	1
	IDA Medchal I		125	20	749,350	146.3	20	1,026,486	1
	kandlakoya		185	45	3,693,094	146.3	45	2,309,594	1
	Medchal Town		75	15	202,324	75	15	202,324	1
	Srinath Spinning Mills		24	5	6,906	24	5	6,906	1

Ranga Reddy North

Substation Name	Name of Feeder	Nos of feeder	Max Load(A)	Length (km)	Loss (kWh/year)	L.L. Max Load (A)	Length (km)	Loss (kWh/year)	Loss Data No
Medicity(MEDI) 5MVA,1.6MVA	Pudur	3		25			25		0
	Raj Bollaram			15			15		0
	Medicity			0.05			0.05		0
Charlapally(CHER)	ECIL	6	50	6	35,969	50	6	35,969	1
	IDA Phase-I		70	4	46,999	70	4	46,999	1
	IDA Phase-II		160	5	306,934	162.5	5	316,600	1
	Krupp		190	7	605,954	162.5	7	443,240	1
	Rampally		180	8	621,541	162.5	8	506,560	1
	Nagaram		120	6	207,180	162.5	6	379,920	1
Gatkesar(GATK)	Ghatkesar	8	120	15	517,950	120	15	517,950	1
	Keesara								0
	Edulabad		80	25	383,667	80	25	383,667	1
	Aushapur		110	30	870,444	110	30	870,444	1
	Medipally		70	25	293,745	70	25	293,745	1
	Syndicate		20			20			0
	HPCL		10	10	2,398	10	10	2,398	1
	NTPC		5	8	480	5	8	480	1
Keesara(KEES)	Cheral	3	170	18	1,247,397	145	18	907,492	1
	Ankireddipally		70	8	93,998	70	8	93,998	1
	Keesara		120	15	517,950	145	15	756,244	1
Malkajgiri(MLKJ)	Anandbagh	4	120	3	103,590	147.5	3	156,509	1
	Durga Nagar		220	3	348,178	147.5	3	156,509	1
	M.K. Nagar		110	2	58,030	147.5	2	104,339	1
	Suryanagar		140	7	328,994	147.5	7	365,188	1
Mallapur(MALL)	Mallapur Village	4	100	8	191,833	100	8	191,833	1
	IDA Phase-II		80	4	61,387	80	4	61,387	1
	BEL		105	3	79,311	105	3	79,311	1
	A.P. Food		30	5	10,791	30	5	10,791	1

Ranga Reddy North

Substation Name	Name of Feeder	Nos of feeder	Max Load(A)	Length (km)	Loss (kWh/year)	L.L. Max Load (A)	Length (km)	Loss (kWh/year)	Loss Data No
Moulali(MOUL)	FBP	8	10	2	480	10	2	480	1
	HCL		180	3	233,078	148.3	3	158,211	1
	HMT		40	3	11,510	40	3	11,510	1
	Malkajgiri		180	7	543,848	148.3	7	369,160	1
	Meerpet		130	4	162,099	148.3	4	210,949	1
	Mirjalguda		130	7	283,674	148.3	7	369,160	1
	Moula-Ali		140	4	187,997	148.3	4	210,949	1
	Spectra		130	3	121,574	148.3	3	158,211	1
Nacharam(NARC)	S.R. Feeder	7	130	3	121,574	155	3	172,830	1
	Multisteel		30	4	8,633	30	4	8,633	1
	Tungabhadra		220	4	464,237	155	4	230,440	1
	IPM		120	3.5	120,855	155	3.5	201,635	1
	Laxmi Starch		150	5	269,766	155	5	288,050	1
	NILE		45	2	9,712	45	2	9,712	1
	India Extruction		10	1	240	10	1	240	1
NGRI(NGRI)	Habsiguda	6	170	3	207,900	167.5	3	201,830	1
	HMT		210	4	422,993	167.5	4	269,106	1
	Kalyanpuri		130	1	40,525	167.5	1	67,277	1
	NGRI		40	1	3,837	40	1	3,837	1
	Penguin		20	2	1,918	20	2	1,918	1
	S.O.I		160	2	122,773	167.5	2	134,553	1
Sainikpuri(SAIN)	ASRAO Nagar	7	200	5	479,584	200	5	479,584	1
	Kamalanagar		100	3	71,938	100	3	71,938	1
	Kapra		110	10	290,148	110	10	290,148	1
	Kushaiguda		170	5	346,499	170	5	346,499	1
	Neredmet		180	5	388,463	180	5	388,463	1
	Sainikpuri		180	5	388,463	180	5	388,463	1
	Yapral		140	25	1,174,980	140	25	1,174,980	1

Ranga Reddy North

Substation Name	Name of Feeder	Nos of feeder	Max Load(A)	Length (km)	Loss (kWh/year)	L.L. Max Load (A)	Length (km)	Loss (kWh/year)	Loss Data No
Uppal(UPPA)	Boduppal	7	120	6	207,180	120	6	207,180	1
	Doordarshan								0
	Indi Ghatkesar		130	18	729,447	130	18	729,447	1
	Nav Bharath		180	4	310,770	180	4	310,770	1
	Ramanthapur								0
	Uppal		50	2	11,990	50	2	11,990	1
	Gangappa		100	4	95,917	100	4	95,917	1

Ranga Reddy South

Substation Name	Name of Feeder	Nos of feeder	Max Load(A)	Length (km)	Loss (kWh/year)	L.L. Max Load (A)	Length (km)	Loss (kWh/year)	Loss Data No
Kothapet(Mixed)(8MVAx2)	Kamalangar	4	85	10.54	182,605	85	10.54	182,605	1
	Sroornagar		170	16.56	1,147,605	170	16.56	1,147,605	1
	Stadium(old Kothapet)		75	4.35	58,674	75	4.35	58,674	1
	Huda Complex		40	4.86	18,646	40	4.86	18,646	1
Katedan (Industry) (8MVAx2)	Katedan 1	5	170	6.2	429,659	176	6.2	460,523	1
	Katedan 2		160	4.3	263,963	176	4.3	319,395	1
	Balapur		220	17.5	2,031,037	176	17.5	1,299,864	1
	Katedan 3		160	7.7	472,678	176	7.7	571,940	1
	Katedan 4		170	4.1	284,129	176	4.1	304,539	1
AP Police Academy(Himayat Sagar)(5MVAx1)	AP Police Academy	3	15	0.4	216	15	0.4	216	1
	Himayat Sagar		22	12	13,927	22	12	13,927	1
	Azz Nagar		180	31	2,408,469	180	31	2,408,469	1
Champapet (8MVAx2)	Kharmanghat	5	130	4.8	194,519	130	4.8	194,519	1
	Champapet		80	3.6	55,248	80	3.6	55,248	1
	Sulthanvallua		40	3.3	12,661	40	3.3	12,661	1
	Meerpat		150	13.7	739,158	150	13.7	739,158	1
	Balapur		110	16.5	478,744	110	16.5	478,744	1
Gaganpahad (GAGA) 8MVAX2	NPA(55mm2, 172A)	6	40	4.15	15,922	40	4.15	15,922	1
	Gagan Pahad(ditto)		150	12.36	666,861	125	12.36	463,098	1
	Jai Bhawani(ditto)		120	5.2	179,556	125	5.2	194,831	1
	Manage(ditto)		140	8.35	392,443	125	8.35	312,853	1
	Ralendra Nagar(ditto)		80	13.05	200,274	80	13.05	200,274	1
	Shiva Shathi(ditto)		90	9.05	175,779	125	9.05	339,081	1
Hyath Nagar(8MVAx3)	L.B. Nagar	7	45	9	43,702	45	9	43,702	1
	Mansurabad		115	7	221,987	115	7	221,987	1
	MothfrDairy		120	17	587,010	120	17	587,010	1
	AutoNagar, HighCourtColony		120	10	345,300	120	10	345,300	1
	Hyat Nagar		80	12	184,160	80	12	184,160	1
	A.I.R.		10	7	1,679	10	7	1,679	1
	SERIER		60	10	86,325	60	10	86,325	1

Ranga Reddy South

Substation Name	Name of Feeder	Nos of feeder	Max Load(A)	Length(km)	Loss (kWh/year)	L.L. Max Load (A)	Length(km)	Loss (kWh/year)	Loss Data No
Ibrahimbagh(8MVAx2)	New Military	5	40	8	30,693	40	8	30,693	1
	Osman Sagar		160	28	1,718,828	130	28	1,134,695	1
	Military I		130	35	1,418,369	130	35	1,418,369	1
	Military II		70	15	176,247	70	15	176,247	1
	Pedda Mangalaran		100	32	767,334	130	32	1,296,794	1
Mamidipally(MAMI) 5MVAx2	Errakunta(34mm2, 150A)	4	120	23	794,191	141.7	23	1,107,394	1
	Pahachisharey(ditto)		125	27	1,011,622	141.7	27	1,299,984	1
	Thukkuguda(ditto)		180	28	2,175,392	141.7	28	1,348,131	1
	Catalytic(ditto)		5	4	240	5	4	240	1
NationalPoliceAcademy(NPPA)5MVAx2	Sastri Puram(55m2)	5	53	10	67,358	53	10	67,358	1
	Uppar Pally(ditto)		175	11	807,799	154.5	11	629,628	1
	Shivarampally(ditto)		134	8	344,456	154.5	8	457,911	1
	NPA(ditto)		29	0.5	1,008	29	0.5	1,008	1
	Kattadan(ditto)		42	6	25,380	42	6	25,380	1
Shamshabad (SHAM) 8MVAX2	OmJaiBhavani(34mm2)	5	60	12.5	107,906	60	12.5	107,906	1
	Shamshabad(ditto)		120	10	345,300	135	10	437,021	1
	Narkuda(diito)		200	18.5	1,774,460	135	18.5	808,488	1
	Raikunta(ditto)		110	16.2	470,040	135	16.2	707,973	1
	HameedullaNagar(diitto)		110	12	348,178	135	12	524,425	1
Turkayamjal(TURK)(5+3.5)MVA	Turka Yanjal(55mm2)	2	120	5.8	200,274	120	5.8	200,274	1
	Manneguda(55mm2)		120	6.5	224,445	120	6.5	224,445	1
Vanastalipuram (VANA) 8MVAx2	Vanasthalipuram(55mm2)	4	140	9.7	455,892	147.5	9.7	506,046	1
	NGO's(55mm2)		170	15.5	1,074,148	147.5	15.5	808,631	1
	Injarpoor(55mm2)		170	38.6	2,674,974	147.5	38.6	2,013,751	1
	Bairamlaguda(55mm2)		110	15.4	446,828	147.5	15.4	803,414	1
Bandlaguda(BAND)(132/33/11kV) 5MVAx1	Nagole(55mm2)	3	150	23.5	1,267,899	125	23.5	880,486	1
	Alkapuri(55mm2)		100	4.5	107,906	125	4.5	168,604	1
	GSI(55mm2)		15	2	1,079	15	2	1,079	1

Hyderabad North

Substation Name			Name of Feeder	Max Load (A)	Length (km)	Loss (kWh/year)	L.L. Max Load (A)	Length (km)	Loss (kWh/year)	Loss data No
1	ALLWYN (City-IV) 8MVAX2	1	Industrial Estate	80	2.1	32,228	80	2.1	32,228	1
		2	Crown Carting	10	3.6	863	10	3.6	863	1
		3	IOL	140	2.38	111,858	140	2.38	111,858	1
		4	Motinagar	80	2.64	40,515	80	2.64	40,515	1
		5	ESI	20	2.24	2,149	20	2.24	2,149	1
		6	Sanathnagar	130	3.18	128,869	130	3.18	128,869	1
		7	Tele Exchange	10	0.47	113	10	0.47	113	1
		8	Allwyn Compressor	10			10			0
										0
2	AIRPORT (City-IV) 8MVAX2	1	Air port	80	1.4	21,485	80	1.4	21,485	1
		2	International Airport	60	0.22	1,899	60	0.22	1,899	1
		3	Domestic Airport	60	0.21	1,813	60	0.21	1,813	1
		4	Chikoti Garden	140	3.24	152,277	166.7	3.24	215,899	1
		5	Prakash Nagar	190	5.32	460,525	166.7	5.32	354,501	1
		6	Motilal Nagar	170	5.07	351,350	166.7	5.07	337,842	1
										0
3	ROAD NO: 2 8MVAX2	1	Sagar society	70	2.17	25,497	70	2.17	25,497	1
		2	Road No.02	115	1.4	44,397	115	1.4	44,397	1
		3	Road No.10	85	5.61	97,193	85	5.61	97,193	1
		4	Road No.14	145			145			0
		5	L.V.Prasad Marg	65	6.25	63,320	65	6.25	63,320	1
		6	LV.Prasad film Lab	40			40			0

Resitance (Ohm/km)	0.5
a	0.3
Load Factor(F)	0.7
Loss factor (= aF+(1-a)F²)	0.553
Dispersal L.F.(h)	0.33

Hyderabad North

Substation Name			Name of Feeder	Max Load (A)	Length (km)	Loss (kWh/year)	Max Load (A)	Length (km)	Loss (kWh/year)	Loss data No
4	BEGUMPET (City-IV) 8MVAX2	1	S.R.Nagar	145	4.5	226,873	145	4.5	226,873	1
		2	Yellamma Temple	65	5.22	52,885	65	5.22	52,885	1
		3	Shantibagh	145	4.17	210,236	145	4.17	210,236	1
		4	AMP	55	4.09	29,668	55	4.09	29,668	1
		5	DKR	345	1.22	348,203	345	1.22	348,203	1
		6	Hyderabad Public School	120			120			0
		7	Maitrivanam	50	2.13	12,769	50	2.13	12,769	1
		8	Vidyut Soudha							0
5	BOWENPLLY (City-VI) 8MVAX2	1	Bapuji Nagar	195	12.48	1,137,937	132	12.48	521,431	1
		2	Bowenpally	100	6.6	158,263	132	6.6	275,757	1
		3	Tadbund	100	9.97	239,072	132	9.97	416,560	1
		4	IAF	25			25			0
		5	Gputham Nagar	170	8.88	615,383	132	8.88	371,018	1
		6	Ferroj guda	95	5.79	125,303	132	5.79	241,914	1
										0
6	CLOCKTOWER (City-V) 8MVAX2 7.5MVA	1	Sangeeth	180	1	77,693	188.8	1	85,475	1
		2	Minerva	170	3	207,900	188.8	3	256,425	1
		3	Natraj	185	1.5	123,103	188.8	1.5	128,212	1
		4	St.Road	220	3	348,178	188.8	3	256,425	1
										0
7	GREENLANDS (City-IV) 8MVAX2	1	Ameerpet	195	1.61	146,801	195	1.61	146,801	1
		2	Kundan bagh	190	2.54	219,875	195	2.54	231,599	1
		3	Rajiv Gandhi	190	3.43	296,917	195	3.43	312,750	1
		4	Somajiguda	205	3.04	306,348	195	3.04	277,190	1
										0

Hyderabad North

Substation Name			Name of Feeder	Max Load (A)	Length (km)	Loss (kWh/year)	Max Load (A)	Length (km)	Loss (kWh/year)	Loss data No
8	GYMKHANA (City-V) 8MVAX2	1	Paredgrounds	210	6	634,489	178.3	6	457,392	1
		2	Sikh village	85	3.9	67,567	85	3.9	67,567	1
		3	Vikram Puri	195	6.5	592,676	178.3	6.5	495,508	1
		4	Marredpally	130	6	243,149	178.3	6	457,392	1
										0
9	HAKIMPET (City-VI) 5MVAX2	1	M.Bollaram	110	13.38	388,218	110	13.38	388,218	1
		2	Hakimpet Airforce	65			65			0
		3	Allen by lines	60	14.42	124,481	60	14.42	124,481	1
		4	Risak Bazar	75	5.76	77,693	75	5.76	77,693	1
										0
10	HAL 8MVAX2	1	Sowbhagya Nagar	60	4.94	42,645	60	4.94	42,645	1
		2	Sri Rama	50	2.08	12,469	50	2.08	12,469	1
		3	NRSA	100	2.34	56,111	145	2.34	117,974	1
		4	SAMRAT	190	4.44	384,348	145	4.44	223,848	1
		5	HAL	30			30			0
		6	I.A.L	60	2.7	23,308	60	2.7	23,308	1
										0
11	HMT 8MVAX2	1	Chintal	150			150			0
		2	HMT Road	40			40			0
		3	QBP	110			110			0
		4	G.N.R	60	2.8	24,171	60	2.8	24,171	1
		5	A.O.L	130	5.94	240,717	130	5.94	240,717	1
										0

Hyderabad North

Substation Name			Name of Feeder	Max Load (A)	Length (km)	Loss (kWh/year)	Max Load (A)	Length (km)	Loss (kWh/year)	Loss data No
12	IDPL 3MVAX2(6.6kV) 5MVA 8MVAX3	1	6.6kV IDPL	60			60			0
		2	SIFCO	80	5.5	84,407	80	5.5	84,407	1
		3	SVCIE	130	7.1	287,726	130	7.1	287,726	1
		4	Vijaya Electricals	130	13.5	547,085	130	13.5	547,085	1
		5	Oblum	150	13.1	706,787	130	13.1	530,875	1
		6	Balanagar	100	9.8	234,996	130	9.8	397,143	1
		7	I.E	140	8.9	418,293	130	8.9	360,671	1
		8	Moosapet	170			170			0
		9	Bharath Nagar	80			80			0
										0
13	FILMNAGAR (City-IV) 8MVAX2	1	Ambedkar Nagar	20	1.1	1,055	20	1.1	1,055	1
		2	MLA colony	85	1.86	32,224	85	1.86	32,224	1
		3	Padmalaya Studio	35	3.08	9,047	35	3.08	9,047	1
		4	Ramanaidu Studio	25	0.9	1,349	25	0.9	1,349	1
		5	Appollo	40	2.49	9,553	40	2.49	9,553	1
		6	Bharathiya Vidya Bhavan	55	3.45	25,025	55	3.45	25,025	1
										0
14	JAMES STREET 8MVAX2	1	Park Lane	185	0.69	56,381	147.5	0.687	35,841	1
		2	P.G Road	190	3.62	313,105	147.5	3.617	188,698	1
		3	M.G Road	125	1.37	51,443	147.5	1.373	71,629	1
		4	Mahankali Temple	90	0.76	14,820	147.5	0.763	39,805	1
		5	S.D Temple							0
		6	S.P Road							0

Hyderabad North

Substation Name			Name of Feeder	Max Load (A)	Length (km)	Loss (kWh/year)	Max Load (A)	Length (km)	Loss (kWh/year)	Loss data No
15	KALYANNAGAR (City-IV) 8MVAX3	1	Krishna Nagar	80	5.33	81,798	80	5.33	81,798	1
		2	Yousuf Guda	200	2.64	253,220	200	2.64	253,220	1
		3	Madhura Nagar	160	4.73	290,359	160	4.73	290,359	1
		4	V.Road Nagar	40	1.72	6,599	40	1.72	6,599	1
		5	A.G.Colony	80	3.77	57,857	80	3.77	57,857	1
		6	Sri.Ram Nagar	40	2.3	8,824	40	2.3	8,824	1
		7	CTI	5			5			0
		8	SCADA							0
										0
16	MADHAPUR 8MVAX2	1	Shilparamaam	50			50			0
		2	APIIC-II	60	4.52	39,019	60	4.52	39,019	1
		3	APIIC I	100	1.44	34,530	100	1.44	34,530	1
		4	HUDA	60	9.12	78,728	60	9.12	78,728	1
		5	NAC GROUNDS		4.37			4.37		0
17	MAITRIVANAM (City-IV) 8MVAX2	1	Sarathi Studio	80	2.67	40,976	80	2.67	40,976	1
		2	Srinivas Colony	30	1.38	2,978	30	1.38	2,978	1
		3	Mathrivanam	110	0.48	13,927	130	0.48	19,452	1
		4	Amberpet	180	3	233,078	130	3	121,574	1
		5	Anandbagh	100	1.85	44,361	130	1.85	74,971	1
		6	Aditya	50	0.36	2,158	50	0.36	2,158	1
										0
18	MARREDPALLY 8MVAX2	1	AOC	10	3.88		10	3.88		0
		2	Mahindra Hills	130	6	243,149	145	6	302,497	1
		3	Nehru Nagar	170	6.2	429,659	145	6.2	312,581	1
		4	Military Hospital	20	6.85	6,570	20	6.85	6,570	1
		5	Rly. Colony	135	7.2	314,655	145	7.2	362,997	1
		6	R.K.Puram	85	12.7	220,720	85	12.74	220,720	1

Hyderabad North

Substation Name			Name of Feeder	Max Load (A)	Length (km)	Loss (kWh/year)	Max Load (A)	Length(km)	Loss (kWh/year)	Loss data No
19	NIMS 8MVAX3	1	GVK Hotel	90	4.59	89,152	90	4.59	89,152	1
		2	Banjara Hills	70	3.08	36,189	70	3.08	36,189	1
		3	Panjagutta	80	1.64	25,169	80	1.64	25,169	1
		4	NIMS	75			75			0
		5	Tata Rao	65	1.28	12,968	65	1.28	12,968	1
		6	Sai baba temple	60	1.47	12,690	60	1.47	12,690	1
		7	Road No.5	80			80			0
		8	Erramanzil	90	3.75	72,837	90	3.75	72,837	1
		9	Andhra Jyothi	250	2.19	328,215	250	2.19	328,215	1
		10	BhaskaraPalace							0
20	PATIGADDA 8MVAX3	1	Ranigunj	115			115			0
		2	Rasoolpura	130			130			0
		3	Budda Bhavan	14			14			0
		4	Zeera	190			190			0
		5	Minister Road	190			190			0
		6	Sangeevaiah park	20			20			0
21	R.P.NILAYAM (City-VI) 7.5MVA 8MVA	1	Alwal	110	11.74	340,634	115	11.74	372,304	1
		2	EME	80	14.85	227,898	80	14.85	227,898	1
		3	V.Puram	120	12.81	442,330	115	12.81	406,237	1
		4	R.P.Nilayam	5			5			0
										0
22	SRINAGAR COLONY 8MVAX2	1	Udyog Nagar	80	2.08	31,921	80	2.08	31,921	1
		2	Kamlapuri colony	120			120			0
		3	Srinagar colony	180	3.58	278,139	160	3.58	219,764	1
		4	Yella reddy guda	170	3.66	253,637	160	3.66	224,675	1
		5	Satya sai nigam	150	1.05	56,651	160	1.05	64,456	1
		6	Nagarjuna Nagar	140	4.05	190,347	160	4.05	248,616	1

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Substation Name			Name of Feeder	Max Load (A)	Length (km)	Loss (kWh/year)	Max Load (A)	Length (km)	Loss (kWh/year)	Loss data No
23	YOUSUF GUDA 8MVAX2	1	Borabonda	85	6.3	109,147	85	6.3	109,147	1
		2	Vinayak Nagar	110	2.73	79,210	130	2.73	110,633	1
		3	Police Lines	150	6.19	333,970	130	6.19	250,849	1
		4	Gayatri Hills	35	2.81	8,254	35	2.81	8,254	1
		5	IOA	5	0.88	53	5	0.88	53	1
		6	MLA colony	5			5			0
										0
24	LALAGUDA (City-V) 5MVAX3	1	A.P.Dairy	40	0.8	3,069	40	0.8	3,069	1
		2	Shanti Nagar	180	6	466,155	150	6	323,719	1
		3	Lalapet	50	4	23,979	50	4	23,979	1
		4	Tarnaka	100	5	119,896	150	5	269,766	1
		5	Vijayapuri	170	5.5	381,149	150	5.5	296,742	1
										0
25	OSMANIA UNIVERSITY 5MVA,7.5MVA	1	Osmania University	55	3	21,761	55	3	21,761	1
		2	Boudhanagar	140	6.5	305,495	132.5	6.5	273,640	1
		3	RTC Hospita;	125	5	187,337	132.5	5	210,492	1
		4	Ravindra Nagar	50	3	17,984	50	3	17,984	1
										0
26	PRAGA TOOLS (City-VI) 8MVAX2	1	Indoswing	120	4.62	159,529	136.7	4.62	207,021	1
		2	T.C Balnagar	160	4.95	303,864	136.7	4.95	221,808	1
		3	Asbestos Hills	50	6.91	41,424	50	6.91	41,424	1
		4	Nagarjuna signode	130	6.91	280,027	136.7	6.91	309,635	1
										0

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Substation Name			Name of Feeder	Max Load (A)	Length (km)	Loss (kWh/year)	Max Load (A)	Length (km)	Loss (kWh/year)	Loss data No
27	ROAD NO :12 8MVAX2	1	CRPF	190			190			0
		2	C.Palace	55	4.06	29,450	55	4.06	29,450	1
		3	M.Quarters	10	1.31	314	10	1.31	314	1
		4	I.T.Colony	10			10			0
		5	Road No.12	125	4.45	166,730	152.5	4.45	248,161	1
		6	Road No.10	180	3.87	300,670	152.5	3.87	215,817	1
28	SEETHA PALMANDI 8MVA,5MVA	1	Gandhi Statue	80	4	61,387	80	4	61,387	1
		2	Namalagundu	130	5	202,624	130	5	202,624	1
		3	Warasiguda	70	4	46,999	70	4	46,999	1
		4	Medibavi	155	3.51	202,211	155	3.51	202,211	1
		5	Seethapahlmandi	80	3	46,040	80	3	46,040	1
29	132/33/11KV GUNROCK 8MVAX2	1	M.Hospital	160	8.31	510,124	160	8.31	510,124	1
		2	MDF	160	13.85	850,206	160	13.85	850,206	1
		3	GPH	130	12.45	504,534	130	12.45	504,534	1
		4	Medchal	140	28.16	1,323,498	140	28.16	1,323,498	1
		5	Bowenpally	130	7.7	312,041	130	7.7	312,041	1
		6	Gymkhana	120			120			0
		7	AWHO	20	2.64	2,532	20	2.64	2,532	1
		8	SPH US Cable		2.23			2.23		0
30	132/33/11KV JUBLEE HILLS 8MVAX2	1	IOA	80	3.5	53,713	80	3.5	53,713	1
		2	MLA Colony	15	4.94	2,665	15	4.94	2,665	1
		3	Jublihills	80	6.5	99,753	80	6.5	99,753	1
		4	PEI (OH)	20	2.06	1,976	20	2.06	1,976	1
		5	PEI (UG)	5	0.76	46	5	0.76	46	1
		6	Film nagar	15			15			0
		7	AOU	20			20			0
		8	Prasasan Nagar	20			20			0

Hyderabad Central

Substation Name		Name of Feeder		Max Load (A)	Length (km)	Loss (kWh/year)	Max Load (A)	Length (km)	Loss (kWh/year)	Loss data No
1	A C GUARDS 8MVAX2, 5MVA	1	Mahaveer Hospital	115	3.94	124,947	130	3.94	159,668	1
		2	Bazar ghat	155	10.6	610,666	130	10.6	429,563	1
		3	Shanthi Nagar	120	8.37	289,016	130	8.37	339,193	1
		4	N.M.D.C	80	3.9	59,852	80	3.9	59,852	1
		5	Mahaveer Hospital cable	135			135			0
		6	Mahaveer							0
		7	Niloper Hospital							0
		8	Niloufer	70	9.76	114,678	70	9.76	114,678	1
2	AMBERPET (City-II) 8MVAX2	1	CPL feeder	35	2.14	6,286	35	2.14	6,286	1
		2	Patel Nagar	145	4.8	241,998	145	4.8	241,998	1
		3	Amberpet Feeder	145	4.72	237,965	145	4.72	237,965	1
		4	Zinda thilasmat	145	5.32	268,214	145	5.32	268,214	1
		5	Tilaknagar	65	5.98	60,585	65	5.98	60,585	1
		6	Golnaka	75	4.5	60,697	75	4.5	60,697	1
										0
3	ASIF NAGAR 8MVAX3, 5MVA	1	Gudimalkapur	210	12.82	1,355,692	141.7	12.82	617,252	1
		2	Jyothi Nagar	110	6.05	175,540	141.7	6.05	291,293	1
		3	Padmanabha Nagar	60	6.83	58,960	60	6.83	58,960	1
		4	Alapatinagar	120	8.73	301,447	141.7	8.73	420,328	1
		5	Mehdipatnam	180	8.84	686,802	141.7	8.84	425,624	1
		6	Military	30	5.69	12,280	30	5.69	12,280	1
		7	JCO Quarters	10	3.27	784	10	3.27	784	1
		8	Hakimpet	120	10.95	378,104	141.7	10.95	527,216	1
		9	Water works	10			10			0
		10	Kakatiynanagar	110	12.97	376,322	141.7	12.97	624,474	1
										0

Hyderabad Central

Substation Name		Name of Feeder		Max Load (A)	Length (km)	Loss (kWh/year)	Max Load (A)	Length (km)	Loss (kWh/year)	Loss data No
4	HYDERGUDA (City-I) 8MVAX2	1	King kothi	160	1.88	115,407	156	1.88	109,709	1
		2	Hyderguda	185	3.35	274,930	156	3.35	195,492	1
		3	Hi May/03/03ath Nagar	140	2.34	109,978	156	2.34	136,552	1
		4	Boggukunta	160	1.34	82,258	156	1.34	78,197	1
		5	Abids	135	0.85	37,147	156	0.85	49,602	1
		6	MLA Quarters	20	1.47	1,410	20	1.47	1,410	1
5	HUSSAINSAGAR (City-I,VII) 5MVAX4, 7.5MVAX3	1	Maruthi Nagar	80	2.44	37,446	80	2.44	37,446	1
		2	BRK Bhavan	100			100			0
		3	Lakdi-Ka-Pool	60			60			0
		4	AG feeder	100	1.92	46,040	141.4	1.92	92,052	1
		5	Gunfoundry Kev SS	90			90			0
		6	Nampally Kev SS	100			100			0
		7	Kharirtabad	170	5.47	379,070	141.4	5.47	262,253	1
		8	J.Block	60			60			0
		9	MGV							0
		10	Anand Nagar	160	4.98	305,706	141.4	4.98	238,761	1
		11	Inst.of Engineers	20			141.4			0
		12	HACA	200			200			0
		13	Telephone Bhavan+Secretariat Press	110			110			0
		14	RBI	90			90			0
		15	Secretariat	60			60			0
		16	Adarsh Nagar	40	3.69	14,157	40	3.69	14,157	1
		17	Lumbini Park	30			30			0
		18	I.G.Mint	10			10			0
		19	Andhra Bank+ECR(Mint Compound)	60			60			0
		20	TankBund	130	4.02	162,910	141.4	4.02	192,734	1
		21	Basheer Bagh	140	1.73	81,309	141.4	1.73	82,943	1
		22	LIC	160	4.04	248,002	141.4	4.04	193,693	1
		23	Multi purpose		1.97			1.97		0
		24	ECR							0
		25	Secretariet Press							0
		26	Multi purpose	130	6.75	273,543	141.4	6.75	323,621	1

Hyderabad Central

Substation Name			Name of Feeder	Max Load (A)	Length (km)	Loss (kWh/year)	Max Load (A)	Length (km)	Loss (kWh/year)	Loss data No
6	CHILKAL-GUDA 8MVAX2	1	Dandu pentaiah	75	2.8	37,767	75	2.8	37,767	1
		2	Pragatools	75	3.95	53,279	75	3.95	53,279	1
		3	New Boiguda	90	4	77,693	90	4	77,693	1
		4	P.R.Nagar	85	3	51,975	85	3	51,975	1
		5	Parsigutta	110	6.63	192,368	110	6.63	192,368	1
		6	Musheerabad	120	2.29	79,074	120	2.29	79,074	1
		7	GolcondaX Road	150	3.15	169,952	150	3.15	169,952	1
7	EXHIBITION GROUNDS 8MVAX3	1	Jawaharlal Nehru	175	3.25	238,668	175	3.25	238,668	1
		2	Nampally Hospital	150	5.74	309,691	150	5.74	309,691	1
		3	Collection Office	110			110			0
		4	Exhibition Gandhi Bhavan							0
		5	Seetharampet	140			140			0
		6	Exhibition - Ajantha Gate	2			2			0
		7	Ware House	70	1.32	15,510	70	1.32	15,510	1
		8	Exibition							0
8	GOLCONDA 8MVAX2	1	Golconda	100	5.32	127,569	126.7	5.32	204,786	1
		2	Motimahal	180	14.7	1,143,635	126.7	14.72	566,625	1
		3	Adityanagar	100	10.3	247,465	126.7	10.32	397,253	1
		4	Darga	70	13.7	160,385	70	13.65	160,385	1
		5	Waterworks	5	0.86		5	0.86		0
		6	Q.Q.Tombs	20			20			0
		7	Colconda AB Cable	55	6.36	46,134	55	6.36	46,134	1

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Substation Name			Name of Feeder	Max Load (A)	Length (km)	Loss (kWh/year)	Max Load (A)	Length(km)	Loss (kWh/year)	Loss data No
9	INDUSTRIAL AREA(City-II) 8MVAX3	1	Shankermutt	90	7.98	154,997	128	7.98	313,514	1
		2	Ram Nagar	160	4.67	286,676	128	4.67	183,473	1
		3	R.O.M	50	3.48	20,862	50	3.48	20,862	1
		4	11 KV DDH	80	8.97	137,660	80	8.97	137,660	1
		5	11 KV RTC X road	110	4.79	138,981	128	4.79	188,187	1
		6	Azamabad	100	5.42	129,967	128	5.42	212,938	1
		7	Barkatpura	180	7	543,848	128	7	275,012	1
		8	11 KV VST	80	1.35	20,718	80	1.35	20,718	1
		9	11 KV Azamabad Key SS	60	2.95	25,466	60	2.95	25,466	1
		10	11kV DDH UG		1.48			1.48		0
10	NARAYAN-GUDA 8MVAX2	1	Lingampally	145	4.38	220,823	145	4.38	220,823	1
		2	Chikkadpally	55	3.48	25,243	55	3.48	25,243	1
		3	Narayanaguda	85	3.58	62,023	85	3.58	62,023	1
		4	Preventive medicine	95	4.77	103,229	95	4.77	103,229	1
		5	Preventive medicine(UG)		3.4			3.4		0
		6	Linganpally		4.6			4.6		0
11	INDIRA PARK (City-I) 8MVAX3	1	Vivek Nagar	150	2.98	160,780	150	2.98	160,780	1
		2	Gandhi Nagar		6.74			6.74		0
		3	Bakaram->TallaBshi	60	5.11	44,112	60	5.11	44,112	1
		4	Jawahar Nagar	50	2.27	13,608	50	2.27	13,608	1
		5	Ashok Nagar	175	3.85	282,730	148.8	3.85	204,409	1
		6	R.K.Mutt	120	4.47	154,349	148.8	4.47	237,327	1
		7	Lower Tank Bund	150	3.34	180,204	148.8	3.34	177,332	1
		8	Kawadiguda	150	2.75	148,371	148.8	2.75	146,007	1
		9	Indian Express	40			40			0
		10	Vaartha							0

Hyderabad Central

Substation Name			Name of Feeder	Max Load (A)	Length (km)	Loss (kWh/year)	Max Load (A)	Length (km)	Loss (kWh/year)	Loss data No
12	LAKE VIEW(City-I) 8MVAX2	1	Vidyut Soudha	60			60			0
		2	Dilkusha	105	3.46	91,472	105	3.46	91,472	1
		3	Raj Bhavan							0
		4	Lake View	25			25			0
		5	Medinova	140	2.79	131,128	140	2.79	131,128	1
		6	Eenadu	100			100			0
										0
13	PUBLIC GARDEN (City-I) 8MVAX2	1	Parshiram Bhavan	160	0.71	43,585	160	0.71	43,585	1
		2	Nampally OH	180	3.87	300,670	180	3.87	300,670	1
		3	Ravindra Bharathi	120			120			0
		4	Assembly	10			10			0
		5	Nampally							0
		6	LB Stadium							0
14	S.D. HOSPITAL 8MVAX2	1	Police Mess	75	5.55	74,860	75	5.55	74,860	1
		2	Crsent Hospital	85	6.84	118,503	85	6.84	118,503	1
		3	Hu May/03un Nagar	170	8.72	604,295	170	8.72	604,295	1
		4	Ahmednagar	140	9.17	430,983	140	9.17	430,983	1
		5	Chacha Nehru Nagar	55	5.35	38,807	55	5.35	38,807	1
		6	S.D.Hospital	10			10			0

Hyderabad South

Substation Name			Name of Feeder	Max Load (A)	Length (km)	Loss (kWh/year)	Max Load (A)	Length (km)	Loss (kWh/year)	Loss data No
1	ASMANGADH (City-VIII) 8MVAX2	1	SAIBABA	140	4.1	192,697	132.5	4.1	172,604	1
		2	KODANDARAM NGR	130	4.32	175,067	132.5	4.32	181,865	1
		3	VIDYUTH NGR	55	1.82	13,202	55	1.82	13,202	1
		4	SHANKESH BZR	120	5.25	181,283	132.5	5.25	221,017	1
		5	ASMANGADH	140	5.45	256,146	132.5	5.45	229,437	1
		6	TV STATION	10	0.84	201	10	0.84	201	1
										0
2	ATTAPUR (City-III) 8MVAX2	1	NM GUDA	140	6.27	294,685	152.5	6.27	349,657	1
		2	DEVIGAUGH	150	4.62	249,264	152.5	4.62	257,642	1
		3	BHADURPURA	200	9.8	939,984	152.5	9.8	546,513	1
		4	KISHAN BAUGH	120	3.26	112,568	152.5	3.26	181,799	1
										0
3	CHANCHALGUDA (City-VIII) 8MVAX3	1	CHANCHALGUDA	90	3.36	65,262	120	3.36	116,021	1
		2	ARAYA SAMAJ	150	3.9	210,417	120	3.9	134,667	1
		3	CHOWNI	180	2.35	182,578	120	2.35	81,146	1
		4	MADANNAPET	90	2.26	43,896	120	2.26	78,038	1
		5	SAIDABAD	90	3.59	69,729	120	3.59	123,963	1
		6	GOVT. PRESS							0
										0
4	ENT (City-IX) 8MVA 5MVA	1	TROOP BAZAR	55	1.56	11,316	55	1.56	11,316	1
		2	CENTRAL BANK OF INDIA	115	2.55	80,867	105	2.55	67,414	1
		3	RANGA MAHAL ROAD	45	1.47	7,138	45	1.47	7,138	1
		4	ENT HOSPITAL		0.07			0.07		0
		5	JAM BAGH	105	2.7	71,380	105	2.7	71,380	1
		6	GURUDWARA	95	2.54	54,969	105	2.54	67,150	1
										0

Hyderabad South

Substation Name			Name of Feeder	Max Load (A)	Length (km)	Loss (kWh/year)	Max Load (A)	Length (km)	Loss (kWh/year)	Loss data No
5	FALAKNUMA 8MVAX3	1	CRPF							0
		2	C'GUTTA	140	5.15	242,046	140	5.15	242,046	1
		3	BARKAS							0
		4	FALAKNAMA	80	3.64	55,862	80	3.64	55,862	1
		5	J'METT	100	6.41	153,707	140	6.41	301,265	1
		6	CHATRINAKA	180	5.6	435,078	140	5.6	263,196	1
										0
6	KARWAN 8MVAX2	1	ZIAGUDA	160	5.88	360,954	160	5.88	360,954	1
		2	KARWAN	170	5.12	354,815	170	5.12	354,815	1
		3	TALLAGADDA	170	5.52	382,535	170	5.52	382,535	1
		4	LANGER HOUSE	140	10.15	477,042	140	10.15	477,042	1
										0
7	KHILWATH (City-III) 8MVAX2	1	TELEPHONE EXCHANGE	80	5.81	89,164	80	5.81	89,164	1
		2	KHILWATH	150	4.31	232,538	172.5	4.31	307,532	1
		3	CHARMINAR	140	3.75	176,247	172.5	3.75	267,574	1
		4	MOGHALPURA	200	6.72	644,561	172.5	6.72	479,493	1
		5	LALDARWAZA	200	5.95	570,705	172.5	5.95	424,551	1
		6	IQ BAL-UD-DOULA							0
8	KANCHANBAGH 8MVAX2	1	OWASI HOSPITAL	20	0.35	336	20	0.35	336	1
		2	VINAY NGR	70	2.76	32,429	70	2.76	32,429	1
		3	IS SDAN	110	2.73	79,210	110	2.73	79,210	1
		4	DARGA	140			140			0
		5	RAKSHAPURAM	55			55			0
		6	KANCHAN BAUGH	5	1.57	94	5	1.57	94	1

Hyderabad South

Substation Name			Name of Feeder	Max Load (A)	Length (km)	Loss (kWh/year)	Max Load (A)	Length (km)	Loss (kWh/year)	Loss data No
9	MALAKPET 8MVAX3	1	DABEERPURA	160	1.41	86,555	156.7	1.41	83,022	1
		2	MALAKPET (EM)	150	4.76	256,817	156.7	4.76	280,272	1
		3	AKBERBAUGH	130	2.63	106,580	156.7	2.63	154,856	1
		4	AIR	10	1.32	317	10	1.32	317	1
		5	CHADERGHAT (EM)	170	3.92	271,655	156.7	3.92	230,812	1
		6	AZAMPURA	180	4.1	318,540	156.7	4.1	241,411	1
		7	MM HOSPITAL	10	2.96	710	10	2.96	710	1
		8	KACHIGUDA	150	4.13	222,827	156.7	4.13	243,177	1
										0
10	MIRALAM (City-III) 8MVAX3	1	ZOOPARK	180	8.89	690,687	166.7	8.89	592,390	1
		2	INDUSTRIAL	180	5.99	465,378	166.7	5.99	399,147	1
		3	TADBAN	170	6.83	473,318	166.7	6.83	455,120	1
		4	FATHE DARWAZA	140	3.85	180,947	166.7	3.85	256,547	1
		5	SHAMSHER GUNJ	190	6.44	557,478	166.7	6.44	429,133	1
		6	WATER WORKS (ETM) (M.F.B)	20	2.45	2,350	20	2.45	2,350	1
		7	JAHNUMA (EM)	140	4.69	220,426	166.7	4.69	312,520	1
										0
11	MOOSARAMBAGH (City-VIII) 8MVAX2	1	SBI COLONY	30	2.18	4,705	30	2.18	4,705	1
		2	SRIPURAM CLY	65	3.08	31,204	65	3.08	31,204	1
		3	SALEEM NGR	70	3.58	42,064	70	3.58	42,064	1
		4	SV NAGAR	70	2.83	33,252	70	2.83	33,252	1
		5	AB COLONY	130	5.5	222,887	130	5.5	222,887	1
		6	DILSUKH NGR	65	3.03	30,698	65	3.03	30,698	1
										0

Hyderabad South

Substation Name		Name of Feeder		Max Load (A)	Length (km)	Loss (kWh/year)	Max Load (A)	Length (km)	Loss (kWh/year)	Loss data No
12	OSMANIA HOSPITAL 8MVAX3	1	BEGUM BAZAR	140	3.19	149,927	133.3	3.19	135,921	1
		2	PURANA PHOOL	130	2.72	110,228	133.3	2.72	115,895	1
		3	HIGH COURT	20	2.49	2,388	20	2.49	2,388	1
		4	PUTHLI BOWLI	80	1.76	27,010	80	1.76	27,010	1
		5	GOWLIGUDA	10	1.18	283	10	1.18	283	1
		6	OSMAN GUNJ	130	3.08	124,816	133.3	3.08	131,234	1
		7	OSMANIA HOSPITAL	10			10			0
		8	GOWLIGUDA TEL EXCHA							0
										0
13	SALARJUNG 8MVAX3	1	SALARJUNG	60	1.96	16,920	60	1.96	16,920	1
		2	MADINA	180	5.43	421,871	158	5.43	325,049	1
		3	HUSSAINILALAM	130	5.67	229,776	158	5.67	339,415	1
		4	PATHARGATTI	180	3.68	285,909	158	3.68	220,291	1
		5	YAKUTPURA	190			190			0
		6	PURANIHAVELI	200	5.71	547,685	158	5.71	341,810	1
		7	DARULSHAFA	100	2.14	51,315	158	2.14	128,104	1
										0
14	SANTOSH NAGAR 8MVAX3	1	SANTOSH NAGAR	50	0.95	5,695	50	0.95	5,695	1
		2	REIN BAZAR	140	1.86	87,419	140	1.86	87,419	1
		3	DRYLAND	90	1.95	37,875	90	1.95	37,875	1
		4	BHAVANI NAGAR	170	5.76	399,167	170	5.76	399,167	1
		5	EDI BAZAR	210	5.2	549,891	210	5.2	549,891	1
		6	RIYASATH NAGAR	100	4.97	119,177	100	4.97	119,177	1
		7	MOINBAGH	110	6.62	192,078	110	6.62	192,078	1
										0

Hyderabad South

Substation Name		Name of Feeder		Max Load (A)	Length (km)	Loss (kWh/year)	Max Load (A)	Length (km)	Loss (kWh/year)	Loss data No
15	SEETARAMBAGH 8MVAX2,5MVA	1	SEETHARAMBAGH	90	2.12	41,177	125	2.12	79,431	1
		2	DHOOLPET	160	4.13	253,527	125	4.13	154,741	1
		3	ASIFNAGAR	70	2.49	29,257	70	2.49	29,257	1
		4	AGAPURA	70	1.7	19,975	70	1.7	19,975	1
		5	ZINCHICHOWRAHA	140	3.9	183,297	125	3.9	146,123	1
		6	DATTATREYA	110	6.93	201,073	125	6.93	259,650	1
										0
16	SULTAN BAZAR 8MVAX2	1	SULTAN BAZAR	165	3.48	227,186	171.3	3.48	244,866	1
		2	KOTI FEEDER	185	3.44	282,317	171.3	3.44	242,051	1
		3	KENDRIYA SADAN	140	2.91	136,768	171.3	2.91	204,759	1
		4	TARAKARAMA	195	4.24	386,151	171.3	4.235	297,991	1
		5	IMA UG		3.24			3.24		0
17	CRPF (City-III) 7.5MVAX2	1	JAMAL BANDA	80	1.37	21,025	80	1.37	21,025	1
		2	BARKAS	50	1.33	7,973	50	1.33	7,973	1
		3	SALAL	130	4.17	168,989	130	4.17	168,989	1
		4	CRPF BAZAR	36	4.2	13,052	36	4.2	13,052	1
		5	BALAPUR	125	7.88	295,244	125	7.88	295,244	1
		6	KESHAVAGIRI	145	4.8	241,998	145	4.8	241,998	1

Chapter 5 Physical Improvement of Distribution Network

Contents

Chapter 5 Physical Improvement of Distribution Network

5.1 General

The present status of distribution loss rate in Andhra Pradesh states in India is about 20%. This loss rate is a very high value in comparison with other countries. In order to reduce this value, Andhra Pradesh states need an improvement plan.

For grasping the existing status and identify problems, 3 model feeders are selected in 2 districts in Andhra Pradesh states. These feeders represent major categories, namely, domestic/commercial, industrial and agriculture, respectively. Loss kWh, voltage and current of these feeders are to be measured and collected for analyzing and evaluating present situation and making an improvement plan of the distribution network.

5.2 Current Situation of Distribution Loss

5.2.1 Current Situation of Power Loss

Main causes of power loss in distribution facilities are resistance loss in distribution lines and iron loss and copper loss in distribution transformers. This power loss in distribution facilities accounts for a sizable portion of all losses. In particular, cost of power in distribution line is higher in comparison with those in other transmitting facilities since distribution line is the last part of transmitting facilities from power station to customers. To reduce distribution power loss is one of the major problems of distribution network.

Change of loss rate in Japan is shown in Figure 5.1. In 1951 to 1960, loss rate was reduced drastically. Total Loss Rate = (1 – kWh at customer's end (Total of Light & Power) / kWh at end of power sending) * 100%

Up to the present, many strategic measures for reducing distribution loss have been taken in Japan. Some of main strategic measures are as follows.

- 1952 Introducing single phase three wire system in 100/200V distribution lines
- 1956 Starting to upgrade high voltage distribution lines to 3kV – 6kV
- 1957 Starting to use transformer in common for servicing light load and power load.
- 1960 Introducing winding-core type distribution transformer
- 1968 Introducing 22kV distribution line
- 1991 Introducing low loss type distribution transformer (amorphous metal)

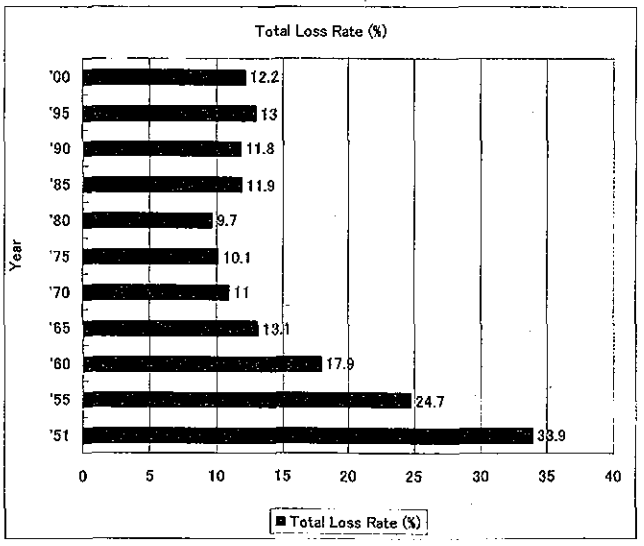


Figure 5.1 Total loss rate

Japan's distribution loss rate in 2002 was about 5%.

In 2000-01, the loss rate in APTRANSCO was 33.1% and the distribution loss rate was about 20%. And the distribution loss rate of Ranga Reddy South was 9.9% (2002-03) and that of Ranga Reddy North was 25.0% (2002-03).

Compared to Japan, there is room for further improvement in distribution loss.

5.2.2 Current Situation of Loss Control

After interviewing at APCPDCL, the study team found that loss measuring is not practiced periodically. It is made temporarily when some problems occurred concerning energy loss.

To grasp the amount of energy loss, APCPDCL calculates energy loss from difference between energy at the secondary side of outgoing of the feeder and amount of customers' sales energy. But energy loss of each of distribution facilities (11kV line, distribution transformer, low voltage line) is not calculated. They are needed for making improvement plan to reduce loss energy.

In Japan energy loss calculation is made periodically, once a year, using measured data from energy meter at outgoing of the feeder and measured data of consumption of each customer. Energy loss of each distribution facility (such as high voltage line, transformer and low voltage line) is calculated periodically, using various factors concerning energy loss (such as numbers of facilities and so on) proportionally. As the commercial loss in Japan is now almost nil, all the energy loss is regarded as technical loss.

5.3 Current Situation of Improvement of Distribution Network

5.3.1 Organization for Improvement of Distribution Network

APCPDCL makes basic plans for reducing energy loss, for example, a plan for introducing HVDS (High Voltage Distribution System) to introduce high voltage lines and reduce losses of low voltage facilities. These plans are executed by the respective Division offices.

In Japan, a major project covering whole area is conducted under the control of the head office. Improvement plan of each facility (substation, feeder, distribution line, etc.) is conducted by each branch office or service station. To make an improvement plan, efforts are made to develop an economical and effective plan by considering long term future demand. When any inevitable urgent construction work is required, it will be executed in the light of the long term plan.

5.3.2 Criteria for Network Formation

In making improvement plan of feeder, 11kV line, distribution transformer and low voltage line, APCPDCL uses criteria for network formation as shown in Annex 5.1.

5.3.3 Current Situation of Improvements and Future Plans

In APCPDCL, a project of installing small size transformers in agricultural districts is now in progress. This project also installs high voltage lines and shortens low voltage line length.

A project to replace defective meters with new meters is also in progress. It reduces energy loss rate by 5 to 10%.

In Japan, a plan for upgrading the size of high voltage lines is now under way to reduce energy loss. It applies only outgoing part of the feeder so that it has effects largely on the parts in which large amount of current flows.

5.4 Survey of Existing Facilities

5.4.1 Time Schedule of the Survey

Time Schedule of the Survey is as follows.

Table 5.1 Time schedule

		Fiscal Year 2002			Fiscal Year 2003											
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
Selecting model feeder																
Meter Procurement																
Meter Installation																
Loss measurment & data collction																
Survey of feeder Data																
Analisys (Loss calculation)																
Improvement plan																
Seminar			▲											▲		

5.4.2 Loss Measurements

(1) Selection of Model Feeder

The model feeders of 3 major categories were selected as follows.

Table 5.2 Feeder specification for measuring

Feeder specification for measuring

Category	Name of feeder	Name of substation (Division)	Number of DTR	Number of customer	Installing meter to pumpsets	
					Name of DTR	Number of pump sets
Domestic/commercial	Kamalanagar	Kothapet SS (Ranga Reddy)	39	3,650		
Industrial	Kattedan#2	Kattedan SS (Ranga Reddy)	78	529		
Agriculture	Malkapur	Malkapur SS (Medak)	15	743	Malkapur No. 6 (63kVA)	16

(2) Job for Each Staff

Job for each staff is shown in Table 5.3.

Because of the delay of meter installation, data analysis and evaluation were conducted by the study team in Japan. Explanation of methods of analysis and evaluation was made by the study team at the visit to APTRANSCO and APCPDCL.

(3) Counterpart

Counterparts are shown in Table 5.4.

(4) Installing Site for Measuring, Number of Measurement, Measuring Devices

Installing sites for measuring are outgoing part of the model feeder, secondary side of distribution transformer and customer's end. (See Figure 5.2)

Number of measurement is shown in Table 5.5.

Installing sites of volt meter are selected after discussing with counterparts. As it is preferable to select measuring sites where a large voltage drop occurs, the study team decided to install the meters at the longest end of low voltage line. They are shown in Table 5.6.

Measuring devices are as follows.

- Electronic meter (Including logging function) : Outgoing part of feeder, secondary side of distribution transformer, volt meter at customer's end
- Electro-magnetic meter : Pump set, customer's end (Using existing meter)

(5) Measuring Item

Measuring items are as follows.

- Outgoing part of feeder (kWh, maximum kW, power factor , voltage, current)
- Secondary side of distribution transformer(kWh, maximum kW, power factor, voltage, current)
- Customer's end (site of volt meter) (voltage etc.)
- Customer's end (kWh)
- Customer's end (pump set) (kWh)

(6) Data Collection

Data collection was scheduled to be conducted every month from May to June. It was expected that the peak demand in this year would be measured. But because of the delay of meter installation, the study team were forced to measure for only one month, from the end of July to the end of August.

The study team brought back measured data to Japan during the third survey at Hyderabad. But that was measured data for only one week and the rest of the data were sent to the study team via E-mail or other means by the respective counterparts in India.

After collecting these data, the study team found that there were still missing data or insufficient data. At the 4th visit, additional measurement and confirmation of missing data were conducted.

(7) Collection Format

Collection format and results are shown in Annex 5.2.

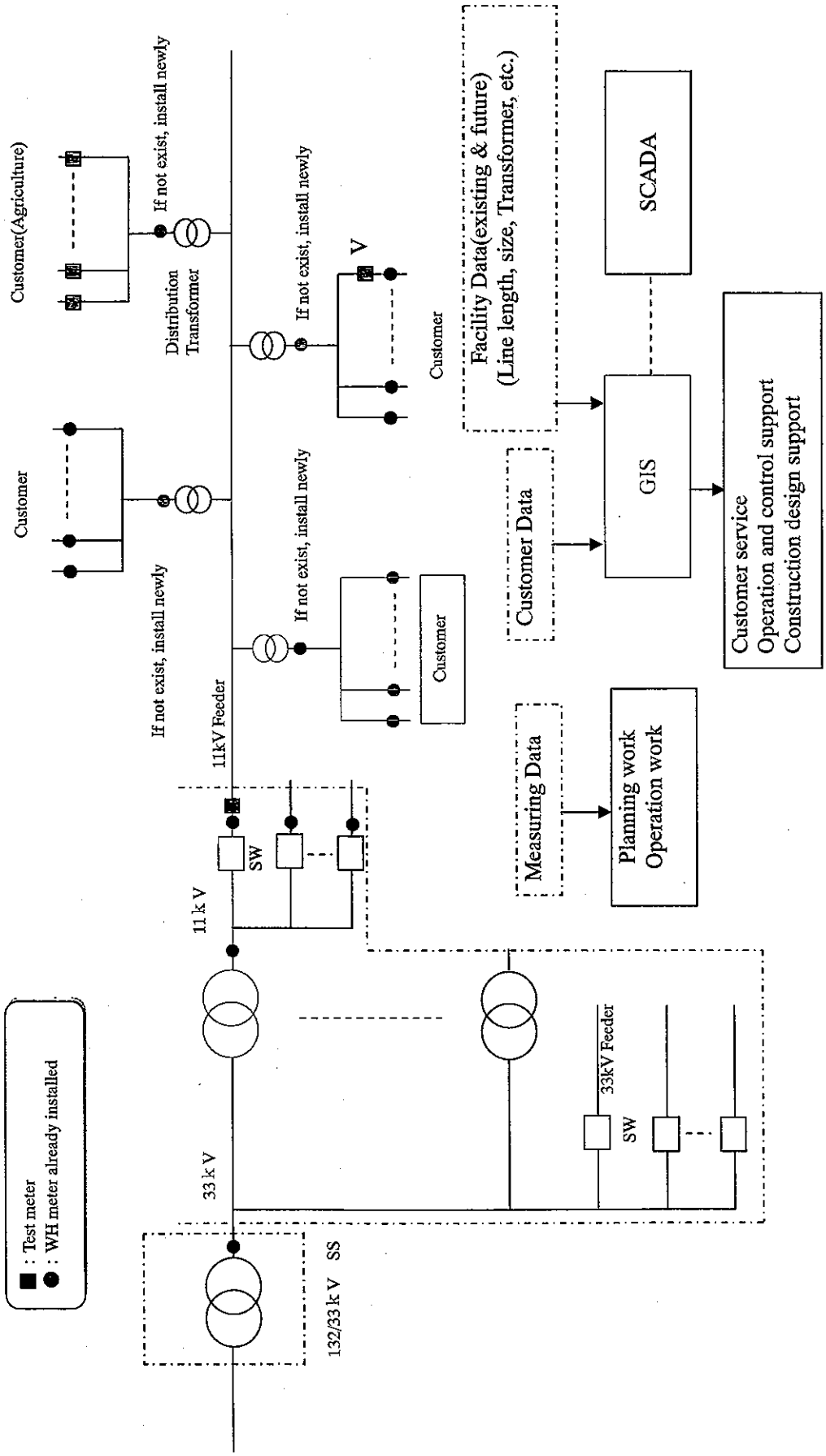


Figure 5.2 Installation site of meters for measuring

Table 5.3 Job for staff of improvement group

		Study team	Counterpart 1 (Ranga Reddy) (domestic/commercial)	Counterpart 2 (Ranga Reddy) (industrial)	Counterpart 3 (Medak) (agriculture)	Agency	Period
Meter installation	D/C					○	from Feb. to First of Mar.
	I					○	
	A					○	
Inspection for meter	D/C	△	○				from Feb. to First of Mar.
	I			○			
	A				○		
Measuring (Sheet No. 1)	D/C	△	○				from Mar. to Jun.(collecting and downloading every month)
	I			○			
	A				○		
Survey for feeder specification (Sheet No. 2)	D/C	△	○				from Feb. to end of Mar.
	I			○			
	A				○		
Survey for existing standard (Sheet No. 3)			○				from Feb. to end of Mar.
Survey for existing facilities specification (Sheet No. 4)				○			from Feb. to end of Mar.
Survey for construction Cost (Sheet No. 5)					○		from Feb. to end of Mar.
Survey for power demand (Sheet No. 6 & 7)			○ Ranga Reddy	○ Ranga Reddy	○ Medak		from Feb. to end of Mar.
Survey for loss kWh (Sheet No. 8)			○ Ranga Reddy	○ Ranga Reddy	○ Medak		from Feb. to end of Mar.

D/C : Domestic/Commercial
I : Industrial
A : Agriculture

○ : Main job
△ : Sub job

Table 5.4 Counterpart for physical improvement group

No	Group	District	Position	Name
1	1 (Mixed)	Ranga Reddy(South)	Divisional Engineer/OP/Saroornagar	Sri Raghuma Reddy
2		ditto	Assit. Divisional Engineer/OP/Saroonnagar	Sri Chittaranjan
3	2 (Industrial)	ditto	Divisional Engineer/OP/	Er. Y. Markandaiah
4		ditto	Assit. Divisional Engineer/OP/G.Pahad	N. L. Prabhakar
5	3 (Agricultural)	Medak	AE/Comm.	Bagaiah
6		ditto	Addi. Assit. Engineer/OP/Condapur	Syod Masood
7		ditto	DE/Meter	Venkalaiah
8		ditto	Addi. Assit. Engineer/LT-CT Meters	Mohd Gousuddin

Table 5.5 Number of measuring meters

Number of attaching meters for measurment

Substation	Feeder	Category	Meter at mouth of feeder	Meter at DTR	Volt meter at Customer	Meter at pump set
Kothapet	Kamalanagar	Domestic/Commercial	0	44	3	0
Kattedan	Kattedan#2	Industrial	0	66	0	0
Malkapur	Malkapur	Agriculture	1	15	1	16
Total			1	125	4	16

Number of measuring meters

Substation	Feeder	Category	Meter at mouth of feeder	Meter at DTR	Volt meter at Customer	Meter at pump set	kWh meter at customer
Kothapet	Kamalanagar	Domestic/Commercial	1	44	3	0	3,650
Kattedan	Kattedan#2	Industrial	1	78	8	0	465
Malkapur	Malkapur	Agriculture	1	15	1	16	842
Total			3	137	12	16	4,957

Table 5.6 Site of meter installation

Installation site of voltmeter

Kamalanagar

NO	Name of customer	Category	Customer No.	Name of pole	Name of transfomer
1	K. Ramulu	Domestic	1163-1390	A5/2	Sarada Nagar Kata TN23 (315 kVA)
2	Vijetra Shelters	Domestic	New	B/3/4	Grave yard-II TN14 (315 kVA)
3	Sanscrit Collage(Pamineeya)	Domestic	1172-957	B/B/3/2	Grave yard-I TN11 (250 kVA)

Kattedan #2

NO	Name of customer	Category	Customer No.	Name of pole	Name of transfomer
1		Industrial	3355	242	80 (100 kVA) 74HP
2		Industrial	1423	200	67 (100 kVA) 70HP
3	M/S Maheshwari Oil	Industrial	398	128	66 350 kVA
4		Industrial	1221	127	55 (100 kVA) 70HP
5		Industrial	864	116	53 (100 kVA) 60HP
6		Industrial	1315	86	38 (100 kVA) 74HP
7		Industrial	438	68	26 (100 kVA) 70HP
8		Industrial	1426	45	13 (100 kVA) 50HP

Malkapur

NO	Name of customer	Category	Customer No.	Name of pole	Name of transfomer
1	Indera Parwathi (5HP*3P)	Agriculture	614		DTR SS VII 63 kVA

5.4.3 Survey of Technical Features of Feeders

Along with loss measurement, collection of feeder specifications (size of conductor, length of lines etc.) was conducted. They are as follows.

(1) Feeder Specification of Each Facility

Format and result of feeder specification of each facility are as follows.

Table 5.7 Specification of 11kV line

Surveying Item Name of substation Malkapur Name of feeder : Malkapur Sheet No 2-1
11kV Line (Span by Span)

From	To	Type of conductor	Phase	Size of conductor	Length	Transformer	End Mark
SS	1	A1	3	55mm2	65		
1	2	A1	3	55mm2	61.6		
2	3	A1	3	55mm2	61		
3	4	A1	3	55mm2	49		
4	5	A1	3	55mm2	50		
5	6	A1	3	55mm2	42		
6	7	A1	3	55mm2	74		
7	8	A1	3	55mm2	61		
8	SS IV	A1	3	55mm2	61		End
8	9	A1	3	55mm2	70		
9	10	A1	3	55mm2	53		
10	11	A1	3	55mm2	76		
11	12	A1	3	55mm2	71 5		
12	13	A1	3	55mm2	72		
13	14	A1	3	55mm2	52		
14	15	A1	3	55mm2	51		
15	16	A1	3	55mm2	52		
16	17	A1	3	55mm2	60		
17	18	A1	3	55mm2	49		
18	19	A1	3	55mm2	65		
19	20	A1	3	55mm2	63		
20	21	A1	3	55mm2	62		
21	22	A1	3	55mm2	62		
22	23	A1	3	55mm2	62		
23	24	A1	3	55mm2	73		
24	25	A1	3	55mm2	52		
25	SS XIII	A1	3	55mm2	55		End
22	26	A1	3	55mm2	63		
26	27	A1	3	55mm2	62		
27	28	A1	3	55mm2	66		
28	29	A1	3	55mm2	63		
29	30	A1	3	55mm2	56		
30	31	A1	3	55mm2	53		
31	32	A1	3	55mm2	66		
32	33	A1	3	55mm2	64		
33	34	A1	3	55mm2	50		End
SS XII	35	A1	3	55mm2	27		
35	36	A1	3	55mm2	48		
36	37	A1	3	55mm2	30		
37	38	A1	3	55mm2	50		
38	39	A1	3	55mm2	40		
39	40	A1	3	55mm2	50		
40	41	A1	3	55mm2	34		
41	42	A1	3	55mm2	47		
42	43	A1	3	55mm2	63		
43	44	A1	3	55mm2	50		
44	45	A1	3	55mm2	41		
45	46	A1	3	55mm2	26		
46	47	A1	3	55mm2	50		
47	48	A1	3	55mm2	52		
48	49	A1	3	55mm2	31		
49	50	A1	3	55mm2	44		
50	SS II	A1	3	55mm2	62		End
47	51	A1	3	55mm2	41		
51	52	A1	3	55mm2	25		
52	53	A1	3	55mm2	53		
53	54	A1	3	55mm2	51		
54	55	A1	3	55mm2	41		
55	56	A1	3	55mm2	25		

Table 5.8 Specification of transformer (DTR)

Surveying Item Name of substation : Malkapur Name of feeder : Malkapur Sheet No 2-2

Transformer :

Name of pole	Phase	Category	kVA	tap	date of manufacture	date of attachment	Nominal iron loss(W)	Nominal copper loss(W)
100 kVA SS I Near Eswar Temple	3	Agricultural	100 kVA	11000/415			70	150
Transformer								
100 kVA SS II Village	3/1.	AGL / Dom/Comml	100 kVA	11000/415			70	150
Transformer								
100 kVA SS IV Bujangareddy	3	Agricultural	100 kVA	11000/415			70	150
Transformer :								
63 kVA SS V Tungamadugu	3	Agricultural	63 kVA					
Transformer :								
100 kVA SS VI Vital Panthulu	3	Agricultural	100 kVA	11000/415			70	150
Transformer :								
63 kVA SS V Pipe line Road	3	Agricultural	63 kVA					
Transformer :								
100 kVA SS VIII Near Chenna Reddy Knachela	3	Agricultural	100 kVA	11000/415			70	150
Transformer :								
63 kVA SS IX Chenna Reddy	3	Agricultural	63 kVA					
Transformer :								
100 kVA SS XII Village	3/1.	AGL / Domestic	100 kVA	11000/415			70	150
Transformer :								
3 x 15 kVA SS XIII Near Pinugulakunta	3	Agricultural	3 x 15 kVA					
Transformer :								
100 kVA SS XIV Near Eswar Temple	3	Agricultural	100 kVA	11000/415			70	150
Transformer :								
63 kVA SS I Near Garalavagu	3	Agricultural	63 kVA	11000/415				
Transformer :								
100 kVA SS Togarpally	3	Agricultural	100 kVA				70	150
Transformer :								
63 kVA SS IV Near Eswar Temple	3	Agricultural	63 kVA					
Transformer :								
100 kVA SS XIII Togarpally	3	Agricultural	63 kVA				70	150

Table 5.9 Specification of low voltage line

Surveying Item Name of substation : Malkapur Name of feeder : Malkapur Sheet No 2-2
LV line

Name of pole	To	Length	EndMark	Phase	No.of conductor	Common line No. 1		Common line No. 2		Power line		Nutral line	
						Type of conductor	Size of conductor	Type of conductor	Size of conductor	Type of conductor	Size of conductor	Type of conductor	Size of conductor
SS 1	1	5		3	3	Al	34mm2	Al	34mm2	Al	34mm2		
1	2	70	End	3	3	Al	34mm2	Al	34mm2	Al	34mm2		
SS 1	3	70	70	3	3	Al	34mm2	Al	34mm2	Al	34mm2		
3	4	70		3	3	Al	34mm2	Al	34mm2	Al	34mm2		
4	5	70		3	3	Al	34mm2	Al	34mm2	Al	34mm2		
5	6	70	End	3	3	Al	34mm2	Al	34mm2	Al	34mm2		
5	7	70		3	3	Al	34mm2	Al	34mm2	Al	34mm2		
7	8	70		3	3	Al	34mm2	Al	34mm2	Al	34mm2		
8	9	70		3	3	Al	34mm2	Al	34mm2	Al	34mm2		
9	10	70		3	3	Al	34mm2	Al	34mm2	Al	34mm2		
10	11	70	End	3	3	Al	34mm2	Al	34mm2	Al	34mm2		
SS1	12	70		3	3	Al	34mm2	Al	34mm2	Al	34mm2		
12	13	70		3	3	Al	34mm2	Al	34mm2	Al	34mm2		
13	14	70		3	3	Al	34mm2	Al	34mm2	Al	34mm2		
15	39	70	End	3	3	Al	34mm2	Al	34mm2	Al	34mm2		
15	40	70		3	3	Al	34mm2	Al	34mm2	Al	34mm2		
40	41	70	End	3	3	Al	34mm2	Al	34mm2	Al	34mm2		
15	16	70		3	3	Al	34mm2	Al	34mm2	Al	34mm2		
16	17	70		3	3	Al	34mm2	Al	34mm2	Al	34mm2		
17	37	70	End	3	3	Al	34mm2	Al	34mm2	Al	34mm2		
17	18	70		3	3	Al	34mm2	Al	34mm2	Al	34mm2		
18	19	70		3	3	Al	34mm2	Al	34mm2	Al	34mm2		
19	20	70		3	3	Al	34mm2	Al	34mm2	Al	34mm2		
20	21	70		3	3	Al	34mm2	Al	34mm2	Al	34mm2		
21	22	70		3	3	Al	34mm2	Al	34mm2	Al	34mm2		
22	23	70		3	3	Al	34mm2	Al	34mm2	Al	34mm2		
23	24	70		3	3	Al	34mm2	Al	34mm2	Al	34mm2		
24	33	70		3	3	Al	34mm2	Al	34mm2	Al	34mm2		
33	34	70		3	3	Al	34mm2	Al	34mm2	Al	34mm2		
34	35	70		3	3	Al	34mm2	Al	34mm2	Al	34mm2		
35	36	70	End	3	3	Al	34mm2	Al	34mm2	Al	34mm2		
24	25	70		3	3	Al	34mm2	Al	34mm2	Al	34mm2		
25	26	70		3	3	Al	34mm2	Al	34mm2	Al	34mm2		
26	27	70		3	3	Al	34mm2	Al	34mm2	Al	34mm2		
27	30	70		3	3	Al	34mm2	Al	34mm2	Al	34mm2		
30	31	70		3	3	Al	34mm2	Al	34mm2	Al	34mm2		
31	32	70	End	3	3	Al	34mm2	Al	34mm2	Al	34mm2		
27	28	70		3	3	Al	34mm2	Al	34mm2	Al	34mm2		
28	39	70	End	3	3	Al	34mm2	Al	34mm2	Al	34mm2		
SS V	1			3	3	Al	34mm2	Al	34mm2	Al	34mm2		
1	2	70	End	3	3	Al	34mm2	Al	34mm2	Al	34mm2		
1	3	70		3	3	Al	34mm2	Al	34mm2	Al	34mm2		
3	4	70		3	3	Al	34mm2	Al	34mm2	Al	34mm2		
4	5	70	End	3	3	Al	34mm2	Al	34mm2	Al	34mm2		
4	6	70		3	3	Al	34mm2	Al	34mm2	Al	34mm2		
6	7	70		3	3	Al	34mm2	Al	34mm2	Al	34mm2		
7	8	70	End	3	3	Al	34mm2	Al	34mm2	Al	34mm2		
7	9	70		3	3	Al	34mm2	Al	34mm2	Al	34mm2		
9	10	60		3	3	Al	34mm2	Al	34mm2	Al	34mm2		

Table 5.10 Specification of service wire, meter

Surveying Item LV line | Name of SS Malkapur | Name of Feeder Malkapur | Sheet No 2-4

Name of pole	Service wire						Customer	WHM		
	Type of conductor	Phase	No of conductor	Kind of conductor	Size of conductor	Length	Numbers	Date of manufacture	Date of attachment	Maker
SS I NEAR ESWAR TEMPLE 100 kVA										
2 SS1	Al	3	3	AL	14mm2	10	341			
4 SS1	Al	3	3	AL	14mm2	15	49			
6 SS1	Al	3	3	AL	14mm2	24	NEW			
9 SS1	Al	3	3	AL	14mm2	27	173			
11 SS1	Al	3	3	AL	14mm2	21	160			
14 SS1	Al	3	3	AL	14mm2	28	450			
15 SS1	Al	3	3	AL	14mm2	30	348			
39 SS1	Al	3	3	AL	14mm2	25	483			
38 SS1	Al	3	3	AL	14mm2	27	456			
37 SS1	Al	3	3	AL	14mm2	30	538			
17 SS1	Al	3	3	AL	14mm2	31	453			
22 SS1	Al	3	3	AL	14mm2	22 5	466			
36 SS1	Al	3	3	AL	14mm2	27.1	848			
32 SS1	Al	3	3	AL	14mm2	28 1	848*			
41 SS1	Al	3	3	AL	14mm2	23	273			
SS IV BHUJNGAREDDY TRANSFORMER 100 kVA										
3SS IV	Al	3	3	AL	14mm2	25	171			
8SS IV	Al	3	3	AL	14mm2	28	860			
9SS IV	Al	3	3	AL	14mm2	29	404			
5SS IV	Al	3	3	AL	14mm2	26	197			
10 SS IV	Al	3	3	AL	14mm2	27	850			
11 SS IV	Al	3	3	AL	14mm2	30	417			
14 SS IV	Al	3	3	AL	14mm2	29	412			
14 SS IV	Al	3	3	AL	14mm2	32	455			
16 SS IV	Al	3	3	AL	14mm2	31	187			
19 SS IV	Al	3	3	AL	14mm2	29	156			
17 SS IV	Al	3	3	AL	14mm2	28	228			
21 SS IV	Al	3	3	AL	14mm2	23	847			
22 SS IV	Al	3	3	AL	14mm2	26	37			
29 SS IV	Al	3	3	AL	14mm2	31	479			
24 SS IV	Al	3	3	AL	14mm2	29	175			
30 SS IV	Al	3	3	AL	14mm2	25	20			
31 SS IV	Al	3	3	AL	14mm2	29	481			
31 SS IV	Al	3	3	AL	14mm2	26	512			
34 SS IV	Al	3	3	AL	14mm2	31	228			
40 SS IV	Al	3	3	AL	14mm2	21	50			
41 SS IV	Al	3	3	AL	14mm2	26	422			
43 SS IV	Al	3	3	AL	14mm2	32	120			
44 SS IV	Al	3	3	AL	14mm2	30	195			
45 SS IV	Al	3	3	AL	14mm2	27	120			
46 SS IV	Al	3	3	AL	14mm2	23 2	608			
50 SS IV	Al	3	3	AL	14mm2	28	373			
51 SS IV	Al	3	3	AL	14mm2	20 5	344			
53 SS IV	Al	3	3	AL	14mm2	25	352			
54 SS IV	Al	3	3	AL	14mm2	29	440			
56 SS IV	Al	3	3	AL	14mm2	26	230			
SS V THUNGAMADUGU TRANSFORMER 63 kVA										
1 SS V	Al	3	3	AL	14mm2	21	472			
1 SS V	Al	3	3	AL	14mm2	21	227			
2 SS V	Al	3	3	AL	14mm2	28	424			
3 SS V	Al	3	3	AL	14mm2	30	121			
5 SS V	Al	3	3	AL	14mm2	25	42			
8 SS V	Al	3	3	AL	14mm2	27	420			
10 SS V	Al	3	3	AL	14mm2	30	865			
12 SS V	Al	3	3	AL	14mm2	31	513			
13 SS V	Al	3	3	AL	14mm2	22 5	265			
24 SS V	Al	3	3	AL	14mm2	27	421			
17 SS V	Al	3	3	AL	14mm2	23.2	480			
18 SS V	Al	3	3	AL	14mm2	28	639			
22 SS V	Al	3	3	AL	14mm2	20 5	467			

(2) Specifications of Distribution Facilities

Specifications of distribution facilities are as follows.

Table 5.11 Specification of distribution facilities

Specification of distribution facilities Sheet No. 4

Transformer

kVA	Phase	Copper loss (W)	Iron loss (W)	Nominal voltage	Nominal current
63	3	1,235	180	433	84
100	3	1,760	260	433	134
160	3	2,000	400	433	213
250	3	3,500	550	433	333
315	3	3,500	650	433	420
15	single	314	82	433	35

11 kV line

Size	Material	Impedance(Ω /km)	Resistance(Ω /km)	Reactance(Ω /km)	Max allowable current
55mm3	AAA1	0.6528	0.5560	0.3420	234

$impedance(\Omega/km) = equivalent\ resis\tan ce(\Omega/km) = R\cdot\cos\theta + X\cdot\sin\theta \qquad \cos\theta = 0.85$

Low voltage line

Size	Material	Impedance(Ω /km)	Resistance(Ω /km)	Reactance(Ω /km)	Max allowable current
34mm2	AAA1	0.9862	0.9352	0.3630	175

$impedance(\Omega/km) = equivalent\ resis\tan ce(\Omega/km) = R\cdot\cos\theta + X\cdot\sin\theta$

Service wire

Size	Material	Impedance(/km)	Resistance(Ω /km)	Reactance(Ω /km)	Max allowable current
14mm2	ACSR	2.3452	2.5216	0.3830	88

$impedance(\Omega/km) = equivalent\ resis\tan ce(\Omega/km) = R\cdot\cos\theta + X\cdot\sin\theta$

Meter

AMP	Phase	Type	kW (internal consumption)	Max allowable current
	single/3	electro-magnetic	1 Watt	20
	3phse/3		3 Watts	40

5.4.4 Survey of Load Conditions

Results of past demand of the 3 model feeders are as follows.

Table 5.12 Result of feeder kWh

Feeder data
33/11kV Substation (Kothapet) Name of feeder : 11kV Kamalanagar Sheet No. 6

Fiscal year	Item	Apr.	May.	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Total
2000	kWh	40,511	40,820	40,455	39,652	38,046	28,743	29,536	30,446	32,864	32,964	35,860	32,770	422,667
	Max amp	110	105	100	95	105	105	110	105	110	90	95	100	110
	Ave. kW													
	PF(%)													
2001	kWh	34,500	33,470	30,560	29,950	28,670	31,725	30,990	29,960	30,662	30,975	32,671	33,625	377,758
	Max. amp	100	90	110	100	105	95	100	90	100	90	95	100	110
	Ave. kW													
	PF(%)													
2002	kWh	27,072	36,839	40,638	38,252	36,630	35,770	37,431	36,024	35,901	33,968	34,433	40,494	433,452
	Max amp	100	95	105	110	100	110	95	95	100	110	100	110	110
	Ave kW													
	PF(%)													

Feeder data
33/11kV Substation (Kattedan) Name of feeder : 11kV Kattedan II Sheet No 6

Fiscal year	Item	Apr.	May.	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Total
2000	kWh				1,120,720	1,099,000	1,106,720	1,140,240	1,404,600					5,871,280
	Max amp				180	160	160	160	180					180
	Min. amp				40	20	40	40	40					20
	PF(%)													
2001	kWh										1,778,040	1,178,280	930,160	3,886,480
	Max. amp										220	220	140	220
	Min. amp										60	30	20	20
	PF(%)													
2002	kWh	1,017,440	1,094,080	1,017,840	1,017,560	1,024,720	1,020,160	1,121,520	1,137,360	1,135,060	1,438,140	1,221,820	1,196,240	13,441,940
	Max. amp	130	140	150	160	160	160	180	180	160	170	160	160	180
	Min. amp	40	30	40	40	40	60	30	60	40	40	40	40	30
	PF(%)													
2003	kWh	1,221,360	1,226,700	1,125,980	1,210,320									4,784,360
	Max. amp	170	170	160	160									170
	Min. amp	40	40	40	40									40
	PF(%)													

33/11kV Substation (Malkapur) Name of feeder : Malkapur

(B1 - Monthly Consumption Domestic , Commercial and Industrial Customers Excluding Un Metered Agricultural Customers of 11 kV Malkapur Feeder) at customers end

Fiscal year	Item	Apr.	May.	Jun.	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Total
2000	kWh		21,655		20,964		24,577		30,042		24,516		27,124	148,878
	Max. kW													
	Ave kW													
	PF(%)													
2001	kWh		26,256		27,892		28,816		25,335		26,565		29,489	164,353
	Max kW													
	Ave. kW													
	PF(%)													
2002	kWh		41,404		46,543		52,635	33,249		33,242		29,630		236,703
	Max. kW													
	Ave. kW													
	PF(%)													
2003	kWh	36,765		35,924										72,689
	Max kW													
	Ave. kW													
	PF(%)													

5.4.5 Analysis and Evaluation

After installing measuring meters, in the third and fourth field surveys measuring was conducted for one month between the end of July and the end of August. Moreover, additional measuring of missing data and confirmation of uncertain data were conducted. All the data collecting work was completed by counterpart's help.

Using these measured data analysis and evaluation of the data were conducted for following items:

- load curve
- distribution energy loss
- voltage drop at customer's end

And also, using collected data (measured data, Specifications of feeder, results of past demand etc.), analysis and evaluation were conducted for the following items:

- technical energy loss
- voltage drop
- over current

The distribution facilities that exceed the allowable range of voltage drop or current need improvement. An improvement plan of these facilities will be explained in Clause 5.5 of this Chapter.

(1) Load Curve

Figures 5.3 – 5.10 show load curves of kW or current of each model feeder.

Compared to Japanese load curves, differences between peak load and off peak load are smaller than Japanese ones, and values of kW or current do not vary much over 24 hours are almost the same. This is very effective in utilization of electricity, but this also means energy loss would be larger as total load time in one day is larger than Japan.

Kamalanagar (Domestic/Commercial)
kW (2003/8/25 Monday)

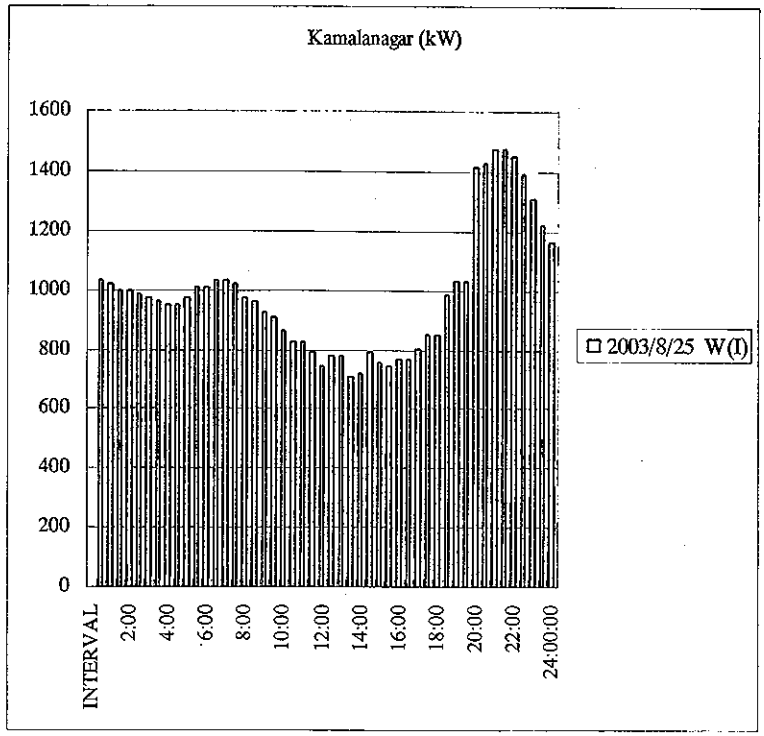
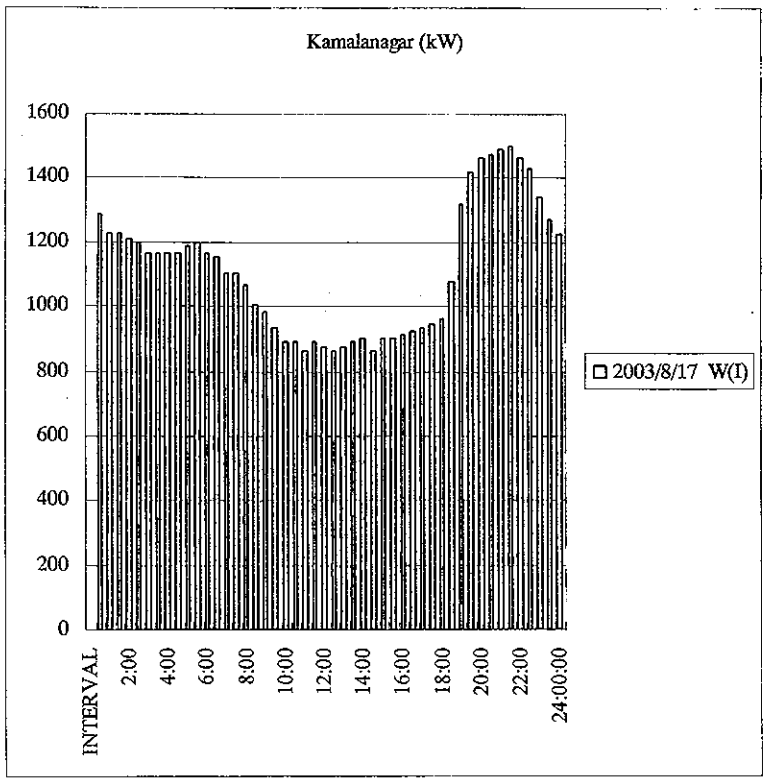


Figure 5.3 Load curve (Domestic/Commercial) (2003/8/25 Monday)

kW (2003/8/17 Sunday)



Characteristics
- Amount of load is larger in Sunday as the feeder provides power to domestic and commercial customers.
-The peak is at night.
-The difference between peak load and off peak load is smaller than Japan.

Figure 5.4 Load curve (Domestic/Commercial) (2003/8/17 Sunday)

Domestic Load (Sample in Japan)

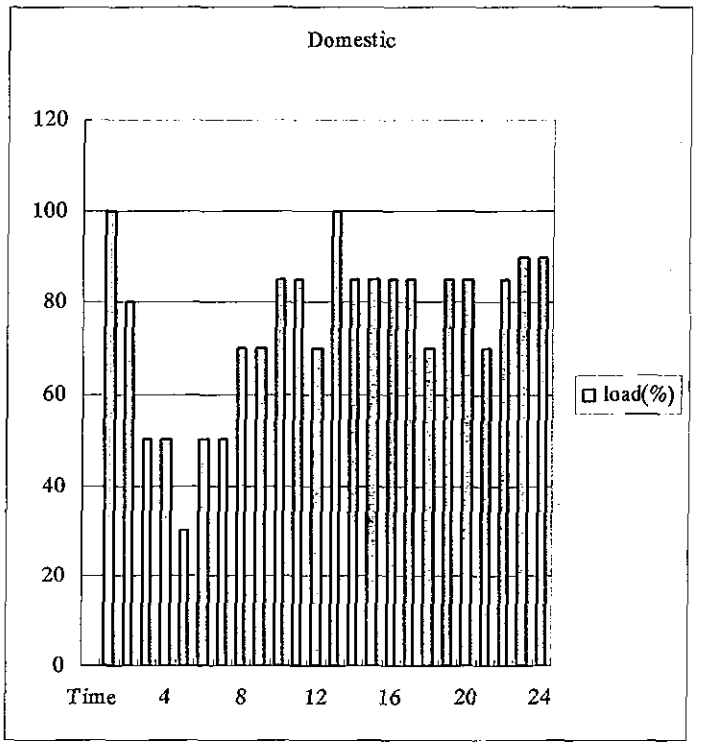


Figure 5.5 Load curve (Domestic/Commercial) (Sample in Japan)

Kattedan #2 (Industrial)
kW(2003/8/29 Friday)

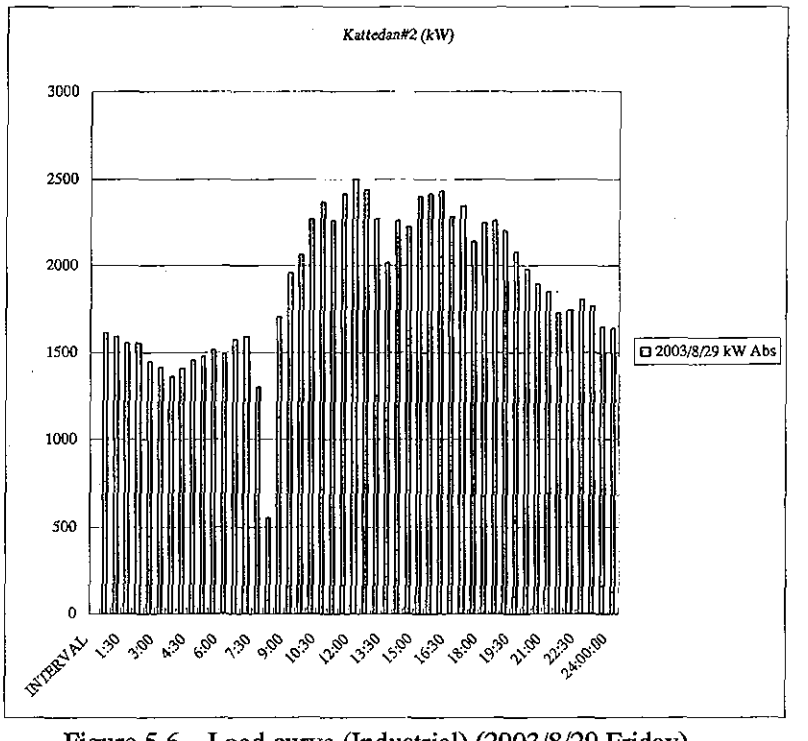
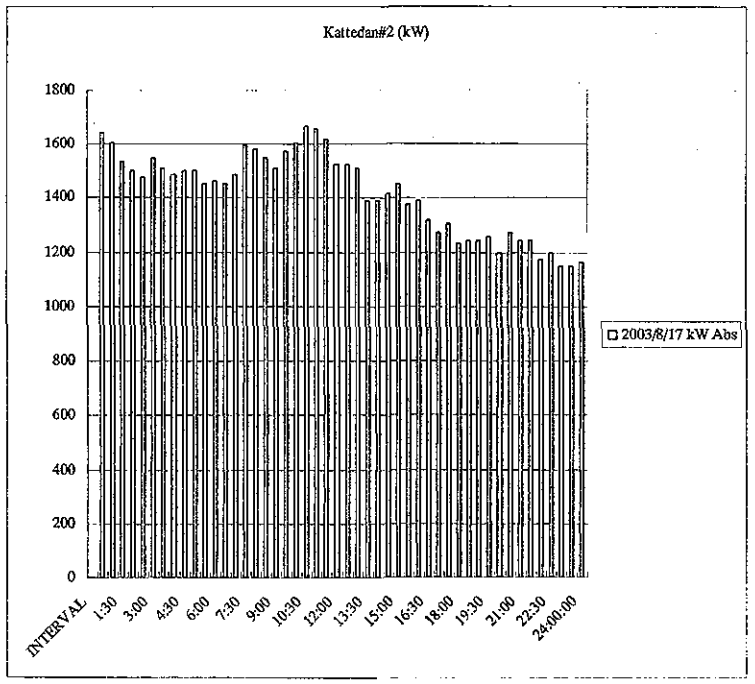


Figure 5.6 Load curve (Industrial) (2003/8/29 Friday)

kW(2003/8/7 Sunday)



Characteristics
- The amount of load hardly changes even on Sunday.
- The amount of load hardly changes even at night.

Figure 5.7 Load curve (Industrial) (2003/8/7 Sunday)

Industrial Load (Sample in Japan)

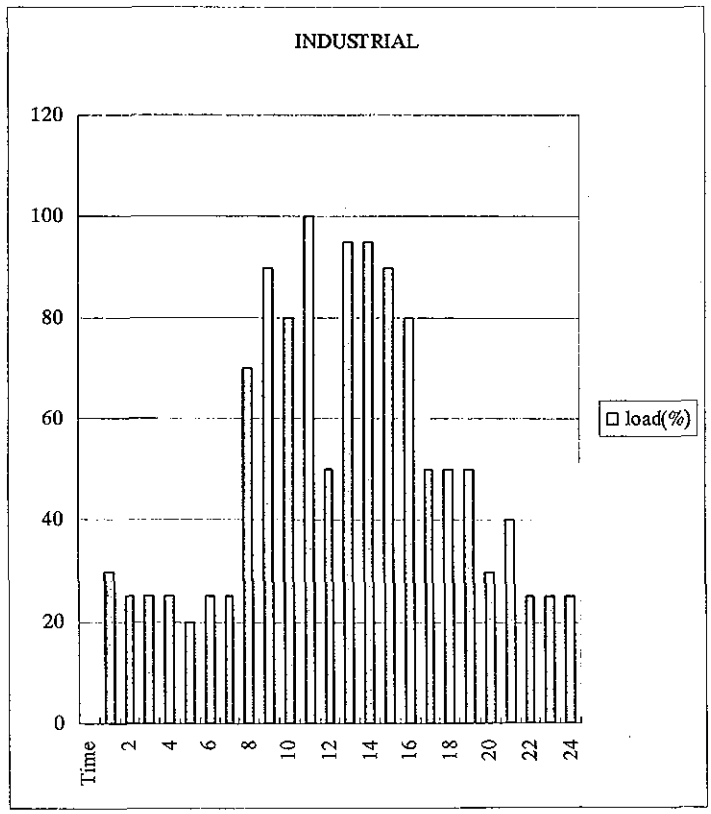


Figure 5.8 Load curve (Industrial) (Sample in Japan)

Malkapur (Agriculture)
Amp(2003/9/8 Monday)

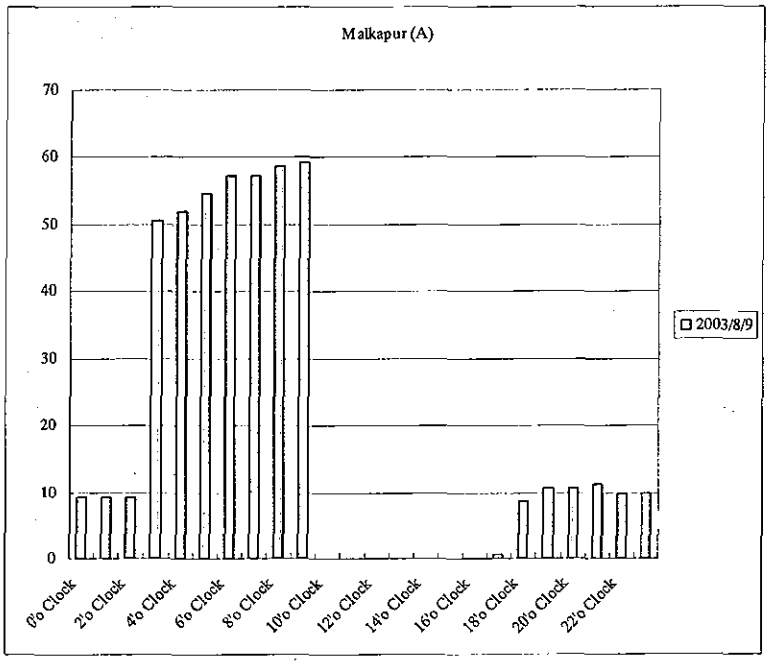
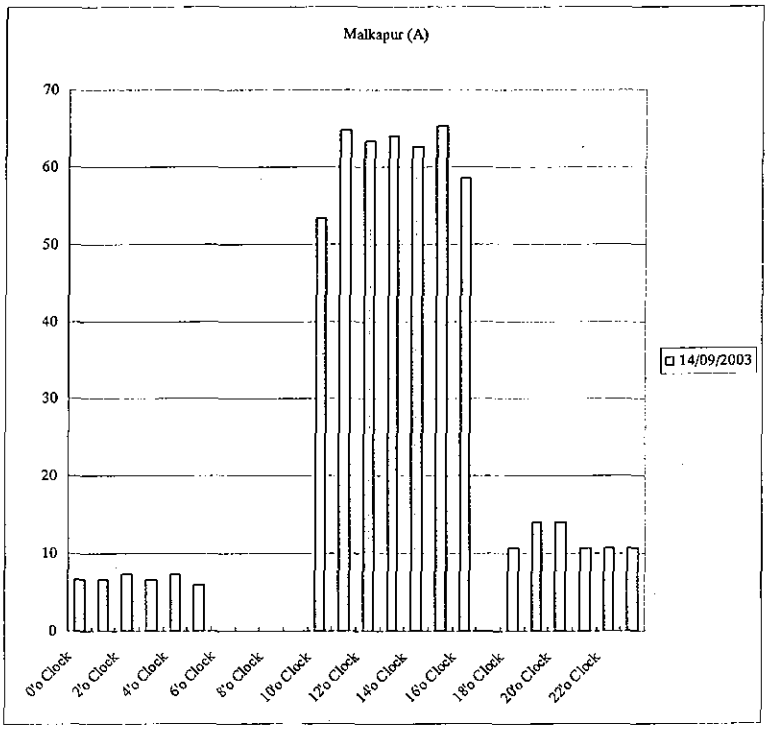


Figure 5.9 Load curve (Agriculture) (2003/9/8 Monday)

Amp (2003/9/14 Sunday)



Characteristics
- The feeder services only 11 hours in the night time and 7 hours for pump set customers.
(Servicing time for pump set varies each week)

Figure 5.10 Load curve (Agriculture) (2003/9/14 Sunday)

(2) Distribution Energy Loss

Tables 5.13 – 5.15 show measurement results.

As measurement could not be made at the outgoing of the feeder, distribution transformer and customer's end meter for the same time period, energy loss rates could not be calculated on a unified basis.

While the average of total distribution energy loss rate is about 20%, the total loss from the outgoing of the substation to the customer's meter amounted to 3.3 to 24.4% in the measurement of this time.

Causes of this result are as follows:

- The measuring interval was short (1 month).
- Measuring of loads of all distribution transformers could not be made.
- There was some omission in reading of customers' meters.

In short, the results of measurement were not very accurate.

The study team can expect much improvement in loss measurement by conducting measurement continuously throughout the year without omission.

Excluding kWh data, other data (current, kW etc.) were used fully for grasping present status of load on subsequent distribution transformer and calculating technical loss, load factor, etc.

Table 5.15 shows measuring results of energy loss at pump set transformers. On the basis of the results for seven days, the loss was about 5 % and this value is comparable to the line loss, indicating that there is no stealing of electricity on this low voltage line network.

Table 5.13 Measuring result (Energy loss) (Kamalanagar feeder)

(Substation - DTR)

	Outgoing of the feeder (a)	Secondary side of DTR (Total) (b)	Loss kWh (Substation – DTR) (a-b)	Rate of loss kWh ((a-b)/a)
Value of measuring kWh	193,110	169,399	23,711	12.3%
Measuring period	8/11 – 8/4	8/11 – 8/4	------	------

(DTR - Customer)

	Secondary side of DTR (Total) (c)	Customer's end (Total) (d)	Loss kWh (DTR - Customer) (c-d)	Rate of loss kWh ((c-d)/c)
Value of measuring kWh	651,824	572,954	78,870	12.1 %
Measuring period	7/29 – 8/12	7/29 – 8/12	------	------

Table 5.14 Measuring result (Energy loss) (Kattedan #2 feeder)

(Substation - DTR)

	Outgoing of the feeder (a)	Secondary side of DTR (Total) (b)	Loss kWh (Substation – DTR) (a-b)	Rate of loss kWh ((a-b)/a)
Value of measuring kWh (convert to 1 month)	1,341,308	1,298,562	42,746	3.2 %
Measuring period	9/12 – 10/16	9/10 – 10/14	------	------

(DTR - Customer)

	Secondary side of DTR (Total) (c)	Customer's end (Total) (d)	Loss kWh (DTR - Customer) (c-d)	Rate of loss kWh ((c-d)/c)
Value of measuring kWh (convert to 1 month)	1,298,562	1,296,624	1,938	0.15 %
Measuring period	9/10- 10/14	9/10 – 10/14	------	------

Table 5.15 Measuring result (Energy loss) (Malkapur feeder)

(Substation - DTR)

	Outgoing of the feeder (a)	Secondary side of DTR (Total) (b)	Loss kWh (Substation – DTR) (a-b)	Rate of loss kWh ((a-b)/a)
Value of measuring kWh	59,460	54,128	5,332	9.0%
Measuring period	10/11 – 10/17	10/11 – 10/17	------	------

(DTR - Customer) (Measuring DTR of pump set)

	Secondary side of DTR (DTR SS VII) (c)	Customer's end (Pump set total) (d)	Loss kWh (DTR – Customer(pump set)) (c-d)	Rate of loss kWh ((c-d)/c)
Value of measuring kWh	1,409.4	1,402.0	7.4	0.5%
Measuring period	7/23 – 7/30	7/23 – 7/30	------	------

(3) Voltage Drop at Customer's End

Table 5.16 shows voltage drop at customer's end. As the measuring meters of Kamalanagar feeder did not have logging function, voltage drop was measured at one time point only. Since some of voltage drops exceeded the upper limit or the lower limit, adjustment of the sending voltage at the substation must be conducted more precisely.

Table 5.16 Voltage drop at customer's end

Kmalanagar Measuring date (20/10/2003)

No	Name of customer	Category	Name of transfomer	Secure meter No	Voltage	measuring time
1	K Ramulu	Domestic	Sarada Nagar Kata TN23 (315 kVA)	APE13485	405.7	13:11
2	Vijetra Shelters	Domestic	Grave yard-II TN14 (315 kVA)	APE13560	434 6	13 28
3	Sanscrit Collage(Pamineeya)	Commercial	Grave yard-I TN11 (250 kVA)	APE13501	434 3	11 42

Kattedan #2 Measuring date (02/08/2003-24/07/2003)

No	Name of customer	Category	Name of transfomer	Secure meter No	Voltage	
					Max	Min
1		Industrial	80 (100 kVA) 74HP	AP010655	469 7	400 4
2		Industrial	67 (100 kVA) 70HP	AP013652	473 9	406 0
3	M/S Maheshwari Oil	Indust (HT)	66 350 kVA	AP006232	12 4	10 4
4		Industrial	55 (100 kVA) 70HP	AP006823	483 6	381 0
5		Industrial	53 (100 kVA) 60HP	AP010523	485 0	392 1
6		Industrial	38 (100 kVA) 74HP	AP013585	469 7	399.1
7		Industrial	26 (100 kVA) 70HP	AP016111	479 4	414 3
8		Industrial	13 (100 kVA) 50HP	AP013487	479 4	411 5

Malkapur Measuring date (02/08/2003-24/07/2003)

No	Name of customer	Category	Name of transfomer	Secure meter No	Voltage	
					Max	Min
1	Indera Parwathi (5HP*3P)	Agriculture	DTR SS VII 63 kVA	APE13611	462 1	394 4

(4) Technical Energy Loss

On the basis of the measured currents, specification of the feeders by facility and actual loads, technical energy loss of each of distribution facilities (11kV line, distribution transformer, low voltage line etc.) was calculated for the three model feeders. The results are shown in Figures 5.11 – 5.14.

The method of calculation is shown in Annex 5.3.

Some examples of charts for calculating load distribution and cumulative equivalent resistance on the basis of the findings of the survey of specifications of feeder are shown in Annex 5.4.

Comparison of the calculated results and the energy loss rates in Japan shows that the loss rates of the distribution transformer and low voltage line rate of all the three feeders account for greater portions. It is necessary to lower these loss rates.

Kamalanagar

LOSS (kWh/Year)	kWh	%
11kV Line	42,686	8.9%
DTR(IronLoss)	121,589	25.4%
DTR(CopperLoss)	120,360	25.1%
DTR(Total Loss)	241,949	50.5%
LV Line	136,063	28.4%
Service Line	7,158	1.5%
Meter	51,173	10.7%
TOTAL	479,029	100.0%

2002 kWh/Year	8,669,040
Rate of Loss kWh	5.5%

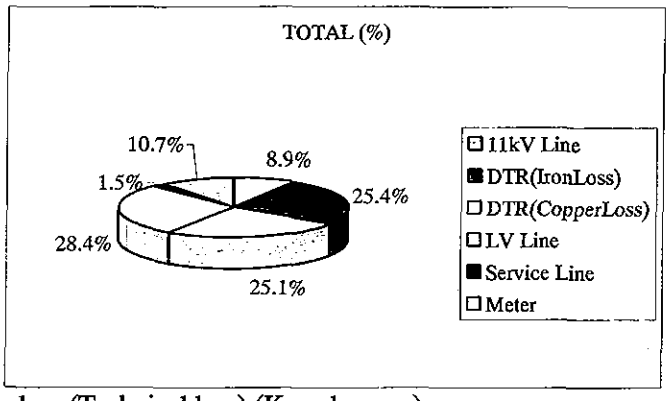


Figure 5.11 Distribution loss (Technical loss) (Kamalanagar)

Kattedan #2

LOSS (kWh/Year)	kWh	%
11kV Line	238,386.8	22.0%
DTR(IronLoss)	176,952.0	16.4%
DTR(CopperLoss)	354,857.0	32.8%
DTR(Total Loss)	531,809.0	49.2%
LV Line	172,506.9	16.0%
Service Line	132,694.4	12.3%
Meter	6,126.1	0.6%
TOTAL	1,081,523.2	100.0%

2002 kWh/Year	13,441,940.0
Rate of Loss kWh	8.0%

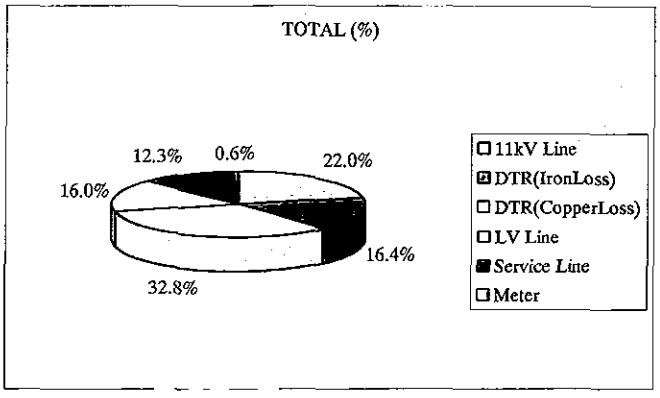


Figure 5.12 Distribution loss (Technical loss) (Kattedan #2)

Malkapur

LOSS (kWh/Year)	kWh	%
11kV Line	93,122	17.5%
DTR(IronLoss)	29,837	5.6%
DTR(CopperLoss)	122,966	23.1%
DTR(Total Loss)	152,803	28.7%
LV Line	282,484	53.0%
Service Line	2,310	0.4%
Meter	2,490	0.5%
TOTAL	533,208	100.0%

2003 kWh/Year	2,441,021
Rate of Loss kWh	21.8%

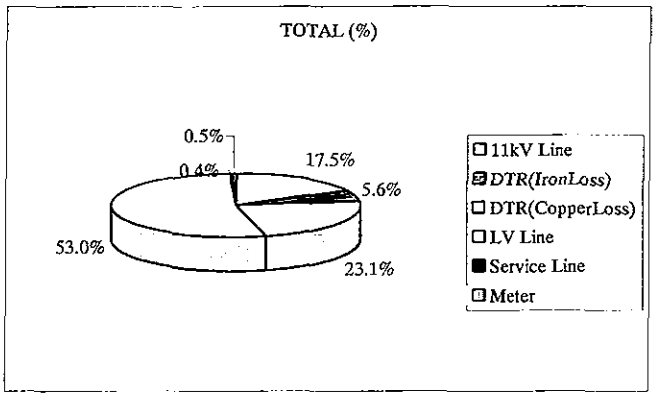


Figure 5.13 Distribution loss (Technical loss) (Malkapur)

JAPAN (1997)

		Loss Rate(%)	Total Loss(%)
HV Line	6kV Line	2.82	55.4%
LVLine	DTR(IronLoss)	1.04	20.4%
	DTR(CopperLoss)	0.68	13.4%
	LVLine	0.19	3.7%
	ServiceLine	0.20	3.9%
	Meter	0.16	3.1%
	Total	2.27	44.6%
Total		5.09	100.0%

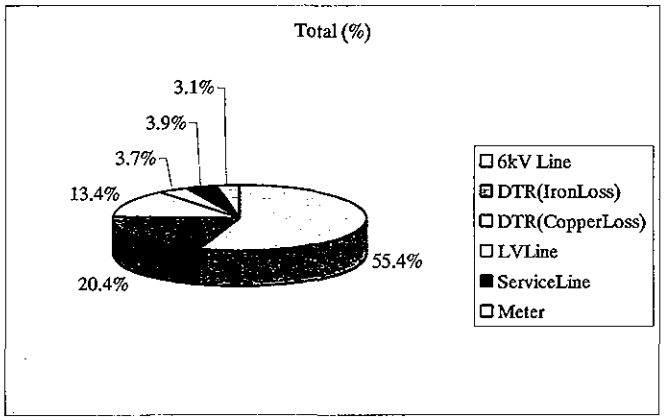


Figure 5.14 Distribution loss (Technical loss)(Japan)

(5) Voltage Drop

On the basis of the measured currents, the feeder specifications by facility, actual loads, etc, voltage drops by facility (11kV line, low voltage line, Service wire) was calculated. The results are shown in Tables 5.17 – 5.19.

Improvement plans were developed for facilities exceeding the limits in the results as shown in Chapter 5.5.

Table 5.17 Maximum voltage drop of Kamalanagar feeder

	Name of DTR	kVA	Max. VD	Allowable VD	% of VD
11 kV Line			83.7	660	(+-6%)
Low voltage line	KN-01	100	0.6	+-40V(+-20V)	(+-10%)
	KN-02	100	3.3	+-40V(+-20V)	(+-10%)
	KN-03	250	11.0	+-40V(+-20V)	(+-10%)
	KN-04	100	8.6	+-40V(+-20V)	(+-10%)
	KN-06	250	37.6	+-40V(+-20V)	(+-10%)
	KN-07	250	21.3	+-40V(+-20V)	(+-10%)
	KN-08	250	15.8	+-40V(+-20V)	(+-10%)
	KN-09	250	11.4	+-40V(+-20V)	(+-10%)
	KN-11	250	11.4	+-40V(+-20V)	(+-10%)
	KN-13	100	1.4	+-40V(+-20V)	(+-10%)
	KN-14	315	16.6	+-40V(+-20V)	(+-10%)
	KN-15	100	6.8	+-40V(+-20V)	(+-10%)
	KN-17	100	5.8	+-40V(+-20V)	(+-10%)
	KN-18	315	22.1	+-40V(+-20V)	(+-10%)
	KN-19	100	3.5	+-40V(+-20V)	(+-10%)
	KN-22	100	11.0	+-40V(+-20V)	(+-10%)
	KN-23	315	16.6	+-40V(+-20V)	(+-10%)
	KN-24	315	69.0	+-40V(+-20V)	(+-10%)
	KN-25	100	6.2	+-40V(+-20V)	(+-10%)
	KN-27	100	2.2	+-40V(+-20V)	(+-10%)
	KN-37	100	4.1	+-40V(+-20V)	(+-10%)

(Shaded figures show Max VD of 11kV line or DTR network exceeds the allowable VD)

Table 5.18 Maximum voltage drop of Kattedan #2 feeder

	Name of DTR	kVA	Max VD	Allowable VD	% of VD
11 kV line			364.2	+-660V	(+-6%)
Low voltage line	#8	315	8.9	+-40V(+-20V)	(+-10%)
	#10	160	14.3	+-40V(+-20V)	(+-10%)
	#12	1,000	8.8	+-40V(+-20V)	(+-10%)
	#13	100	0.7	+-40V(+-20V)	(+-10%)
	#15	63	2 4	+-40V(+-20V)	(+-10%)
	#16	100	18	+-40V(+-20V)	(+-10%)
	#17	100	2.1	+-40V(+-20V)	(+-10%)
	#25	63	2 8	+-40V(+-20V)	(+-10%)
	#26	100	3.3	+-40V(+-20V)	(+-10%)
	#28	315	15 9	+-40V(+-20V)	(+-10%)
	#29	100	6 1	+-40V(+-20V)	(+-10%)
	#30	250	5.9	+-40V(+-20V)	(+-10%)
	#31	100	4.1	+-40V(+-20V)	(+-10%)
	#32	100	4 4	+-40V(+-20V)	(+-10%)
	#33	100	9 5	+-40V(+-20V)	(+-10%)
	#34	63	12 6	+-40V(+-20V)	(+-10%)
	#35	100	4	+-40V(+-20V)	(+-10%)
	#37	100	11 5	+-40V(+-20V)	(+-10%)
	#38	100	8 8	+-40V(+-20V)	(+-10%)
	#39	250	30 6	+-40V(+-20V)	(+-10%)
	#40	250	10 6	+-40V(+-20V)	(+-10%)
	#41	160	1.6	+-40V(+-20V)	(+-10%)
	#47	63	3 4	+-40V(+-20V)	(+-10%)
	#48	100	8.1	+-40V(+-20V)	(+-10%)
	#50	250	12.1	+-40V(+-20V)	(+-10%)
	#52	100	2.7	+-40V(+-20V)	(+-10%)
	#53	100	7.4	+-40V(+-20V)	(+-10%)
	#57	100	4.7	+-40V(+-20V)	(+-10%)
	#58	100	4 7	+-40V(+-20V)	(+-10%)
	#59	100	4.7	+-40V(+-20V)	(+-10%)
	#60	100	4 7	+-40V(+-20V)	(+-10%)
	#61	100	4 7	+-40V(+-20V)	(+-10%)
	#62	100	4 7	+-40V(+-20V)	(+-10%)
	#67	100	0 8	+-40V(+-20V)	(+-10%)
	#71	63	5.5	+-40V(+-20V)	(+-10%)

Table 5.19 Maximum voltage drop of Malkapur feeder

	Name of DTR	Max VD	Allowable VD	% of VD
11kV Line		355	+-660V	(+-6%)
Low voltage line	SS I (100 kVA)	142.7	+-40V(+-20V)	(+-10%)
	SS II (100 kVA)	12.4	+-40V(+-20V)	(+-10%)
	SS III (63 kVA)	26 6	+-40V(+-20V)	(+-10%)
	SS IV (100 kVA)	95 8	+-40V(+-20V)	(+-10%)
	SS V (63 kVA)	90.6	+-40V(+-20V)	(+-10%)
	SS VI (100 kVA)	50.1	+-40V(+-20V)	(+-10%)
	SS VII (63 kVA)	109 6	+-40V(+-20V)	(+-10%)
	SS VIII (100 kVA)	137.2	+-40V(+-20V)	(+-10%)
	SS XV (63 kVA)	25.2	+-40V(+-20V)	(+-10%)
	SS IX (63 kVA)	27 6	+-40V(+-20V)	(+-10%)
	SS XII (100 kVA)	93	+-40V(+-20V)	(+-10%)
	SS XIII(45kVA)	13	+-40V(+-20V)	(+-10%)
	SS X (63 kVA)	185.8	+-40V(+-20V)	(+-10%)
	SS XIV (100 kVA)	269.7	+-40V(+-20V)	(+-10%)
	SS XI (100 kVA)	37.4	+-40V(+-20V)	(+-10%)

(6) Overcurrent

On the basis of the measured currents, the feeder specifications by facility, actual loads, etc., over currents by facility (11kV line, distribution transformer, low voltage line) were calculated. The results are shown in Tables 5.20 – 5.24.

Improvement plans were developed for the distribution facilities exceeding the limits in the results as shown in Chapter 5.5.

Table 5-20 Maximum current of Kamalanagar feeder (DTR)

	Name of DTR	kVA	Max Current	Allowable Current	% of nominal current of DTR
11kV Line			106	234	(55mm2)
DTR	KN-01	100	33	209	150%
	KN-02	100	132	209	150%
	KN-03	250	242	522	150%
	KN-04	100	61.6	209	150%
	KN-05	63	17.6	131	150%
	KN-06	250	246.4	522	150%
	KN-07	250	246.4	522	150%
	KN-08	100	136.4	209	150%
	KN-09	250	290.4	522	150%
	KN-10	63	17.6	131	150%
	KN-11	250	290.4	522	150%
	KN-12	100	17.6	209	150%
	KN-13	63	57.2	131	150%
	KN-14	315	255.2	522	150%
	KN-15	100	70.4	209	150%
	KN-16	63	30.8	131	150%
	KN-17	100	136.4	209	150%
	KN-18	315	312.4	657	150%
	KN-19	100	79.2	209	150%
	KN-20	160	0	334	150%
	KN-21	100	17.6	209	150%
	KN-22	100	123.2	209	150%
	KN-23	315	96.8	657	150%
	KN-24	315	299.2	657	150%
	KN-25	100	154	209	150%
	KN-26	100	17.6	209	150%
	KN-27	100	70.4	209	150%
	KN-28	100	17.6	209	150%
	KN-29	160	39.6	334	150%
	KN-30	160	35.2	334	150%
	KN-31	100	17.6	209	150%
	KN-32	100	26.4	209	150%
	KN-33	100	26.4	209	150%
	KN-34	63	8.8	131	150%
	KN-35	63	26.4	131	150%
	KN-36	100	13.2	209	150%
	KN-37	100	105.6	209	150%
	KN-38	160	22	334	150%
	KN-39	100	13.2	209	150%

Table 5.21 Maximum current of Kamalanagar feeder (LV line)

	Name of DTR	kVA	Max Current	Allowable Current	Conductor size
Low voltgae line	KN-01	100	16.3	175	(34mm2)
	KN-02	100	65.5	175	(34mm2)
	KN-03	250	137.5	175	(34mm2)
	KN-04	100	55.0	175	(34mm2)
	KN-06	250	245.2	175	(34mm2)
	KN-07	250	237.3	175	(34mm2)
	KN-08	250	98.1	175	(34mm2)
	KN-09	250	133.0	175	(34mm2)
	KN-11	250	143.6	175	(34mm2)
	KN-13	100	22.1	175	(34mm2)
	KN-14	315	137.2	175	(34mm2)
	KN-15	100	70.4	175	(34mm2)
	KN-17	100	117.7	175	(34mm2)
	KN-18	315	213.7	175	(34mm2)
	KN-19	100	50.3	175	(34mm2)
	KN-22	100	123.2	175	(34mm2)
	KN-23	315	96.3	175	(34mm2)
	KN-24	315	299.2	175	(34mm2)
	KN-25	100	86.4	175	(34mm2)
	KN-27	100	52.3	175	(34mm2)
	KN-37	100	69.6	175	(34mm2)
Service line			88	(14mm2)	

Table 5.22 Maximum current of Kattedan #2 feeder (DTR)
(Shaded figures show maximum current of 11kV line or DTR network exceeds the allowable current)

	Name of DTR	kVA of DTR	Max current	Allowable current	% of nominal current of DTR
11 kV line			180	234	(55mm2)
DTR	#8	315	164	522	150%
	#10	160	168	334	150%
	#12	100	112	209	150%
	#13	100	24	209	150%
	#15	63	88	131	150%
	#16	100	176	209	150%
	#17	100	64	209	150%
	#18	100	120	209	150%
	#20	63	52	131	150%
	#25	63	55	131	150%
	#26	100	64	209	150%
	#28	315	272	522	150%
	#29	100	72	209	150%
	#30	250	116	522	150%
	#31	100	32	209	150%
	#32	100	86	209	150%
	#33	100	72	209	150%
	#34	63	108	131	150%
	#35	100	86	209	150%
	#36	100	100	209	150%
	#37	100	124	209	150%
	#38	100	164	209	150%
	#39	250	208	522	150%
	#40	250	52	522	150%
	#41	160	44	334	150%
	#42	100	80	209	150%
	#47	63	76	131	150%
	#48	100	152	209	150%
	#49	100	116	209	150%
	#50	250	296	522	150%
	#51	100	100	209	150%
	#52	100	120	209	150%
	#53	100	108	209	150%
	#57	100	22	209	150%
	#58	100	86	209	150%
	#59	100	86	209	150%
	#60	100	86	209	150%
	#61	100	36	209	150%
	#62	100	37	209	150%
	#63	100	64	209	150%
	#64	100	112	209	150%
	#65	100	56	209	150%
	#67	100	120	209	150%
	#71	63	32	131	150%

Table 5.23 Maximum current of Kattedan #2 feeder (LV line)

	Name of DTR	kVA of DTR	Max current	Allowable current	Conductor size
Low voltage line	#8	315	164.0	175	(34mm2)
	#10	160	168.0	175	(34mm2)
	#12	1000	112.0	175	(34mm2)
	#13	100	24.0	175	(34mm2)
	#15	63	88.0	175	(34mm2)
	#16	100	176.0	175	(34mm2)
	#17	100	64.0	175	(34mm2)
	#25	63	55.0	175	(34mm2)
	#26	100	64.0	175	(34mm2)
	#28	315	129.0	175	(34mm2)
	#29	100	72.0	175	(34mm2)
	#30	250	116.0	175	(34mm2)
	#31	100	32.0	175	(34mm2)
	#32	100	86.0	175	(34mm2)
	#33	100	72.0	175	(34mm2)
	#34	63	108.0	175	(34mm2)
	#35	100	86.0	175	(34mm2)
	#37	100	124.0	175	(34mm2)
	#38	100	164.0	175	(34mm2)
	#39	250	143.1	175	(34mm2)
	#40	250	52.0	175	(34mm2)
	#41	160	44.0	175	(34mm2)
	#47	63	76.0	175	(34mm2)
	#48	100	152.0	175	(34mm2)
	#50	250	94.2	175	(34mm2)
	#52	100	120.0	175	(34mm2)
	#53	100	108.0	175	(34mm2)
	#57	100	22.0	175	(34mm2)
	#58	100	86.0	175	(34mm2)
	#59	100	86.0	175	(34mm2)
	#60	100	86.0	175	(34mm2)
	#61	100	36.0	175	(34mm2)
	#62	100	37.0	175	(34mm2)
	#67	100	120.0	175	(34mm2)
	#71	63	24.0	175	(34mm2)
Service line				88	(14mm2)

Table 5.24 Maximum current of Malkapur feeder

	Name of DTR	Max. current	Allowable current	% of nominal current of DTR
11 kV line		75	234	(55mm2)
DTR	SS I (100 kVA)	186.5	167	120%(Agriculture)
	SS II (100 kVA)	48	209	150%
	SS III (63 kVA)	84.7	105	120%(Agriculture)
	SS IV (100 kVA)	275.1	167	120%(Agriculture)
	SS V (63 kVA)	174.7	105	120%(Agriculture)
	SS VI (100 kVA)	131	167	120%(Agriculture)
	SS VII (63 kVA)	74.2	105	120%(Agriculture)
	SS VIII (100 kVA)	104.8	167	120%(Agriculture)
	SS XV (63 kVA)	65.5	105	120%(Agriculture)
	SS IX (63 kVA)	87.3	105	120%(Agriculture)
	SS XII (100 kVA)	227.1	209	150%
	SS XIII (45 kVA)	69.9	94	150%
	SS X (63 kVA)	170.3	105	120%(Agriculture)
	SS XIV (100 kVA)	200.9	167	120%(Agriculture)
	SS XI (100 kVA)	83	167	120%(Agriculture)

	Name of DTR	Max. current	Allowable current	Conductor size
Low voltage line	SS I (100 kVA)	149.2	175	(34mm2)
	SS II (100 kVA)	48	175	(34mm2)
	SS III (63 kVA)	84.7	175	(34mm2)
	SS IV (100 kVA)	142	175	(34mm2)
	SS V (63 kVA)	90.8	175	(34mm2)
	SS VI (100 kVA)	131	175	(34mm2)
	SS VII (63 kVA)	74.2	175	(34mm2)
	SS VIII (100 kVA)	104.8	175	(34mm2)
	SS XV (63 kVA)	65.5	175	(34mm2)
	SS IX (63 kVA)	87.3	175	(34mm2)
	SS XII (100 kVA)	227.1	175	(34mm2)
	SS XIII (45 kVA)	69.9	175	(34mm2)
	SS X (63 kVA)	170.3	175	(34mm2)
	SS XIV (100 kVA)	200.9	175	(34mm2)
	SS XI (100 kVA)	51.1	175	(34mm2)
Service line			88	(14mm2)

5.5 Improvement and Expansion Plan of Distribution Network

In order to reduce energy loss and to improve voltage drop and over current, improvement plans were conducted for every feederand every facility together withcounterparts. Particular plans are shown below.

Period of planning was set at 10 years in the improvement plans. The loads in the ten years were estimated on the following results of demand forecast.

5.5.1 Demand Forecast

Method of demand forecast include

- a macroscopic method wherein demand is estimated from past records of demands or correlations between electric power and population, production index, economic index, etc.
- a microscopic method wherein loads of respective areas are added up on the basis of field survey of land utilization plan, production plan, plant and equipment investment plan, etc.
- a mixed method of the above-mentioned two methods.

Demand forecast of this time was based on kW growth rates that were derived from the forecasted values developed by the respective divisions (Table 5.25).

Growth rate of Ranga Reddy is 4% and that of Medak is 1%.

Table 5.25 kWh growth rates

growth rate																		
		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	
R R	MAX MW	540	575	590	620	650	680	710	740	770	810							AVE
(Kamalanagar	growth rate	0.82	1.06	1.03	1.05	1.05	1.05	1.04	1.04	1.04	1.05							1.04
Medak	MAX MW	495	505	508	511	514	518	521	524	527	531	535	539	542	546	550		AVE
	growth rate	0.99	1.02	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01		1.01

The state of voltage drop and over current for ten (10) years was estimated from these growth rates as shown in Tables 5.26 – 5.31.

Table 5.26 Maximum voltage drop of Kamalanagar feeder (10 years)

Voltage drop			Max voltage drop											
	Name of DTR	kVA	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Allowable VD	
11kV Line			83.7	87.0	90.5	94.2	97.9	101.8	105.9	110.1	114.5	119.1	660	(+-6%)
	KN-01	100	0.6	0.6	0.6	0.7	0.7	0.7	0.8	0.8	0.8	0.9	+-40V(+-20V)	(+-10%)
	KN-02	100	3.3	3.4	3.6	3.7	3.9	4.0	4.2	4.3	4.5	4.7	+-40V(+-20V)	(+-10%)
	KN-03	250	11.0	11.4	11.9	12.4	12.9	13.4	13.9	14.5	15.1	15.7	+-40V(+-20V)	(+-10%)
	KN-04	100	8.6	8.9	9.3	9.7	10.1	10.5	10.9	11.3	11.8	12.2	+-40V(+-20V)	(+-10%)
	KN-06	250	37.6	39.1	40.7	42.3	44.0	45.7	47.6	49.5	51.5	53.5	+-40V(+-20V)	(+-10%)
	KN-07	250	21.3	22.2	23.0	24.0	24.9	25.9	27.0	28.0	29.2	30.3	+-40V(+-20V)	(+-10%)
	KN-08	250	15.8	16.4	17.1	17.8	18.5	19.2	20.0	20.8	21.6	22.5	+-40V(+-20V)	(+-10%)
	KN-09	250	11.4	11.9	12.3	12.8	13.3	13.9	14.4	15.0	15.6	16.2	+-40V(+-20V)	(+-10%)
	KN-11	250	11.4	11.9	12.3	12.8	13.3	13.9	14.4	15.0	15.6	16.2	+-40V(+-20V)	(+-10%)
	KN-13	100	1.4	1.5	1.5	1.6	1.6	1.7	1.8	1.8	1.9	2.0	+-40V(+-20V)	(+-10%)
Low voltage line	KN-14	315	16.6	17.3	18.0	18.7	19.4	20.2	21.0	21.8	22.7	23.6	+-40V(+-20V)	(+-10%)
	KN-15	100	6.8	7.1	7.4	7.6	8.0	8.3	8.6	8.9	9.3	9.7	+-40V(+-20V)	(+-10%)
	KN-17	100	5.8	6.0	6.3	6.5	6.8	7.1	7.3	7.6	7.9	8.3	+-40V(+-20V)	(+-10%)
	KN-18	315	22.1	23.0	23.9	24.9	25.9	26.9	28.0	29.1	30.2	31.5	+-40V(+-20V)	(+-10%)
	KN-19	100	3.5	3.6	3.8	3.9	4.1	4.3	4.4	4.6	4.8	5.0	+-40V(+-20V)	(+-10%)
	KN-22	100	11.0	11.4	11.9	12.4	12.9	13.4	13.9	14.5	15.1	15.7	+-40V(+-20V)	(+-10%)
	KN-23	315	16.6	17.3	18.0	18.7	19.4	20.2	21.0	21.8	22.7	23.6	+-40V(+-20V)	(+-10%)
	KN-24	315	69.0	71.8	74.6	77.6	80.7	83.9	87.3	90.8	94.4	98.2	+-40V(+-20V)	(+-10%)
	KN-25	100	6.2	6.4	6.7	7.0	7.3	7.5	7.8	8.2	8.5	8.8	+-40V(+-20V)	(+-10%)
	KN-27	100	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	+-40V(+-20V)	(+-10%)
	KN-37	100	4.1	4.3	4.4	4.6	4.8	5.0	5.2	5.4	5.6	5.8	+-40V(+-20V)	(+-10%)

(Shaded figures show Maximum VD of 11kV line or DTR network exceeds the allowable VD)

Table 5.27 Maximum voltage drop of Kattedan #2 feeder (10 years)

Voltage drop			Max. voltage drop											
	Name of DTR	kVA	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Allowable VD	
11 kV line			364.2	378.8	393.9	409.7	426.1	443.1	460.8	479.3	498.4	518.4	+-660V	(+-6%)
	#8	315	8.9	9.3	9.6	10.0	10.4	10.8	11.3	11.7	12.2	12.7	+-40V(+-20V)	(+-10%)
	#10	160	14.3	14.9	15.5	16.1	16.7	17.4	18.1	18.8	19.6	20.4	+-40V(+-20V)	(+-10%)
	#12	1,000	8.8	9.2	9.5	9.9	10.3	10.7	11.1	11.6	12.0	12.5	+-40V(+-20V)	(+-10%)
	#13	100	0.7	0.7	0.8	0.8	0.8	0.9	0.9	0.9	1.0	1.0	+-40V(+-20V)	(+-10%)
	#15	63	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.2	3.3	3.4	+-40V(+-20V)	(+-10%)
	#16	100	18	18.7	19.5	20.2	21.1	21.9	22.8	23.7	24.6	25.6	+-40V(+-20V)	(+-10%)
	#17	100	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	+-40V(+-20V)	(+-10%)
	#25	63	2.8	2.9	3.0	3.1	3.3	3.4	3.5	3.7	3.8	4.0	+-40V(+-20V)	(+-10%)
	#26	100	3.3	3.4	3.6	3.7	3.9	4.0	4.2	4.3	4.5	4.7	+-40V(+-20V)	(+-10%)
	#28	315	15.9	16.5	17.2	17.9	18.6	19.3	20.1	20.9	21.8	22.6	+-40V(+-20V)	(+-10%)
	#29	100	6.1	6.3	6.6	6.9	7.1	7.4	7.7	8.0	8.3	8.7	+-40V(+-20V)	(+-10%)
	#30	250	5.9	6.1	6.4	6.6	6.9	7.2	7.5	7.8	8.1	8.4	+-40V(+-20V)	(+-10%)
	#31	100	4.1	4.3	4.4	4.6	4.8	5.0	5.2	5.4	5.6	5.8	+-40V(+-20V)	(+-10%)
	#32	100	4.4	4.6	4.8	4.9	5.1	5.4	5.6	5.8	6.0	6.3	+-40V(+-20V)	(+-10%)
	#33	100	9.5	9.9	10.3	10.7	11.1	11.6	12.0	12.5	13.0	13.5	+-40V(+-20V)	(+-10%)
	#34	63	12.6	13.1	13.6	14.2	14.7	15.3	15.9	16.6	17.2	17.9	+-40V(+-20V)	(+-10%)
	#35	100	4	4.2	4.3	4.5	4.7	4.9	5.1	5.3	5.5	5.7	+-40V(+-20V)	(+-10%)
Low voltage line	#37	100	11.5	12.0	12.4	12.9	13.5	14.0	14.6	15.1	15.7	16.4	+-40V(+-20V)	(+-10%)
	#38	100	8.8	9.2	9.5	9.9	10.3	10.7	11.1	11.6	12.0	12.5	+-40V(+-20V)	(+-10%)
	#39	250	30.6	31.8	33.1	34.4	35.8	37.2	38.7	40.3	41.9	43.6	+-40V(+-20V)	(+-10%)
	#40	250	10.6	11.0	11.5	11.9	12.4	12.9	13.4	13.9	14.5	15.1	+-40V(+-20V)	(+-10%)
	#41	160	1.6	1.7	1.7	1.8	1.9	1.9	2.0	2.1	2.2	2.3	+-40V(+-20V)	(+-10%)
	#47	63	3.4	3.5	3.7	3.8	4.0	4.1	4.3	4.5	4.7	4.8	+-40V(+-20V)	(+-10%)
	#48	100	8.1	8.4	8.8	9.1	9.5	9.9	10.2	10.7	11.1	11.5	+-40V(+-20V)	(+-10%)
	#50	250	12.1	12.6	13.1	13.6	14.2	14.7	15.3	15.9	16.6	17.2	+-40V(+-20V)	(+-10%)
	#52	100	2.7	2.8	2.9	3.0	3.2	3.3	3.4	3.6	3.7	3.8	+-40V(+-20V)	(+-10%)
	#53	100	7.4	7.7	8.0	8.3	8.7	9.0	9.4	9.7	10.1	10.5	+-40V(+-20V)	(+-10%)
	#57	100	4.7	4.9	5.1	5.3	5.5	5.7	5.9	6.2	6.4	6.7	+-40V(+-20V)	(+-10%)
	#58	100	4.7	4.9	5.1	5.3	5.5	5.7	5.9	6.2	6.4	6.7	+-40V(+-20V)	(+-10%)
	#59	100	4.7	4.9	5.1	5.3	5.5	5.7	5.9	6.2	6.4	6.7	+-40V(+-20V)	(+-10%)
	#60	100	4.7	4.9	5.1	5.3	5.5	5.7	5.9	6.2	6.4	6.7	+-40V(+-20V)	(+-10%)
	#61	100	4.7	4.9	5.1	5.3	5.5	5.7	5.9	6.2	6.4	6.7	+-40V(+-20V)	(+-10%)
	#62	100	4.7	4.9	5.1	5.3	5.5	5.7	5.9	6.2	6.4	6.7	+-40V(+-20V)	(+-10%)
	#67	100	0.8	0.8	0.9	0.9	0.9	1.0	1.0	1.1	1.1	1.1	+-40V(+-20V)	(+-10%)
	#71	63	5.5	5.7	5.9	6.2	6.4	6.7	7.0	7.2	7.5	7.8	+-40V(+-20V)	(+-10%)

Table 5.28 Maximum voltage drop of Malkapur feeder (10 years)

Voltage drop		Max. voltage drop											
	Name of DTR	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Allowable VD	
11 kV line		355	358.6	362.1	365.8	369.4	373.1	376.8	380.6	384.4	388.3	+-660V	(+-6%)
Low volatge line	SS I (100kVA)	142.7	144.1	145.6	147.0	148.5	150.0	151.5	153.0	154.5	156.1	+-40V(+-20V)	(+-10%)
	SS II (100kVA)	12.4	12.5	12.6	12.8	12.9	13.0	13.2	13.3	13.4	13.6	+-40V(+-20V)	(+-10%)
	SS III (63kVA)	26.6	26.9	27.1	27.4	27.7	28.0	28.2	28.5	28.8	29.1	+-40V(+-20V)	(+-10%)
	SS IV (100kVA)	95.8	96.8	97.7	98.7	99.7	100.7	101.7	102.7	103.7	104.8	+-40V(+-20V)	(+-10%)
	SS V (63kVA)	90.6	91.5	92.4	93.3	94.3	95.2	96.2	97.1	98.1	99.1	+-40V(+-20V)	(+-10%)
	SS VI (100kVA)	50.1	50.6	51.1	51.6	52.1	52.7	53.2	53.7	54.3	54.8	+-40V(+-20V)	(+-10%)
	SS VII (63kVA)	109.6	110.7	111.8	112.9	114.1	115.2	116.3	117.5	118.7	119.9	+-40V(+-20V)	(+-10%)
	SS VIII (100kVA)	137.2	138.6	140.0	141.4	142.8	144.2	145.6	147.1	148.6	150.1	+-40V(+-20V)	(+-10%)
	SS XV (63kVA)	25.2	25.5	25.7	26.0	26.2	26.5	26.8	27.0	27.3	27.6	+-40V(+-20V)	(+-10%)
	SS IX (63kVA)	27.6	27.9	28.2	28.4	28.7	29.0	29.3	29.6	29.9	30.2	+-40V(+-20V)	(+-10%)
	SS XII (100kVA)	93	93.9	94.9	95.8	96.8	97.7	98.7	99.7	100.7	101.7	+-40V(+-20V)	(+-10%)
	SS XIII (45kVA)	13	13.1	13.3	13.4	13.5	13.7	13.8	13.9	14.1	14.2	+-40V(+-20V)	(+-10%)
	SS X (63kVA)	185.8	187.7	189.5	191.4	193.3	195.3	197.2	199.2	201.2	203.2	+-40V(+-20V)	(+-10%)
	SS XIV (100kVA)	269.7	272.4	275.1	277.9	280.7	283.5	286.3	289.2	292.0	295.0	+-40V(+-20V)	(+-10%)
	SS XI (100kVA)	37.4	37.8	38.2	38.5	38.9	39.3	39.7	40.1	40.5	40.9	+-40V(+-20V)	(+-10%)

Table 5.29 Maximum current of Kamalanagar feeder (10 years)

Overcurrent			Max. current											
	Name of DTR	kVA	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Allowable Current	
11 kV line			106	110.2	114.6	119.2	124.0	129.0	134.1	139.5	145.1	150.9	234	(55mm2)
DTR	KN-01	100	33	34.3	35.7	37.1	38.6	40.1	41.8	43.4	45.2	47.0	209	150%
	KN-02	100	132	137.3	142.8	148.5	154.4	160.6	167.0	173.7	180.7	187.9	209	150%
	KN-03	250	242	251.7	261.7	272.2	283.1	294.4	306.2	318.5	331.2	344.4	522	150%
	KN-04	100	61.6	64.1	66.6	69.3	72.1	74.9	77.9	81.1	84.3	87.7	209	150%
	KN-05	63	17.6	18.3	19.0	19.8	20.6	21.4	22.3	23.2	24.1	25.1	131	150%
	KN-06	250	246.4	256.3	266.5	277.2	288.3	299.8	311.8	324.2	337.2	350.7	522	150%
	KN-07	250	246.4	256.3	266.5	277.2	288.3	299.8	311.8	324.2	337.2	350.7	522	150%
	KN-08	100	136.4	141.9	147.5	153.4	159.6	166.0	172.6	179.5	186.7	194.1	209	150%
	KN-09	250	290.4	302.0	314.1	326.7	339.7	353.3	367.4	382.1	397.4	413.3	522	150%
	KN-10	63	17.6	18.3	19.0	19.8	20.6	21.4	22.3	23.2	24.1	25.1	131	150%
	KN-11	250	290.4	302.0	314.1	326.7	339.7	353.3	367.4	382.1	397.4	413.3	522	150%
	KN-12	100	17.6	18.3	19.0	19.8	20.6	21.4	22.3	23.2	24.1	25.1	209	150%
	KN-13	63	57.2	59.5	61.9	64.3	66.9	69.6	72.4	75.3	78.3	81.4	131	150%
	KN-14	315	255.2	265.4	276.0	287.1	298.5	310.5	322.9	335.8	349.3	363.2	522	150%
	KN-15	100	70.4	73.2	76.1	79.2	82.4	85.7	89.1	92.6	96.3	100.2	209	150%
	KN-16	63	30.8	32.0	33.3	34.6	36.0	37.5	39.0	40.5	42.2	43.8	131	150%
	KN-17	100	136.4	141.9	147.5	153.4	159.6	166.0	172.6	179.5	186.7	194.1	209	150%
	KN-18	315	312.4	324.9	337.9	351.4	365.5	380.1	395.3	411.1	427.5	444.6	657	150%
	KN-19	100	79.2	82.4	85.7	89.1	92.7	96.4	100.2	104.2	108.4	112.7	209	150%
	KN-20	160	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	334	150%
	KN-21	100	17.6	18.3	19.0	19.8	20.6	21.4	22.3	23.2	24.1	25.1	209	150%
	KN-22	100	123.2	128.1	133.3	138.6	144.1	149.9	155.9	162.1	168.6	175.4	209	150%
	KN-23	315	96.8	100.7	104.7	108.9	113.2	117.8	122.5	127.4	132.5	137.8	657	150%
	KN-24	315	299.2	311.2	323.6	336.6	350.0	364.0	378.6	393.7	409.5	425.9	657	150%
	KN-25	100	154	160.2	166.6	173.2	180.2	187.4	194.9	202.7	210.8	219.2	209	150%
	KN-26	100	17.6	18.3	19.0	19.8	20.6	21.4	22.3	23.2	24.1	25.1	209	150%
	KN-27	100	70.4	73.2	76.1	79.2	82.4	85.7	89.1	92.6	96.3	100.2	209	150%
	KN-28	100	17.6	18.3	19.0	19.8	20.6	21.4	22.3	23.2	24.1	25.1	209	150%
	KN-29	160	39.6	41.2	42.8	44.5	46.3	48.2	50.1	52.1	54.2	56.4	334	150%
	KN-30	160	35.2	36.6	38.1	39.6	41.2	42.8	44.5	46.3	48.2	50.1	334	150%
	KN-31	100	17.6	18.3	19.0	19.8	20.6	21.4	22.3	23.2	24.1	25.1	209	150%
	KN-32	100	26.4	27.5	28.6	29.7	30.9	32.1	33.4	34.7	36.1	37.6	209	150%
	KN-33	100	26.4	27.5	28.6	29.7	30.9	32.1	33.4	34.7	36.1	37.6	209	150%
	KN-34	63	8.8	9.2	9.5	9.9	10.3	10.7	11.1	11.6	12.0	12.5	131	150%
	KN-35	63	26.4	27.5	28.6	29.7	30.9	32.1	33.4	34.7	36.1	37.6	131	150%
	KN-36	100	13.2	13.7	14.3	14.8	15.4	16.1	16.7	17.4	18.1	18.8	209	150%
	KN-37	100	105.6	109.8	114.2	118.8	123.5	128.5	133.6	139.0	144.5	150.3	209	150%
	KN-38	160	22	22.9	23.8	24.7	25.7	26.8	27.8	29.0	30.1	31.3	334	150%
	KN-39	100	13.2	13.7	14.3	14.8	15.4	16.1	16.7	17.4	18.1	18.8	209	150%
Low voltage line	KN-01	100	16.3	17.0	17.6	18.3	19.3	19.8	20.6	21.4	22.3	23.2	175	(34mm2)
	KN-02	100	65.5	68.1	70.8	73.7	76.6	79.7	82.9	86.2	89.6	93.2	175	(34mm2)
	KN-03	250	137.5	143.0	148.7	154.7	160.9	167.3	174.0	180.9	188.2	195.7	175	(34mm2)
	KN-04	100	55.0	57.2	59.5	61.9	64.3	66.9	69.6	72.4	75.3	78.3	175	(34mm2)
	KN-06	250	245.2	255.0	265.2	275.8	286.8	298.3	310.3	322.7	335.6	349.0	175	(34mm2)
	KN-07	250	237.3	246.8	256.7	266.9	277.6	288.7	300.3	312.3	324.8	337.8	175	(34mm2)
	KN-08	250	98.1	102.0	106.1	110.3	114.8	119.4	124.1	129.1	134.3	139.6	175	(34mm2)
	KN-09	250	133.0	138.3	143.9	149.6	155.6	161.8	168.3	175.0	182.0	189.3	175	(34mm2)
	KN-11	250	143.6	149.3	155.3	161.5	168.0	174.7	181.7	189.0	196.5	204.4	175	(34mm2)
	KN-13	100	22.1	23.0	23.9	24.9	25.9	26.9	28.0	29.1	30.2	31.5	175	(34mm2)
	KN-14	315	137.2	142.7	148.4	154.3	160.5	166.9	173.6	180.5	187.8	195.3	175	(34mm2)
	KN-15	100	70.4	73.2	76.1	79.2	82.4	85.7	89.1	92.6	96.3	100.2	175	(34mm2)
	KN-17	100	117.7	122.4	127.3	132.4	137.7	143.2	148.9	154.9	161.1	167.5	175	(34mm2)
	KN-18	315	213.7	222.2	231.1	240.4	250.0	260.0	270.4	281.2	292.5	304.2	175	(34mm2)
	KN-19	100	50.3	52.3	54.4	56.6	58.8	61.2	63.6	66.2	68.8	71.6	175	(34mm2)
	KN-22	100	123.2	128.1	133.3	138.6	144.1	149.9	155.9	162.1	168.6	175.4	175	(34mm2)
	KN-23	315	96.3	100.2	104.2	108.3	112.7	117.2	121.9	126.7	131.8	137.1	175	(34mm2)
	KN-24	315	299.2	311.2	323.6	336.6	350.0	364.0	378.6	393.7	409.5	425.9	175	(34mm2)
	KN-25	100	86.4	89.9	93.5	97.2	101.1	105.1	109.3	113.7	118.2	123.0	175	(34mm2)
	KN-27	100	52.3	54.4	56.6	58.8	61.2	63.6	66.2	68.8	71.6	74.4	175	(34mm2)
	KN-37	100	69.6	72.4	75.3	78.3	81.4	84.7	88.1	91.6	95.3	99.1	175	(34mm2)
Service line			88										(14mm2)	

(Shaded figures show Maximum Current of 11kV line or DTR network exceeds the allowable current)

Table 5.30 Maximum current of Kattedan #2 feeder (10 years)

Overcurrent			Max. Current											
	Name of DTR	kVA	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Allowable Current	
11 kV line			180	187.2	194.7	202.5	210.6	219.0	227.8	236.9	246.3	256.2	234	(55mm2)
DTR	#8	315	164	170.6	177.4	184.5	191.9	199.5	207.5	215.8	224.4	233.4	522	150%
	#10	160	168	174.7	181.7	189.0	196.5	204.4	212.6	221.1	229.9	239.1	334	150%
	#12	100	112	116.5	121.1	126.0	131.0	136.3	141.7	147.4	153.3	159.4	209	150%
	#13	100	24	25.0	26.0	27.0	28.1	29.2	30.4	31.6	32.8	34.2	209	150%
	#15	63	88	91.5	95.2	99.0	102.9	107.1	111.3	115.8	120.4	125.3	131	150%
	#16	100	176	183.0	190.4	198.0	205.9	214.1	222.7	231.6	240.9	250.5	209	150%
	#17	100	64	66.6	69.2	72.0	74.9	77.9	81.0	84.2	87.6	91.1	209	150%
	#18	100	120	124.8	129.8	135.0	140.4	146.0	151.8	157.9	164.2	170.8	209	150%
	#20	63	52	54.1	56.2	58.5	60.8	63.3	65.8	68.4	71.2	74.0	131	150%
	#25	63	55	57.2	59.5	61.9	64.3	66.9	69.6	72.4	75.3	78.3	131	150%
	#26	100	64	66.6	69.2	72.0	74.9	77.9	81.0	84.2	87.6	91.1	209	150%
	#28	315	272	282.9	294.2	306.0	318.2	330.9	344.2	357.9	372.3	387.1	522	150%
	#29	100	72	74.9	77.9	81.0	84.2	87.6	91.1	94.7	98.5	102.5	209	150%
	#30	250	116	120.6	125.5	130.5	135.7	141.1	146.8	152.6	158.8	165.1	522	150%
	#31	100	32	33.3	34.6	36.0	37.4	38.9	40.5	42.1	43.8	45.5	209	150%
	#32	100	86	89.4	93.0	96.7	100.6	104.6	108.8	113.2	117.7	122.4	209	150%
	#33	100	72	74.9	77.9	81.0	84.2	87.6	91.1	94.7	98.5	102.5	209	150%
	#34	63	108	112.3	116.8	121.5	126.3	131.4	136.7	142.1	147.8	153.7	131	150%
	#35	100	86	89.4	93.0	96.7	100.6	104.6	108.8	113.2	117.7	122.4	209	150%
	#36	100	100	104.0	108.2	112.5	117.0	121.7	126.5	131.6	136.9	142.3	209	150%
	#37	100	124	129.0	134.1	139.5	145.1	150.9	156.9	163.2	169.7	176.5	209	150%
	#38	100	164	170.6	177.4	184.5	191.9	199.5	207.5	215.8	224.4	233.4	209	150%
	#39	250	208	216.3	225.0	234.0	243.3	253.1	263.2	273.7	284.7	296.0	522	150%
	#40	250	52	54.1	56.2	58.5	60.8	63.3	65.8	68.4	71.2	74.0	522	150%
	#41	160	44	45.8	47.6	49.5	51.5	53.5	55.7	57.9	60.2	62.6	334	150%
	#42	100	80	83.2	86.5	90.0	93.6	97.3	101.2	105.3	109.5	113.9	209	150%
	#47	63	76	79.0	82.2	85.5	88.9	92.5	96.2	100.0	104.0	108.2	131	150%
	#48	100	152	158.1	164.4	171.0	177.8	184.9	192.3	200.0	208.0	216.3	209	150%
	#49	100	116	120.6	125.5	130.5	135.7	141.1	146.8	152.6	158.8	165.1	209	150%
	#50	250	296	307.8	320.2	333.0	346.3	360.1	374.5	389.5	405.1	421.3	522	150%
	#51	100	100	104.0	108.2	112.5	117.0	121.7	126.5	131.6	136.9	142.3	209	150%
	#52	100	120	124.8	129.8	135.0	140.4	146.0	151.8	157.9	164.2	170.8	209	150%
	#53	100	108	112.3	116.8	121.5	126.3	131.4	136.7	142.1	147.8	153.7	209	150%
	#57	100	22	22.9	23.8	24.7	25.7	26.8	27.8	29.0	30.1	31.3	209	150%
	#58	100	86	89.4	93.0	96.7	100.6	104.6	108.8	113.2	117.7	122.4	209	150%
	#59	100	86	89.4	93.0	96.7	100.6	104.6	108.8	113.2	117.7	122.4	209	150%
	#60	100	86	89.4	93.0	96.7	100.6	104.6	108.8	113.2	117.7	122.4	209	150%
	#61	100	36	37.4	38.9	40.5	42.1	43.8	45.6	47.4	49.3	51.2	209	150%
	#62	100	37	38.5	40.0	41.6	43.3	45.0	46.8	48.7	50.6	52.7	209	150%
	#63	100	64	66.6	69.2	72.0	74.9	77.9	81.0	84.2	87.6	91.1	209	150%
	#64	100	112	116.5	121.1	126.0	131.0	136.3	141.7	147.4	153.3	159.4	209	150%
	#65	100	56	58.2	60.6	63.0	65.5	68.1	70.9	73.7	76.6	79.7	209	150%
	#67	100	120	124.8	129.8	135.0	140.4	146.0	151.8	157.9	164.2	170.8	209	150%
	#71	63	32	33.3	34.6	36.0	37.4	38.9	40.5	42.1	43.8	45.5	131	150%
Low voltage line	#8	315	164.0	170.6	177.4	184.5	191.9	199.5	207.5	215.8	224.4	233.4	175	(34mm2)
	#10	160	168.0	174.7	181.7	189.0	196.5	204.4	212.6	221.1	229.9	239.1	175	(34mm2)
	#12	1000	112.0	116.5	121.1	126.0	131.0	136.3	141.7	147.4	153.3	159.4	175	(34mm2)
	#13	100	24.0	25.0	26.0	27.0	28.1	29.2	30.4	31.6	32.8	34.2	175	(34mm2)
	#15	63	88.0	91.5	95.2	99.0	102.9	107.1	111.3	115.8	120.4	125.3	175	(34mm2)
	#16	100	176.0	183.0	190.4	198.0	205.9	214.1	222.7	231.6	240.9	250.5	175	(34mm2)
	#17	100	64.0	66.6	69.2	72.0	74.9	77.9	81.0	84.2	87.6	91.1	175	(34mm2)
	#25	63	55.0	57.2	59.5	61.9	64.3	66.9	69.6	72.4	75.3	78.3	175	(34mm2)
	#26	100	64.0	66.6	69.2	72.0	74.9	77.9	81.0	84.2	87.6	91.1	175	(34mm2)
	#28	315	129.0	134.2	139.5	145.1	150.9	156.9	163.2	169.8	176.5	183.6	175	(34mm2)
	#29	100	72.0	74.9	77.9	81.0	84.2	87.6	91.1	94.7	98.5	102.5	175	(34mm2)
	#30	250	116.0	120.6	125.5	130.5	135.7	141.1	146.8	152.6	158.8	165.1	175	(34mm2)
	#31	100	32.0	33.3	34.6	36.0	37.4	38.9	40.5	42.1	43.8	45.5	175	(34mm2)
	#32	100	86.0	89.4	93.0	96.7	100.6	104.6	108.8	113.2	117.7	122.4	175	(34mm2)
	#33	100	72.0	74.9	77.9	81.0	84.2	87.6	91.1	94.7	98.5	102.5	175	(34mm2)
	#34	63	108.0	112.3	116.8	121.5	126.3	131.4	136.7	142.1	147.8	153.7	175	(34mm2)
	#35	100	86.0	89.4	93.0	96.7	100.6	104.6	108.8	113.2	117.7	122.4	175	(34mm2)
	#37	100	124.0	129.0	134.1	139.5	145.1	150.9	156.9	163.2	169.7	176.5	175	(34mm2)
	#38	100	164.0	170.6	177.4	184.5	191.9	199.5	207.5	215.8	224.4	233.4	175	(34mm2)
	#39	250	143.1	148.8	154.8	161.0	167.4	174.1	181.1	188.3	195.8	203.7	175	(34mm2)
	#40	250	52.0	54.1	56.2	58.5	60.8	63.3	65.8	68.4	71.2	74.0	175	(34mm2)
	#41	160	44.0	45.8	47.6	49.5	51.5	53.5	55.7	57.9	60.2	62.6	175	(34mm2)
	#47	63	76.0	79.0	82.2	85.5	88.9	92.5	96.2	100.0	104.0	108.2	175	(34mm2)
	#48	100	152.0	158.1	164.4	171.0	177.8	184.9	192.3	200.0	208.0	216.3	175	(34mm2)
	#50	250	94.2	98.0	101.9	106.0	110.2	114.6	119.2	124.0	128.9	134.1	175	(34mm2)
	#52	100	120.0	124.8	129.8	135.0	140.4	146.0	151.8	157.9	164.2	170.8	175	(34mm2)
	#53	100	108.0	112.3	116.8	121.5	126.3	131.4	136.7	142.1	147.8	153.7	175	(34mm2)
	#57	100	22.0	22.9	23.8	24.7	25.7	26.8	27.8	29.0	30.1	31.3	175	(34mm2)
	#58	100	86.0	89.4	93.0	96.7	100.6	104.6	108.8	113.2	117.7	122.4	175	(34mm2)
	#59	100	86.0	89.4	93.0	96.7	100.6	104.6	108.8	113.2	117.7	122.4	175	(34mm2)
	#60	100	86.0	89.4	93.0	96.7	100.6	104.6	108.8	113.2	117.7	122.4	175	(34mm2)
	#61	100	36.0	37.4	38.9	40.5	42.1	43.8	45.6	47.4	49.3	51.2	175	(34mm2)
	#62	100	37.0	38.5	40.0	41.6	43.3	45.0	46.8	48.7	50.6	52.7	175	(34mm2)
	#67	100	120.0	124.8	129.8	135.0	140.4	146.0	151.8	157.9	164.2	170.8	175	(34mm2)
	#71	63	24.0	25.0	26.0	27.0	28.1	29.2	30.4	31.6	32.8	34.2	175	(34mm2)
Service line													88	(14mm2)

Table 5.31 Maximum current of Malkapur feeder (10 years)

Overcurrent		Max. Current											
	Name of DTR	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Allowable Current	
11 kV line		75	75.8	76.5	77.3	78.0	78.8	79.6	80.4	81.2	82.0	234	(55mm2)
DTR	SS I(100kVA)	186.5	188.4	190.2	192.2	194.1	196.0	198.0	200.0	202.0	204.0	167	120%(Agriculture)
	SS II(100kVA)	48	48.5	49.0	49.5	49.9	50.4	51.0	51.5	52.0	52.5	209	150%
	SS III(63kVA)	84.7	85.5	86.4	87.3	88.1	89.0	89.9	90.8	91.7	92.6	105	120%(Agriculture)
	SS IV(100kVA)	275.1	277.9	280.6	283.4	286.3	289.1	292.0	294.9	297.9	300.9	167	120%(Agriculture)
	SS V(63kVA)	174.7	176.4	178.2	180.0	181.8	183.6	185.4	187.3	189.2	191.1	105	120%(Agriculture)
	SS VI(100kVA)	131	132.3	133.6	135.0	136.3	137.7	139.1	140.4	141.9	143.3	167	120%(Agriculture)
	SS VII(63kVA)	74.2	74.9	75.7	76.4	77.2	78.0	78.8	79.6	80.3	81.2	105	120%(Agriculture)
	SS VIII(100kVA)	104.8	105.8	106.9	108.0	109.1	110.1	111.2	112.4	113.5	114.6	167	120%(Agriculture)
	SS XV(63kVA)	65.5	66.2	66.8	67.5	68.2	68.8	69.5	70.2	70.9	71.6	105	120%(Agriculture)
	SS IX(63kVA)	87.3	88.2	89.1	89.9	90.8	91.8	92.7	93.6	94.5	95.5	105	120%(Agriculture)
	SS XII(100kVA)	227.1	229.4	231.7	234.0	236.3	238.7	241.1	243.5	245.9	248.4	209	150%
	SS XIII(45kVA)	69.9	70.6	71.3	72.0	72.7	73.5	74.2	74.9	75.7	76.4	94	150%
	SS X(63kVA)	170.3	172.0	173.7	175.5	177.2	179.0	180.8	182.6	184.4	186.3	105	120%(Agriculture)
	SS XIV(100kVA)	200.9	202.9	204.9	207.0	209.1	211.1	213.3	215.4	217.5	219.7	167	120%(Agriculture)
	SS XI(100kVA)	83	83.8	84.7	85.5	86.4	87.2	88.1	89.0	89.9	90.8	167	120%(Agriculture)
Low volatge line	SS I(100kVA)	149.2	150.7	152.2	153.7	155.3	156.8	158.4	160.0	161.6	163.2	175	(34mm2)
	SS II(100kVA)	48	48.5	49.0	49.5	49.9	50.4	51.0	51.5	52.0	52.5	175	(34mm2)
	SS III(63kVA)	84.7	85.5	86.4	87.3	88.1	89.0	89.9	90.8	91.7	92.6	175	(34mm2)
	SS IV(100kVA)	142	143.4	144.9	146.3	147.8	149.2	150.7	152.2	153.8	155.3	175	(34mm2)
	SS V(63kVA)	90.8	91.7	92.6	93.6	94.5	95.4	96.4	97.3	98.3	99.3	175	(34mm2)
	SS VI(100kVA)	131	132.3	133.6	135.0	136.3	137.7	139.1	140.4	141.9	143.3	175	(34mm2)
	SS VII(63kVA)	74.2	74.9	75.7	76.4	77.2	78.0	78.8	79.6	80.3	81.2	175	(34mm2)
	SS VIII(100kVA)	104.8	105.8	106.9	108.0	109.1	110.1	111.2	112.4	113.5	114.6	175	(34mm2)
	SS XV(63kVA)	65.5	66.2	66.8	67.5	68.2	68.8	69.5	70.2	70.9	71.6	175	(34mm2)
	SS IX(63kVA)	87.3	88.2	89.1	89.9	90.8	91.8	92.7	93.6	94.5	95.5	175	(34mm2)
	SS XII(100kVA)	227.1	229.4	231.7	234.0	236.3	238.7	241.1	243.5	245.9	248.4	175	(34mm2)
	SS XIII(45kVA)	69.9	70.6	71.3	72.0	72.7	73.5	74.2	74.9	75.7	76.4	175	(34mm2)
	SS X(63kVA)	170.3	172.0	173.7	175.5	177.2	179.0	180.8	182.6	184.4	186.3	175	(34mm2)
	SS XIV(100kVA)	200.9	202.9	204.9	207.0	209.1	211.1	213.3	215.4	217.5	219.7	175	(34mm2)
	SS XI(100kVA)	51.1	51.6	52.1	52.6	53.2	53.7	54.2	54.8	55.3	55.9	175	(34mm2)
Service line												88	(14mm2)

In the following, improvement measures are examined for eliminating bottle necks for ten years.

5.5.2 Substations for Distribution

Current situation of each substation are shown in Table 5.32. Almost all the substations did not exceed the allowable kW this year. As for feeders that might exceed the limit, improvement will be made by the following method.

Table 5.32 Result of load at distribution substation

Name of substation : Kothapet

No	Name of TR	MVA	No	Name of feeder	Category	Max kW 2003	Allowable kW
1	8MVA PTR-1	8				6,287	7,200 (8,000)
2	8MVA PTR-2	8				6,287	7,200 (8,000)
			1	Kamalanagar	Domestic/Com	2,191	2,800 (3,800)
			2	Hudacomplex	Domestic/Com	2,572	2,800 (3,800)
			3	Vidyuthnagar	Domestic/Com	2,839	2,800 (3,800)
			4	Stadium	Domestic/Com	2,667	2,800 (3,800)
			5	Saroornagar	Domestic/Com	3,810	2,800 (3,800)

Name of substation : Kattedan

No	Name of SS-TR	MVA	No	Name of feeder	Category	Max kW 2003	Allowable kW
1	Kattedan PTR-I	8		BANK Total		6,668	7,200 (8,000)
			1	Kattedan #1	Industrial	3,429	2,800 (3,800)
			2	Kattedan #2	Industrial	3,239	2,800 (3,800)
2	Kattedan PTR-II	8		BANK Total		7,049	7,200 (8,000)
			1	Balapur	Domestic/Com/Indu	3,810	2,800 (3,800)
			2	Kattedan #3	Industrial	3,429	2,800 (3,800)
3	Kattedan PTR-III	8		BANK Total		4,573	7,200 (8,000)
			1	Kattedan #4	Industrial	3,429	2,800 (3,800)
			2	Ida/Balapur	Industrial	1,334	2,800 (3,800)

Name of substation : Malkapur

No	Name of SS-TR	MVA	No	Name of feeder	Category	Max kW 2003	Allowable kW
1	11kV Malkapur	5		BANK Total		4,378	4,500 (5,000)
			1	Malkapur	Agricultural	***	2,800 (3,800)
			2	Kothapur	Agricultural	***	2,800 (3,800)
			3	Mallpally	Agricultural	***	2,800 (3,800)
			4	Industrial	Industrial	***	2,800 (3,800)

(Shaded figures show maximum kW of feeder exceeds the allowable kW)

As for a feeder that may pose a bottleneck this year, first the load conditions are examined carefully, then the feeder is improved by the following method:

The ratio of loads of each feeder is investigated. If it exceeds the limit, the following steps are taken while considering economy.

- First, consider evenly balancing loads on respective feeders of a bank. If it results excess or deficiency, consider reallocating loads within each feeder. If necessary, consider switching a high voltage portion of distribution line to another feeder.
- Secondly, consider installing a new bank
- Thirdly, consider installing a new substation to reassign loads by bank from another substation.

It is also necessary to consider sharing loads with another feeder and newly installing high voltage line to interconnect with another feeder whenever there is an opportunity.

As for Kattedan #2 substation, substation transformer banks of the substation are independent from each other. At present, loads on each bank are close to the limit. As a tentative solution of the overload problem, it is proposed to mutually interconnect the buses of the primary side of transformer banks to share loads of the three banks and efficiently interchange loads.

5.5.3 High Voltage Distribution Lines

Bottlenecks of 11kV lines for ten years are shown in Tables 5.26 – 5.31. As the current of 11kV line in Kattedan #2 feeder will exceed the allowable limit in 2010, an improvement plan was conducted as shown in Table 5.33.

Table 5.33 Improvement plan of 11kV line

	Vd (V)			LV(11 kV) line current (A)			Revised contents	
	before	after	subtract	before	after	subtract	before	after
11 kV line	479 3	381 9	-97 4	236.9	177.3	-59.6		+ 11 kV line 730m*3

(Shaded figures show 11kV line exceeds the allowable limitation)

Cause of improvement	Improvement plan
The current flow in 11 kV line at the outgoing part of the feeder will exceed the allowable current in 2010.	Add another11kV line of 730 m to the outgoing part of Kattedan #2 feeder.

As only wire of 55 sqmm is used in 11kV line, in place of using thicker wires, a line of the same wire is added to make required improvement.

Generally, improvement plans to avoid any bottlenecks of voltage drop or over current are as follows:

- Up-sizing 11kV line or installing an additional 11kV line
- Shifting a part of load to another feeder
- Installing a voltage regulator when voltage drop is very large
- Installing a power capacitor at a point of excessively large load power factor.

Consider installing a new feeder when the above-mentioned measures are not adequate.

5.5.4 Low Voltage Distribution Lines

Bottlenecks in distribution transformers and low voltage lines in coming ten years will occur as shown in Tables 5.26 – 5.31.

Generally, improvement plans to reduce voltage drop or over current include

- Transferring a transformer to the center of loads
- Splitting a low voltage line(newly installing a transformer and dividing loads with the existing transformer)
- *Share half of load to another newly transformer*
- Up-sizing a low voltage line or installing an additional 11kV line to lower the current density.

Improvement is made by selecting an optimal method from the above-mentioned plans. Results are as shown in Table 5.34.

Table 5.34 Improvement plan of low voltage line

Kamalanagar

	Name of DTR	kVA	Vd (V)			DTR Cur (A)			LV Line Cur (A)			Revised contents	
			before	after	subtract	before	after	subtract	before	after	subtract	before	after
DTR	KN-03	250	14.4	14.4	0.0	318.5	318.5	0.0	180.9	120.8	-60.1		+ LVLine30m*1*4
	KN-06	250	37.6	7.2	-30.4	246.4	81.6	-164.8	245.2	81.6	-163.6	DTR250kVA	+ 11kV30m*8*3+DTR160kVA
	KN-07	250	21.3	4.9	-16.4	246.4	50.0	-196.4	237.3	108.4	-128.9	DTR250kVA	+ 11kV30m*4*3+DTR160kVA
	KN-08	100	20.7	3.2	-17.5	179.5	87.0	-92.5	129.1	45.1	-84.0	DTR250kVA	+ 11kV30m*5*3+DTR100kVA
	KN-09	250	15	10.1	-4.9	382.1	382.1	0.0	175.1	92.1	-83.0		+ LVLine30m*3*4
	KN-11	250	14.4	12.1	-2.3	367.4	367.4	0.0	181.6	117.0	-64.6		+ LVLine30m*3*4
	KN-14	315	20.2	18.0	-2.2	310.5	143.6	-166.9	166.9	143.5	-23.4	DTR315kVA	+ 11kV30m*5*3+DTR160kVA
	KN-18	315	22.1	8.0	-14.1	312.4	171.8	-140.6	213.7	97.8	-115.9	DTR315kVA	+ 11kV30m*5*3+DTR100kVA
	KN-22	100	15.6	13.8	-1.8	175.4	175.4	0.0	175.4	120.7	-54.7		+ LVLine30m*1*4
	KN-23	315	20.2	8.1	-12.1	117.8	57.8	-60.0	117.7	57.7	-60.0	DTR315kVA	+ 11kV30m*9*3+DTR63kVA
	KN-24	315	69	18.6	-50.4	299.2	138.5	-160.7	299.2	138.3	-160.9	DTR315kVA	+ 11kV30m*11*3+DTR160kVA
	KN-25	100	8.5	8.5	0.0	210.8	210.8	0.0	118.3	118.3	0.0	DTR100kVA	DTR 160 kVA

Kattedan #2

	Name of DTR	kVA	Vd (V)			DTR Cur (A)			LV(11kV) line Cur (A)			Revised contents	
			before	after	subtract	before	after	subtract	before	after	subtract	before	after
DTR	#8	315	9.7	7.4	-2.3	177.4	177.4	0.0	177.4	98.3	-79.1		+ LVLine15m*3
	#10	160	15.5	9.6	-5.9	181.7	181.7	0.0	181.7	93.7	-88.0		+ LVLine38m*3
	#16	100	18	11.7	-6.3	176.0	176.0	0.0	176.0	90.3	-85.7	DTR100kVA	DTR160kVA+ LVLine15m*3
	#28	315	21.7	21.7	0.0	372.3	372.3	0.0	176.5	116.0	-60.5		+ LVLine30m*3
	#34	63	15.3	15.3	0.0	131.4	131.4	0.0	131.4	131.4	0.0	DTR63kVA	DTR100kVA
	#37	100	16.3	7.4	-8.9	176.5	176.5	0.0	176.5	142.6	-33.9		+ LVLine30m*3
	#38	100	9.6	6.8	-2.8	177.4	177.4	0.0	177.4	88.7	-88.7	DTR100kVA	DTR160kVA + LVLine18m*3
	#39	250	38.7	23.2	-15.5	263.2	263.2	0.0	181.1	90.6	-90.5		+ LVLine134m*3
	#48	100	9.4	7.8	-1.6	177.8	177.8	0.0	177.8	132.2	-45.6	DTR100kVA	DTR160kVA+ LVLine11m*3

Malkapur

	Name of DTR	kVA	Vd (V)			DTR Cur (A)			LV line current (A)			Revised contents	
			before	after	subtract	before	after	subtract	before	after	subtract	before	after
DTR	SS I (100kVA)	100	142.7	29.0	-113.7	186.5	102.6	-83.9	149.2	65.3	-83.9	DTR100kVA	+ 11kVLine910m*3+DTR63kVA
	SS IV (100kVA)	100	95.8	25.5	-70.3	275.1	142.0	-133.1	275.1	62.1	-213.0	DTR100kVA	+ 11kVLine742m*3+DTR100kVA
	SS V (63kVA)	63	90.6	23.1	-67.5	174.7	90.8	-83.9	90.8	48.9	-41.9	DTR63kVA	+ 11kVLine980m*3+DTR63kVA
	SS VI (100kVA)	100	50.1	35.0	-15.1	131.0	131.0	0.0	131.0	131.0	0.0		+ LVLine70*3*3
	SS VII (63kVA)	63	169.6	16.2	-93.4	74.2	34.9	-39.3	74.2	21.8	-52.4	DTR63kVA	+ 11kVLine1120m*3+DTR63kVA
	SS VIII (100kVA)	100	137	37.7	-99.3	104.8	42.0	-62.8	104.8	42.0	-62.8	DTR100kVA	+ 11kVLine910m*3+DTR63kVA
	SS XII (100kVA)	100	93	35.1	-57.9	227.1	114.4	-112.7	227.1	66.5	-160.6	DTR100kVA	+ 11kVLine780m*3+DTR100kVA+LVLine773m*3
	SS X (63kVA)	63	185.8	12.7	-173.1	170.3	106.4	-63.9	170.3	42.6	-127.7	DTR63kVA	+ 11kVLine70m*14*3+DTR63kVA
	SS XIV (100kVA)	100	269.7	31.7	-238.0	200.9	109.6	-91.3	200.9	54.8	-146.1	DTR100kVA	+ 11kVLine70m*16*3+DTR63kVA
	SS XI (100kVA)	100	40.1	34.4	-5.7	89.0	89.0	0.0	54.8	41.1	-13.7		+ LVLine70*2*3

(Shaded figures show DTR network exceeds the allowable limitation)

Legend of contents of improvement in Table 5.34 is listed in Table 5.35.

Table 5.35 Legend of contents of improvement

Revised contents (symbol)	Revised contents
+11kVLine 100m*3	Installing an additional 55sqmm *3 wire 11kV line to install a new distribution transformer
+LV line 100m*4	Installing an additional 34sqmm *4 wire LV line to reduce resistance
+DTR 100 kVA	Installing a new 100 kVA distribution transformer to divide the existing loads into two parts
DTR160kVA	Upgrading the existing distribution transformer to 160 kVA

When improving distribution facilities, the time margin for distribution transformer and low voltage line after improvement is set at ten years. The criteria for upgrading wire size or installing a new distribution transformer are as shown in Table 5.36.

Table 5.36 Criteria of improvement of low voltage network

Cause of improvement	Contents of improvement
Exceeding voltage drop limit	If time margin of the existing distribution transformer is less than 3 years, install a new distribution transformer and divide existing loads into two parts. Otherwise upgrade size of wire or install an additional LV line.
Exceeding overload limit of distribution transformer	If time margin of the existing LV line is less than 3 years, install a new distribution transformer and divide existing loads into two parts. Otherwise upgrading kVA of the existing distribution transformer.

As only wire of 34 sqmm is used in low voltage line, in place of using thicker wires, a line of the same wire is added to make required improvement.

When installing a new distribution transformer, kVA of the distribution transformer is decided according to the criteria of Table 5.37. When installing new distribution transformer, kVA of distribution transformer is decided according current limitation of Table 5.37. Initial current of distribution transformer must be under the current limitation.

Table 5.37 Criteria of selection of distribution transformer

kVA of DTR (kVA)	Current limitation when installing new DTR (A)		(reference) current for each degree of load (A)		
	growth rate 4% degree of load 150%	growth rate 1% degree of load 120%	100%	120%	150%
	Ranga Reddy	Medak			
63	89	96	88	106	132
100	141	152	139	167	209
160	226	243	223	268	335
250	353	380	348	418	522
315	444	478	438	526	657

A sample of improvement of low voltage network is shown in Figures 5.15 and 5.16.

Name of DTR : DTR KN-14 Kamalanagar feeder

Cause of improvement :

- Max voltage drop will be 20.2 V in 2008 (6 years later), exceeding the voltage drop limit.
- Max current will be 180.8 A in 2010 (8 years later), exceeding allowable current of low voltage line.

Contents of improvement :

- Install a new 160kVA DTR and divide existing loads of Kn-14 bank into two parts.

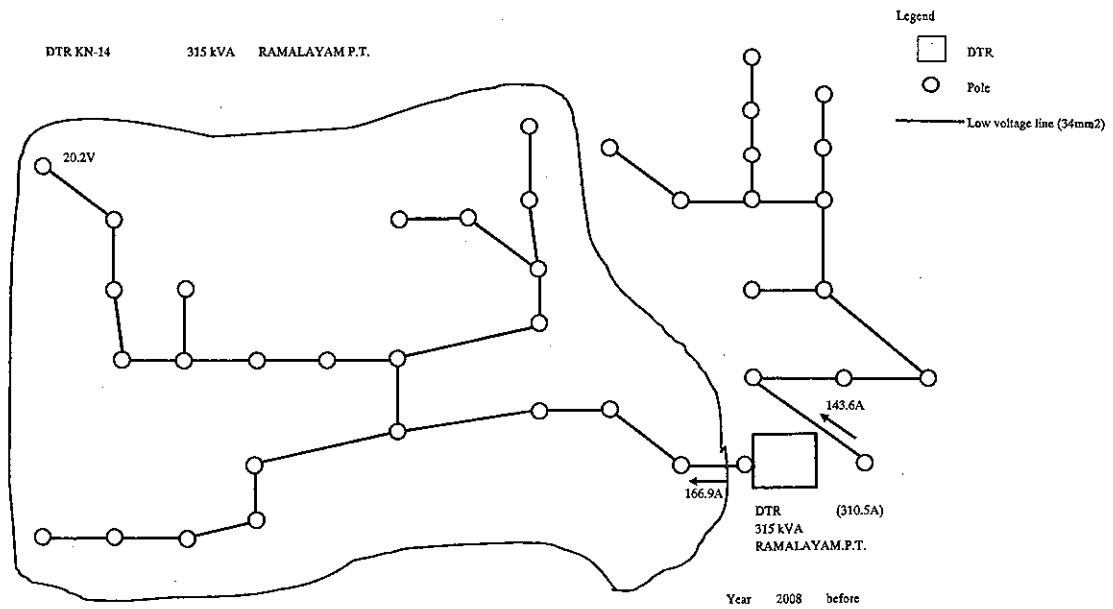


Figure 5.15 Sample of improvement in LV network (before improvement)

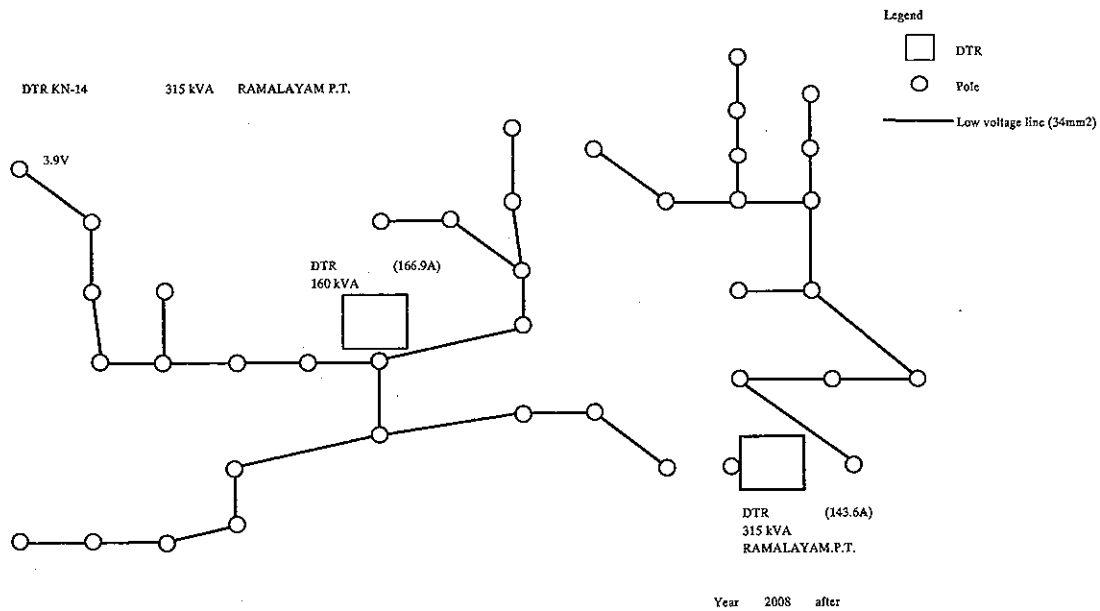


Figure 5.16 Sample of improvement in LV network (after improvement)

Service wire

When a bottleneck occurs in service wire, improvement plans include

- Changing to 3 wire system (changing from single phase 2 wire system to single phase 3 wire system)
- Splitting the customers connected to service wire (when a service wire is used commonly for two or more customers, a new service wire is installed for a single customer).
- Upgrading size of conductor of service wire line (reducing the current density by using thicker wires).

5.5.5 Implementation Plan

All of the above-mentioned improvement plans are integrated and the works are to be executed in the coming ten years as shown in Tables 5.38 – 5.40. Construction for improvement is executed when each facility exceed the allowable limitation of voltage drop or current.

Table 5.41 shows construction cost.

Table 5.38 Implementation plan (facility-wise) (Kamalanagar)

Construction Cost(Rs)

(Rs : 1,000)

	Name of DTR	kVA	Revised contents		start-ing year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	total
			before	after												
11kV Line																
DTR&LVLine	KN-03	250		+ LVLine30m*1*4	8								12.7			12.7
	KN-06	250	DTR250kVA	+ 11kV30m*8*3+DTR160kVA	1	240.9										240.9
	KN-07	250	DTR250kVA	+ 11kV30m*4*3+DTR160kVA	1	196.1										196.1
	KN-08	100	DTR250kVA	+ 11kV30m*5*3+DTR100kVA	8								186.7			186.7
	KN-09	250		+ LVLine30m*3*4	8								38.2			38.2
	KN-11	250		+ LVLine30m*3*4	7							37.8				37.8
	KN-14	315	DTR315kVA	+ 11kV30m*5*3+DTR160kVA	6						217.9					217.9
	KN-18	315	DTR315kVA	+ 11kV30m*5*3+DTR100kVA	1	174.1										174.1
	KN-22	100		+ LVLine30m*1*4	10										13.0	13.0
	KN-23	315	DTR315kVA	+ 11kV30m*9*3+DTR63kVA	6						216.7					216.7
	KN-24	315	DTR315kVA	+ 11kV30m*11*3+DTR160kVA	1	274.5										274.5
	KN-25	*100*	*DTR100kVA*	*DTR160kVA*	9									163.9		163.9
				Current Value		885.6	0.0	0.0	0.0	0.0	434.6	37.8	237.5	163.9	13.0	1,772.4
			total	Present Value		885.6	0.0	0.0	0.0	0.0	340.5	28.2	168.8	110.9	8.4	1,542.4

(Price Rate=0.01/year, Discount Rate=0.05/year)

Table 5.39 Implementation plan (facility-wise) (Kattedan #2)

(Rs : 1,000)

	Name of DTR	kVA	Revised contents		start-ing year	Construction Cost(Rs) 2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	total
			before	after												
11kV Line				+ 11KVLine730m*3	8								291.9			291.9
DTR&LVLine	#8	315		+ LVLine15m*3	3			4.5								4.5
	#10	160		+ LVLine38m*3	3			11.5								11.5
	#16	100	DTR100kVA	DTR160kVA+ LVLine15m*3	1	163.8										163.8
	#28	*315*		*+ LVLine30m*3*	9									9.6		9.6
	#34	63	DTR63kVA	DTR100kVA	6						124.2					124.2
	#37	100		+ LVLine30m*3	10										9.7	9.7
	#38	100	DTR100kVA	DTR160kVA + LVLine18m*3	3			159.9								159.9
	#39	250		+ LVLine134m*3	7							42.2				42.2
	#48	100	DTR100kVA	DTR160kVA+ LVLine11m*3	5					160.9						160.9
				Current Value		163.8	0.0	175.9	0.0	160.9	124.2	42.2	291.9	9.6	9.7	978.3
			total	Present Value		163.8	0.0	159.5	0.0	132.4	97.3	31.5	207.5	6.5	6.3	804.8

(Price Rate=0.01/year, Discount Rate=0.05/year)

Table 5.40 Implementation plan (facility-wise) (Malkapur)

	Name of DTR	kVA	Revised contents		start-ing year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	total
			before	after												
11kV Line																0.0
DTR&LVLine	SS I	100	DTR100kVA	+ 11kVLine910m*3+DTR63kVA	1	444.9										444.9
	SS IV	100	DTR100kVA	+ 11kVLine742m*3+DTR100kVA	1	406.6										406.6
	SS V	63	DTR63kVA	+ 11kVLine980m*3+DTR63kVA	1	482.6										482.6
	SS VI	100		+ LVLine70*3*3	1	62.3										62.3
	SS VII	63	DTR63kVA	+ 11kVLine1120m*3+DTR63kVA	1	534.9										534.9
	SS VIII	100	DTR100kVA	+ 11kVLine910m*3+DTR63kVA	1	444.9										444.9
	SS XII	100	DTR100kVA	+11kVLine780m*3+DTR100kVA+ LVLine773m*3	1	677.7										677.7
	SS X	63	DTR63kVA	+ 11kVLine70m*14*3+DTR63kVA	1	482.6										482.6
	SS XIV	100	DTR100kVA	+ 11kVLine70m*16*3+DTR63kVA	1	534.9										534.9
	SS XI	100		+ LVLine70*2*3	8									44.5		44.5
				Current Value		4,071.3	0.0	0.0	0.0	0.0	0.0	0.0	44.5	0.0	0.0	4,115.8
			total	Present Value		4,071.3	0.0	0.0	0.0	0.0	0.0	0.0	31.6	0.0	0.0	4,102.9

(Price Rate=0.01/year, Discount Rate=0.05/year)

Table 5.41 Construction cost

Construction Cost of distribution facilities

Sl. No.	Item	Specification	Unit Rate in Lakhs		
			Material	Labour	Total
1	Substation (33/11kV)		40.647	10.280	50.927
2	Transformer(33 / 11 kV Sub station) (kVA-wise)	5000 kVA	10.097	1.110	11.207
3	11 kV line (km) (Size-wise)	ACSR, 55sqmm,	1.015	0.229	1.243
		ACSR, 34 sqmm,	0.829	0.229	1.058
4	Low voltage line (km) (Size-wise)	34sqmm 5 wire line	0.942	0.216	1.158
		34sqmm 4 wire line	0.803	0.186	0.989
		34sqmm 3 wire line	0.679	0.186	0.865
5	Pole -mounted transformer (kVA , Phase-wise)	315 kVA 3 Phase	2.134	0.116	2.250
		250 kVA 3 Phase	1.700	0.116	1.816
		160 kVA 3 Phase	1.397	0.116	1.514
		100 kVA 3 Phase	1.065	0.116	1.181
		63 kVA 3 Phase	0.938	0.116	1.054
		25 kVA 3 Phase	0.479	0.055	0.534
		3 x 15 kVA 3 Phase	0.767	0.094	0.861
		15 kVA Single Phase	0.255	0.016	0.271
6	* Support (length-wise)	9.0 meters	0.016	0.005	0.021
		8.0 meters	0.008	0.005	0.013
7	Service wire (km) (size-wise)	Al, 14 sqmm	0.064	0.001	0.065
8	Meter (type-wise)	Single Phase (5-20 Amp)	0.014	0.004	0.018
		3 Phase (5-20 Amp)	0.033	0.007	0.040
		3 Phase (10-40 Amp)	0.065	0.007	0.072
9	Voltage regulator (kVA-wise)				
10	Power condenser (kVA-wise)				
	Total		63.946	13.211	77.157

* Cost of the poles is included in the serial No. 6 & 7

5.5.6 Cost and Benefit

Result of implementation of the improvement plan, and its cost and benefit are as shown in Tables 5.42 – 5.47. Cost consists of construction cost of improvement plan in every year. Benefit consists of profit by reducing energy loss.

The profit of reducing energy loss that was used in calculating the benefit is based on the power tariff of domestic use (201-300kWh), 475 Rs/ kWh.

In addition to loss reduction, benefits include

- Improvement of quality of electricity (Improvement of voltage drop, over current)
- Improvement of reliability of electricity supply due to reduced failures
- Improvement of customer services through the above-mentioned improvements.

Table 5.42 Cost of improvement plan for Kamalanagar feeder

Construction Cost (1000Rs) (Rs : 1,000)

	Name of DTR	kVA	start-ing year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	total
11kV Line														
DTR&LVLine	KN-03	250	8								12.7			12.7
	KN-06	250	1	240.9										240.9
	KN-07	250	1	196.1										196.1
	KN-08	100	8								186.7			186.7
	KN-09	250	8								38.2			38.2
	KN-11	250	7							37.8				37.8
	KN-14	315	6						217.9					217.9
	KN-18	315	1	174.1										174.1
	KN-22	100	10										13.0	13.0
	KN-23	315	6						216.7					216.7
	KN-24	315	1	274.5										274.5
	KN-25	100	9									163.9		163.9
total	Current Value			885.6	0.0	0.0	0.0	0.0	434.6	37.8	237.5	163.9	13.0	1,772.4
	Present Value			885.6	0.0	0.0	0.0	0.0	340.5	28.2	168.8	110.9	8.4	1,542.4

(Price Rate=0.01/year, Discount Rate=0.05/year)

Table 5.43 Benefit of improvement plan for Kamalanagar feeder

Benefit by reducing loss energy (1000Rs/year) (Rs : 1,000)

	Name of DTR	kVA	start-ing year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	total
11kV Line														
DTR&LVLine	KN-03	250	8								5.1	5.1	5.2	15.3
	KN-06	250	1	88.8	89.7	90.6	91.5	92.4	93.4	94.3	95.2	96.2	97.2	929.4
	KN-07	250	1	33.8	34.2	34.5	34.8	35.2	35.5	35.9	36.3	36.6	37.0	353.8
	KN-08	100	8								15.5	15.7	15.8	47.0
	KN-09	250	8								11.6	11.8	11.9	35.3
	KN-11	250	7							12.7	12.8	13.0	13.1	51.6
	KN-14	315	6						25.5	25.7	26.0	26.2	26.5	129.9
	KN-18	315	1	4.5	4.5	4.6	4.6	4.7	4.7	4.7	4.8	4.8	4.9	46.8
	KN-22	100	10										4.9	4.9
	KN-23	315	6						7.5	7.6	7.7	7.7	7.8	38.3
	KN-24	315	1	178.8	180.6	182.4	184.2	186.0	187.9	189.8	191.7	193.6	195.5	1,870.4
	KN-25	100	9									41.6	42.0	83.6
total	Current Value			305.9	309.0	312.1	315.2	318.3	354.5	370.7	406.7	452.3	461.7	3,606.4
	Present Value			305.9	294.2	283.0	272.3	261.9	277.7	276.7	289.0	306.2	297.6	2,864.5

(Price Rate=0.01/year, Discount Rate=0.05/year)

Table 5.44 Cost of improvement plan for Kattedan #2 feeder

(Rs : 1,000)

	Name of DTR	kVA	start-ing year	Construction Cost (1000Rs)										
				2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	total
11kV Line			8								291.9			291.9
DTR&LVLine	#8	315	3			4.5								4.5
	#10	160	3			11.5								11.5
	#16	100	1	163.8										163.8
	#28	315	9									9.6		9.6
	#34	63	6						124.2					124.2
	#37	100	10										9.7	9.7
	#38	100	3			159.9								159.9
	#39	250	7							42.2				42.2
	#48	100	5					160.9						160.9
total	Current Value			163.8	0.0	175.9	0.0	160.9	124.2	42.2	291.9	9.6	9.7	978.3
	Present Value			163.8	0.0	159.5	0.0	132.4	97.3	31.5	207.5	6.5	6.3	804.8

(Price Rate=0.01/year, Discount Rate=0.05/year)

Table 5.45 Benefit of improvement plan for Kattedan #2 feeder

(Rs : 1,000)

	Name of DTR	kVA	start-ing year	Benefit by reducing loss energy (1000Rs/year) 2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	total
11kV Line			8								664.1	670.7	677.4	2,012.3
DTR&LVLine	#8	315	3			4.9	5.0	5.0	5.1	5.1	5.2	5.2	5.3	40.8
	#10	160	3			32.8	33.1	33.4	33.8	34.1	34.5	34.8	35.1	271.6
	#16	100	1	56.3	56.8	57.4	58.0	58.6	59.1	59.7	60.3	60.9	61.6	588.8
	#28	315	9									25.9	26.2	52.1
	#34	63	6						19.2	19.4	19.5	19.7	19.9	97.8
	#37	100	10										26.2	26.2
	#38	100	3			38.7	39.1	39.5	39.9	40.3	40.7	41.1	41.5	320.5
	#39	250	7							105.2	106.3	107.4	108.4	427.3
	#48	100	5					33.8	34.1	34.4	34.8	35.1	35.5	207.8
total	Current Value			56.3	56.8	133.8	135.1	170.3	191.1	298.3	301.3	330.2	359.7	4,045.2
	Present Value			56.3	54.1	121.4	116.7	140.1	149.8	222.6	214.1	223.5	231.9	1,530.4

(Price Rate=0.01/year, Discount Rate=0.05/year)

Table 5.46 Cost of improvement plan for Malkapur feeder

(Rs : 1,000)

	Name of DTR	kVA	start-ing year	Construction Cost (1000Rs) 2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	total
11kV Line														0.0
DTR&LVLine	SS I	100	1	444.9										444.9
	SS IV	100	1	406.6										406.6
	SS V	63	1	482.6										482.6
	SS VI	100	1	62.3										62.3
	SS VII	63	1	534.9										534.9
	SS VIII	100	1	444.9										444.9
	SS XII	100	1	677.7										677.7
	SS X	63	1	482.6										482.6
	SS XIV	100	1	534.9										534.9
	SS XI	100	8								44.5			44.5
total	Current Value			4,071.3	0.0	0.0	0.0	0.0	0.0	0.0	44.5	0.0	0.0	4,115.8
	Present Value			4,071.3	0.0	0.0	0.0	0.0	0.0	0.0	31.6	0.0	0.0	4,102.9

(Price Rate=0.01/year, Discount Rate=0.05/year)

Table 5.47 Benefit of improvement plan for Malkapur feeder

(Rs : 1,000)

	Name of DTR	kVA	start-ing year	Benefit by reducing loss energy (1000Rs/year) 2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	total
11kV Line														
DTR&LVLine	SS I	100	1	94.6	95.5	96.5	97.4	98.4	99.4	100.4	101.4	102.4	103.4	989.4
	SS IV	100	1	155.0	156.6	158.1	159.7	161.3	162.9	164.5	166.2	167.9	169.5	1,621.8
	SS V	63	1	71.3	72.0	72.7	73.4	74.2	74.9	75.7	76.4	77.2	78.0	745.7
	SS VI	100	1	11.4	11.5	11.6	11.7	11.8	12.0	12.1	12.2	12.3	12.5	119.1
	SS VII	63	1	39.0	39.4	39.8	40.2	40.6	41.0	41.4	41.8	42.2	42.6	407.8
	SS VIII	100	1	32.4	32.8	33.1	33.4	33.7	34.1	34.4	34.8	35.1	35.5	339.3
	SS XII	100	1	183.2	185.1	186.9	188.8	190.7	192.6	194.5	196.4	198.4	200.4	1,916.9
	SS X	63	1	183.8	185.6	187.4	189.3	191.2	193.1	195.1	197.0	199.0	201.0	1,922.5
	SS XIV	100	1	361.2	364.8	368.4	372.1	375.8	379.6	383.4	387.2	391.1	395.0	3,778.5
	SS XI	100	8								2.3	2.3	2.4	7.0
total	Current Value			1,131.8	1,143.1	1,154.5	1,166.1	1,177.7	1,189.5	1,201.4	1,215.7	1,227.9	1,240.2	11,848.0
	Present Value			1,131.8	1,088.7	1,047.2	1,007.3	968.9	932.0	896.5	864.0	831.1	799.4	9,566.9

(Price Rate=0.01/year, Discount Rate=0.05/year)

5.6 Recommendations

5.6.1 Reduction of Energy Loss

In the preceding analysis needs of reducing energy losses of low voltage distribution facilities have been pointed out. At present the control is not adequate as shown below:

- The status of loads on each distribution transformer is not supervised constantly.
- Some divisions do not have network management documents including connections between distribution transformers and low voltage lines. Some documents are not updated by constant maintenance.
- There is no document of connections between customers and low voltage distribution lines.
- Some divisions do not have any document of facilities concerning span, size of low voltage lines.

It, therefore, is necessary to compile lacking data, and give proper load control and voltage control by using estimated load, which is based on measurement or derived from the correlation formula of kWh-A (refer to 5.6.3 kWh-A management).

When the above-mentioned management is done properly, parts causing electric excesses will be improved gradually. These improvements also serve as loss reduction measures. Improvement of bottlenecks of distribution facilities will reduce energy loss at the same time.

As energy loss of low voltage distribution facilities in APCPDCL accounts for a larger portion in comparison with the case of Japan, it is important, in improving existing low voltage facilities, to shorten the length of low voltage line and reduce the capacity of distribution transformer.

General improvement plans for reducing energy loss are as follows.

Plans for reducing energy loss in distribution facilities include, in theory, reduction of line current, reduction of line resistance, and rational arrangement and use of line facilities. These plans can be divided facility wise; high-voltage line, low voltage line, distribution transformer.

High-voltage line

- Upgrading voltage
  -Upgrading voltage from 11kV to 33kV
- Strengthening distribution line
  -Reducing resistance by upgrading size of wire or installing additional wire
  -Dividing distribution line into two by installing additional wire
  -Dividing distribution line into two by installing new substation
  -Shortening length of line by installing new substation
  -Installing condenser for improving power factor and reducing energy loss
- Changing distribution system
  -Installing loop distribution system
  -Installing network distribution system
- Correcting current unbalance
  -Shortening length of single phase distribution line

-Changing from single phase line to 3 phase line
-Rearranging single phase facilities and making them balanced load as a whole

Low voltage line

- Upgrading voltage
- Strengthening distribution line
- -Upgrading size of wire
  -Rearranging size of wire, length of wire, size of distribution transformer, span of facilities properly
- Changing distribution system
  -Changing from single phase 2 wire system to single phase 3 wire system
- -Changing from single phase 3 wire system and 3 phase 3 wire system to 3 phase 4 wire system
- -Installing low voltage banking system or low voltage network system
- Correcting current unbalance
- -Installing balancer (refer to 5.6.5 installing balancer)

Distribution transformer

- Using revised core of transformer (from layer core type to winding core type)
  -Reducing iron loss
  -Reducing energy loss by upgrading allowable limitation of load in distribution transformer
- Installing single phase facilities
- -Reducing energy loss
- -Simplified construction work
- Installing low loss type distribution transformer using amorphous metal
- Installing small size distribution transformer by dividing existing low voltage line network into two

5.6.2 Measuring

As for measuring, the study team recommend to continue measuring for following reasons.

- Accurate energy loss must be measured by measuring throughout the year. Especially, measuring energy loss of distribution transformer must be performed since energy loss of low voltage facilities is larger compared to Japan.
- Measuring kW, current and etc. at distribution transformer must be conducted every month. By using these data and managing current and voltage drop properly, improvement of distribution facilities to reduce energy loss can be performed timely.

And another reason for further measuring is that pilferage can be detected from the result of measuring as shown below:

Table 5.48 shows measuring results of distribution transformer (Name of DTR : SS IV) at pump set in Malkapur feeder.

The data show that electric power is used in the night time, whereas this transformer services only pump set for 7 hours in the day time and not in the night time. It is estimated that pilferage is conducted in the night time somewhere in this low voltage network of this transformer. Load measuring revealed the pilferage.

Table 5.48 Measurement result of distribution transformer at pump set

Meter Serial No.:APE13601
Measuring Item:
Transformer Sub Station: IV (Bujangareddy)
Place of Measuring: Malkapur Sub Station, Malkapur Feeder
Measuring Item: KW (KW)

-1.0 indicates ALL POTENTIALS MISSING

DATE	0'o Clock	1'o Clock	2'o Clock	3'o Clock	4'o Clock	5'o Clock	6'o Clock	7'o Clock	8'o Clock	9'o Clock	10'o Clock	11'o Clock	12'o Clock	13'o Clock	14'o Clock	15'o Clock	16'o Clock	17'o Clock	18'o Clock	19'o Clock	20'o Clock	21'o Clock	22'o Clock	23'o Clock
1/8/2003	2.4	2.4	2.4	91.8	86.4	90	85.8	92.4	90.6	100.8	0	0	0	0	0	0	0	0	1.8	25.8	25.8	25.8	25.2	13.2
2/8/2003	2.4	3	2.4	76.8	75.6	79.8	71.4	68.4	81	85.2	0	0	0	0	0	0	0	0	0	23.4	21.6	22.2	22.2	21.6
3/8/2003	21.6	21	20.4	0.6	1.8	1.8	0	0	0	0	89.4	95.4	100.2	101.4	99.6	96.6	97.2	0	0.6	14.4	14.4	14.4	14.4	13.8
4/8/2003	14.4	13.8	13.8	1.8	1.8	1.8	0	0	0	0	91.2	95.4	93.6	105	85.8	84.6	90.6	0	0	3	2.4	2.4	2.4	1.8
5/8/2003	1.8	2.4	1.8	1.8	1.8	1.2	0	0	0	0	88.2	86.4	87.6	87.6	78.6	76.2	72	0	1.2	6.6	7.2	6.6	6.6	6.6
6/8/2003	6.6	6.6	6.6	2.4	2.4	2.4	0	0	0	0	68.4	70.8	70.2	63	65.4	65.4	65.4	0	0.6	6.6	7.2	6.6	6.6	6
7/8/2003	6	6.6	6	1.8	1.8	1.2	0	0	0	0	64.2	71.4	70.2	67.2	69.6	69	69	0	0.6	3	3.6	3	3	2.4
8/8/2003	2.4	2.4	2.4	0.6	2.4	2.4	0	0	0	0	73.4	67.8	67.2	69	61.2	67.8	65.4	0	0	3	3.6	3	3	3
9/8/2003	2.4	2.4	2.4	0.6	2.4	1.8	0	0	0	0	86.4	82.2	94.8	93.6	87	94.8	93.6	0	0	5.4	7.2	7.2	6.6	6.6
10/8/2003	6.6	6.6	6.6	64.2	66.6	75.6	94.8	93	104.4	116.4	0	0	0	0	0	0	0	0	0.6	3.6	3.6	4.2	3	3
11/8/2003	3	3	3	63.6	82.2	82.2	79.8	103.8	113.4	97.2	3	0.6	0	0	0	0	0	0	0	3.6	3	3.6	3.6	3
12/8/2003	2.4	3	2.4	81	81	91.8	109.8	115.2	112.8	106.8	0	0	0	0	0	0	0	0	0	3	3.6	3	2.4	3
13/08/2003	2.4	3	2.4	91.2	93.6	93.6	95.4	41.4	49.2	51	0	0	0	0	0	0	0	0	0.6	5.4	4.8	4.2	3.6	3
14/08/2003	3	3	3	40.8	39	37.8	48	50.4	109.2	117	0	0	0	0	0	0	0	0	0.6	18	18	18	18	16.8
15/08/2003	16.2	16.8	16.2	99.6	107.4	108	96.6	120	133.2	132.6	0	0	0	0	0	0	0	0	1.2	10.8	13.2	12.6	13.2	12.6
16/08/2003	12	11.4	11.4	106.2	118.2	111	124.2	49.8	123.6	135	0	0	0	0	0	0	0	0	0	7.2	7.8	3.6	2.4	2.4
17/08/2003	2.4	2.4	2.4	1.8	2.4	2.4	0	0	0	0	124.8	134.4	125.4	117.6	116.4	118.2	124.8	0	0	17.4	17.4	16.8	17.4	16.2
18/08/2003	16.8	16.8	16.2	2.4	2.4	2.4	0	0	0	0	121.8	124.8	132.6	132	125.4	109.8	108.6	0	0.6	18.6	7.2	7.8	7.2	6.6
19/08/2003	6.6	7.2	6.6	1.8	1.8	1.8	0	0	0	0	70.2	93.6	106.8	109.8	108	118.2	118.8	0	0	12	4.8	3	2.4	2.4
20/08/2003	2.4	2.4	2.4	2.4	2.4	0.6	0	0	0	0	66.6	102	136.8	91.2	129.6	121.2	121.8	0	1.8	6	11.4	3	2.4	2.4
21/08/2003	2.4	2.4	1.8	2.4	1.8	1.8	0.6	0	0	0	61.2	93.6	93	88.8	91.2	84	88.2	0	0	3.6	3.6	3	3	2.4
22/08/2003	1.8	2.4	3	1.8	2.4	0	0	0	0	0	0	0	0	0	0	0	0	0	31.2	66	70.8	73.4	72.6	72
23/08/2003	72	72.6	73.8	1.8	1.8	1.8	0	0	0	0	46.8	46.2	19.8	36.6	40.8	43.2	45.6	0	0	3	2.4	2.4	2.4	2.4
24/08/2003	2.4	2.4	2.4	25.8	36.6	36	56.4	58.8	66	82.8	0	0	0	0	0	0	0	0	0	2.4	2.4	2.4	3	2.4
25/08/2003	1.8	2.4	2.4	39	63	67.8	61.8	87	85.2	82.2	24.6	0	0	0	0	0	0	0	0	3	2.4	2.4	3	2.4
26/08/2003	1.8	2.4	2.4	48.6	73.2	71.4	91.2	108.6	134.6	99.6	0	0	0	0	0	0	0	0	0	6.6	7.2	7.2	6.6	6.6
27/08/2003	6	6.6	6.6	66	83.4	0	0	0	0	0	0	0	0	0	0	118.2	119.4	131.4	118.8	123.6	3	2.4	2.4	1.8
28/08/2003	1.8	1.8	1.8	104.4	110.4	108	121.8	142.2	144	142.2	0	0	0	0	0	0	0	0	0.6	3	3	3	2.4	2.4
29/08/2003	2.4	2.4	1.8	81.6	88.8	88.2	95.4	108	105	103.2	0	0	0	0	0	0	0	0	0	3	3.6	3.6	3	2.4
30/08/2003	1.8	1.8	1.8	0	74.4	91.2	106.8	131.4	130.8	131.4	0	0	0	0	0	0	0	0	0.6	7.2	7.2	7.2	2.4	2.4
31/08/2003	2.4	2.4	2.4	1.2	1.8	1.8	0	0	0	0	135	136.8	127.8	127.2	130.8	124.2	111.6	0	2.4	7.8	7.8	7.8	7.2	2.4
1/9/2003	1.8	2.4	2.4	0	1.8	1.8	0	0	0	0	99.6	118.2	122.4	122.4	118.8	124.8	119.4	0	0	3	3	3	3	2.4
2/9/2003	2.4	2.4	1.8	1.8	1.8	1.8	0	0	0	0	0	0	85.2	134.4	139.2	122.4	92.4	15	2.4	15	18.6	18.6	3	2.4
3/9/2003	1.8	2.4	2.4	2.4	2.4	1.8	0	0	0	0	91.2	117	124.2	86.4	121.2	126	129.6	18.6	0	13.8	14.4	13.2	13.2	12.6
4/9/2003	12.6	12.6	12.6	2.4	2.4	1.8	0	0	0	0	85.2	124.2	133.8	119.4	135	136.2	127.2	0.6	1.8	9	8.4	8.4	7.8	8.4

As for measuring kWh at customer's end, it is not easy to measure kWh of all customers at the same time for following reason.

- It needs a lot of people to measure at the same time
- Incorrect reading of kWh meter and omission occur frequently when measurement is done by inexperienced people.

Therefore in place of measuring kWh at customer's end, the study team recommend you to use the energy consumption data of respective customers for a given feeder. Such data are for calculating electricity tariffs. The reason for this recommendation is that although the accuracy is lower because measuring can not performed at the same time, errors due to omission or misreading are smaller.

5.6.3 "kWh-A Management"

In Japan, from a view point of ensuring efficiency in voltage control and load control of distribution transformer, "kWh-A managing" is carried for low voltage distribution network.

This managing method is to estimate the peak load current of a distribution transformer by using customers' electricity consumption (kWh). There is a strong correlation between the annual maximum current of the secondary side of a distribution transformer bank and the total consumption (kWh) of all customers in the bank in a domestic/commercial area in a peak month.

To use this method, load currents are sampled on a distribution transformer in the field. After that a correlation formula is made by using these sampling data and data of customers' consumption.

Using this formula, the peak load of current of the distribution transformer is calculated. Then using these data and the data of specifications of distribution transformer and low voltage line, voltage drop and degree of load on the distribution transformer are calculated. Without going out and measuring, management of load and voltage drop can be conducted in their office.

Using measuring data of this survey, a formula of kWh-A correlation was calculated as shown below in an attempt to put the method to practical use at APCPDCL. Although the number of samples is small, coefficient of correlation is 0.88, showing a strong correlation. The study team recommend you to take more samples to improve the accuracy of the formula.

Using this formula, load management and voltage drop can be conducted in the office. And only when the data exceeding the limits are calculated, measuring in the field can be conducted. The need of improvement can be judged on the basis of the results of measurement. In this way, the efficiency of the management is enhanced significantly in comparison with the case wherein measuring is made on all the distribution transformers.

kWh-A correlation formula

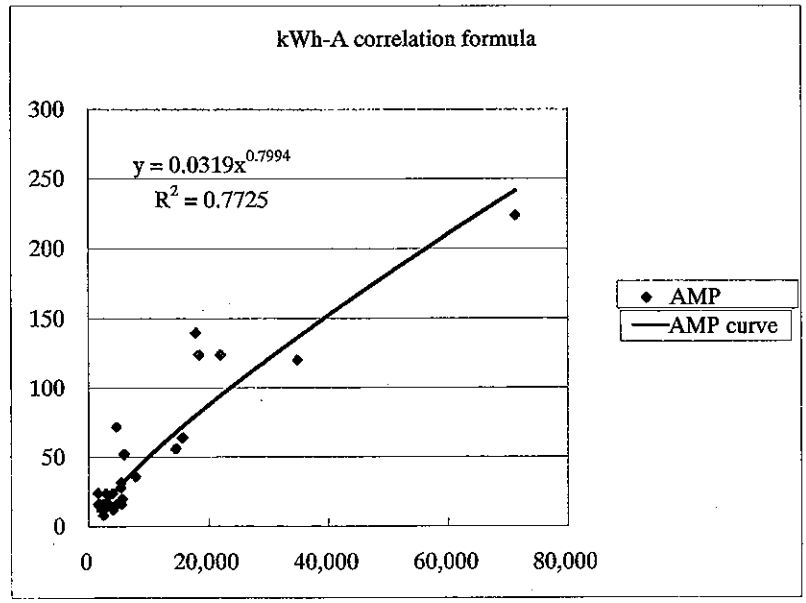
$$Y = 0.0319X^{0.7994}$$

Y : maximum current of secondary side of distribution transformer (A)

X: Total consumption of all customer in peak month (kWh)

Coefficient of correlation = 0.88 (Coefficient of decision $R^2 = 0.7725$)

kWh	AMP
34,829	120
14,569	56
4,646	16
71,260	224
22,046	124
1,585	16
3,379	16
5,870	52
15,658	64
5,349	28
4,637	72
5,466	16
18,456	124
17,917	140
1,831	16
2,443	16
7,797	36
5,376	32
2,049	16
2,861	24
3,975	24
2,417	8
1,537	24
2,465	12
5,572	20
4,049	12



To implement this management, the following data must be compiled:

- connection between distribution transformer and low voltage line network
- connection between low voltage facilities and customers' facilities
- specifications of distribution facilities (size of conductor, length of conductor, etc.)

5.6.4 Install Fuses between Low Voltage Lines

Compared to Japan, APCPDCL has longer low voltage lines. Accordingly, when short circuit occurs on a low voltage line, the short-circuit current can not melt the fuse on the primary side of the distribution transformer because the impedance of long low voltage line is large. As the short circuit can not be detected, the short-circuit current may break down the transformer or a delay in detecting the trouble may endanger customers.

To avoid such situations, it is necessary to install fuses in the middle of a low voltage line when the fuse on the primary side of its distribution transformer can not be melted.

The allowable length of a low voltage line varies depending on kVA of the distribution transformer as shown in Table 5.49.

Table 5.49 Allowable length of low voltage line

kVA of distribution transformer	Allowable LV length (m)	Nos. of span (span length=40m)	Nos. of span (span length=70m)
63	920	23	13
100	920	23	13
160	650	16	9
250	390	10	5
315	160	4	2

5.6.5 Installation of Balancer

Energy loss is reduced by installing single phase 3 wire systems. However, it is essential to balance loads between both phases. It is also recommended to install a balancer at the end of a low voltage line of a relatively long length.

Balancer is a kind of autotransformer wherein two coils are connected in series. The balancer is installed at the end of a low voltage line, and its voltage compensating function provides buffering effects against unbalanced load.

Furthermore, balancer restrains the voltage from rising abnormally when the neutral line is cut off or short circuit between the neutral line and an outer line occurs. (See Figure 5.18)

According to a trial calculation, installing a balancer can reduce energy loss by about 5% as shown below:

Specifications of balancers are shown in Table 5.50.

Construction costs of balancers in Japan are shown in Table 5.51.

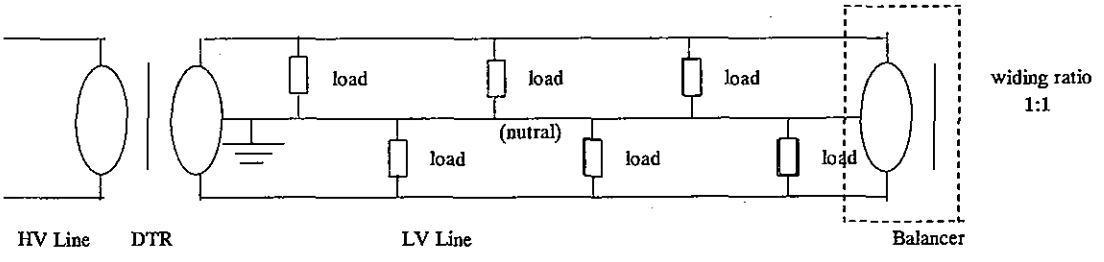
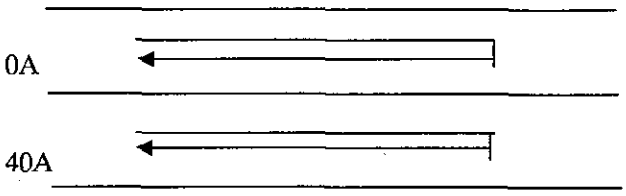


Figure 5.18 Installation of balancer

(Trial calculation)
Result of calculation shows reduction of energy loss is 5%.

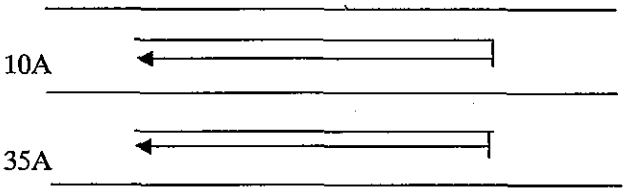
BALANCED
40m 80AMP
40A



R = 0.9352 ohm/km

Loss kW = 40AMP*40AMP*R*40m/1000+40AMP*40AMP*R*40m/1000+0
= 119.7W

UNBALANCED
40m 80AMP
45A



R = 0.9352 ohm/km

Loss kW =
45AMP*45AMP*R*40m/1000+35AMP*35AMP*R*40m/1000+10AMP*10AMP*R*40m/1000
= 125.3W

125.3W/119.7W=1.05

Table 5.50 Specification of balancer

Nominal Voltage	100/200V
Nominal kVA	1 kVA 0.5 kVA
Nominal Current	10A 5A
Frequency	60 Hz

Table 5.51 Construction cost of balancer

(Rs)

	Material cost	Construction cost	Total
Balancer 0.5 kVA	11,880	11,650	23,530
Balancer 1.0 kVA	28,890	11,650	40,540

5.6.6 Linking to GIS System

By linking to "ArcView" application programs in GIS system, the efficiency of execution of duties can be improved significantly.

The present distribution network improvement project uses excel application programs for calculating energy loss, voltage drop and over current.

By linking these excel application programs to the ArcView application programs, specification data of distribution facilities that are saved in the ArcView application programs can be used in computation. Thus computation can be done without newly inputting data for computation. ("ArcView" needs functions for linking with excel (customization)).

5.6.7 Expansion Plan

Expansion plan is to be conducted by counterpart after project member finish technical transfer to counterparts. Counterparts will replicate this method to other feeder or other substation.